Creating Science – Hearing.

Our sense of hearing is such an amazing thing!

Suggested outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Science Inquiry Skills, Planning and conducting F: Participate in guided investigations and make observations using the senses.

Science Content, Physical sciences 1: Light and sound are produced by a range of sources and can be sensed.

Science Inquiry Skills, Questioning and predicting 4: With guidance, identify questions in familiar contexts that can be investigated scientifically and make predictions based on prior knowledge (ACSIS064)

Warning

- Don't make loud noises such as shouting in the reversible ears, the sound ways are amplified by the cone and can be painful and just a little dangerous.
- This activity involves scissors and possibly cutting knifes, please exercise all appropriate caution.

Preparation

You will need

- Some toys that make sound, as many as you can get your hands on.
- Piping or hose, about 1 meter per participant. Clean, and make sure its empty and dry inside.
- Two funnels for every student (about 10cm in diameter) OR cardboard that you can roll into

We're looking forward to seeing you all for this week's science activity! Please be sure to bring along;

1. A sense of scientific curiosity.
2. Old cereal boxes – we're going to need some cardboard! (And if any of you have empty pop top bottles or old Cd's I'd love to put them to good use with some of the other classes I have.)
3. But most importantly, any questions or knowledge you already possess about the **sense of Hearing**. Try brainstorming questions about our sense of sound, and see how many of those questions can be answered during science club.

Just three things! You're going to love this science club!! <3

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students questions can and should guide student learning, more material is presented for you convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

This activity is well suited to this age group.

Children at this age can have difficulty with focus. Avoid tangents into interesting side tracts if you're attempting to make a key point.

Middle:

This can be a good activity for this age group if students are allowed to pursue their questions.

Teen:

Some teens will have trouble appreciating the complexity within this simple lesson. Try adding maths; there are many formula's on line relating an objects properties to the notes it will create. Can they predict and create a device to make a perfect middle c?

Engage

- ⇨ Set off a rocket balloon. Encourage students to ask questions about it, since science always begins with questions. Eventually focus on the question, 'how does it make noise'.

Explore

- Suggest that one idea is that all noise is made when something vibrates. Demonstrate some vibrations:
    - o Feel a table (or metal fence) vibrate when someone taps it.
    - o Feel the vibrations in your voice box (works best with adult males).
    - o See the waves as a tuning fork touches a glass with water.
- ⇨ Explore a music box. Ask for suggestions of how to make it louder, and test those suggestions.
    - o Is faster louder?
    - o Is slower louder?
    - o Is bigger louder? (Often, but unless you have a second, larger music box it might be hard to test.) But you CAN make it effectively bigger by putting it on something hard and empty: like a box or table.
- ⇨ Many acoustic musical instruments use this trick to make their sound 'bigger' – violins and guitars for instance have a music box to help make those vibrations bigger!
    - o (so do our heads – the empty spaces in our face, chest and head all help to make our sounds bigger and louder, and when those spaces are stuffed up, like with snot because we have a flu, the sound is noticeably different!)

Explain

The idea is that all sound is made up of vibrations, and that our body can detect some of those vibrations.

- ⇨ Place the music box on someone's head (preferably with short hair so nothing gets tangled up). Demonstrate how the sound is loud to them, but soft to everyone else. The theory is that the vibrations travel better through the bones in their head than through the air outside.

Explain that we can't hear every kind of vibration, just those that are between about 20 times a second, and 20,000 times a second

- ⇨ Demonstrate with a ruler plucked on the edge of a table. When it is far from the table (apart from being a little hard to hold) there is a clear point at which no one can hear the main noise any more – you can still hear the 'little noises' as the ruler taps the table for instance, but the main not disappears. The same happens at the other extreme, where the main not vanishes to our ears because it is too high. But the sound is still there!
    - o Children can generally hear higher pitched sounds than grown ups. Can you think of a way to test this idea? Are there really phone ring tones so high pitched teenagers can hear it, but not adults?

Demonstrate sound waves, if students are curious.

- Use a slinky to show the transverse nature of sound waves (slowed down over a hundred times) as well as what echo's look like. If possible, show how sound waves move effortlessly through each other.

Human hearing

- ⇨ Display the human hear, and explain how sound waves move down to become electronic impulses.

Some interesting facts:

- The smallest bones in the adult human body are in the inner ear - The smallest bones are the ossicles in the middle ear: the incus, the malleus, and the stapes (also called the anvil, hammer, and stirrup).
- your ear drum is less than 2cm in width and only has to move less than a millionth of a centimetre to do its job. (2 may 2017 from http://www.thesinusdoctor.com/8-interesting-facts-about-human-ears/)
- The number one cause of hearing loss is exposure to excessively loud sounds (85 decibels or higher). (2 May 2017 from http://www.hearingaids.com/about-hearing-loss/how-we-hear/10-cool-facts-about-hearing/)
- Your ears never turn off, even when you sleep – you brain just stops paying attention to the noises.
- Hearing declines with age – there are sounds kids and teenagers hear that adults cannot.
- Human ears are self-cleaning organs. The outer ears produce what is known as ear wax known as cerumen which is produced by tiny pores in ear canal. Tiny hairs along the ear canal known as cilia are angled to help the wax out. (they don't 'push' the wax out, they only let it move in one direction – out)

- American Indians and Asians usually have flaky and dry ear wax whereas Africans and Caucasians have moist brown wax, or so I'm told. Also, ear wax has been used by anthropologists to study early migratory patter of mankind! (taken 2 may 2017 from http://factslegend.org/20-interesting-human-ear-facts/2/)

Auditory illusions

Just as we can trick our sense of sight into seeing things that aren't there, so too with our sense of hearing.

https://en.wikipedia.org/wiki/Auditory_illusion

Elaborate

- ⇨ Bring along some noise toys and let students make sound.
  - o Ask: why can we hear?
- ⇨ Encourage and validate student explanations of this phenomenon. You may like to ask students to write or draw their explanation personally to avoid embarrassment to students unfamiliar with this material. Remember, 'I don't know' is a valid explanation in science – it is the beginning of learning new things!

Other animals (from Wikipedia)

Only vertebrate animals have ears, though many invertebrates detect sound using other kinds of sense organs. In insects, tympanal organs are used to hear distant sounds. They are located either on the head or elsewhere, depending on the insect family.[72] The tympanal organs of some insects are extremely sensitive, offering acute hearing beyond that of most other animals. The female cricket fly Ormia ochracea has tympanal organs on each side of her abdomen. They are connected by a thin bridge of exoskeleton and they function like a tiny pair of eardrums, but, because they are linked, they provide acute directional information. The fly uses her "ears" to detect the call of her host, a male cricket. Depending on where the song of the cricket is coming from, the fly's hearing organs will reverberate at slightly different frequencies. This difference may be as little as 50 billionths of a second, but it is enough to allow the fly to home in directly on a singing male cricket and parasitise it.[73]

Simpler structures allow other arthropods to detect near-field sounds. Spiders and cockroaches, for example, have hairs on their legs which are used for detecting sound. Caterpillars may also have hairs on their body that perceive vibrations[74] and allow them to respond to sound.

Evaluate

Diagnostic:

Have students write down a list of questions about hearing.

Formative:

Take a journey of the inner ear as a sound wave, personifying its experience and travel.

Summative:

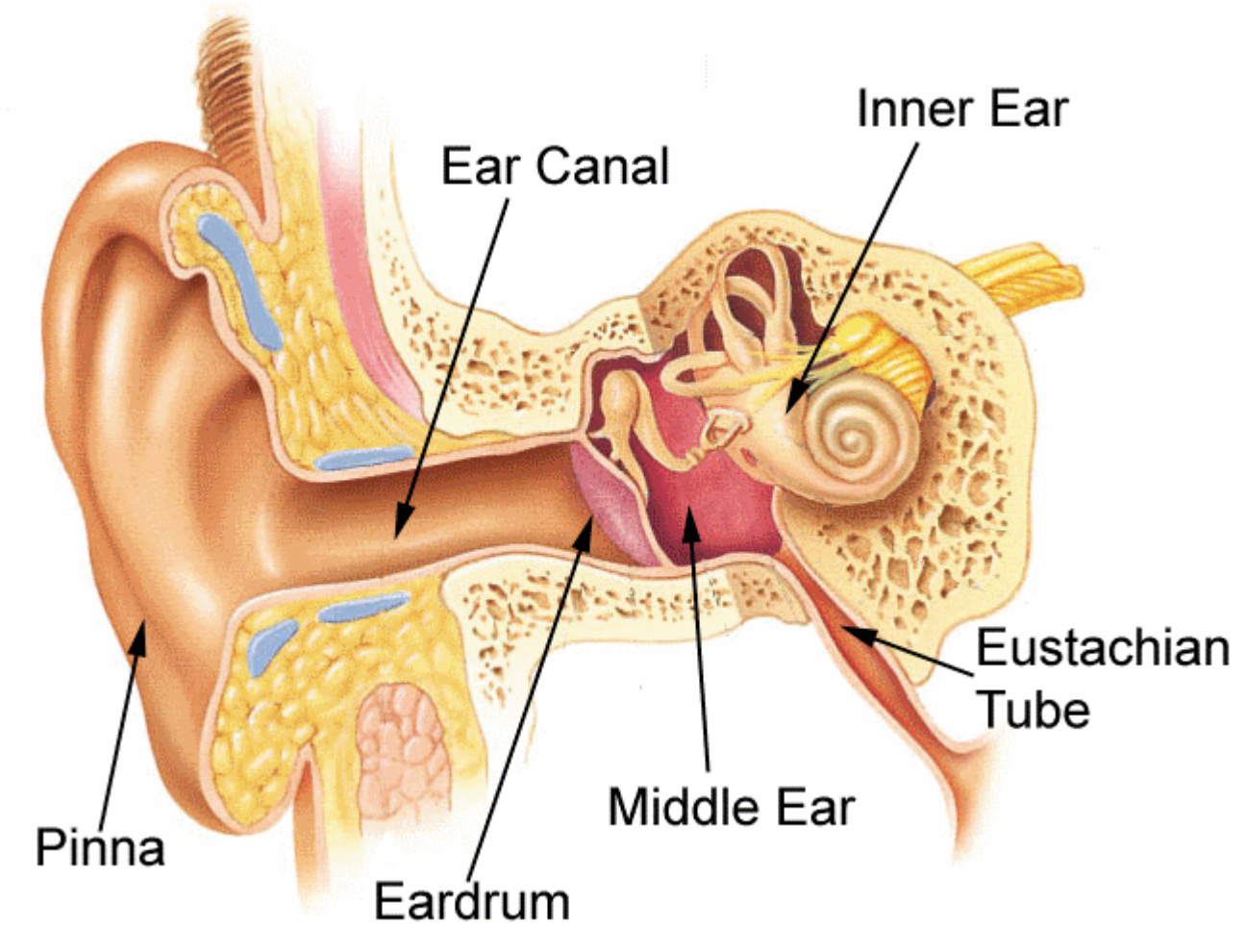
Help students consider ways they can communicate their new understanding to others, just as scientists need to do.

Creating science

Gain an appreciation and respect for the human sense of hearing.

Practice scientific though through predictions and testing ideas.

Appendix: The human ear



1. Sound is collected at the Pinna and directed down the ear canal to the ear drum.
2. The ear drum vibrates, pushing the malleus "hammer" bone, which moves the Incus "anvil" bone, setting in motion the staple "stirrup".
3. The Stirrup press against the 'oval window' of the inner ear. It is filled with fluid that vibrates as the sound waves travel through the oval window. Those fluid waves make teeny, tiny hairs in the inner ear move, which sets of nerve signals.
4. These nerve signals are processed on their way to the auditory lobe on the *other side* of the brain. So the right side of the brain listens primarily (but not exclusively) with the left ear. It's called being "Contralateral".

The Eustachian tube helps balance out air pressure between the middle ear and the outside world.

The Cochlea (semicircular canals) are used to help us keep balance – more on that later!