KS3/4 Science – Physics Lesson Starters - Sound

These are suggested activities you could carry out to follow-up the starters in the programme:

1. Starter Titles: Making sound and saxophones

Key concepts: Sound is a vibration. The term 'pitch' describes how high or low a sound is. High and low sounds can be loud or soft.

Follow-up activities: Investigating sound

Ask the students to discuss the following questions in their group and to keep a record of their discussion so that they can look at it when they have finished the investigations:

- Does everything that moves make a sound?
- Can something make a sound without moving?

Investigations

Ask the students to try the following investigations to investigate some different sounds. If they cannot observe any movement they can hold a table-tennis ball on a thread against the object making the sound. If the ball moves they can infer that the object is moving.

a. Tuning fork

The students should strike the tuning fork and then try and answer the following questions through their investigations:

- Can you see any movement?
- How can you change the note?
- What happens if you put the prongs of the fork into a bowl of water?

b. Flicking a ruler

The students should hold the ruler at the end of the desk so part of it is sticking over the edge, and then flick/twang that end. They should answer the following questions:

- Can you see any movement?
- How can you change the note?

c. Nails in a block of wood

The students should hammer some nails 3cm apart into a block of wood. They should make sure the nails are hammered in to different lengths, and then hit the nails with another piece of metal. They should answer the following questions:

- Can you see any movement?
- How can you change the note?

d. Test tubes filled to different depths with volumes water

The students should put test tubes into a test tube rack and then fill them to different depths with water. They should tap each test tube in turn with a pencil. They should ask the following questions:

- Can you see any movement?
- Can you make the note louder?
- Can you 'play' the test tube in a different way?
- How does the depth of water change the note?

e. Stretching an elastic band

The students should hang an elastic band from a clamp on a retort stand. They should attach a slotted mass hanger to the bottom of the elastic band and then twang the band. They should answer the following questions:

- Can you see any movement?
- Can you make the note louder?
- What happens when you stretch the band more?

f. Elastic bands around a box

The students should stretch bands of different thickness around a box and then twang the bands. They should then answer the following questions:

- Can you see any movement?
- How can you change the notes?
- How does the thickness make a difference to the note?

g. Straw saxophones

The students should cut a v-shaped end in a drinking straw, flatten that end slightly and blow down it. They should then answer the following questions:

- Can you see or feel any vibration?
- How can you change the notes?
- Can you make it louder?
- What happens when you change the length of the straw?

When the students have completed all the investigations ask them to discuss the following questions:

- A movement that goes backwards and forwards or up and down is called a vibration. Were any of the movements that you found vibrations?
- What makes some sounds louder and some of a different pitch?
- Look back at the ideas you had at the beginning of the activity. How have your ideas changed?

Ask the students to produce a poster of what they have found out about movement and sound. They should relate their ideas to musical instruments. They should include loudness and pitch.

Additional notes

The activities would be suitable for cross-curricular links with music and design technology.

Equipment

Table tennis ball
Thread
Glue
Tuning forks
Nails
Hammer
Blocks of wood
Rulers
Test tube rack and test tubes
Retort stands, bosses and clamps
Elastic bands of different lengths and thickness
Slotted 10g masses and hangers
Shoe boxes
Straws of different thicknesses
Scissors

Safety

Students should take care when hammering nails into wood. This could be done beforehand by a technician if a vice is not readily available. Pupils should wear safety glasses when stretching the elastic bands.

2. Starter Titles: Bubbles, Candles and Glass

Key concept: Sound needs a medium to pass through

Follow-up activities: String telephone investigations

Ask the students to discuss the following questions:

- How often do people in their group use their phones?
- What are the advantages of sending messages by phone?
- When would they use a phone rather than sending a message by some other means?

Demonstrate a string telephone to the class.

The students should then carry out investigations to find the answers to the following questions by using a range of different materials:

- Is it best to use thick or thin string, wire or cotton?
- What makes the best mouthpiece, yoghurt pots, polystyrene cups or something else?
- What makes the best receiver, yoghurt pots, polystyrene cups or something else?
- Does the size of the receiver or mouthpiece make a difference?
- Does the length of the string or wire between them make a difference?

It should be emphasised that the students should plan and carry out fair tests. They should record their results in the form of a large poster to advertise their telephone system, saying what the advantages of it are over other systems.

They could carry out further investigations to develop a system so that three or more people could hold a conversation. Also to see if they could make a telephone exchange so that different people could hold different conversations.

Additional notes

Students may have met this activity at primary school. However, they always get a great deal of fun making string telephones, and if they are familiar with them they can enter it at a higher level, for example investigating if wire is better than string. This provides an opportunity to introduce telecommunications and the economic and social implications of phones.

Equipment

Selection of 'strings' of different types and thicknesses including wire and thread
Selection of disposable containers such as yoghurt pots, polystyrene cups, plastic cups and maybe tin cans
Buttons
Paper clips
Scissors
Poster materials

Safety

Tin cans can have sharp edges. They should be smoothed or covered before use with the students.

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

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

Safety

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

4. Starter title: Sonic boom

Key concepts: The sonic boom from the whip shows an accelerating wave, and gets across concept of speed of sound. Sound travels much more slowly than light.

Follow-up activity: Calculating the speed of sound

Students can use the following method to help them calculate the speed of sound:

- They should find a high brick or concrete wall in front of which there is a large open space.
- They should measure 60 m from the wall.
- They should clap once with two blocks of wood, and listen for the echo.
- They should then clap again when they hear the echo.
- They should carry on clapping every time they hear the echo.
- When they have built up a rhythm they should time twenty claps.
- This is the time for the sound to go to the wall and back twenty times.
- They should repeat the experiment 3 times and calculate the average.
- For one clap the sound must have travelled 60m x 2 (=120m)
- Therefore for 20 claps it will have travelled 120 x 20 (=2400m)
- To calculate the speed of sound the students divide 2400 m by their average time for twenty claps.

If their results are above 400m/s or under 200m/s they should check their results.

The students should record their results and add their results to a class result. They should then compare their results.

Additional notes

Some students will need help initially to get into the clapping rhythm with the echo. Some students will also find the calculations difficult. Group work should help. The method is used because it is difficult to measure times of less than a second accurately using a stop clock. Instead several times (20) are added together, which makes it much easier to measure.

Equipment

Stopclock
Wooden blocks
Calculator
Measuring tape

Safety

This is an outdoor activity. Students will need appropriate supervision.