3. Starter Title: Confusaphone

Key concept: When objects such as the prongs of a tuning fork vibrate, it moves the air molecules near the prongs, the vibration is transmitted through air to the ear. Ear trumpets, for example, allow the ear to catch more of the vibrations (sound energy) produced. Two ears are better than one.

Follow-up activities: Investigating hearing

The students can carry out a range of investigations to investigate hearing acuity, directional hearing and passive devices for improving hearing.

a. How well can you hear?

The students could plan their own investigation or use the following approach to investigate how well each person in their group hears. They should blindfold the person being tested, and then using a sound source such as a ticking stop clock move away until the person can no longer hear the sound. They should then move back towards the person to check when they can hear the sound again. They should plan a fair test and try and ensure reliability. They should then answer the following questions:

- Why was the person blindfolded?
- Does it make a difference if one ear is covered (ear muffs should be used to investigate this)?
- Do different noises produce different results?

b. Which direction?

Students can investigate if a person can tell which direction a sound is coming from by blindfolding the person being tested. They should then stand at eight different points of "the compass" around the person, as Trevor did, and knock two sticks together. They should ask the person to point in the direction of the sound. They should try all eight points. They should carry out investigations to answer the following questions:

- Does it make a difference if one ear is covered?
- Does distance make a difference?
- Do different noises produce different results?

When the students have completed their investigations, they should write a report of the investigations. They should also evaluate their investigations. The following questions could help.

- Were your investigations fair tests?
- How did you try to make them fair?
- What criticisms could you make of your investigations?
- How could you improve your investigations?

c. Improving your hearing

The students can make ear trumpets, by making a cone from a sheet of paper, or a listening tube by using a cardboard tube. Or you can follow these simple instructions using funnels. They can use a ticking stop clock as a sound source. They should plan investigations to find out how each could help improve their hearing.

They should record the results of their investigations and describe what they have found out. The following questions could help them:

- When do you think these devices may be used?

- What other devices have you seen which are used to improve hearing?
- Did devices improve your hearing?
- What happened when you changed the design?
- Which worked best with quiet sounds?

Additional notes

Hearing acuity

Students will show surprisingly different results with this activity. They should be encouraged to repeat their experiment several times. Background noise should be kept to a minimum during the activity and other relating to hearing. If a quiet room is available it should be used. The results should be significantly different if only one ear is used. This investigation, like the next, may reveal students with hearing difficulties. If any students produce unexpected or anomalous results, parents or guardians should be informed and professional advice sought. Similarly, students already known to have hearing loss should be treated especially sensitively during this activity.

Directional hearing

The notes for the previous activity apply to this one, except that directional hearing depends more on whether one ear is covered than does the previous activity: performance with one ear covered being worse than with two ears.

Improving your hearing

The devices are passive, that is, they improve the hearing by allowing the ear to catch a greater proportion of the sound energy (vibrations) produced usually via resonance. Active devices such as hearing aids amplify the sound electronically.

Equipment

Metre rules
Clockwork stopclocks or similar sources of ticking
Two blocks of wood or sticks to make sound
Blindfold
Ear muff
Long cardboard tube from kitchen foil rolls or similar
Large pieces of paper
Scissors
Sticky tape
Disinfectant and tissues
Equipment for funnel devices at http://salfordacoustics.co.uk/listening-devices/4

Safety
Students must disinfect the ends of the tubes before putting them against their ears.