Western Engineering Outreach

Soundproofers!

Grade 3-5

Meet Today's ENG HERO!

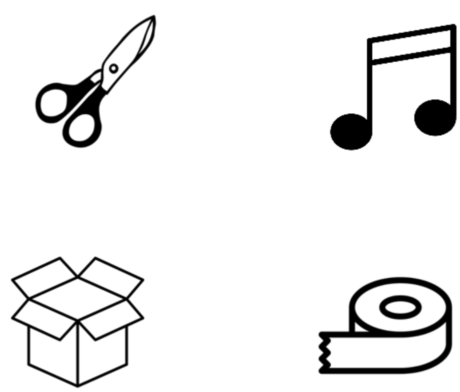
L. Y. Jiang – Professor with Western Engineering

Dr. Jiang's research focuses on theoretical modeling and numerical simulation to develop mechanics and physics models for challenging problems related to materials behavior, ranging from traditional composites, to smart materials, and to nanostructured materials. Research topics include multiphysics modeling on smart materials and soft matters for transduction technology applications, computational mechanics modeling on composites, nanomechanics, and failure analysis of advanced materials. To learn more about Dr. Jiang visit:
https://www.eng.uwo.ca/mechanical/faculty/jiang_l/index.html

Learning Goal:

- Light and sound are forms of energy with specific properties
- Sound is created by vibrations
- Investigate the characteristics and properties of light and sound
- Curriculum connections: Grade 4: light and sound Grade 5: Properties and Changes in Matter

Materials Needed:



- Tape
- Scissors
- Styrofoam
- Fabric
- Sponges
- Aluminum foil
- Paper
- Cardboard shoebox or pieces of cardboard made into a box
- Music playing device
- Any decibel measuring app (downloadable from Apple store, Google play, or Online)

Engineering and Science Connections:

There are lots of times where we engineer something to interact with sound in a particular way. One big example of when we want to be careful about how our design interacts with sound is in a movie theater. What do engineers do so that the sound quality is good for everyone in a movie theater? How do they make it so that the sound in the auditoriums don't interfere with each other? To look into how we do this, we need to know a bit more about what sound is, and how it works.

Which is louder: dropping something on carpet or on tile? It is quieter on carpet because the carpet absorbs the sound waves. Sound waves need molecules to travel through, but sometimes sound waves are absorbed by an object or material. Sometimes when you are in an empty, tiled room your voice echoes or sounds hollow. This is because the tiles are more likely to reflect the sound waves than some other materials. It may be amusing to play with the echo in an empty room, but echoes can interfere with the sounds we want to make next; therefore, for a lot of applications we want to minimize the size of echoes.

Engineers use this idea when designing rooms that are meant to be quiet. Have you ever noticed how the walls of a movie theater are covered with carpet or fabric? This serves two important roles: first, it prevents echoes within the room; second, it prevents the sound from escaping the room into the rest of the theatre.

When we think of sound, we generally think of it as travelling through air. That is how sound waves travel when you talk to a friend. How about water? Can you hear sound travel under water? How about a solid? Can sound move through a solid object?

Understanding the properties of sound and how sound waves travel helps engineers determine the best room shape and construction materials when designing libraries, classrooms, sound recording studios, concert halls, theatres, the inside of vehicles, and more. Room shape and materials can impact how sound waves travel since sound waves bounce off different object in different ways.

Recommended Video: https://www.youtube.com/watch?v=3-xKZKxXuu0

Activity:

Imagine that you have a problem with turning off the music on your device and really need to find a way to escape the noise for a while. It is our job today to soundproof our box from the music inside so that we can relax a bit.

Step 1:

Start by placing the music/noise player inside the box and listen to how loud it is before the box is soundproofed. Play an alarm sound or music from your device and measure it with your decibel reading app. This will give you a baseline of how loud the initial sound is.

Step 2:

Make a plan for what you will do with the materials you have. How effective do you expect each material to be in soundproofing the box? Why do you think that? Would it be better only use some of the materials or all of them?

Step 3:

Spend around 20 minutes to build your design -

- Add to the challenge: introduce a budget for yourself. You can have a total of six handfuls of materials. Each time you grab a piece of foil, paper, or fabric only take as much as can fit inside the outline of your hand.

Step 4:

Now it's time to test our design! Place your music/noise player inside the box blasting the same music it was when you tested at the start. Use the decibel measurer to find and write down the sound levels to compare to the initial decibel level. How effective was your soundproofing?

To debrief: Discuss the differences in what made a good material vs a bad one. Which material worked the best? If you were to repeat this activity, what would you change? Where can you see this in your everyday life?

Extensions and Accommodations
Can have an initial testing phase, and then provide opportunities to fix their design and retest

What Did You Learn?

- What was different between the materials you found to be effective and the ones that weren't?
- If you were to repeat this activity, what would you change?
- What are some common places where we need effective soundproofing?

Future Learning

- Turn this soundproofing activity into a longer design challenge! In order to do this, record the materials you used in each iteration and how much sound was able to escape. Then restart from step 2 in the activity. Once you have built the soundproof box three or four times look at the data you gathered. Were your expectations at the start correct? Did any of the results surprise you?

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!