



Royal Academy
of Engineering

THIS IS
ENGINEERING

ENGINEERING IN THE MOVIES GOOD VIBRATIONS

STEM

Science, Technology and Engineering Focus



INTRODUCTION

Some of the biggest moments in cinematic history hit your ears before your eyes. The first spine-tingling notes from John Williams' **STAR WARS** main title and Booger's no-contest belch in **REVENGE OF THE NERDS** stay with you long after you have left the cinema.

But for a movie's sound team, it's about capturing the subtlety and realism that makes a film truly memorable.

In cinema's early days, experimental attempts were made to merge audio and visual entertainment, with nearly 40 different varieties and many one-offs before the talkies (movies with sound) hit the scene.

Productions such as **DON JUAN** in 1926 featured a score and sound effects but no dialogue; it wasn't until **THE JAZZ SINGER** spoke to audiences in 1927 that the talking picture revolution truly took hold of Hollywood.

First through mono, then stereo and then onto Dolby Digital.



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OVERVIEW

Learn all about how we can see sound and vibration through these three practical fun experiments.

Sound is produced by vibrations: bigger vibrations produce louder sounds and faster vibrations produce sounds with a higher pitch.

Sound waves travel through solids, liquids and gases, moving through each of these by vibrating the molecules in the matter. Sound travels about four times faster and further in water than it does in air.

CHALLENGE

-  Teams of two
-  30 minutes
-  KS2/3
-  Developing



CHALLENGE 1: LED PATTERNS

MATERIALS

- Scissors
- Balloon
- Clear plastic cup
- Sticky tape
- Glue
- Clear acrylic tube
- LED pointer
- Mirrored piece
- Mobile phone
- Speaker

TERMS & CONCEPTS

- Amplifier
- Equaliser
- LED (light emitting diode)
- Frequency
- Signal

1. Cut out the bottom of the cup.
2. Cut the balloon in half and dispose of the neck end.
3. Stretch the remaining piece of the balloon over the top of the plastic cup.
4. Secure the balloon with sticky tape.
5. Tape the clear acrylic tube to the side of the cup.
6. Glue the small mirrored piece and stick onto the centre of the balloon drum.
7. Secure the LED pointer onto the acrylic tube, making sure that the light hits the mirror.
8. Lastly, position your mobile phone speaker next to the bottom of the cup and play some music. Make sure you have the sound on full volume and watch what happens when you turn the LED pointer on.

EXTENSION

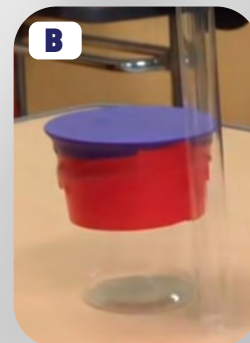
Experiment by playing different sounds at different volume. What changes of patterns are there?

YOUTUBE GUIDE

www.youtube.com/watch?v=vY6BTjAARkA



Stretch the balloon over the top of the cup and secured with tape



Attach the acrylic tube to the side of the cup



Stick the mirrored piece to the centre of the balloon drum



Attach the LED pointer to the tube so the beam hits the mirror. Now see what patterns you can make.

CHALLENGE 2: THE SOUND CAROUSEL

This experiment will illustrate how to move objects with only sound by using the power of resonance.

1. Start by blowing into the bottle. Record this on your mobile phone. What frequency do you think the sound is?
2. Attach the bottles to each end of the dowel rod with the elastic bands (as seen in the illustration).
3. Secure the pivot to a secure surface. A bench vice in design technology would work well.
4. Balance the centre of the dowel rod on the pivot point.
5. Now play the recorded bottle sound through a speaker towards the bottles and see what happens.

EXTENSION

The more exact frequency you play, the faster the carousel will spin. The force comes from Helmholtz resonance. Experiment by playing different sounds at different volume. Do the bottles spin?

YOUTUBE GUIDE

www.youtube.com/watch?v=SemQS4RLeFU

MATERIALS

- Wooden dowel rod
- 1.5 litre bottles (x2)
- Rubber bands (x2)
- A pivoting point
- Mobile phone
- Speaker

TERMS & CONCEPTS

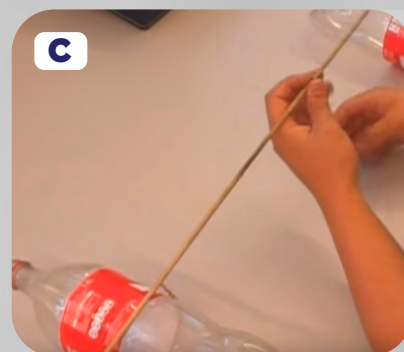
- Resonance
- Haptics
- Ultrasound
- Acoustic
- Feedback



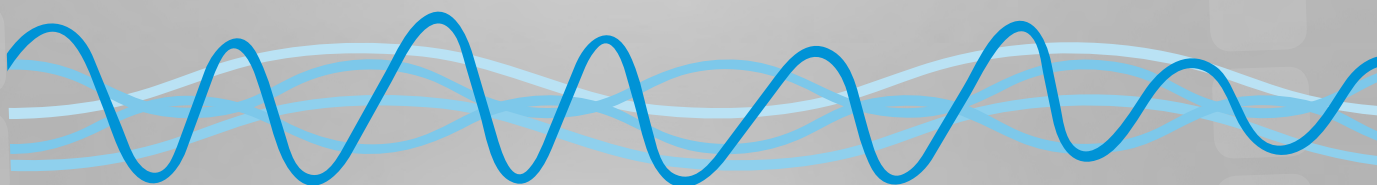
Blow into the bottle and record the sound on your mobile phone



Balance the centre of the dowel rod on the pivot point. Now play the recorded bottle sound through a speaker towards the bottles and see what happens



Attach the bottles at each end of the dowel rod with the elastic bands



CHALLENGE 3: SOUND SANDWICH

For this experiment, you will make a cool sound instrument that is super annoying for your teacher!

1. Start by stretching the large rubber band from one end of the lolly stick to the other.
2. Cut off the bendy part of the straws and sandwich these between the two lolly sticks. Place one at each end, about an inch from the ends.
3. Wrap the rubber bands around the ends of the lolly sticks. Make sure they are not touching the straw.
4. Hold the sandwich to your mouth and see what happens when you blow.

EXTENSION

When you blow, the large rubber band will vibrate and create an annoying sound. See how long you can play your instrument before your teacher has had enough.

YOUTUBE LINKS

www.youtube.com/watch?v=IADGbk5xk6I

www.youtube.com/watch?v=LVWTQcZbLgY

MATERIALS

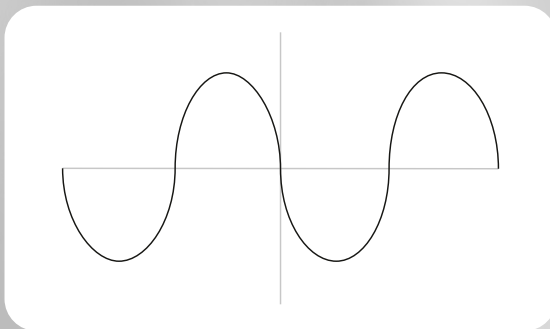
- 1 pair of scissors
- 2 bendy straws
- 2 large wooden lolly sticks
- 2 large rubber bands
- 1 small rubber band

TERMS & CONCEPTS

- Reverberation
- Vibration
- Peak
- Trough
- Wavelength
- Amplitude



SOUND WAVE EXERCISE



Label the following points on the diagram above:

PEAK - the tip of a wave.

TROUGH - the bottom of a wave.

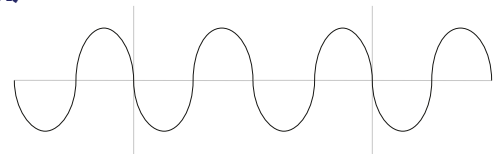
WAVELENGTH - the distance from a peak to peak or trough to trough. It is the length of one wave.

AMPLITUDE - the height of a peak in the wave

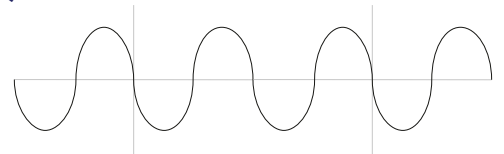
On the diagrams on the right, draw a wave that has:

- | | |
|---------------------|---|
| (A) A quieter sound | (B) A higher pitch |
| (C) A louder sound | (D) A louder sound
AND a lower pitch |

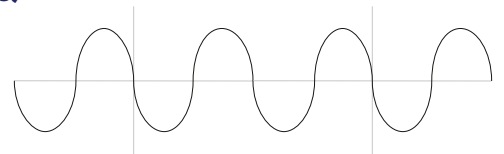
(A)



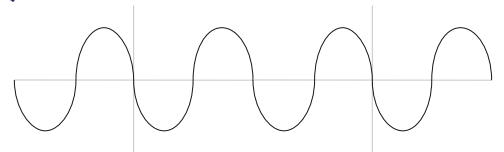
(B)



(C)



(D)





The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

What we do

Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

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We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.