Making music

Whether it’s thinking about how we hear sounds, record and play back music, or make musical instruments, STEM has a role to play. This activity was inspired by Mark Bush, a STEM Ambassador.

During this session students will model musical instruments, and investigate the musical notes they produce. How close can they get to the notes produced by real instruments?

Introduction

Download sound recording and editing software (there are lots of different types available online, such as Audacity – a free, open source programme for recording and editing sounds: audacity.sourceforge.net/download). Please note the school may already have suitable software.

What you need

Per group (of two to four students)

- A computer and a microphone (some laptop computers may have an integrated microphone).
- A selection of recycled materials: cardboard tubes, plastic boxes/tubs, plastic bottles, biscuit tin
- Different width elastic bands / elastic
- G clamp
- Masking tape
- Balloons
- Rulers
- Scissors
- Drinking straws
- Greaseproof paper
- String, cord or steel wire, a pulley and masses

Note for STEM Ambassadors: schools will have many of the items you need, so check with the teacher before your session.

Remember a risk assessment should be done by the school before beginning this session.
What to do

Part one

1. Download a recording and editing programme prior to your session. Check that the programme loads on to your computer and that you are happy with how it works.

2. Record a series of sounds from a variety of the musical instruments. Remember to save a copy of how each note looks as well as sounds.

   Show your group a spectrum of sounds on screen such as musical instrument notes, glasses being tapped, crisp packets being rustled.

   If your time or equipment is limited start with the quicker sound-sources such as popping a balloon and twanging the clamped rulers.

3. Students should now make their own musical instruments out of the materials available and attempt to replicate the sound and look of notes produced by the ‘real’ versions.

Wind instruments:

a. The easiest wind instrument to make is a straw kazoo (pictured below).

   Flatten one end of your straw. Then cut a small (flat top) triangle into the end of the straw (see diagram on the right). Don’t let the triangle form a point.

   Blow into the opposite end. What happens if you cut different shapes, or make your straw shorter?

b. Attach greaseproof paper to the end of some card tubing and blow into the opposite end. What note is produced? Where should finger holes be placed?

String instruments:

Stretch elastic bands across your plastic box or biscuit tin. Can the students extend the musical instrument to include different frets?

These are just basic ideas. Your group can be as creative as they want! You can also record the students talking or singing to compare notes and waves.

Part two

4. In turn, groups should record the notes their musical instrument makes. Does this match any of the ‘real’ instruments?

5. Questions to think about:

   a. Why have they chosen a particular style of instrument?
   b. How close were they to the pre recorded notes?
   c. How could they adapt their musical instrument to make it better?
   d. What limitations do their musical instruments have?
   e. How could the instruments be manufactured on a large scale?

Some extras

You could select the more successful instrument designs and build them at different pitches, then play a simple piece of music. Can your STEM club fool the rest of the school into believing that the piece of music is being played ‘real’ instruments?

To further extend this session students can investigate three aspects of musical sound:

Pitch – what is the link between the pitch of the sound and the trace on the screen? You can introduce the idea of frequency – the number of complete oscillations per second.

Amplitude – what is the link between the loudness and the trace on the screen?

Attack and decay – what is the link between the type of instrument used and the trace on the screen? The attack (sudden rise in amplitude) is evident in a handclap. The trace decays away almost instantly because the energy from the impulse propagates away in the air. When the energy impulse is retained in a material (like a drum skin), you can see a slower decay in the trace as the energy dissipates.

Growing Sounds is a project from the Universities of Southampton and Salford, and EPSRC and contains lots of recipes for making musical instruments out of fruit and vegetables! (www.growingsounds.sound101.org)

Or you could experiment further with the audio editing software. Ask the groups to imagine they are radio producers asked to speed up the terms and conditions blurb at the end of an advert so that it doesn’t take up too much air time. The students must record a short statement then use the sound editing software to speed it up.

How fast can they make this? What is the time difference between the original and the fast versions?

Cut along the dotted lines
Who works with these ideas?

STEM Ambassador profiles

James Rene
Engineer/acoustician

James Rene is an engineer/acoustician working in the construction industry. James needs to use his knowledge of sound and apply this to buildings.

What I do on an average day: There is no average day! My time is split between desk work, meetings and the most exciting part – construction sites. This is where everything we design on paper, or electronically these days, is brought to life. I also carry out acoustic surveys using noise level meters, and occasional site inspections when the structure of a building goes up.

How I got here: Via the careers service at university. I always knew I wanted to be in engineering from school, but not specifically the construction industry. You could say it happened a bit by accident! I did a couple of summer placements at my now current employer who have encouraged me to continue building up knowledge and experience in the industry.

My favourite part of my job: Seeing everything come together when a project is completed. Not necessarily seeing the things that we have designed, but how our clever and discrete systems contribute to the pleasant environment inside a building.

Likes: ‘Eureka’ moments, when you’ve finally cracked something which for whatever reason has been impossible to solve.

What is engineering? Engineering is simply problem solving. It is applying scientific principles and research to everyday problems, and continually improving our lives and environment.

Handy hints

This really is a creative activity as there are many different types of musical instruments that could be created.

However students should always think about the ‘user’. If frets or finger holes are too far apart a musical instrument becomes useless. How could your group adapt their musical instrument for different users?

This is a really good opportunity to show how scientists and engineers can use IT to test and adapt their theories and products. You may also wish to take the opportunity to discuss arithmetic progressions in maths; vibrations, frequency and wavelength are concepts from physics; and even timbre and note structure are concepts from music.

Mark Bush
STEM Ambassador

Mark Bush, is the STEM Ambassador who helped to inspire and develop this activity.

Industry sector: Various engineering and IT

How I got here: I have an electronic engineering degree and have worked in the computer and electronics industry for about 30 years. I’ve always had a strong interest in live music, including rock, classical music and blues/jazz. I also play tenor saxophone.

I am currently doing an Open University degree in music.

My favourite part of my job: I hope this activity will give people some idea about what a musical instrument is, how it makes sounds, and exactly what sound is. You may be surprised at just what is going on when you play even a single note on an instrument, and just how clever the ear and brain are in sorting out the complicated patterns that are part of any kind of music.

Hobbies: Music, film, science and technology.

The future? I think the future for making music is very strong. There are many computer programmes which allow people to create and edit sounds, and which help people to improve their instrument playing ability, so making music has never been easier.

What is engineering? It’s a great way of finding out about the world and earning a good living.

Explanation

Sounds are made as a result of vibrations. By plucking the string or blowing down a tube we are causing the air particles to vibrate, in turn neighbouring particles vibrate and so on. Sound is transmitted through the medium as a longitudinal wave.

When you look at your recordings of various sound sources, you will distinguish two groups, those where the sound has a harmonic structure and those where it is essentially unstructured. This is what defines a musical sound as opposed to a non-musical one, look for repeating patterns.

For further information on the physics of musical Instruments visit: hyperphysics.phy-astr.gsu.edu/hbase/hframe.html
This is engineering

Being creative to solve a problem is what engineering is all about. In this activity students are required to manufacture their own musical instruments and use IT to test their accuracy.

Acoustics, audio and sound engineering are offered at many universities. These degrees will often require STEM A levels (Advanced Highers in Scotland) including mathematics and preferably physics too. Alternatives include STEM-related Advanced Diplomas (or BTEC National Extended Diplomas) plus appropriate qualifications in mathematics and possibly physics too. See www.ucas.com for more information.

There are many engineering opportunities for apprenticeships, which cover a wide range of business sectors. For more information in England visit www.apprenticeships.org.uk, or in Scotland visit www.apprenticeshipsinscotland.com and in Wales wales.gov.uk/apprenticeships

Next steps

Remember there are more resources at networking.stemnet.org.uk

For more on STEM Clubs visit: www.stemclubs.net

For more information on Engineers and Engineering: www.raeng.org.uk

Visit Southampton University’s Institute of Sound and Vibration Research site for information on their public engagement Programmes: www.isvr.soton.ac.uk

CREST Awards are easy-to-run, encourage students to continue with STEM subjects, and add real value to UCAS applications. To link this activity to CREST Bronze Awards, contact your CREST Local Coordinator: www.britishscienceassociation.org/crestcontacts

Curriculum links

Using this activity you can discuss:

Science: Sound waves

Music: Develop deeper understanding of the music that they perform

Students can be very creative. These students at Amersham School decided to make a water xylophone!