

Engineering Design Challenge

Can you hear me now?

Big Idea:

In this challenge, students follow the engineering design process to do the follow:

1. Design and build a sound-absorbing panel using blankets, pillows, foam, etc.
2. Test panel in the music classroom.
3. Use testing results to improve panels.
4. Try to absorb the maximum amount of sound for tolerable listening levels.

Standards:

Music Standards: Theory and Expression

- Demonstrate proper care of voice and instruments (1.1.c)
- Analyze and apply dynamics, tempo, meter, and articulation using appropriate music vocabulary (3.1)

NGSS

5-LS2-1.

- Develop a model to describe the movement of matter amount plants, decomposers, and the environment.

PS3 Energy

- Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- Apply scientific ideas to design, test, and refine a device that converts energy from one form to another

Science and Engineering Practices

- Practice 2- Developing and using models
- Practice 4- Analyzing and Interpreting Data
- Practice 6-Constructing Explanations and Designing Solutions

Problem Solving and Declarative/Procedure Knowledge

Declarative Knowledge:

- Certain levels of sound can be harmful to the human ear.
- Certain materials have the properties to amplify and absorb sound.
- Acoustics are the properties or qualities of a room or building that determine how sound is transmitted in.
- Sound quality can be measured through an oscilloscope or a sound meter.

Procedural Knowledge:

- Moderately structured problem.
- More than one acceptable solution strategy.
- Needed information needs to be gathered.
- Convergent but may be more than one solution.
- Requires modeling.
- Learner must invent a strategy which suits application to the music classroom.

Objectives and Cross-cutting Concepts

Students will be able to independently use their learning to...

- Demonstrate how energy can be transferred in various ways and between objects.
- Compare how engineers improve existing technologies or develop new ones.
- Explain how science affects everyday life.

Students will know...

- How sound affects the human body.
- Dynamic levels and terminology.
- Measurements of sound.
- What are acoustics.

Possible Activities/Learning Plan

Engage:

- As students are coming in to class, play a selection from Mozart's Eine Kleine Nachtmusik. While it is playing, project the oscilloscope from this website <https://academo.org/demos/virtual-oscilloscope/>
- Ask the class what are their observations from the oscilloscope? Shapes, sizes, patterns, etc.
- Tell the class what they are seeing are the visual representation of actual sound waves using a device called an oscilloscope. They can determine the frequency and amplitude of a signal or sound.
- Now I'm going to play the same song but I'm going to change it somehow. Determine what has been changed by viewing the oscilloscope. Teacher plays song but changes the volume.
- What has been changed? The Volume and we call that in music dynamics.

Explore:

- Explore using instruments and singing and how it affects the oscilloscope.
- Introduce how sound is measured in hertz and use the NIOSH Sound Level Meter app to measure their sound level.
- Have class measure the sound levels of different spaces such as outside, in the music room, library, classroom, gym, cafeteria, etc. Designate one or two people to take notes on their findings and then share with the class.
- Set-up stations where different materials will be tested.
- Make predictions of what materials will absorb more sound.
- Have students share their findings of the effect of different materials.
- Brainstorm other materials that could be tested.

Explain:

- After groups or individuals have explored all the stations, they will come back and share their findings on how different materials absorb sound.
- They will also share something new they discovered and wondered from the stations.

- Share with class the Noisy Planet website and show them the animation “Journey of Sound to the Brain”.
<https://www.noisyplanet.nidcd.nih.gov/have-you-heard/travel-through-the-ear-journey-of-sound>
- Go to the “Listen up! Protect your hearing” to view how sound can affect and even damage your hearing and how to prevent it.
<https://www.noisyplanet.nidcd.nih.gov/kids-preteens/listen-up-infographic>

Elaborate/Extend:

- After analyzing data from the noisy planet website and observations from measuring sound levels in different spaces, have them create a model classroom which will allow for safe levels of sound to be played using a shoe box or cardboard model.
- Have them complete their classroom design worksheet and list all the parts and materials they will need in order to build it.
- Build design using household items either provided by teacher or brought in by students.
- Refer back to resources to analyze what materials can enhance their design.
- Test to see if design can hold up, absorb sound, and get feedback from peers or teacher.

Evaluate:

- Groups will demonstrate why they choose to design their model and how it’s a safe space for listening by playing the recording of “Eine Kleine Nachtmusik” and using either the oscilloscope or NIOSH Sound Level Meter app to measure sound levels.
- Students will be given the rubric at the beginning of the assignment so they can track their progress.

- Class will give descriptive feedback on something they liked about their model or presentation, one question they might be wondering, and a suggestion to make it better.

Best activities

- Viewing sound through oscilloscope.
- Testing different materials.
- Creating prototype sound absorption panel.