Title: The Science of Sound

Level: Junior (Grade 4-6)

Connection to a Culminating Activity:
This unit is designed for grade 4-6 students, and relates directly to the Ontario Science Curriculum for Grade 4. It combines key science concepts with an application to musical sounds, and culminates in a project where students create their own musical instrument.

Overall Expectation:
Understanding Matter and Energy: Expectation #2

- Investigate the characteristics and properties of sound

Specific Expectations:
Students will:

- Investigate the characteristics and properties of sound
- describe properties of sound, including the following: sound travels; sound can be absorbed or reflected and can be modified (e.g., pitch, loudness
- explain how vibrations cause sound
- assess the impacts on personal safety of devices that apply the properties sound

Learning Objectives:

- Investigate the characteristics and properties of sound
- Demonstrate an understanding of sound as a form of energy with specific characteristics and properties (eg. frequency and amplitude)

Success Criteria:
Students will demonstrate their knowledge and understanding through discussion, recording of their inquiry and learning through their K-W-L chart, review games and quizzes and lastly, through their culminating task, where they build their own musical instrument, and describe the key properties of how it produces and/or modulates sound waves.

Prior Student Knowledge Required:
Students should already have a basic understanding of the concept of energy, being something that is invisible at times.

Unit Outline

Provocation Activity

Getting Started: The Provocation - Sounds All Around Us
Listening Activity (~15-20 minutes)
Slide 7

This first activity is meant to spur students about their brain's amazing ability at discerning sounds, even when they are short or minimal.

For this activity, project slide 7 to your students, and click on each question mark button, and have students guess what sound they are hearing.

Spend some time reflecting on:

- How quickly they were able to identify the sound
- How some of the sounds may have been difficult to identify after one hearing
- How some sounds are loud, soft, high-pitched, low-pitched, shrill, gentle, etc.

Inquiry Activity

Generating Inquiry: Beginning a K-W-L Chart
Guided Writing Activity (~15-20 minutes)
Slide 9 and 10

This next activity is meant to track students' inquiry, reflection and learning around sound.

For this activity, students will start by activating their prior knowledge about sound, and then generating questions to guide their inquiry and knowledge.

Show slides 9 to support students in this process. You may also use the suggested K-W-L chart on the next slide (slide 10) to model what it could look like for your students. After each lesson in this unit, it is important for students to return to this chart to focus their inquiry and chart their growth.

Lesson 1

Lesson: Sound is Energy
Teacher-Led and Student Experiment (45 minutes)
Slide 12

This first lesson is designed to introduce sound as a form of energy, one we cannot normally see. In this lesson, students will be able to participate in or observe a short experiment where sound behaves in a way that students *can* see.

Slide 12 shows the experiment. Using a glass of water and a tuning fork, activate the tuning fork by hitting it on a solid surface, then gradually having the tips of the fork touch the surface of the water. Before doing the experiment, ask students to predict what will happen.

If you are showing the experiment, show slide 12 instead with the slow-motion video of the experiment.

After each lesson in this unit, it is important for students to return to their K-W-L chart to focus their inquiry and chart their growth.

Lesson 2

Lesson: Frequency in Sound
Teacher-Led and Student Experiments (60 minutes)
Slide 14, 15, 16, 17

This second lesson is designed to introduce the concept of FREQUENCY, or the speed of the vibration/sound wave. The frequency (or speed) of the sound wave determines the pitch of a sound- whether it is a high or low pitch. It is important that you use the term “pitch” when describing this characteristic, as simply saying “high” or “low” sometimes indicates volume level instead of pitch, which can be confusing for students.

Part of this lesson is presenting a video of an OSCILLOSCOPE, which is a device which can measure the frequency of a sound wave. The speed of the wave on the screen of this device is the FREQUENCY of the sound wave. Show this short video, and then continue by using the Chrome Music Lab Sound Experiments (just click on the images). You can also direct students to the experiments for them to try independently. Here are links to these experiments as well.

Oscillator Experiment Strings Experiment Piano Experiment

After each lesson in this unit, it is important for students to return to their K-W-L chart to focus their inquiry and chart their growth.

Lesson 3

Lesson: Amplitude in Sound
Teacher-Led and Student Experiments (60 minutes)
Slide 19, 20

This third lesson is designed to introduce the concept of AMPLITUDE, or the volume of the vibration/sound wave. The amplitude of the sound wave determines how loud or soft the sound is.

Part of this lesson is again presenting the OSCILLOSCOPE, which also can measure amplitude of a sound wave. How large or small the wave on the screen of this device is the AMPLITUDE of the sound wave. The amplitude of the sound wave relates directly to how loud or soft the sound is. Show this short video, and then continue by using the Sound Experiments (just click on the images). You can also direct students to the experiments for them to try independently. Here are links to these experiments as well.

Voice Spinner Experiment Bouncy Balls Experiment

After each lesson in this unit, it is important for students to return to their K-W-L chart to focus their inquiry and chart their growth.

Lesson 4

Lesson: How Our Ears Work (and How to Protect them!)
Teacher-Led (45 minutes)
Slide 22

This fourth lesson is designed to explain how our ears and hearing system works. It is truly an amazing system! This lesson also gives some insight on how to protect our hearing as well, and how technology is able to help those with hearing loss or are deaf.

Show slide 22. Use the diagram to introduce the parts of the ear, and then click on the diagram to show a short informative video about how this system works, and how to protect our hearing.

After each lesson in this unit, it is important for students to return to their K-W-L chart to focus their inquiry and chart their growth.

Lesson 5

Lesson: Checking for Understanding
Teacher-Led and student participation (45 minutes)
Slide 24, 25

This fifth lesson is designed to help students check for understanding, and to solidify concepts in preparation for applying them to the upcoming music projects.

Show slides 24 and 25 to go over how to understand the oscillator sound wave diagrams.

Then use this short Google Forms Quiz to check students' understanding.
Science of Sound QUIZ

You can also create your own review games like Kahoot, Blooket, or Quizziz to check for understanding in a fun way.

At your discretion, you may choose for students to use the K-W-L chart to help review, or help them with their Google Form Quiz or review games. This is up to you!

Lesson 6

Lesson: Found Sound
Teacher-led and student participation (45 minutes)
Slide 27, 28, 29

This sixth lesson is designed to help students imagine how the concepts around sound waves can be applied to a musical instrument.

Musical instruments utilize the concepts of VIBRATION, FREQUENCY and AMPLITUDE to turn sound waves into music. This video will spur students to start thinking about how these scientific concepts are what creates the musical sounds of violins, xylophone, trumpets, and so on.

The LandFill Harmonic is a South American musical organization which has taught these concepts to students who used materials destined for the landfill to create fully functioning and beautifully sounding instruments.

Show slides 27, 28 and 29 to find out more, and use the discussion questions after viewing each short video.

Video 1 Discussion Questions:

- What instruments did you hear in this performance?
- Can you identify them?
- Did you notice what they looked like?
- What were they made of?

Video 2 Discussion Questions:

- What materials did they use to make their instruments?
- How did they make sounds?
- What “families” would they belong to?
- Were there any “new” instruments created?
- What were some ways that the frequency of their sound changed?
- What were some ways that the amplitude of the sound was affected?

Culminating Task

Lesson: Build Your Own Instrument
Student Project
Slide 27, 28, 29

This last activity is the culminating task. It is intended to give students a chance to apply what they have learned by building their own musical instrument. The Success Criteria also includes a section wherein students must explain how their instrument works and connect their learning about key concepts learned during this unit.

Musical instruments utilize the concepts of VIBRATION, FREQUENCY and AMPLITUDE to turn sound waves into music. Students should be able to describe these aspects in their presentation about their project.

The following slides can be shared with students to introduce, help explain and provide success criteria about their project: slides 31, 32, 33, 34.

Universal Design for Learning is built throughout this unit. Many activities include contents that enables students from multiple intelligences, including:

Spatial: Students will have the opportunity to utilize building materials during the culminating task in order to build their own instrument, engaging hands-on learners.

Musical/Rhythmic: Students will have the opportunity to utilize online experiments which incorporate pitch to experiment with the properties of sound.

Logical/Mathematical: Students will be able to use their predictive skills in creating hypotheses which explain the properties of sound during their online and hands-on experiments.

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