Science@School Book 5F

Changing sounds

Activity worksheets

Peter Riley

Teacher's sheet: comprehension

See **pages 4 and 5** of *Changing sounds*

Answers

1. **(i) One of the tines of the tuning fork would touch the cling film; (ii) Some sand grains should be shown in the air.**
2. **The loudspeaker moving backwards and forwards very quickly (the vibrations).**
3. **Your throat.**
4. **(i) A sharp jet of air comes out; (ii) The candle flame would wobble. The jet of air causes the flame to wobble.**

Complementary work

(a) The children could use a cassette recorder to make a sound quiz by recording a wide range of everyday sounds, or sounds from around the school which others can then try to identify.

(b) The children can use secondary sources to find out how loudspeakers and microphones work.

Teaching notes

It may well be that the children have not done any formal science work on sound since they were in infant classes. They may however have picked up some ideas about sound from work in music, so at the beginning of this unit it is essential to find out what the children know about sound and to identify any misconceptions that they have.

Sound is produced by vibration. This can be a to and fro, or up and down, movement of an object. An object vibrating in air pushes and pulls on the air close to it, and this makes the air vibrate. This vibrating air then pushes and pulls on the air next to it, and this makes the air next to it vibrate. This vibrating air pushes and pulls on the air next to it, and so on. Each part of the air only vibrates a little, but passes the vibration on to the next part of the air. The vibration passes through the air and is called a sound wave. It is important to stress that the air close to a vibrating object does not pick up the sound wave and carry it through the air.

Some children may ask how we hear a sound. They could be told that in the ear is a very thin piece of skin called the ear drum. When a sound wave reaches the ear drum it causes the ear drum to vibrate. This vibration then passes through three small ear bones (the smallest bones in the body, called the hammer, the anvil and the stirrup) which act as levers to strengthen the vibration so it can be detected by nerves inside the ear. The nerves then inform the brain that a sound has been detected.

Teacher's sheet: activity

Based on **pages 4 and 5** of *Changing sounds*

Introducing the activity

(a) You may use this activity either before or after the children have read pages 4 and 5 in the pupil book. You may like to begin by asking the children to sit in silence to listen to what sounds there are when no one is speaking (see note (i)).

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through tasks 1 and 2 (see note (ii)).

(c) Let the children try tasks 1 and 2.

(d) Let the children try task 3 (see note (iii)).

(e) Go through task 4, then let the children try it (see note (iv)).

(f) Let the children try task 5 (see note (v)).

Completing the activity

(g) Let the children compare their results.

Conclusion

The sounds that are produced around the school may be simply surveyed by going to different locations and listening for a few minutes. A list of sounds can be constructed for each place, and the sounds categorised according to whether they were long and continuous, of short duration, loud or quiet, high-pitched or low-pitched.

Teaching notes

(i) Be prepared for any children who may wish to make sounds of their own to amuse the others and stress the need for sensible behaviour. Let the children listen only for a short time so that some may say they did not have enough time. Tell the children to think about the amount of time they need for listening when they are making their survey about sounds around the school.

(ii) Tell the children that they should think about how they are going to record their results as they make their plan. It may actually help them make their plan.

(iii) The plan should include visiting different places around the school and listening at each place for a few minutes. Children may suggest listening with their eyes shut as this helps to focus on the sense of hearing. The children may simply record the sounds at each place or categorise them into loud or quiet sounds. Some may categorise sounds into high- or low-pitched. The table should have one column for locations and one or more columns to categorise the sounds.

(iv) Some children may need help to sort out which were quiet places and which were noisy places.

(v) The children may suggest spending longer in each place or visiting it at different times of day.

Teacher's sheet: comprehension

See **pages 6 and 7** of *Changing sounds*

Answers

1. **(i) The elastic band should be drawn moving up and down; (ii) It causes a band of squashed air to move through the air.**
2. **A coil of wire.**
3. **A wave of tightly packed coils moves along the slinky.**
4. **A sound wave.**
5. **Space.**
6. **(i) The string must be taut; (ii) It goes through the air in your cup, along the string and through the air in your friend's cup.**

Complementary work

(a) The children could make string telephones, as featured on page 7 of the pupil book. They could then add a third 'line' to the string telephone and see if a third person can join in. This should work if the strings are kept taut.

(b) The children can use secondary sources to find out how a telephone works.

Teaching notes

From their work on materials, the children may be aware that materials can be divided into three groups – solids, liquids and gases – and that all the substances in these groups are made from tiny particles. It is important for the children to realise that these particles are much smaller than the particles of sand and dust they can see, and that in fact a grain of sand is made up from millions of tiny particles of matter.

When a solid object, such as a ruler, vibrates, the particles in it are also vibrating. In solids, the particles are held firmly and close together, but can still move a little. This means that when a solid vibrates, its particles can spread the vibration quickly through the material. Sound is a form of energy, and in a solid less energy is used to make the particles vibrate, so the strength of the sound does not decrease quickly as the sound wave passes through a solid. In a liquid, the particles are held less securely and more energy is used to make them vibrate. This means that sounds travel slower and lose their power more quickly in liquids than in solids.

In a gas the particles are free to move about. This results in sound travelling much slower in gas (air is a mixture of gases) than in a liquid or a solid.

Sounds cannot travel in space because there are not enough gas particles to transport the vibrations.

Teacher's sheet: activity

Based on **pages 6 and 7** of *Changing sounds*

Introducing the activity

(a) You may use this activity before or after the children read pages 6 and 7 in the pupil book.

Remind the children that there are three kinds of materials – solids, liquids and gases, and their task is to find out if sound travels through all of them.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Let the children try task 1.

(d) Go through tasks 2 and 3, then let the children try them (see note (ii)).

(e) Go through task 4, then let the children try it (see note (iii)).

(f) Go through tasks 5 and 6, then let the children try them.

(g) Let the children try task 7.

(h) Let the children try task 8.

(i) Go through tasks 9 and 10, then let the children try them.

(j) Let the children try tasks 11 and 12.

Completing the activity

(k) Let the children compare their results.

Conclusion

The sound of the clock or radio may be heard faintly through the balloon filled with air. The sound of the clock or radio may be heard more loudly through the balloon filled with water. The sound of the clock or radio is loudest when heard through the wood.

The two metal spoons made a tinny, clinking noise when tapped in the air in the bowl. The spoons made a deeper, louder sound when tapped underwater in the bowl. These observations support the observations made with the air-filled and water-filled balloons.

Teaching notes

(i) Do **NOT** use a radio connected to the mains.

(ii) If the children have the appropriate ability and attitude, they could blow up the balloon themselves with a pump. The children do not need to write anything down until they have completed task 6.

(iii) If the children have the appropriate ability and attitude, they could fill the balloon with water themselves. The children do not need to write anything down until they have completed task 6.

Teacher's sheet: comprehension

See **pages 8 and 9** of *Changing sounds*

Answers

1. **(i) The waves spreading out as shown on page 9 of the pupil book; (ii) The waves spreading out as shown on page 9 of the pupil book; (iii) The box around loudspeaker B sends out sound waves too.**
2. **(i) Light and heat; (ii) Watts.**
3. **It is made louder.**
4. **The case.**
5. **(i) Decibels; (ii) Cause pain, cause temporary deafness or cause permanent hearing damage.**
6. **Ear defenders or ear plugs. The drill makes such a loud sound that it may cause pain or harm the person's hearing.**

Complementary work

(a) You may like to demonstrate the relationship between a vibration and a wave form in the following way. Make a small hole in the bottom of a yoghurt pot and attach a string handle to the yoghurt pot. Attach a long piece of string to the yoghurt pot, through the hole, to make it into a pendulum. Place one end of a long sheet or roll of paper (such as wallpaper) under the yoghurt pot.

Now fill the yoghurt pot with sand, raise it above the paper and start it swinging. This represents a vibrating object. Move the paper along under the swinging yoghurt pot. Waves will be made by the stream of sand on the paper.

(b) The children could do the decibel survey at home at different times of the day.

Teaching notes

Children sometimes confuse loudness with pitch. Loudness is related to the amount of movement made by a vibrating object, and thus the amount of movement in the surrounding material that carries the sound wave away.

If an object makes a small vibration (for example, a ruler which is gently twanged), the object pushes and pulls only weakly on the surrounding material (for example, air). These weak pushes and pulls cause the particles of matter in the surrounding material to move only a short distance when they move to and fro. This can be thought of as producing sound waves with small crests and troughs, like the waves blown by a breeze across a pond. The small movements of the vibrating object and the particles in the surrounding material produce a quiet sound.

If an object makes a large vibration, the object pushes and pulls strongly on the surrounding material. These strong pushes and pulls cause the particles to move further as they swing to and fro. This can be thought of as producing sound waves with high crests and deep troughs like those seen in a stormy sea. The large movements of the vibrating object and the particles in the surrounding material produce a loud sound.

Information on pitch is found on page 47.

In the introduction to this unit you may have sung into a piano. This is an example of resonating. Further information on resonating is found on page 55.

Teacher's sheet: activity

Based on **pages 8 and 9** of *Changing sounds*

Introducing the activity

(a) You may like to begin by getting the children to be silent, then whisper, then use their normal speaking voices, then shout, then speak more quietly, until they are silent again. Tell them that as they spoke they used different loudness of their voices, and in this activity they have two investigations to make about the different loudness of sounds.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 and let the children try it.

(c) Go through task 2, then let the children try it.

(d) Go through tasks 3 and 4, then let the children try them.

(e) Let the children try task 5.

(f) Let the children try tasks 6 and 7 (see note (i)).

(g) Go through task 8, then let the children try it (see note (ii)).

(h) Let the children try task 9.

Completing the activity

(i) Let the children compare their results.

(j) You may like to play a violin, then cover up the opening on the front to show how the sound is changed when the sound box is stopped from working.

Conclusion

When an elastic band is plucked on a piece of wood it makes a quiet sound. When the wood is placed over a bowl and the elastic band is plucked again, a louder sound is made.

The loudness of sounds varies in different parts of the school.

Teaching notes

(i) The children should be aware of the need to repeat experiments to check the results. This activity gives you an opportunity to check how well they realise that experiments can be checked by repeating them.

(ii) You may like children to see if they can hear a pin drop, then whisper, and then talk at normal speech. You could finish by switching on a vacuum cleaner so the children have some idea of the loudness of some sounds and their decibel value.

If the children have done activity 1, you may like to return to the results they obtained there. You could then let the children repeat activity 1, but this time estimate the loudness of the sounds in each place they visit.

Teacher's sheet: comprehension

See **pages 10 and 11** of *Changing sounds*

Answers

1. **The path may be shown by an arrow going from the person to the wall and an arrow going from the wall back to the person. Or, it may be shown as a series of curved sound waves going in each direction.**

2. **(i) Ever larger circles; (ii) Near where the pebble was dropped; (iii) They get lower as they spread out.**

3. **It gets lower.**

4. **Thunder.**

5. **(i) It gets faster when it enters the water and faster again when it enters the solid; (ii) Light travels faster than sound.**

Complementary work

(a) Ask the children to predict what would happen if you struck a tuning fork, then dipped a vibrating tine in water. When this activity is performed they should see waves move across the surface of the water. There may also be some splashes.

(b) The children could, in turn, put a sound source such as a battery powered radio, in the middle of a large space, then walk away, and back, to show how sound changes with distance. They could walk a little distance from the sound source, then try to walk round it and keep the same level of sound reaching their ears. They should find that they walk round the object in a circle.

Teaching notes

If you throw a pebble into a puddle, waves spread out across the surface in all directions. This suggests that the wave is a real object that rushes across the surface. If a little boat is put in the puddle, and another pebble is dropped in, you may expect the wave to rush along and carry the boat with it to the edge of the puddle. This does not happen. The boat simply bobs up and down as the wave passes by. The motion of the boat gives a clue to what is happening in the water. The particles from which the water is made simply move up and down when the pebble is thrown into the water, and this up and down movement is seen as a wave moving across the surface of the puddle.

In a similar way, a sound wave is not a wall of compressed gas which pushes its way through the air. It is made by the movement of particles as they swing to and fro over a small distance. The vibrating object causes the particles of air next to it to swing to and fro. These particles then push on particles next to them and start them swinging. In this way the movement (we call it a sound wave) passes through the particles, but the particles only travel a little way to and fro themselves.

Sound is a form of energy, and as the particles vibrate they use some of the energy. This explains why sound dies away as it travels further from the source. The energy has simply been converted to motion by all the vibrating particles, so there is less sound energy left to make the ear drums vibrate.

Teacher's sheet: activity

Based on **pages 10 and 11** of *Changing sounds*

Introducing the activity

(a) You may like to begin by explaining that sound is made by vibrating objects, which produce sound waves that travel through the air. Tell the children that a vibrating object in water also produces sound waves, and show them a tray full of water. Wiggle a finger at one end of the tray to represent a vibrating object, and let the children see the waves spread out through the water. Tell the children that they are going to study how waves travel through the air, but it may help them if they think of the sound waves moving like the waves in the water.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form. Go through tasks 1 to 4 and let the children try them.

(c) Let the children try task 5.

(d) Go through tasks 6 and 7, then let the children try them.

(e) Let the children try task 8.

(f) Go through tasks 9 and 10 with the children (see note (ii)).

(g) Let the children try tasks 9 and 10.

(h) Let the children try task 11 (see note (iii)).

Completing the activity

(i) Let the children compare their results.

(j) If you have a cassette recorder, or a micro-cassette recorder used for dictation purposes, you may ask the children how they could use them to test their devices to find if a person can be heard more clearly from a distance (see note (i)).

Conclusion

When the hands are cupped over the ears, a voice can be heard over a greater distance. This is due to the sound waves being prevented from completely spreading out. When the ears are cupped, the sound from an object is heard more loudly and clearly because the cupped ears collect waves that are spreading out and direct them into the ears.

A cone of card can be used to improve hearing.

Teaching notes

(i) This could be set as a separate task for children who have the appropriate ability and attitude, if it is in accordance with your school safety policy.

(ii) A simple device, which will serve as both a megaphone and an ear trumpet, can be made from a card shaped into a cone.

(iii) To test if the cone helps people hear better over distances, a sound-recording device can be set up at different distances from a person who talks normally, then uses a megaphone.

Teacher's sheet: comprehension

See **pages 12 and 13** of *Changing sounds*

Answers

1. **(i) The sound waves all leave the surface at the same angle and their paths are parallel; (ii) The sound waves leave the surface at different angles and their paths go in different directions; (iii) A is smooth and B is rough.**

2. **A.**

3. **B.**

4. **One sound comes directly through the air to you from the cymbals. The other sound goes from the cymbal and is reflected by the walls and ceiling.**

5. **Caves and tunnels. The walls are curved and focus almost all the reflected sound back to the person who made the sound.**

Complementary work

(a) Ask the children to get a hard-back book and hold it about 20 centimetres in front of them. Ask them to lower the book below their faces and start making a steady "arh" sound. Now ask them to raise the book until it is in front of their faces. They should hear the sound become louder, due to some of the waves being reflected off the surface of the book. If they move the book below their faces again, they should hear their "arh" sound becoming slightly fainter.

(b) Show the children a tennis ball and a tray. Tell them that the ball represents an air particle and the tray represents a hard surface. Hold the tray and ask someone to throw the ball at it. This represents a particle in a sound wave striking the surface. Note what happens to the ball. Now repeat the activity with a cushion instead of a tray. The cushion represents the surface of a soft material. See how the material soaks up the energy of the ball and prevents it from bouncing back.

Teaching notes

The human ear can only hear two separate sounds if they reach the ear more than a tenth of a second apart. This means that for the reflection of a sound to be heard, it must reach the ear one-tenth of a second after the source of the sound.

In the activity on page 36, the sound of the reflection from the wall must reach the ear at least one-tenth of a second after the sound of the clap from the hands. Sound travels at about 330 metres per second, or 33 metres in one-tenth of a second. If a child stands about 17 metres from the wall, the clap and the echo will be heard because the sound from the clap will have travelled 17 metres towards the wall and 17 metres back again.

The children may have heard about echo location in bats. These animals produce high-pitched sounds (called ultrasonic sounds) that we cannot hear. These sounds behave in the same way as the sounds we can hear. The bats use the echoes of these ultrasounds to find food.

Teacher's sheet: activity

Based on **pages 12 and 13** of *Changing sounds*

Introducing the work

(a) If the children have done the activity in the previous unit, ask them what they thought happened to the sound waves that left their mouths and hit the sides of the megaphone. Look for an answer about reflection. Ask them about how an ear trumpet collects sound, and look for an answer that includes the sound waves striking the inside of the ear trumpet and being reflected down into the ear.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form. Go through task 1 and let the children try it.

(c) Go through tasks 2 and 3, then let the children try them (see note (i)).

(d) Go through task 4, then let the children try it.

(e) Go through task 5, then let the children try it (see note (ii)).

(f) Let the children try task 6 (see note (iii)).

(g) Go through tasks 7 to 10, then let the children try them (see note (iv)).

Completing the activity

(h) Let the children compare their results.

Conclusion

The clock is heard the loudest when the tubes are pointing to the sheet of card at the same angle, but in different directions. When the tubes are arranged like this, the angle at which the sound is reflected from the surface is the same as the angle of the sound which strikes it. This relationship between the two angles is also found when light is reflected from a flat mirror.

An echo can be heard when the child is 17 metres from the wall (an explanation for this is given on page 35).

Teaching notes

(i) Some children may have difficulty in organising themselves to make the sequence of observations required. They may need to be taken through the sequence step-by-step. You may like to demonstrate how to make the sequence of tasks from steps 2 to 5.

(ii) Some children may think they only have to set up the tubes in the positions shown on the sheet. Remind them to think of other arrangements and try them.

(iii) Some children may wish to use a protractor, but this is not essential. The diagram should show that tube A and tube B point at the same angle to the sheet but in different directions.

(iv) There needs to be a space of at least 17 metres in front of the wall where the child can walk. This is best done in a quiet place, with one child, or pairs of children working together, at the wall while the rest of the class are doing other things.

Teacher's sheet: comprehension

See **pages 14 and 15** of *Changing sounds*

Answers

1. **The ruler will spring up and down, or vibrate.**
2. **The ruler will not spring up or down, or vibrate, as much.**
3. **It goes quiet.**
4. **The loudspeaker vibrates less.**
5. **Washing machine or fish tank pump. (Also dishwasher, vacuum cleaner, spin drier.)**
6. **(i) Piano; (ii) Reduce its loudness.**

Complementary work

(a) The children can find out how different materials can damp the sound of a drum.

(b) The children could study the effect of touching a cymbal after it has been struck to see how its ringing sound is damped.

Teaching notes

The process of damping a sound occurs at the object that is vibrating. This can be compared with muffling a sound, which is a process of absorbing sound once it is moving through a material.

The damping process is widely used with percussion instruments. When some drums are hit they make a ringing sound because the drum resonates when it is struck. This makes the sound linger on. Drums are used to provide a definite beat so other musicians can keep time. An imprecise beat, provided by a lingering sound, is difficult to follow so many drums, especially bass drums, have a damper. This is a piece of felt held on a bracket inside the drum. A screw control on the side allows the damper to be pressed against the drum skin to reduce its vibrations and give a crisp beat.

Percussionists also use the damping process with some cymbals. Many cymbals are designed to produce a lingering note which gradually fades away. Sometimes only a crisp smash with the cymbal is needed. The crisp smash is made by hitting the cymbal then touching it straight afterwards. The fingers on the cymbal damp the vibration and the sound fades very quickly.

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Changing sounds*

Introducing the activity

(a) Use this activity after the children have studied the unit in the pupil book. You may demonstrate the experiment shown on page 15 (see note (i)). Tell the children they are going to look at the effect of damping in a little more detail.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through tasks 1 and 2 and let the children try them.

(c) Go through task 3, then let the children try it (see note (ii)).

(d) Go through task 4 with the children, then let them try it (see note (iii)).

(e) Let the children try tasks 5 and 6.

(f) Go through task 7, then let the children try it (see note (iv)).

Completing the activity

(g) Let the children compare their results.

(h) Show the children a drum, such as a snare drum, and ask the children what they could use to damp its sound. Let one of the children test the damper that is suggested.

Conclusion

When the end of the rope is shaken strongly (a large vibration), large waves travel all the way along the rope. When the end of the rope is shaken weakly (small vibration), small waves travel along the rope but do not get to the end.

Objects which cover a large part of the lid damp the sound well. These objects do not have to be particularly heavy.

Objects which cover a small amount of the lid do not damp the sound well. Some of these objects can be quite heavy.

Pressing on the lid not only damps the sound but increases the tension so much that it changes the pitch of the sound.

Teaching notes

(i) If the children did the activity in the introduction to the unit on page 10 you may like to remind them of it now.

(ii) Tell the children that sometimes scientists make models of things they are investigating to understand more fully what happens to them. In this model, the hand is the vibrating object and the rope is the air carrying the sound wave.

(iii) The children should keep tapping as they put each object on the lid and remove it again.

(iv) The children do not need to press so hard on the tin lid that they bend it permanently.

Teacher's sheet: comprehension

See **pages 16 and 17** of *Changing sounds*

Answers

1. **(i) Car silencer; (ii) The car engine; (iii) It is changed to heat energy.**
2. **Space, or vacuum.**
3. **Some air is pulled from a gap between sheets of glass so it is more difficult for sound to pass through.**
4. **(i) Soft, spongy or porous materials; (ii) It goes into the holes, bounces around and never comes out.**
5. **Sound travels through walls. Walls are made of solids. Sound travels faster and for longer through solids than they do through the air.**

Complementary work

(a) The children could use secondary sources to find out about who uses ear protection in their work and why.

(b) The children could use secondary sources to find out about an anechoic chamber. This is a room which has all its surfaces covered in baffles of soft materials so that all sound waves are absorbed and none are reflected. It is used to test new microphones and loudspeakers.

Teaching notes

Loud sounds make it difficult for people to think properly, prevent relaxation and can cause permanent ear damage which results in deafness. The ear muffs that are worn by engineers primarily protect the ears from damage but also help the wearer to concentrate.

Noise is considered a form of pollution and legislation is now in place to reduce noise levels in many places.

Muffling is different from damping because it deals with reducing the energy in sound waves, while damping is concerned with reducing the vibrations which cause the sound waves.

All materials are made of tiny particles of matter. In air, the particles of matter swing to and fro as they carry the sound wave along. When the sound wave reaches a wall the particles bang on its surface. If the wall is hard and smooth, the particles bounce off and the sound wave is reflected. If the surface is rough and soft, the movement energy possessed by the particle is absorbed and the particle stops moving. This means that the sound wave is not reflected. The activity in (b) of the complementary work on page 35 may also be useful here to help children understand why soft furnishings can muffle the sound in a room. They can reduce the sound level in a room by 10 decibels.

7 Teacher's sheet: activity

Based on **pages 16 and 17** of *Changing sounds*

Introducing the activity

(a) You may like to begin by placing an alarm clock and a battery powered radio on your table and turning them both on. Make sure that they are making a loud noise, then talk loudly over the top of them. Tell the children that these are just two examples of loud noises. Ask the children for examples of other loud noises (see note (i)). Tell the children that they are going to find out how materials can be made to muffle sounds.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 and let the children try it (see note (ii)).

(c) Go through task 2 and let the children try it.

(d) Tell the children that they are to make a plan for the investigation by performing tasks 3 to 6, then let the children try them (see note (iii)).

(e) Let the children try task 7.

(f) Let the children try tasks 8 and 9 (see note (iv)).

Completing the activity

(g) Let the children compare their results.

Conclusion

Materials which are soft and contain many air spaces will muffle sound better than materials which are hard and do not have many air spaces.

Teaching notes

(i) If the children did the activity with the decibel scale in Unit 3, it may be useful to remind them of their results.

(ii) You may want to mention this before the activity so that children could bring in some materials from home.

(iii) The children may choose to use a clock or battery powered radio. Some may wish to use a buzzer they have worked with in their studies of electricity. The material may be wrapped around the object, or it may be more convenient to put the object in a box and cover the box with the material.

When listening for the sound, the listener should sit at the same distance from the object each time. Layers of materials may be added until the sound can no longer be heard. If a radio is used, either music or a 'talk' programme can be used, but not both as music is more difficult to muffle than talking. The results may be recorded in a table which has a column headed 'Material' and one headed 'Number of layers' or 'Thickness (mm)'.

(iv) The children should describe how their predictions and results agree or disagree and should not use terms such as 'OK'.

Teacher's sheet: comprehension

See **pages 18 and 19** of *Changing sounds*

Answers

1. **(i) The bottles have different amounts of water in them as shown on page 18 of the pupil book; (ii) There are eight notes; (iii) The length of the air space that can vibrate.**
2. **A tuning fork.**
3. **The pitch.**
4. **Resonating.**
5. **Music is produced by instruments which vibrate in a simple, regular way. Noise is made by complicated vibrations.**

Complementary work

(a) The children could use secondary sources to find out about musical instruments through history and how they work.

(b) The children could use secondary sources to find out about musical instruments from around the world.

(c) You could demonstrate the relationship between vibrations and pitch in the following way. Put a finger in a bowl of water and move it slowly to and fro. This will produce a small number of waves moving across the surface. If you wiggle your finger faster, the number of waves moving across the water will rise to match the movement of your finger. You can point out that vibrating objects produce sound waves in a similar way, and those which are produced by slow vibrations make low-pitched sounds while those produced by quick vibrations make high-pitched sounds.

Teaching notes

Children sometimes confuse the loudness of sound with the pitch of sound. Information about loudness is provided on page 27. Here is some information about pitch.

When people talk about the highness or the lowness of a note they are really talking about whether a note is high-pitched or low-pitched. When an object is made to vibrate, it moves to and fro a certain number of times in a second. This number is known as the frequency of the vibration. The vibrating object makes the air around it vibrate at the same rate. This means that the particles in the air move to and fro at the same frequency as the object. It also means that sound waves move through the air at the same frequency as the vibrating object.

You could demonstrate the relationship between the frequency of a vibrating object and the frequency of the waves it produces by trying activity (c) in the complementary work on this page. The children do not need to know the term frequency, but may have heard the word used in connection with tuning a radio. Radio waves also have frequency.

Although sound waves, water waves and radio waves all have crests and troughs and frequency, they are not the same. Sound waves are made by particles of matter moving to and fro and pushing on each other. Water waves are made by particles of water going up and down while the wave passes across the surface. Radio waves belong to a huge group of waves called electromagnetic waves (to which light also belongs). These are waves of electrical and magnetic energy.

Teacher's sheet: activity

Based on **pages 18 and 19** of *Changing sounds*

Introducing the activity

(a) Tell the children that scientists often use the results from one experiment to help them predict what will happen in other experiments. In this activity they are going to perform three simple experiments and see if the results from one experiment help in predicting the results of other experiments.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go over tasks 1 to 4 with the children (see note (i)).

(c) Let the children try tasks 1 to 4 (see note (ii)).

(d) Go through tasks 5 and 6, then let the children try them.

(e) Let the children try task 7 (see note (iii)).

(f) Let the children try tasks 8 and 9.

(g) Go through tasks 10 to 12 and let the children try them (see note (iv)).

(h) Let the children try tasks 13 and 14.

Completing the activity

(i) Let the children compare their results and answers (see note (v)).

Conclusion

When an inflated balloon is tapped on a table it makes a high-pitched sound. If some air is released from the balloon, it makes a lower-pitched sound. This suggests that the change in pitch could be due to the reduction in the amount of air.

When an empty bottle is tapped, then water is added and it is tapped again, the pitch of the note increases. This is due to a decrease in the amount of vibrating air in the bottle.

When the top of a straw is blown across while the straw is lowered into water, the pitch of the note changes. This is due to the amount of the air in the straw decreasing.

Teaching notes

(i) It may be useful to blow up a balloon, mime the tapping, let some air out and mime the tapping again to help the children understand what is required.

(ii) Although no reason is asked for the change in note, some children may think that it is due to letting out an amount of air. The change is due to the reduction in the tension of the rubber, but do not discuss it at this stage.

(iii) Some children may suggest that the note will be lower, as it was in the balloon, because the water has pushed some of the air out. Others may refer to some earlier work that they have done on bottles of water and say that the sound will rise due to the shorter column of air in the bottle.

(iv) It may help to mime how the children will blow across the straw as they lower it into the water.

(v) Go through the conclusion carefully and point out that sometimes the results of an experiment may not be interpreted properly and may produce inaccurate predictions to other experiments. Say also that this is normal in science.

Teacher's sheet: comprehension

See **pages 20 and 21** of *Changing sounds*

Answers

1. **(i) The longest pipe should be shaded; (ii) The shortest pipe should be labelled with an X; (iii) It would go down.**
2. **You push steady pulses of air down the bottle.**
3. **You could add water to the bottle.**
4. **Open and close the holes on the recorder body.**
5. **No. You blow over the mouthpiece of the flute to set up vibrations in the air. In the oboe, you blow into a reed which then vibrates to make the sound.**

Complementary work

(a) The children could use secondary sources to find out about wind instruments in the orchestra.

Teaching notes

When someone blows into a wind instrument, the air inside the wind instrument vibrates in a special way to produce a sound wave called a standing wave. This is a wave which remains inside the instrument, it does not come out at the end. The length of the standing wave depends on the way the holes are covered up by the fingers or the valves. If the length of the wave is long, the instrument vibrates slowly (at a low frequency) and a low-pitched note is produced. If the standing wave is short, the instrument vibrates quickly (at a high frequency) and the instrument makes a high-pitched note.

When the instrument is blown gently, the wave makes the instrument vibrate weakly, and a quiet, or soft, note is heard. When the instrument is blown strongly, the wave receives so much energy that it makes the instrument vibrate strongly and a loud sound is heard.

In a trombone, the length of the standing wave is changed by changing the position of the slider.

In a recorder, there is a slot below the mouthpiece. When air is blown into the mouthpiece, it hits the slot and makes the column of air in the recorder produce a standing wave. In a flute, the standing wave is produced by blowing over the mouthpiece.

Some instruments, called reed instruments, have one or more pieces of cane (reeds) in the mouthpiece. A clarinet has one reed and an oboe and bassoon have two. The reed causes the vibration which makes the notes. Players of brass instruments, like the trumpet, use the vibration of their lips as air passes through them to make the notes.

9 Teacher's sheet: activity

Based on **pages 20 and 21** of *Changing sounds*

Introducing the activity

(a) You may use this activity before or after the children have read pages 20 and 21 in the pupil book. You may wish to use this activity as an alternative to the one in Unit 8, or use it to reinforce the work that was done in that activity. Tell the children they are going to make a simple wind instrument.

Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through tasks 1 to 4 and let the children try them (see note (i)).

(c) Go through tasks 5 and 6, then let the children try them (see note (ii)).

(d) Go through tasks 7 and 8, then let the children try them (see note (iii)).

(e) Let the children try tasks 9 and 10 (see note (iv)).

Completing the activity

(f) Let the children compare their results and the performance of their instruments.

Conclusion

When the end of a straw is just dipped into water, there is a long column of air in the straw. When the top of this straw is blown over, the long column of air vibrates and produces a low-pitched note. When the straw is plunged deeper into the water there is a shorter column of air in the straw. When the top of this straw is blown over, the short column of air vibrates and produces a high-pitched note.

A long straw has a longer column of air inside it than a short straw. This means that when its end is blown over, the long column of air vibrates and makes a low-pitched note. The short straw has a short column of air, which vibrates to produce a high-pitched note when the end of the straw is blown over.

Teaching notes

(i) If the children have not done the previous activity they may need a little help. The focus of this part of the activity is to establish that the pitch of the note is related to the length of the column of air in the straw.

(ii) The children should see that the column of air in the straw becomes shorter in task 4 because most of the straw is filled with water. Some children may need help with this.

(iii) The straws should range from long to short. You may like the children to stick them onto two strips of cardboard to make some simple pan pipes. These can then be drawn in the space.

(iv) The longest straw should be labelled as producing the lowest-pitched note, and the shortest straw should be labelled as producing the highest-pitched note. In the explanation, look for a link between the length of the column of air in the tube and the pitch of the note.

Teacher's sheet: comprehension

See **pages 22 and 23** of *Changing sounds*

Answers

1. **(i) The fingers should be further apart; (ii) the fingers should be closer together; (iii) The tension increases.**
2. **(a) Piano, (b) guitar.**
3. **The thicker the string, the lower the pitch.**
4. **It changes the length of the string that vibrates.**
5. **The bow is pulled across the string. The string vibrates. The vibrations pass through the bridge to the body. In the body, the sound resonates and gathers strength so that we can hear the note.**

Complementary work

The children could use secondary sources to find out about stringed instruments in the orchestra.

Teaching notes

When a long length of a string is made to vibrate it tends to vibrate slowly. This produces a low-pitched note. If the length of the string is shortened by putting a finger on it and pressing it down onto a board, the shorter length vibrates more quickly when it is plucked or scraped. This produces a higher-pitched note.

Children may ask why all stringed instruments don't sound the same, or why a violin sounds different from a cello. The difference is due to the way the instruments vibrate. When a note is played on a violin, the vibration passes through all parts of the instrument. In addition to the main vibration, which produces the note, there are other vibrations which produce other sound waves called harmonics or overtones. These merge with the main sound wave to produce the particular quality of sound we associate with the sound of a violin. A similar thing happens when a cello is played. In fact, we recognise each instrument not directly by the note it is playing, but by the harmonics which give it its characteristic sound.

In the introduction to Unit 3, you may have used the piano to show the energy in sound by singing into its open top. The sound waves generated by your voice passed through the air to the piano wires and made some of them start to vibrate and produce sound. Similarly, if you place two similar drums close together, put rice on one and bang the other, the rice bounces on the skin because the skin resonates with the skin of the beaten drum.

Teacher's sheet: activity

Based on **pages 22 and 23** of *Changing sounds*

Introducing the activity

(a) Tell the children they are going to make three investigations and put the results together to discover how the vibration of an elastic band can be changed.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Let the children try tasks 2 to 4 (see note (ii)).

(d) Go through tasks 5 and 6, then let the children try them (see note (iii)).

(e) Go through tasks 7 and 8, then let the children try them (see note (iv)).

(f) Let the children try task 9.

Completing the activity

(g) Let the children compare their results.

Conclusion

As more marbles are added to the yoghurt pot the tension in the elastic band increases (the band is increasingly stretched) and the pitch of the note rises.

When a fair test is made to compare elastic bands of different thickness, but the same length and stretched by the same amount, it is found that the thicker bands give a lower-pitched sound than the thinner bands.

When the length of a stretched elastic band is decreased, the pitch of the note it makes is raised. When the length of the band is increased, the pitch of the note becomes lower.

Teaching notes

(i) The children should draw one end of the elastic band around the drawing pin and the two pencils on the piece of wood under the drawing pin, lifting the elastic band clear of the wood so it is easier to pluck. The other end of the elastic band should be hanging over the end of a table with the pot of marbles hanging from it.

(ii) The plan should state that one marble is placed in the pot, the elastic band plucked and the sound noted. A second marble is then placed in the pot and the process is repeated. The process is repeated until several marbles are in the pot. Care should be taken not to overstretch the elastic band. Check the school safety policy to see if eye protection should be worn.

(iii) The plan could state that the drawing pin could be removed from the wood and several elastic bands, which are the same length but different thicknesses, could be stretched over and under the wood. The two pencils could be placed on the top side of the wood, to make a bridge so the bands can be easily plucked.

(iv) The plan could state that one of the elastic bands from the previous investigation is left on the wood, and one of the pencils is removed. A finger may then be placed on the elastic band at different lengths from the pencil, and the band plucked between the pencil and the finger.