Sounds Like!
A Primary STEM Resource
from DATTA Vic & Discovery Science & Technology Centre

Key communication messages

- Design thinking: Empathise, ideate, design, prototype, test
- Different materials produce different sounds
- Sound as vibration
- Amplification and Pitch

Sound is VIBRATION that moves through stuff. Vibrations move through the air to our ears and the inside of our ears vibrates which we "hear" as sound. This sound can be AMPLIFIED by making more things vibrate. The shape of the vibration gives us the PITCH of the sound. The way the vibrations move depends on the materials used to make the sound.

Kangaroo Flat Primary trialling Sounds Like at Discovery Science & Technology Centre Bendigo

Key Action

To investigate how forces and the properties of materials affect the behaviour of a designed solution

Preparation

Pre-class:

- If possible, obtain buckets with lids for each group of students
    - Each group should be of two or three students
- Drill a small hole in the base of large plastic buckets
- Drill a small hole in the centre of the bucket's lid.

Put supplies in a bucket with lid for each group:

- Large paper cups
- Large Styrofoam cups
- Sheet of tin foil (about 30cm^2)
- Large plastic cup
- Metal slinky (in its packaging if possible)

Set up:

For yourself

- Tuning Fork
- Electrical tuner (if possible)
- Hollow Box
- Wooden, plastic and metal serving spoons
- Skewer
- Slinkies and cups of various sizes and materials
- A paper cup, plastic cup and metal patty pan for crushing (hidden)
- If desired, have a decibel metre on hand to measure volume of different designs
- Have a drill handy for putting small holes in plastic cups

Just in case: (extension activities – see page 9)

On tables/desks:

- Safety glasses
- Some tables have coat hangers on string
- Some tables have whirling sound tubes (next to large open space)

On side bench:

Suggested materials and tools for slinky cup making activity (feel free to tailor your own list)

- Paper and plastic plates
- Paper, plastic, polystyrene cups
- Foil trays
- Wooden pegs
- Thin card
- Cardboard
- Various types of string: wool, ribbon, twine, etc.
- Paper clips
- Plastic cutlery
- Alfoil
- Serviettes
- Cleaning cloths
- Rubber bands
- Straws
- Skewers
- Tape: masking tape and gaff tape
- Beads
- Scissors

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Workshop

Introduction

Design and Technology: while science is about asking questions, D&T is about problem solving: finding a solution to a need.

Innovation is taking an idea and doing something with it: improving it and/or making it a reality.

Empathise, Ideate, Design, Prototype, Test

Ask students:

- Why do we make sounds?
    - Communication
    - Enjoyment
    - Traditions and Ceremony
    - Cheering and showing support
- What are sounds that we can hear?
- What is a quiet sound?
- What is a loud sound?
- What makes sound?

People have designed instruments to make sound. Sound is VIBRATION that moves through stuff. So an instrument must have a vibrating part. Vibrations move through the air to our ears and the inside of our ears vibrates which we "hear" as sound.

These vibrations are really fast!

"Play" tuning fork a few times.

Ask students:

- Can you hear it?
- Can you see it moving (the end goes blurry)?
- Why do you think it was invented? What need does it meet? (hint: it's in the name)
- How has the design changed over time? What do we use now?
  Students may not be able to answer these questions, so if possible, show how an electric tuner works and discuss which they'd rather use and why.

We can change a sound by changing the materials that are vibrating, or the way that something is vibrating.

Warm Up Activity: Strange Instruments

On the tables are musical instruments – do they look like instruments we are used to? Why/Why not? Anything can be an instrument! **Sometimes it just takes some innovative thinking: thinking outside the box.**

Whirling sound tube: These change sound depending on how often they are vibrating. The faster the air moves through it, the more vibrations are made. This produces a higher PITCH.

Coat Hangers on String: These produce a different sound depending on what is vibrating. Sound has to travel through stuff, and it can travel better through solid stuff than air.

Observation

Students put on safety glasses and investigate the Coat Hangers and Whirling Tubes. Rotate the groups/tables after a few minutes.

Discussion

- What did each group notice about each activity?
- What observations did you make?
- Was the Coat Hanger louder with fingers in the ears?
    - Why do you think this was?
- These are unusual ways to make sound – but can they be played another way?
  Remember: innovation is thinking outside of the box! Thinking about all the features of these instruments can help.

Coat Hangers:

- Can be struck with some sort of mallet
    - Show students wooden, plastic and metal spoons as mallets
    - Play coat hangers (as instructed by students) with each mallet
    - Comment on the changes in the sound

Whistling tubes:

- Blowing down the tube à la a trumpet or digeridoo.
- Running a stick along the ridges (a large skewer is great for this)

If they are struggling to think of ideas, ask them to describe all the features of the tube or coat hanger:

- It's bendy
- It's bumpy
- It's thin
- It's hollow
- It's plastic
- It's metal…etc.

Let's change parts and add parts to shape the sound. We saw with the coat hangers and spoons different materials make different sounds. Can we recognise these different sounds? *Ask that students shut their eyes. Crush a cup of different material and have them guess what it is made of.*

Now, let's add something to change the sound. *Pick up tuning fork.* You may be able to just hear this sound, it is very quieter. But if I add something…*Put fork on box, should get louder. But not much…*We can change the sound by making it a little louder. However, I have a better way to show this.

Pick up slinky, have students listen quietly. Drop one end of the slinky so it hits the ground and rings softly. Could you hear that? Not very well. Let's add something. *Attach paper cup by threading the slinky through the bottom of the cup. Holding cup, drop slinky and allow for students' reaction.*

This is a very simple instrument. The slinky vibrates, which makes the cup vibrate and creates a louder sound. But I think you can be innovative thinkers and design this instrument differently.

We can each explore how different materials change sounds with metal slinkies! *Demonstrate Slinky with simple paper cup.* I have an idea that if we change the paper cup, we might change the way the sound is amplified and change the sound slightly. Let's investigate.

Investigation

Cups and Slinkies – how might we change this simple instrument?

Activity 1: Materials Involved

Break students into groups of three, and give each the bucket of materials. Give them about 10 minutes to work together to explore the materials involved and comment on any sound changes they notice.

Use what you have to see how the materials can change the sound…**think outside the box**! Make your own version of a slinky cup by testing and prototyping with your materials.

- Large paper cups with small hole at base
- Large Styrofoam cups with small hole at base
- Plastic buckets or large cups
- Metal Pie dishes
- Metal slinky

Slot slinky into cup, observe sound. Slot slinky into other materials and compare amplification and sound quality. How might you slot the slinky – through the base, or a hole in the side?

Discussion

Have some groups showcase what they worked on. Did any groups see what other groups had done and extend on that? This is perfect as this is innovation. ***Design thinking is not cheating*** *– as long as you improve upon the ideas of others. This is how we progress and create new inventions: by building on each other's work.*

Before starting the next activities, run through a safety briefing of tools and materials, and go through the materials available on the side bench.

Activity 2: How the materials are involved

Activity 3: How it is played

These two activities can be run at the same time so students can work on both the questions simultaneously.

Think of a guitar, a violin, a harp, a piano. These are all different instruments, they have been designed differently, but they all use the same technology: they are vibrating strings attached to a hollow wooden box.

You all have a slinky, but can you change how the components are involved and how it is played?

Give the students, in their groups, 20mins to do this. Though longer is better if time permits. Facilitate as necessary and watch for hazards.

Conclusion

Ask students to share their designs and reiterate that innovation is thinking outside the box, and we were designing and using basic technologies to create something new.

- What did you discover?
- What was frustrating?
    - Attaching things together?
    - Having too many ideas?
    - Having not enough ideas?
- How did you overcome problems you encountered?
- How does your instrument compare to those around you?
- How did you control the sound?
- How does it sound different to those around you?
- Why do you think this is?
- Who needed more time?
- Who would change their design if they could do it again?
- Who wants to do more stuff like this?

Curriculum links

Victorian Curriculum

Design and Technologies

Technologies Contexts

Engineering principles and systems

Level 3 – 4 Investigate how forces and the properties of materials affect the behaviour of a designed solution

Level 5 – 6 Investigate how forces or electrical energy can control movement, sound or light in a designed product or system

Materials and technologies specialisations

Foundation – Level 2 Explore the characteristics and properties of materials and components that are used to create designed solutions

Level 3 – 4 Investigate the suitability of materials, systems, components, tools and equipment for a range of purposes

Level 5 – 6 Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use

Creating Designed Solutions

Investigations

Foundation – Level 2 Explore needs or opportunities for designing, and the technologies needed to realise designed solutions

Level 3 – 4 Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to create designed solutions

Level 5 – 6 Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions

Generating

Foundation – Level 2 Visualise, generate, and communicate design ideas through describing, drawing and modelling

Producing

Foundation – Level 2 Use materials, components, tools, equipment and techniques to produce designed solutions safely

Level 3 – Level 4 Select and use materials, components, tools and equipment using safe work practices to produce designed solutions

Level 5 – Level 6 Apply safe procedures when using a variety of materials, components, tools, equipment and techniques to produce designed solutions

Science

Science Understanding

Physical Sciences

Foundation – Level 2 The way objects move depends on a variety of factors including their size and shape: a push or a pull affects how an object moves or changes shape

Light and sound are produced by a range of sources and can be sensed

Level 3 – Level 4 Forces can be exerted by one object on another through direct contact or from a distance

Science Enquiry Skills

Questioning and Predicting

Foundation – Level 2 Respond to and pose questions, and make predictions about familiar objects and events

Level 3 – Level 4 With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge

Level 5 – Level 6 With guidance, pose questions to clarify practical problems or inform a scientific investigation, and predict what the findings of an investigation might be based on previous experiences or general rules

Planning and Conducting

Foundation – Level 2 Participate in guided investigations, including making observations using the senses, to explore and answer questions

Level 3 – Level 4 Suggest ways to plan and conduct investigations to find answers to questions including consideration of the elements of fair tests

Level 5 – Level 6 With guidance, plan appropriate investigation types to answer questions or solve problems and use equipment, technologies and materials safely, identifying potential risks

Analysis and Evaluation

Foundation – Level 2 Compare observations and predictions with those of others

Level 3 – Level 4 Compare results with predictions, suggesting possible reasons for findings

Extension Activities

SHAKE, RATTLE & ROLL!

SAFETY WARNING

Small items may be swallowed—ensure supervision at all times.

WHAT TO DO

You will need:

- 2 paper or plastic cups
- Rice, lentils, chickpeas, small paper clips and anything else that might work!
- Sticky tape

How to do it:

1. Place a handful of rice, lentils, chickpeas or anything else into one of your cups (it could be just one lot of items, or a mixture of different ones).
2. Turn another cup upset down and tape the two cups together, rim to rim.
3. Shake to make music!
4. Do you notice a difference in the sound depending on what you've used inside your cups?
5. Decorate if you wish.

In class:

1. Lay out all the possible insides to your shaker.
2. Have your students listen to the sound yours makes, and leave it at the front of the class for a reference.
3. Your students' task is to make a shaker that sounds just like yours out of the materials offered (these could include things like marbles, sticks, confetti, etc., as well.)
4. Have them make multiple shakers, each one trialling the sound of different insides to the shaker. Eventually, the students might work out the recipe to yours!
5. Bring all the students together and unveil the contents of your shaker.
6. Discuss the different shaker noises that everyone made.

WHAT'S HAPPENING?

A musical sound is produced by air vibrating a certain number of times per second. Percussion instruments make sounds by two objects hitting each other and then vibrating. These vibrations are called waves.

The number of times that a sound wave vibrates in a second is called its frequency. High notes have a higher frequency than lower notes and this changes their shape. The different items inside the shaker creates different waves and therefore different sounds—the chickpeas are deeper as the vibrations are fewer, and the rice is higher due to more vibrations.

SOMETHING FURTHER…

A rattle is a percussion instrument. It consists of a hollow body filled with small uniform solid objects, like sand or nuts (similar to maracas). Rhythmical shaking of this instrument produces

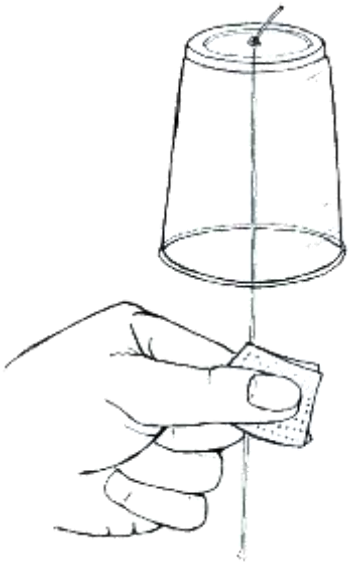
repetitive, rather dry timbre noises. In some kinds of music, a rattle assumes the role of the metronome, as an alternative to the drum (to provide a steady beat).

This instrument was used in the ancient world. Today it plays a role in Cha Cha Cha, Tango and jazz.

A rattle is an idiophone. An idiophone is any musical instrument which creates sound primarily by way of the instrument's vibrating, without the use of strings or membranes—in this case the sound is made through shaking.

Rattles are also used for infants as a toy.

CLUCKING CUPS



SAFETY WARNING

Be careful using the skewer or pin to make the hole in the cup.

WHAT TO DO

You will need:

- Paper cup
- Cotton string
- Sticky tape
- Paper clip or tape
- Pin or skewer
- Piece of fabric or Chux cloth

How to do it:

1. Carefully make a small hole in the bottom of the cup using a
2. Thread the piece of string through the hole.
3. Tie the string to the paper clip or stick it down with tape, so that it can't slip back through the hole.
4. Dampen the fabric or Chux cloth. Hold it firmly around the string and pull downward. Do you hear a loud clucking sound? This may take a little practise!
5. If you wish, decorate your cup to look like a chicken.

WHAT'S HAPPENING?

As the wet sponge moves down the string, it grips a little, then slips a little, then grips again, and so on. This makes the string vibrate. The vibrations travel up the string to the cup. The cup starts to vibrate too, amplifying the clucking sound (making it louder).

KAZOO

Equipment (per student):

- 2 paddle-pop sticks
- 1 thick rubber band
- 2 thin rubber bands
- 2 short (1.5 – 2cm) lengths of straw

Method:

- Stretch the thick rubber band over one paddle-pop stick, longways, so that it wraps around the stick like a belt.
- Place one straw between the band and paddle-pop stick, about 1cm from the end of the stick. Place the other straw on top of the rubber band, about 1cm from the other end.
- Place the other paddle-pop stick on top of the straws.
- Use the thin rubber bands to hold the straws and sticks together by winding them around each end. Make sure it is not tight! Just enough to hold it all together.
- Blow across the stretched elastic band.

Brainstorming Kazoo Activity

Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques on how to make the kazoo adjustable, louder, or produce different sounds (this links to the *Generate* section of the Design and Technology Curriculum).

Cultural Links

These two videos touch on the **Technologies and Societies** part of the curriculum. They are not designed for these age levels, but can be used as a tool to start interesting class discussions.

- News article about instruments made from rubbish:
  - https://www.youtube.com/watch?v=yiYFcuIkBjU
- TEDx talk on making musical instruments out of rubbish:
  - https://www.youtube.com/watch?v=CsfOvJEdurk

If students enjoyed the whirling tube activity and would like more information, here is a video about making them at home and exploring the sound they can make.

- http://www.stevespanglerscience.com/lab/experiments/sound-hose/

Judge for yourself whether this next video is suitable for the classroom. It is included here as an example of all the ways that the one item can produce different sounds. Perhaps you can try a similar thing in the classroom with (unlabelled) bottles. It is the VB Bottle orchestra:

- https://www.youtube.com/watch?v=pUru7nSyKxQ