UBC Geering Up
Engineering Outreach

Make an Instrument

Subject: Science/ ADST	**Grade:** 1-3	**Duration:** 2 hours or over a couple periods
Lesson Overview	In this lesson, students explore the properties of sound and use the Engineering Design Cycle to create their own musical instruments or sound-making devices. Through hands-on prototyping, they investigate how pitch, volume, and tone are affected by materials and structure. Students collaborate, reflect, and iterate on their designs, connecting science, design, and creative expression.	

Curriculum Ties (in addition to satisfying multiple core competencies):

ADST Core Competencies:

- **Communication**
  - Collaborating: Students will collaborate with each other by sharing their design ideas with their peers.
- **Thinking**
  - Creative Thinking: Students will develop their own prototypes of their choice.
  - Critical and Reflective Thinking: Students will brainstorm and think creatively before executing their plan.
- **Personal & Social**
  - Social Awareness & Responsibility: Students will be brainstorming and problem solving with their peers in a constructive and respectful way.

Applied Design

- **Ideating**

    - Identify needs and opportunities for designing, through exploration
    - Generate ideas from their experiences and interests
    - Add to others' ideas
    - Choose an idea to pursue.
- **Making**
    - Choose tools and materials
    - Make a product using known procedures or through modelling of others
    - Use trial and error to make changes, solve problems, or incorporate new ideas from self or others
- **Sharing**
    - Decide on how and with whom to share their product
    - Demonstrate their product, tell the story of designing and making their product, and explain how their product contributes to the individual, family, community, and/or environment
    - Use personal preferences to evaluate the success of their design solutions
    - Reflect on their ability to work effectively both as individuals and collaboratively in a group

Applied Skills

- Use materials, tools, and technologies in a safe manner in both physical and digital environments
- Develop their skills and add new ones through play and collaborative work
- Students will also be able to develop their design and presentation skills.

Science

- Properties of light and sound
- Examples: pitch, tone, volume
- Ways of making, recording, and transmitting sound, etc.

Content Objectives

- Use the engineering design process and knowledge of sound to create your own instrument.

Materials & Equipment Needed

Consumables:	Non-Consumables:
• Plastic bottles • Any containers / Boxes • Bells • Paper plates • String • Hair beads • Shoe boxes • Rubber bands	

Lesson & Activity

Lesson Stages	**Learning Activities**
Introduction	• Start by listening to some different music from around the world. You can point out where the country's are on a map and then listen to some music from that country. Let the students dance around and ask them how it makes them feel. • Then listen to some songs that they suggest. After, ask them what instruments they think they hear in the songs. • Ask them what other instruments they know. Write down all the instruments that the students can think of on a board. • Now ask them how do you think we can hear these instruments? • Introduce key science vocabulary (e.g., vibration, pitch, tone, volume, sound wave) using a short slideshow or poster visuals.

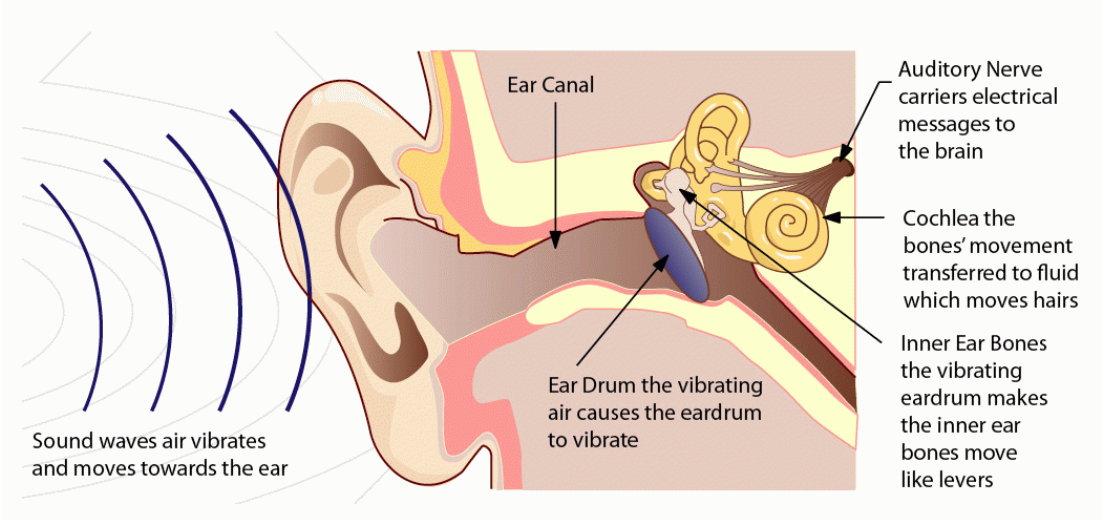
Activity	• Explain the challenge: students will design and build their own musical instruments using classroom materials. • Walk through the Engineering Design Cycle using a student-friendly workbook or worksheet (Ask–Imagine–Plan–Create–Test–Improve). • Support students as they choose materials, sketch designs, and build their instruments. Encourage trial and error, peer feedback, and creative thinking throughout the process. • As students build, prompt them to notice how different materials affect sound. • Examples: https://www.youtube.com/watch?v=BgSfPa56J7o https://www.youtube.com/watch?v=_jF-4QRoQ7U https://www.youtube.com/watch?v=cR1zWr5ZMpY https://www.youtube.com/watch?v=7WWTRL_dtFU https://www.youtube.com/watch?v=INkLmsaC314

Closure	Invite students to present their instruments to the class. Ask them to explain how the sound is produced and what part of their design vibrates or resonates.
	• Encourage use of vocabulary introduced earlier.
	• For a fun group activity, form “classroom bands” and have them try to play a rhythm or simple melody together.
	• Conclude with a short exit slip where students reflect on:
	  ○ What they learned about sound
	  ○ What was challenging or fun about the design process
	  ○ One thing they would improve in their design.

Step Ups & Step Downs	Step Ups • Limit materials to encourage creative problem-solving. • Challenge students to modify their instrument to change pitch or volume. • Connect with science: How does tension or length affect sound? • Form small bands and perform a simple song together. Step Downs • Provide sample instruments or design templates. • Offer pre-selected material kits. • Use visuals or short demo videos for support. • Allow oral or visual explanations instead of written ones.

Background Knowledge

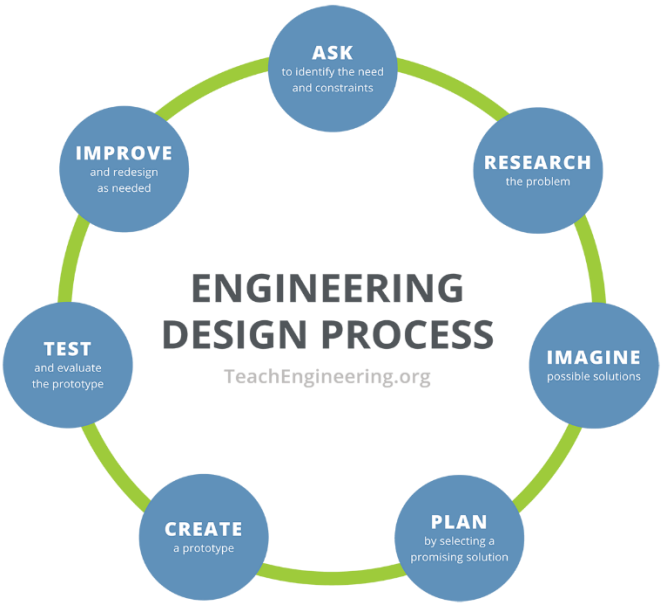
- Sound is a type of energy that is made when an object vibrates.
- The energy of the vibrations move through the air in the form or sound waves.
- When sound waves reach a listener's ear, they cause the eardrum to vibrate.
- These vibrations are transferred to the inner ear, which sends a message to the brain, which perceives sound.



https://www.soundproofingcompany.com/soundproofing_101/what-is-sound

- Pitch=How high or low a sound is.
- Vibration= a quick back and forth movement.
- Sound= A type of energy that is heard when objects vibrate.
- Sound Waves= Energy of the vibrations that move through the air..

The Engineering Design Cycle:



- Ask
    - What is the problem we're trying to solve?
    - What are the limits that our solution needs to follow?
- Research
    - Has someone already created something like this?
    - Who are the experts in this field?
- Imagine
    - Brainstorm a large quantity and variety of ideas before narrowing the options.
- Plan
    - What criteria should we use to narrow down our ideas?
    - Which ideas need to be screened based on the original constraints we identified?
- Create

    - What kind of prototypes can we create? A sketch, scale model, CAD model, computer simulation, etc
- Test
    - What does our final design need to accomplish? Can we test this with the prototype we made?
    - Run an experiment
    - Create a computer simulation
    - What information are we looking to gain from these tests?
- Improve
    - Based on the results from the testing, what can we improve on our design?
    - Are there certain aspects we found too difficult to create?

Additional Resources

- The Physics of Music
  https://www.youtube.com/watch?v=XDsk6tZX55g
  https://www.youtube.com/watch?v=w6EGyFAGpXU
  https://www.youtube.com/watch?v=o0Gl4tfh3KA