●●○○○ **Level 2 · Science** **S2.7**

Sound

How a shaking string makes a sound that reaches your ear.

See sounds as vibrations with rice on a tin, hear sound through a table, make echoes and a string telephone, make loud and quiet sounds and high and low notes, follow sound into the ear, and protect your hearing.

YOU ARE READY FOR THIS BOOK IF

You can make three different sounds with things at home.

One step up	S3.8 Energy stores and transfers
This book	**S2.7 Sound**
One step down	S1.6 Light, dark and sound

Contents

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S2.7.7 How we hear

S2.7.8 Noise and our ears

Key words, A to Z

Written and drawn by attnom. Free to read, print and share.

S2.7.1 CHAPTER 1

Sounds come from vibrations

What is happening when something makes a sound?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** Nothing moves. The sound just appears.
- ☐ **B** Something shakes back and forth very fast.
- ☐ **C** Something gets warm.

BY THE END YOU CAN

- Show that a sound is made when something vibrates
- Show vibrations with rice grains on a tin or tight paper

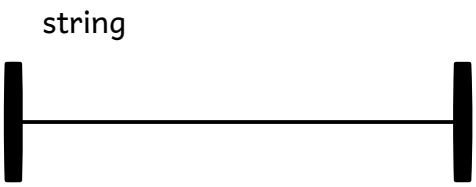
Pluck a rubber band. You hear a sound. What made it?

To **vibrate** is to move back and forth very fast. This fast movement is a **vibration**.

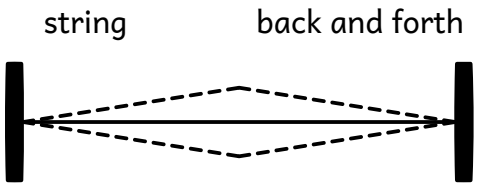
Every sound comes from something that vibrates.

DRAW IT FIRST

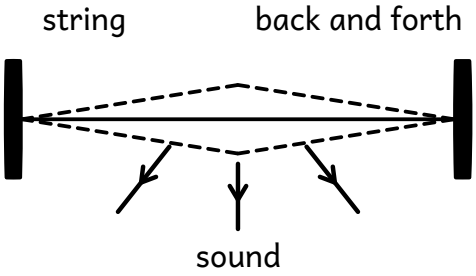
Draw how a plucked string makes a sound



1 Draw two posts with a tight string between them. Write string.



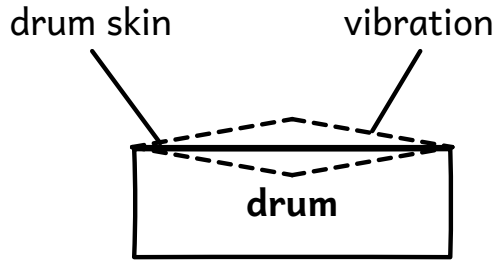
2 Pluck it. Draw dashed lines for where the string goes up and down. Write back and forth.



3 Draw arrows going out from the string. Write sound.

You can see a plucked string blur. It moves too fast to follow.

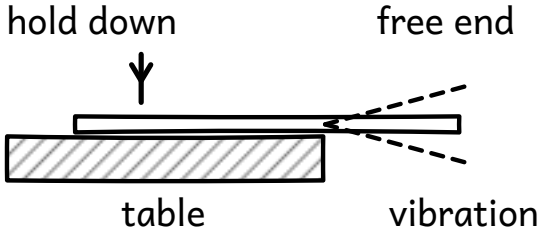
A drum skin vibrates when you hit it. A string vibrates when you pluck it.



The drum skin moves up and down very fast.

A ruler can show it too. Press one end flat on a table. Let the other end stick out.

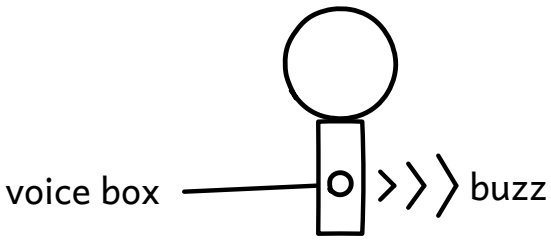
Flick the free end and keep it away from your face. It buzzes up and down. That is a vibration, and you can hear it.



The held part cannot move. The free end vibrates.

Your voice works the same way. In your neck is your **voice box**. It vibrates when you talk.

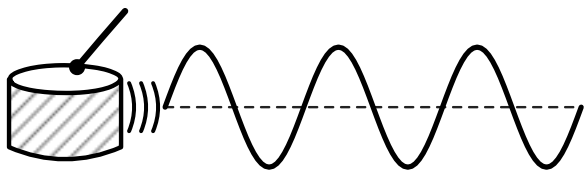
Put your fingers on your throat. Hum a long note. You feel a buzz. That is your voice box vibrating.



Your voice box vibrates, and your fingers feel the buzz.

SEE IT THREE WAYS

As a picture



drum sound

In words

A hit drum skin vibrates. The vibration travels out as sound. When the skin stops, the sound stops.

TRY IT

See a sound shake rice

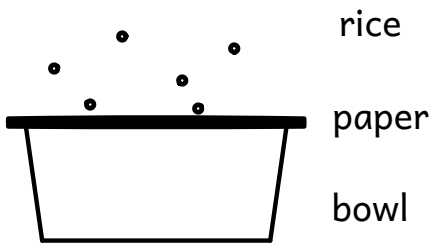
You need: a bowl or a tin with no lid, a sheet of thin paper or a clean plastic bag, string or a strong rubber band, a spoonful of rice, or sand or salt, a pan and a spoon.

Be safe: Never taste or eat the rice from this activity. Wash your hands afterwards.

1. Stretch the paper tight over the bowl. Tie it with string so it stays tight.
2. Sprinkle the rice on the paper.
3. Tap the paper gently with one finger. Watch the rice.
4. Hold the pan close above the paper. Hit the pan with the spoon. Watch again.
5. Now hit the pan harder. Does the rice jump more?

What you will see: The rice grains jump and dance. They jump more with a louder sound. The sound makes the paper vibrate, and the paper shakes the rice.

If you cannot try it, this is what happens.



A WRONG IDEA MANY PEOPLE HAVE

~~Nothing moves when a sound is made.~~

Why it feels right: A drum looks still when it sounds. You cannot see the shaking.

The test that breaks it: Do the rice test. The paper looks still, but the rice jumps. Or put your fingers on your throat and hum. You feel the buzz. Stop humming and the buzz stops too.

What is true: Every sound comes from something that vibrates. The movement is too fast and too small to see.

KEY WORDS

vibrate
to move back and forth very fast.

vibration
the fast movement back and forth.

voice box
the part of your neck that vibrates when you talk.

BACK TO YOUR GUESS

The answer is B: Something shakes back and forth very fast.

Something shakes back and forth very fast. That shaking is a vibration. Every sound starts with one.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. What makes a sound?

    A Something that stays perfectly still

    B Something that gets warm

    C Something that vibrates

    Answer at the back of the book.

2. You hum with your fingers on your throat. What do you feel?

    A A buzz from my voice box

    B Nothing, because a sound does not move anything

    C Air blowing on my fingers

    Answer at the back of the book.

3. Rice jumps on tight paper when you hit a pan close by. Why?

    A The paper stays still. The rice jumps by itself.

    B The sound makes the paper vibrate, and the paper shakes the rice.

    C The rice makes the sound.

    Answer at the back of the book.

4. A guitar string is plucked. What does the string do?

    Answer at the back of the book.

5. Draw a plucked string. Show how it moves.

    Answer at the back of the book.

6. Kofi hits a drum, and it sounds loud. He then lays his hand flat on the skin. What happens to the sound?

    A It goes on, because a sound does not need a vibration.

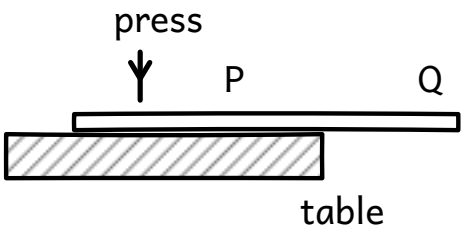
    B It gets louder, because his hand pushes on the skin.

    C It goes into his hand and stays there.

    D It stops, because the skin cannot vibrate.

    Answer at the back of the book.

7. Look at the picture. Joseph presses one end of a ruler and flicks the other end. Which part vibrates?



A The pressed part, P

B None of it, because a ruler is a solid

C The free end, Q

Answer at the back of the book.

8. Lucía plucks a guitar string and sees a blur. What is the blur?

A The string moving back and forth very fast

B The sound, which you can see in the air

C Two strings, because the string splits in two

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

A sound is made when something vibrates. To vibrate is to move back and forth very fast. A drum skin, a string and a voice box all vibrate. Rice on tight paper shows it.

Draw: A string between two posts. Dashed lines for the up and down. Arrows going out.

S2.7.2 CHAPTER 2

Sound travels

How does a sound get from one place to another?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

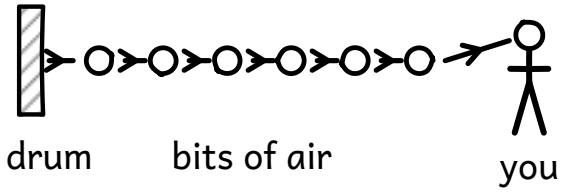
- ☐ **A** Sound travels only through air.
- ☐ **B** Sound can travel through empty space.
- ☐ **C** Sound goes through air, but water stops it.
- ☐ **D** Sound travels through air, water and solids.

BY THE END YOU CAN

- Explain that sound travels through air, water and solids
- Compare a tap heard through air and through a table
- Explain that sound cannot travel through empty space

A drum is hit across a field. You hear it. How does the sound get to you?

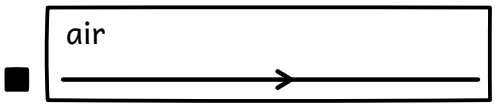
The drum skin vibrates. It pushes the air next to it. That air pushes the air next to it. The vibration passes on, bit by bit, until it reaches your ear.



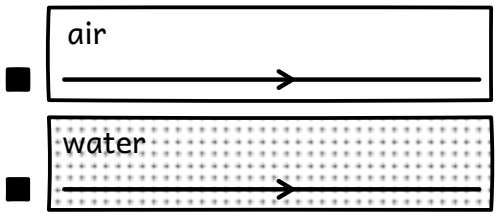
Each bit of air pushes the next one.

DRAW IT FIRST

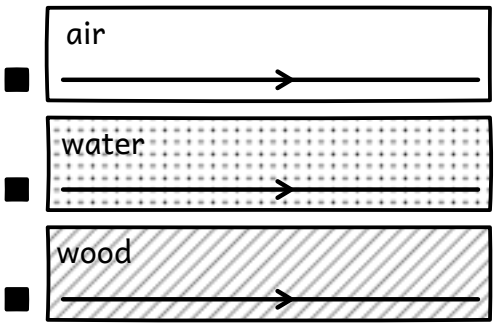
Draw sound going through three things



1 Draw a tap and a block of air. Draw an arrow through it.



2 Draw a block of water. Draw an arrow through it.



3 Draw a block of wood. Draw an arrow through it.

Sound passes through air. It passes through water too. Under water you can hear two stones knock together.

Be safe. Put your head under water only with a grown up beside you. Use a bath or a pool. Never a river, a lake or the sea.

Sound passes through a **solid** as well. A solid keeps its own shape. A table, a wall and a metal bar are solids.

Sound goes faster in water and iron than in air. In air it goes about 340 metres each second.

SEE IT THREE WAYS

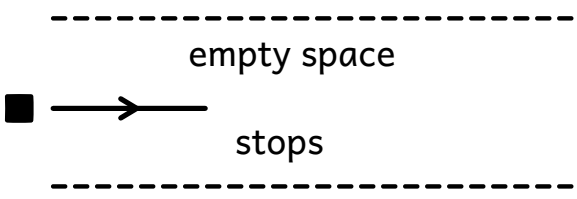
As a picture

Through	Metres a second
air	340
water	1 500
iron	5 000

In words

Sound goes through air, water and solids. It is faster in water and in iron than in air. These numbers are about right.

Sound cannot travel through **empty space**. Empty space has no air at all. With nothing to pass the vibration on, the sound stops.

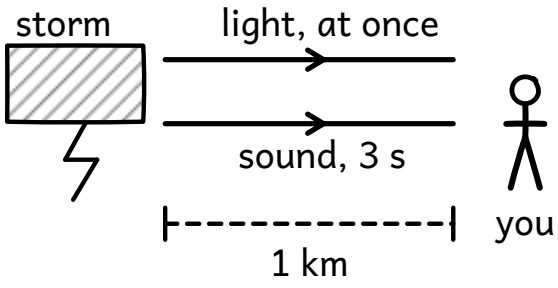


In empty space there is nothing to pass the sound on.

People test this with a bell in a sealed glass jar. A pump takes the air out. The ringing fades away.

Light is much faster than sound. In a storm you see lightning first. The thunder comes later.

In 3 seconds, sound goes about 1 km. Count the seconds from the flash to the thunder. Divide by 3. That is about how many km away the storm is.



Light arrives at once. Sound takes about 3 s for each km.

Be safe. In a storm, stay inside. Never stand under a tall tree or in open ground.

TRY IT

Hear a tap through air and through a table

You need: a wooden table, or a strong wooden bench, a quiet room.

1. Sit at the table. Reach one arm out along it.
2. Keep your head up. Tap the table softly with a finger. Listen.
3. Now rest one ear flat on the table. Keep your arm out.
4. Tap the table softly again, with the same soft tap. Listen.
5. Which tap sounded louder?

What you will see: The tap sounds louder with your ear on the table. The table passes the vibration on better than air does.

If you cannot try it, this is what happens.

Ear	Sound
in the air	quiet
on the table	louder

A WRONG IDEA MANY PEOPLE HAVE

~~Sound only travels through air.~~

Why it feels right: You hear most sounds through the air all day. You rarely think about anything else.

The test that breaks it: Press one ear to a table. Tap the far end softly. The tap is loud and clear. Lift your head and tap again. It is quieter. The table carried the sound.

What is true: Sound travels through air, water and solids. It cannot travel through empty space.

KEY WORDS

solid
keeps its own shape.

empty space
a place with no air at all. Sound cannot travel there.

BACK TO YOUR GUESS

The answer is D: Sound travels through air, water and solids.

Sound travels through air, water and solids. It cannot cross empty space, where there is no air.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. What can sound travel through?

   A Air only

   B Air, water and solids

   C Air, water, solids and empty space

   Answer at the back of the book.

2. Amina rests her ear on a table. Kofi taps the far end. The tap sounds louder than in the air. Why?

   A Sound cannot go through air.

   B The table makes a sound of its own.

   C The table passes the vibration on better than air does.

   Answer at the back of the book.

3. You count 9 seconds from a flash of lightning to its thunder. About how far away is the storm?

   A 3 km

   B 9 km

   C 27 km

   Answer at the back of the book.

4. A storm is 6 km away. About how many seconds pass between the flash and the thunder?

   Answer at the back of the book.

5. Why can you not hear a sound in empty space?

   Answer at the back of the book.

6. **From an earlier chapter**

   A drum is hit and it makes a sound. What is the drum skin doing?

   A Staying perfectly still

   B Vibrating

   C Cooling down

   Answer at the back of the book.

7. Look at the table. Through which does sound go fastest?

Through	Metres a second
air	340
water	1 500
iron	5 000

A Air

B Water

C It goes the same speed through all three

D Iron

Answer at the back of the book.

8. A bell rings inside a sealed glass jar. A pump takes the air out of the jar. What do you hear?

A The ringing fades away, because the air has gone.

B The ringing gets louder, because nothing is in the way.

C The ringing stays the same, because the bell still shakes.

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Sound travels by passing a vibration through air, water and solids. It cannot cross empty space. In air it goes about 340 metres each second. A table can carry a tap better than air.

Draw: A tap, a block, and an arrow through it. Write air, water and wood.

S2.7.3 CHAPTER 3

Echoes

Why do I hear my shout again from a far wall?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** Someone far away is shouting back.
- ☐ **B** The air keeps the sound and says it again later.
- ☐ **C** The wall makes a new sound of its own.
- ☐ **D** The sound bounces back from the wall.

BY THE END YOU CAN

- Explain that an echo is sound bouncing back from a hard surface
- Say which things bounce sound back and which take it in
- Explain how bats and dolphins use echoes to find food

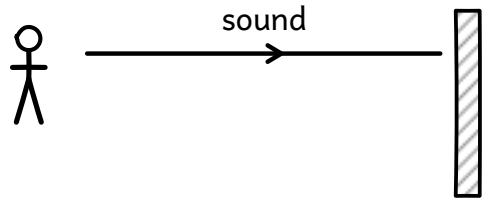
Shout at a big wall far away. A moment later, you hear your shout again.

That sound is an **echo**. An echo is sound that bounces back.

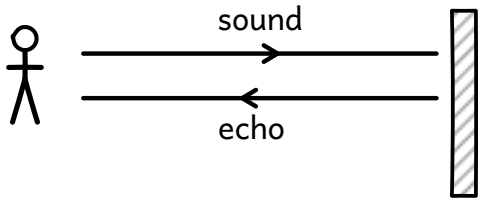
A **hard surface** is a hard, flat face. Walls, cliffs and the inside of a well are hard surfaces. They bounce sound back.

DRAW IT FIRST

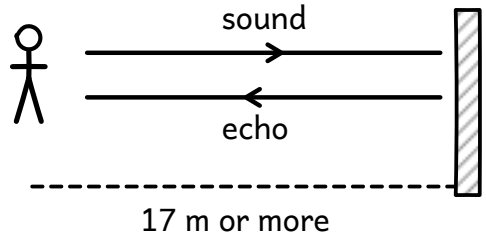
Draw an echo



1 Draw a person and a wall. Draw an arrow to the wall. Write sound.



2 Draw an arrow coming back from the wall. Write echo.



3 Draw a dashed line between them. Write 17 m or more.

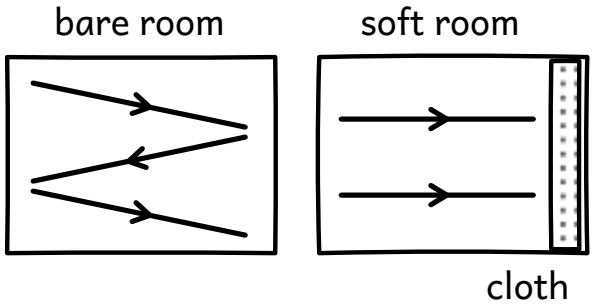
The sound goes to the wall and comes back. It makes the trip twice.

You hear a separate echo only when the wall is far. It must be about 17 m away or more. Then the echo comes back a moment after your shout.

If the wall is closer, the echo comes back too fast. It joins your shout.

Soft things **take in** sound. Cloth, cushions and grass soak it up. They bounce back much less sound.

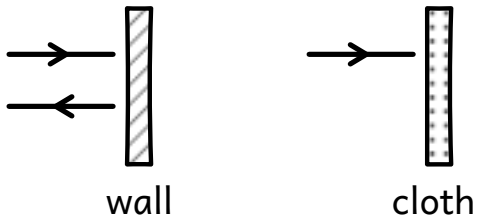
A bare room has many echoes. A room with cushions and curtains has fewer.



A bare room bounces sound about. Cloth takes it in.

SEE IT THREE WAYS

As a picture



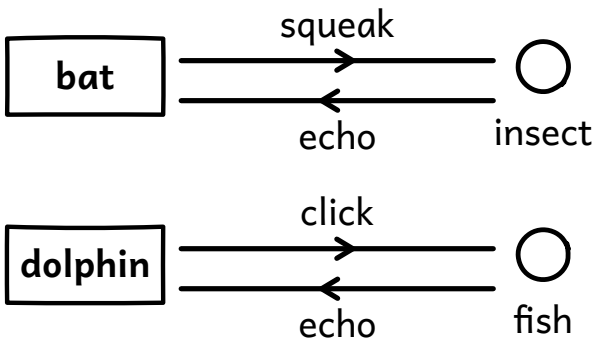
In words

A hard wall bounces sound back. Soft cloth takes the sound in.

Animals use echoes. Many bats make high squeaks as they fly. Most are too high for people to hear.

The squeak hits an insect and bounces back. The bat hears the echo. It knows where the insect is, even in the dark.

Dolphins make clicks under water. They listen for the echoes. The echoes show where the fish are.



Bats and dolphins send out sound and listen for the echo.

TRY IT

Find an echo

You need: a big hard wall, such as the side of a large building, open ground in front of it, a friend, if you like.

Be safe: Keep away from roads, deep water and the edge of a drop. Never lean into a well.

1. Find a big wall with open ground in front of it. Keep away from roads.
2. Walk about 40 big steps from the wall. Turn and face it.
3. Clap once, hard and sharp. Listen.
4. Walk on until you are about 10 steps from the wall. Clap again. Listen.
5. No big wall? Clap in a bare room. Then hang a blanket on one wall and clap again.

What you will see: At 40 steps you hear the clap. A moment later you hear it again. Near the wall, the echo joins the clap. In the bare room, the blanket takes in sound. The echo is weaker.

If you cannot try it, this is what happens.

Distance	You hear
far	clap, then echo
near	one long clap

A WRONG IDEA MANY PEOPLE HAVE

~~Bats are blind, so they use echoes.~~

Why it feels right: Bats fly in the dark and they hunt by sound. People say "blind as a bat".

The test that breaks it: Scientists have watched and tested many kinds of bat. Every kind has eyes that work. Many fruit bats make no echo squeaks at all. They find fruit by sight and smell. A blind bat could not do that.

What is true: No bat is blind. All bats can see. Many also use echoes in the dark.

KEY WORDS

echo
sound that bounces back from a hard surface.

hard surface
a hard, flat face that bounces sound back, such as a wall.

take in
to soak up sound instead of bouncing it back.

BACK TO YOUR GUESS

The answer is D: The sound bounces back from the wall.

The sound bounces back from the wall, like a ball. You hear it a second time. That is an echo.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. What is an echo?

   A A very loud sound

   B A sound that a second person makes

   C Sound that bounces back from a hard surface

   Answer at the back of the book.

2. Which room has the fewest echoes?

   A A small room with thick curtains and cushions

   B A bare room with hard walls

   C A room with a high roof, where sound goes up and away

   Answer at the back of the book.

3. Sound goes 340 metres each second. A wall is 170 metres away. How long until the echo of a clap comes back?



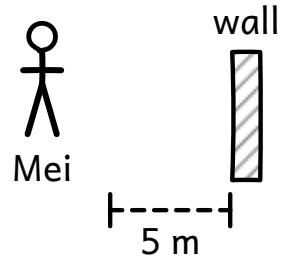
   A Half a second

   B 1 second

   C 2 seconds

   Answer at the back of the book.

4. Mei claps 5 metres from a wall. She hears no separate echo. Why?



A A wall that close cannot bounce sound.

B A clap is too quiet to make an echo.

C The echo comes back so fast that it joins the clap.

Answer at the back of the book.

5. How does a dolphin find fish in the water?

A It listens for the fish breathing.

B It makes light from its own body.

C It smells the fish in the water.

D It makes clicks and listens for the echoes.

Answer at the back of the book.

6. **From an earlier chapter**

A dolphin's clicks must travel through water. Can sound do that?

A No. Sound only travels through air.

B Yes. Sound travels through water.

Answer at the back of the book.

7. Kofi says bats use echoes because they are blind. What is true?

A All bats can see. Many also use echoes in the dark.

B He is right. Bats are blind, so echoes are all they have.

C Bats use echoes only in the daytime.

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

An echo is sound that bounces back from a hard surface. Soft things take sound in. Dolphins and many bats send out sounds and listen for echoes. They find food this way.

Draw: A person, a wall, and two arrows. One goes to the wall. One comes back. Write echo.

S2.7.4 CHAPTER 4

A string telephone

How can a string carry my voice to a friend?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The sound goes along inside the string, like water in a pipe.
- ☐ **B** The string is just there to hold the cups.
- ☐ **C** The string shakes, and the shaking carries the sound.

BY THE END YOU CAN

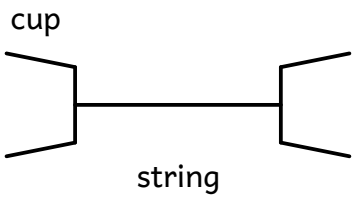
- Make a string telephone with two cups and string
- Explain why the string must be tight for it to work
- Explain that the string itself vibrates

Two cups and a string can carry your voice. You can make one today.

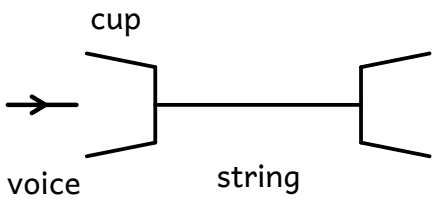
Your voice makes the air vibrate. The air makes the bottom of the cup vibrate.

DRAW IT FIRST

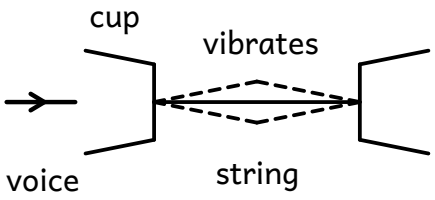
Draw *a* string telephone



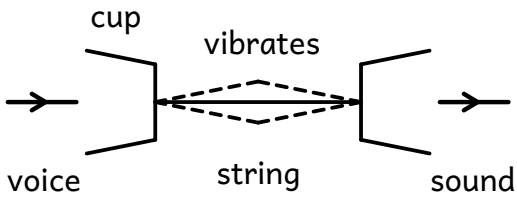
1 Draw two cups with *a* straight string between them. Write cup and string.



2 Draw *an* arrow into the first cup. Write voice.



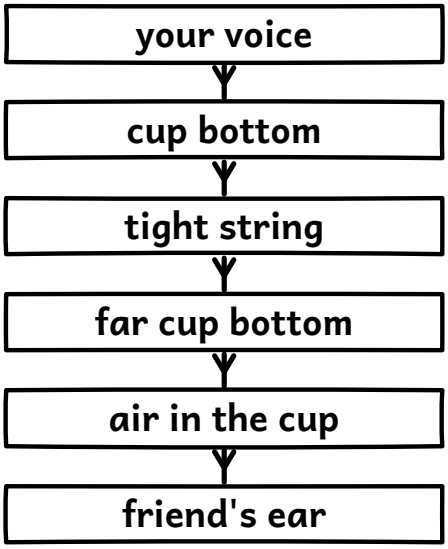
3 Draw dashed lines for the string moving. Write vibrates.



4 Draw *an* arrow out of the far cup. Write sound.

The first cup bottom shakes the string. The vibration runs along the string. At the far end it shakes the other cup bottom.

That cup bottom makes the air in the cup vibrate. Your friend hears your voice.

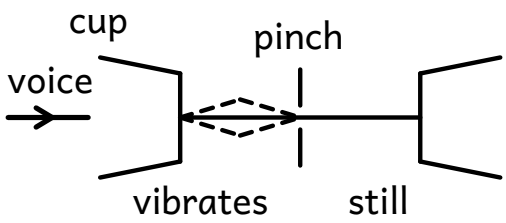


Each part passes the vibration to the next.

The string must be **tight**. A tight string is pulled straight. A **slack** string is loose and sags.

A slack string soaks up the vibration. It does not pass it on.

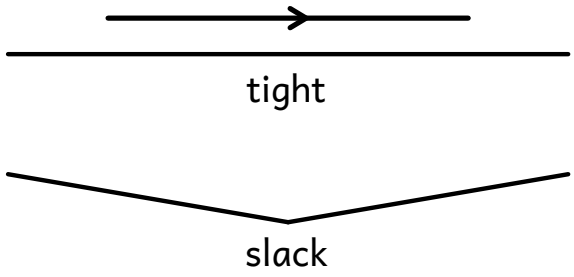
The string must touch nothing, too. A hand, a fence or a wall can stop the vibration.



A pinched string cannot pass the vibration on.

SEE IT THREE WAYS

As a picture



In words

A tight string passes the vibration along. A slack string does not.

TRY IT

Make a string telephone

You need: two paper cups, or two empty tins with smooth edges, string, 5 to 10 metres long, a nail, for a grown up to use, a friend.

Be safe: A grown up makes the holes. Check tin edges are smooth. Never put string around anyone's neck.

1. A grown up makes a small hole in each cup bottom.
2. Push one end of the string into a hole, from outside.
3. Tie a big knot inside the cup. It stops the string slipping out.
4. Do the same with the other cup and the other end.
5. Walk apart until the string is tight. Keep it off the ground and away from walls.
6. Talk quietly into your cup. Your friend holds their cup to their ear.
7. Take two steps closer, so the string sags. Talk again.
8. Step back until it is tight. Pinch the string while you talk. Then let go.

What you will see: Your friend hears you when the string is tight. When it sags, they hear little or nothing. When you pinch the string, the sound stops at once. When you let go, it comes back.

If you cannot try it, this is what happens.

String	Sound
tight	clear
slack	little or none
pinched	none

A WRONG IDEA MANY PEOPLE HAVE

~~**The sound goes along inside the string, like water in a pipe.**~~

Why it feels right: The voice goes in one end and comes out the other. It seems to run through the string.

The test that breaks it: Water goes through a loose pipe as well as a tight one. But a slack string carries almost no sound. Pull it tight and the sound comes back. Hold the tight string lightly while your friend talks. You feel it buzz.

What is true: The string itself vibrates. It passes the vibration along. Nothing runs inside it.

KEY WORDS

tight
pulled straight, with no sag.

slack
loose, so it sags.

BACK TO YOUR GUESS

The answer is C: The string shakes, and the shaking carries the sound.

The string shakes. Your voice makes the first cup vibrate. The tight string passes the vibration to the far cup.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Why must the string of a string telephone be tight?

   A A tight string keeps the sound inside it, like a pipe.

   B A slack string would let the cups fall off.

   C A tight string makes your voice higher.

   D A tight string can pass the vibration along.

   Answer at the back of the book.

2. Ravi talks into his cup. What happens right after the cup bottom vibrates?

   A The tight string vibrates.

   B The far cup vibrates at once, with nothing between.

   C The string fills up with sound.

   Answer at the back of the book.

3. Mei's telephone works. Then her friend steps on the string. The sound stops. Why?

   A The string has run out of sound.

   B The string cannot vibrate where it is pressed.

   C Sound cannot go through string at all.

   Answer at the back of the book.

4. Ana's string is 10 metres long. Joseph stands 7 metres from her, holding his cup. The string sags. How far must he move to pull it tight?

   Answer at the back of the book.

5. **From an earlier chapter**

   You talk into the cup. What does the bottom of the cup do?

   A It vibrates.

   B It stays perfectly still.

   C It cools down.

   Answer at the back of the book.

6. Draw a string telephone. Show how the vibration goes from one cup to the other.

   Answer at the back of the book.

7. Kofi holds the tight string lightly while Ana talks into her cup. What does he feel?

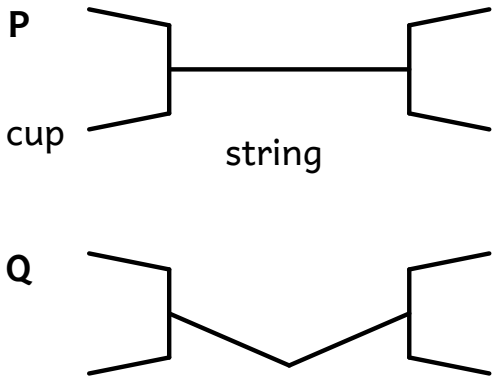
   A Nothing, because the sound runs inside the string.

   B The string buzzing, because it vibrates.

   C A pull, because her voice tugs the string.

   Answer at the back of the book.

8. Look at the picture. Two string telephones, P and Q. Which one carries a voice better?



   A Telephone Q

   B Both carry a voice the same

   C Telephone P

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Your voice makes a cup bottom vibrate. A tight string carries the vibration to the far cup. A slack string, or a pinched one, stops it. The sound does not go inside the string.

Draw: Two cups and a tight string. Dashed lines for the string moving. Arrows for voice and sound.

S2.7.5 CHAPTER 5

Loud and quiet

Why is a shout louder than a whisper?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** The voice box shakes faster.
- ☐ **B** The voice box shakes in a different place.
- ☐ **C** The voice box is bigger when you shout.
- ☐ **D** The voice box shakes more, with bigger moves.

BY THE END YOU CAN

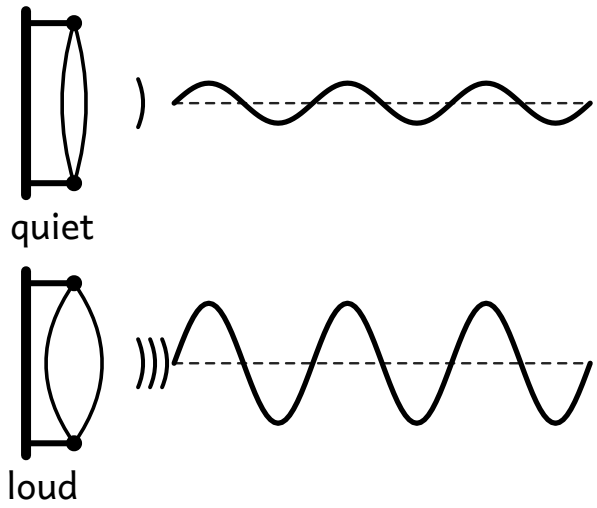
- Explain that bigger vibrations make louder sounds
- Explain why a sound gets quieter as you move away from it

Hit a drum softly. The skin moves a little. Hit it hard. The skin moves a lot.

A bigger move makes a louder sound. The **volume** of a sound is how loud or quiet it is.

SEE IT THREE WAYS

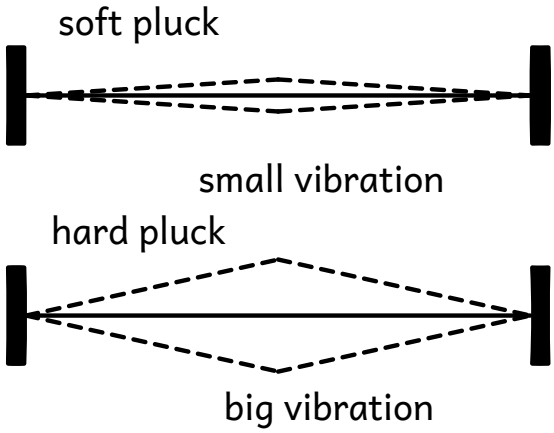
As a picture



In words

A small vibration makes a short wave and a quiet sound. A big vibration makes a tall wave and a loud sound. The number of bumps is the same.

Pluck a rubber band gently. It moves a little, and the sound is quiet. Pluck it harder. It moves further, and the sound is louder.



A hard pluck makes a big vibration and a loud sound.

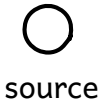
The sound is not higher or lower. It is only louder. The size of the move changes the volume, not the note.

Now think about distance. A bell rings. Close to it, the sound is loud. Far away, it is quiet. Why?

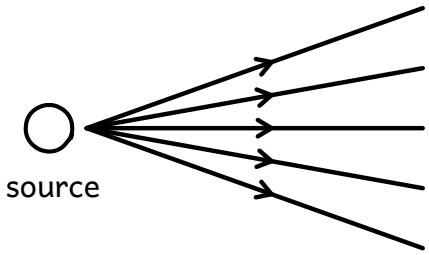
The sound spreads out as it goes. Think of ripples on a pond. They grow into bigger rings, and the rings get weaker.

DRAW IT FIRST

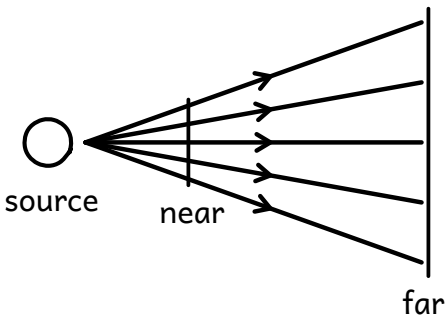
Draw how a sound spreads out



1 Draw a circle for the thing that makes the sound. Write source.



2 Draw five arrows that spread out from it.



3 Draw a short line near the source. Draw a long line far away. Write near and far.

Near the source, the sound meets a short line. Far away, the same sound meets a long line.

The sound is shared over more space. So each part of that space gets less. The sound is quieter.

Air takes in a little sound as it goes. Soft things take in sound too. Cloth and grass take in more than a hard wall.

TRY IT

Hard pluck, soft pluck, and walking away

You need: a rubber band, a small open box, or a tin with no sharp edges, a friend, two spoons, open ground, or a long room.

Be safe: Keep the box away from your face. Pull the band only a little. Tap the spoons gently, away from your face.

1. Stretch the rubber band across the open top of the box.
2. Hold the box away from your face. Pluck the band softly.
3. Watch how far the band moves. Listen.
4. Now pluck it hard. Watch and listen again.
5. Your friend taps the two spoons together, the same way each time.
6. Walk away one step at a time. Stop when the taps are very quiet. Count your steps.

What you will see: A hard pluck moves the band further, and the sound is louder. The note stays the same. The taps get quieter with every step you take away. The step counts in the table are only an example.

If you cannot try it, this is what happens.

Pluck	Band moves	Sound
soft	a little	quiet
hard	a lot	loud

Steps away	You hear
1	loud
5	quiet
15	very quiet

A WRONG IDEA MANY PEOPLE HAVE

~~A louder sound is a higher note.~~

Why it feels right: We say we raise our voice to be louder. To raise is to go up, like a high note.

The test that breaks it: Hum one steady note with a hand on your throat. Hum the same note again, louder. Your throat shakes more, but the note is the same. Or pluck the rubber band softly, then hard. It sounds louder, not higher.

What is true: Bigger vibrations make a louder sound. The note stays the same.

KEY WORDS

volume
how loud or quiet a sound is.

BACK TO YOUR GUESS

The answer is D: The voice box shakes more, with bigger moves.

A shout shakes the voice box with bigger moves. A bigger vibration makes a louder sound.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Kofi plucks a rubber band hard. How is this different from a soft pluck?

   A The band moves the same, but the sound is louder.

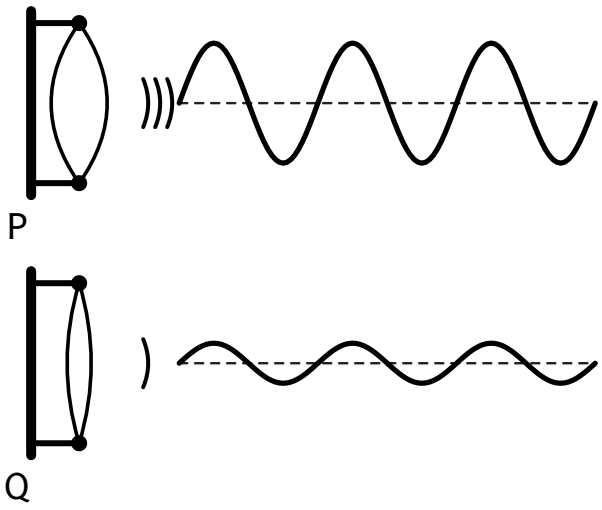
   B The band moves faster, and the note is higher.

   C The band moves further, and the note is lower.

   D The band moves further, and the sound is louder.

   Answer at the back of the book.

2. Look at the picture. Which rubber band makes the louder sound?



A Both make an equally loud sound

B Band P

C Band Q

Answer at the back of the book.

3. Ana walks away from a ringing bell. Why does it get quieter?

A The sound spreads out over a bigger space.

B The bell rings more softly when she walks away.

C The note gets lower as she walks away.

Answer at the back of the book.

4. Lucía plucks a rubber band softly, then hard. What stays the same?

A The volume

B How far the band moves

C The note

Answer at the back of the book.

5. **From an earlier chapter**

   Amina hums and touches her throat. What does she feel?

   A Nothing, because sound does not move anything.

   B Her throat shaking

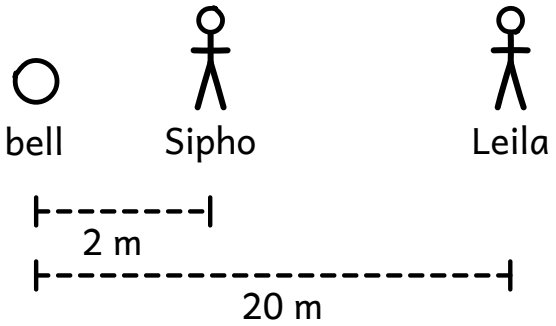
   C Air blowing on her hand.

   Answer at the back of the book.

6. Draw two sound waves from one rubber band. One is quiet. One is loud.

   Answer at the back of the book.

7. Look at the picture. Sipho and Leila hear the same bell. Who hears it louder?



   A Sipho, because the sound has not spread out as far.

   B They hear it the same, because the bell rings the same.

   C Leila, because the sound grows as it travels.

   Answer at the back of the book.

8. Hana plucks a rubber band gently. How can she make a louder sound with the same band?

   A Pluck it again and again, faster.

   B Stretch it tighter.

   C Pluck it harder.

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

A bigger vibration makes a louder sound. The note stays the same. A sound gets quieter as you walk away. It spreads out over a bigger space.

Draw: A short wave and a tall wave. Write quiet and loud.

S2.7.6 CHAPTER 6

High and low notes

Why can one rubber band make high and low notes?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** It shakes harder for a high note.
- ☐ **B** It gets warmer for a high note.
- ☐ **C** It gets longer for a high note.
- ☐ **D** It shakes faster for a high note.

BY THE END YOU CAN

- Make high and low notes with water bottles or stretched rubber bands
- Explain that faster vibrations make higher notes

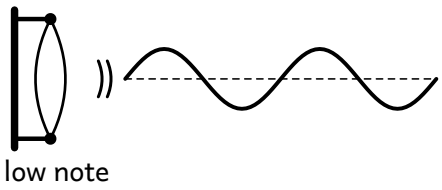
A mouse squeaks. A lion roars. The squeak is high. The roar is low.

A **note** is a steady sound you can sing or hum. The **pitch** of a note is how high or low it is.

Every note comes from a vibration. What makes one note higher than another? It is how fast the thing shakes.

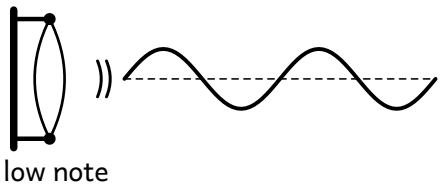
DRAW IT FIRST

Draw *a* low note *and a* high note

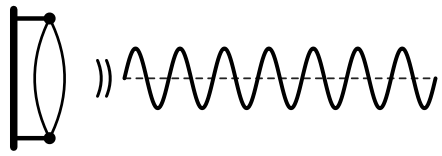


low note

1 Draw *a* slow wave with *a* few bumps. Write low note.

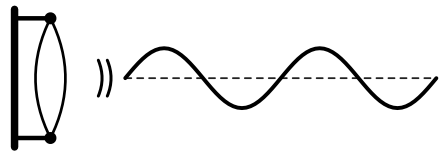


low note

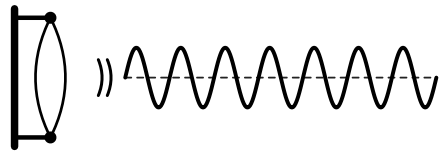


high note

2 Draw *a* fast wave with many bumps, the same height. Write high note.



low note 2 waves



high note 7 waves

3 Count the bumps. Write 2 waves and 7 waves.

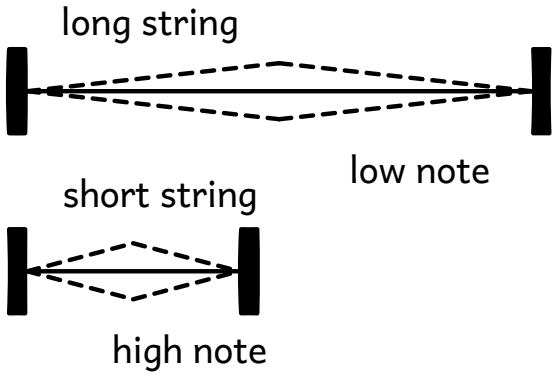
The two waves are the same height. So they are equally loud. The high note has more bumps in the same space.

More bumps means more shakes in the same time. A high note shakes fast. A low note shakes slowly.

A low note might shake 100 times in one second. A high note might shake 1 000 times.

A rubber band shows this well. Stretch it across a box and pluck it. Now stretch it tighter. The note goes higher.

A tight band shakes faster. A thin band shakes faster than a thick one. A short band shakes faster than a long one.



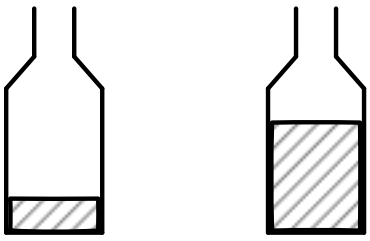
A short string shakes faster, so its note is higher.

Big things shake more slowly. Two drums are made the same way. The big one gives the lower note.

Bottles of water make notes too. How you make the sound matters. Say which one you did.

SEE IT THREE WAYS

As a picture



little water more water

You	More water
tap it	a lower note
blow across	a higher note

In words

Tap the bottles. The one with more water gives a lower note. Blow across the tops. The one with more water gives a higher note.

When you tap, the bottle and the water shake. More water is harder to shake. So it shakes slower, and the note is lower.

When you blow across the top, the air inside shakes. More water leaves less air. Less air shakes faster, so the note is higher.

Be safe. Plastic bottles are best for blowing. Glass bottles ring best when tapped. Tap glass only gently, with a spoon. Never tap hard.

TRY IT

Make high and low notes

You need: a rubber band, a small open box, or a tin with no sharp edges.

Be safe: Keep the box away from your face. Stretch the band only until it is tight. Never stretch it until it might snap.

1. Stretch the rubber band across the open top of the box.
2. Hold the box away from your face. Pluck the band. Listen to the note.
3. Stretch the band a little tighter. Pluck it again. Is the note higher or lower?
4. Press one finger on the middle of the band. Pluck one half. What do you hear?

What you will see: A tighter band gives a higher note. A shorter band gives a higher note. Both shake faster. Pluck with the same strength each time, so you hear the change.

If you cannot try it, this is what happens.

Band	Note
loose	lower
tight	higher
half length	higher

A WRONG IDEA MANY PEOPLE HAVE

~~More water in a bottle always makes a lower note.~~

Why it feels right: Most people tap the bottles first. Then more water does give a lower note.

The test that breaks it: Stand two glass bottles side by side. Put a little water in one and more in the other. Tap each with a spoon, gently. Then blow across the top of each, not into it. Listen each time. The order of the notes turns round.

What is true: It depends how you make the sound. Tap: more water gives a lower note. Blow across: more water gives a higher note.

KEY WORDS

note
a steady sound you can sing or hum.

pitch
how high or low a note is.

BACK TO YOUR GUESS

The answer is D: It shakes faster for a high note.

A band that shakes faster makes a higher note. A band that shakes slower makes a lower note.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Lucía stretches a rubber band tighter and plucks it. What happens to the note?

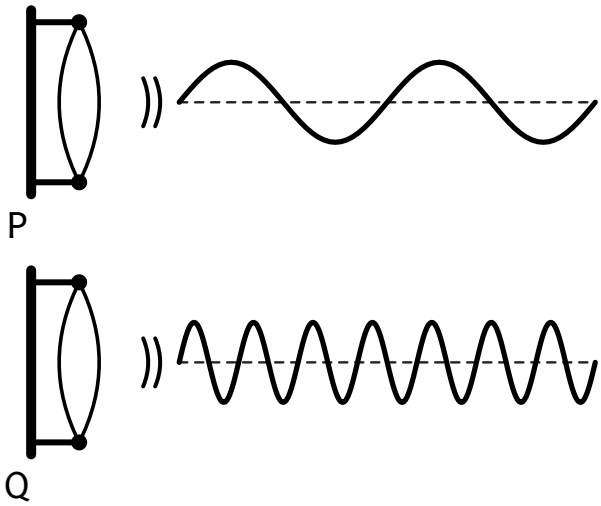
   A It gets lower, because the band shakes slower.

   B It gets louder, but the note stays the same.

   C It gets higher, because the band shakes faster.

   Answer at the back of the book.

2. Look at the picture. Which rubber band gives the higher note?



   A Band Q

   B Band P

   C Both give the same note

   Answer at the back of the book.

3. Tariq gently taps two glass bottles with a spoon. One has more water. Which gives the lower note?

   A The bottle with less water

   B The bottle with more water

   C Both give the same note

   Answer at the back of the book.

4. Ana blows across the tops of two bottles. One has more water. Which gives the higher note?

   A The bottle with less water

   B Both give the same note

   C The bottle she blows harder across

   D The bottle with more water

   Answer at the back of the book.

5. **From an earlier chapter**

   Mei plucks a rubber band hard, not softly. What happens to the note?

   A It goes higher, because the band moves more.

   B It stays the same, and the sound is louder.

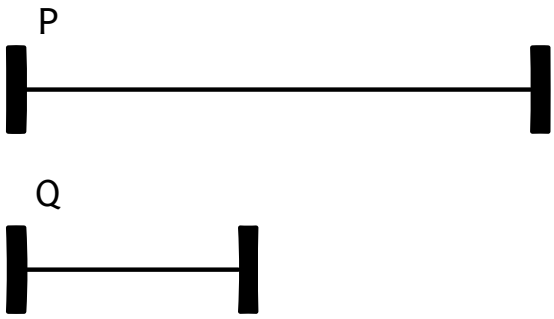
   C It goes lower, because the sound is bigger.

   Answer at the back of the book.

6. Draw the waves for a low note and a high note. Make both the same height.

   Answer at the back of the book.

7. Look at the picture. Hana plucks both strings. They are equally tight and thick. Which gives the higher note?



   A String P, because a long string has more to shake

   B Both give the same note

   C String Q

   Answer at the back of the book.

8. Ravi has two drums made the same way. One is big and one is small. Which gives the lower note?

   A The big drum

   B The small drum

   C They give the same note, because both are drums

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

A faster vibration makes a higher note. A tight, thin or short band gives a higher note. Tap bottles: more water gives a lower note. Blow across: more water gives a higher note.

Draw: A wave with few bumps and a wave with many bumps. Write low and high.

S2.7.7 CHAPTER 7

How we hear

How does sound get from the air into your head?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

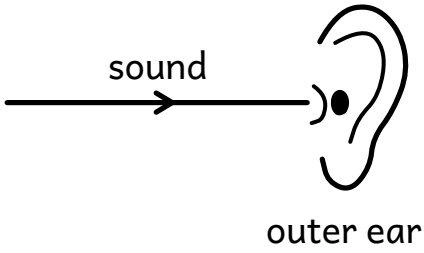
- ☐ **A** The outer ear hears it.
- ☐ **B** Sound shakes the eardrum, and a nerve tells the brain.
- ☐ **C** Sound goes straight into the brain.

BY THE END YOU CAN

- Point to the outer ear, ear canal and eardrum on a drawing
- Explain how vibrations travel to the eardrum

A drum beats far away. You hear it. How does the sound get into your head?

Look at the side of a friend's head. The part you see is the **outer ear**. It collects sound and leads it in.



The outer ear collects sound.

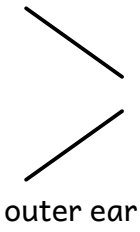
Inside the outer ear is a tube. It is the **ear canal**. The sound goes along it.

Sound in the air is air that shakes. The shaking air goes down the ear canal.

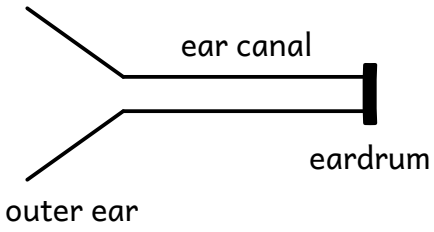
At the end of the canal is a thin piece of skin. It is the **eardrum**. The shaking air makes the eardrum vibrate.

DRAW IT FIRST

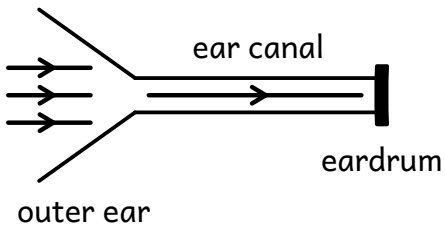
Draw the way into the ear



1 Draw a wide funnel. Write outer ear.



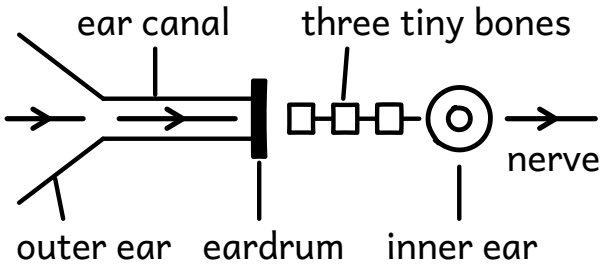
2 Draw a tube from the funnel. Close its end with a thick bar. Write ear canal and eardrum.



3 Draw arrows going in along the tube to the eardrum.

The eardrum shakes three tiny bones. They pass the shake on to the **<u>inner ear</u>**.

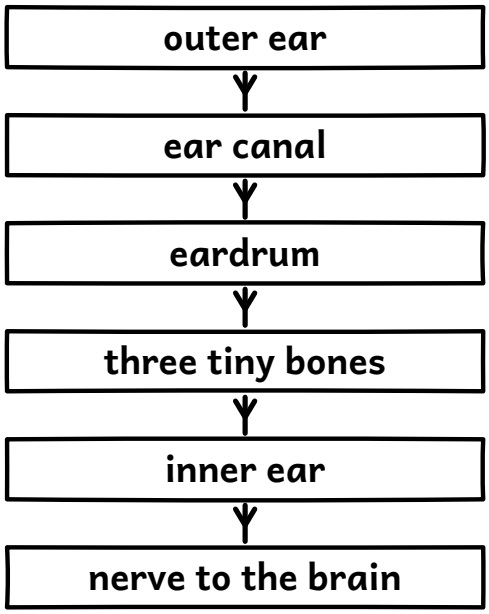
The inner ear sends messages along a nerve. A nerve is like a thin cable. The messages go to your brain. Then you hear the drum.



The way sound goes in, from the outer ear to the nerve.

SEE IT THREE WAYS

As a picture



In words

Sound goes in at the outer ear and along the ear canal. It shakes the eardrum and the tiny bones. A nerve carries messages to the brain.

Be safe. Never push anything into your ear canal. Not a stick, not a finger tip. The eardrum is thin, and it can be hurt.

TRY IT

Collect more sound

You need: a friend who talks softly, a quiet room, your hand.

1. Sit in a quiet room. Your friend sits in front of you, a few steps away.
2. Your friend talks softly. Listen with your hand down.
3. Cup your hand behind one ear. Push the ear forward a little.
4. Listen to the same soft voice again. Is it louder?

What you will see: With your hand cupped, the voice is a little louder. Your hand collects more sound and leads it into your ear canal.

If you cannot try it, this is what happens.

Hand	You hear
down	quiet
cupped	louder

A WRONG IDEA MANY PEOPLE HAVE

~~The outer ear does the hearing.~~

Why it feels right: The outer ear is the part you see. We say we hear with our ears.

The test that breaks it: Cup a hand behind your ear. Sounds in front get a little louder. Your hand did not hear anything. It only helped the outer ear collect more sound. Now press the front flap of your ear over the hole. Do not push anything in. Sounds go much quieter, but the outer ear is still there. The sound must get in to be heard.

What is true: The outer ear collects sound. The eardrum shakes. A nerve sends messages to the brain. That is how you hear.

KEY WORDS

outer ear

the part of the ear you see. It collects sound.

ear canal
the tube that leads sound into the ear.

eardrum
thin skin at the end of the ear canal. It vibrates when sound reaches it.

inner ear
the part deep inside the ear. It sends messages along a nerve to the brain.

BACK TO YOUR GUESS

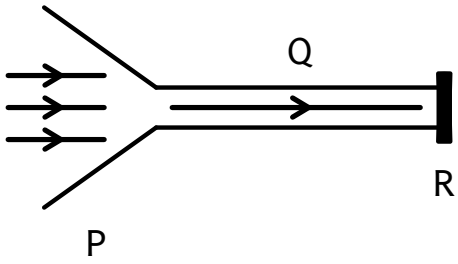
The answer is B: Sound shakes the eardrum, and a nerve tells the brain.

Sound reaches the eardrum and makes it vibrate. The shake goes on, and a nerve sends messages to the brain.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Look at the picture. Which part is the eardrum?



A Part P

B Part R

C Part Q

Answer at the back of the book.

2. What carries sound along the ear canal?

   A Air that shakes

   B A nerve

   C Three tiny bones

   Answer at the back of the book.

3. Ravi cups his hand behind his ear. Sounds in front get louder. Why?

   A His hand makes the sound louder.

   B His hand does the hearing.

   C His hand helps collect more sound.

   Answer at the back of the book.

4. **From an earlier chapter**

   Why can sound not cross empty space, where there is no air?

   A Sound is too slow to cross it.

   B The cold stops the vibrating.

   C Sound is too quiet to hear across such a big space.

   D There is nothing to pass the vibration on.

   Answer at the back of the book.

5. Mei says the outer ear does the hearing. What is true?

   A She is right. The outer ear hears the sound.

   B The eardrum hears the sound.

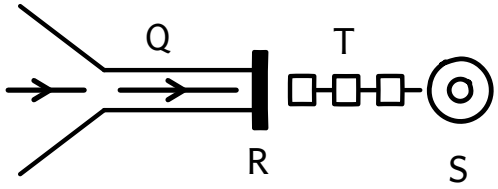
   C The outer ear only collects sound. Messages go to the brain.

   Answer at the back of the book.

6. Draw the way sound goes in. Write outer ear, ear canal and eardrum.

   Answer at the back of the book.

7. Look at the picture. Which part is the inner ear?



A Part T

B Part Q

C Part R

D Part S

Answer at the back of the book.

8. Sipho feels something stuck in his ear. What should he do?

A Ask a grown up or a health worker for help.

B Push a stick in to get it out.

C Leave it. It will come out by itself.

Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

The outer ear collects sound. It goes along the ear canal. The eardrum shakes. Tiny bones pass the shake on. A nerve sends messages to the brain.

Draw: A funnel and a tube with a thick bar at the end. Write outer ear, ear canal and eardrum.

S2.7.8 CHAPTER 8

Noise and our ears

Can a noise harm my ears if it does not hurt?

YOUR GUESS

Pick one before you read on. It is fine to be wrong.

- ☐ **A** No. If it does not hurt, it is safe.
- ☐ **B** No. Ears always get better by themselves.
- ☐ **C** Only old people can lose their hearing.
- ☐ **D** Yes. Loud noise can harm hearing with no pain.

BY THE END YOU CAN

- Test which materials muffle sound best
- Explain how loud noise can harm hearing and how to protect it

Some noises are too loud. We want them quieter. How can we do that?

To **muffle** a sound is to make it quieter. You put something round the thing that makes it.

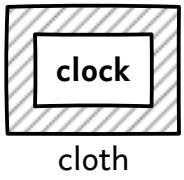
Some things muffle sound better than others. Here is how to test them.

DRAW IT FIRST

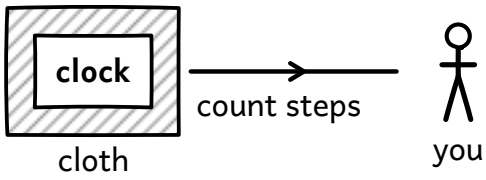
Draw the muffling test



1 Draw a box for the clock. Write clock.



2 Draw a thick wrap round the clock. Write cloth.



3 Draw yourself some way off. Draw an arrow to you. Write count steps.

TRY IT

Which material muffles best?

You need: a ticking clock, or a phone playing a steady alarm, a sheet of paper, a thin cloth, a thick towel, a long clear path.

Be safe: Do not wrap anything that gets warm. Never wrap a phone that is charging. If a phone feels warm, unwrap it at once.

1. Put the clock on the ground. Start close to it.
2. Walk away in a straight line. Stop when you cannot hear it. Count your steps.
3. Wrap the clock in paper. Put it in the same place. Do the walk again.
4. Do the same with the thin cloth. Then do it with the thick towel.
5. Which wrap gave the fewest steps? That wrap muffled best.

What you will see: The table shows example numbers. Yours will differ. Thick, soft, fluffy things should give you the fewest steps. Thin paper changes little.

If you cannot try it, this is what happens.

Wrapped in	Steps
nothing	10
paper	8
thin cloth	5
thick towel	2

Thick, soft, fluffy things muffle sound best. They take in the vibrations. Thin paper takes in very little.

Noise is sound we do not want. Some noise is very loud. Think of an engine, a machine or a firecracker.

Very loud noise can harm the tiny parts inside your ear. Your hearing can get worse for ever.

Harm can happen with no pain at all. Harm depends on how loud it is, and for how long.

Ringing in your ears after a noise is a warning. Your ears have had too much.

SEE IT THREE WAYS

As a picture

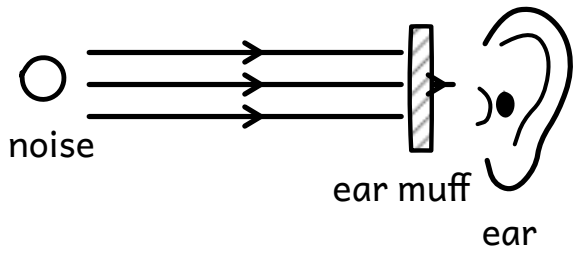
Sound	Can harm?
whisper	no
talking	no
loud engine near	yes
firecracker	yes

In words

A whisper and talking do not harm your ears. A loud engine near you can. A firecracker can.

Here is how to protect your ears. Move away from the noise. Cover your ears with your hands.

Use ear plugs if you are given them. Ear plugs and ear muffs muffle sound before it reaches the eardrum.



Ear muffs stop most of the noise before it reaches the ear.

Keep headphones turned low. If a friend beside you hears your music, turn it down.

Do this	Result
move away	less noise
cover ears	less sound in
ear plugs	muffled sound
music low	safer ears

Four ways to protect your ears.

Be safe. Never push anything into your ear canal, even to clean it. Never make a loud noise near anyone's ears.

A WRONG IDEA MANY PEOPLE HAVE

~~If a noise does not hurt, it cannot harm my hearing.~~

Why it feels right: When something hurts, we move away from it. So no pain feels like no danger.

The test that breaks it: Never test this with a loud noise. Ask an older person who worked near loud machines for years. Many say it never hurt. Many now hear less, and some hear ringing all the time.

What is true: Loud noise can harm hearing with no pain. Ringing is a warning. Protect your ears before the harm is done.

KEY WORDS

muffle
to make a sound quieter.

noise
sound we do not want. Some noise is very loud.

BACK TO YOUR GUESS

The answer is D: Yes. Loud noise can harm hearing with no pain.

Very loud noise can harm your hearing for ever. It can do it with no pain at all.

CHECK YOURSELF

Try each one before you look. A wrong answer tells you where to go next.

1. Which wrap muffles a sound best?

   A A sheet of paper

   B Nothing at all

   C A thick towel

   Answer at the back of the book.

2. Look at the table. Mei hears the clock from 10 steps with nothing round it. With the thick towel, how many steps fewer?

Wrapped in	Steps
nothing	10
paper	8
thin cloth	5
thick towel	2

   Answer at the back of the book.

3. Joseph's ears ring after a very loud noise. What does it mean?

   A It is a warning that his ears have had too much.

   B It is nothing, because it did not hurt.

   C His ears are getting stronger.

   Answer at the back of the book.

4. Which is a good way to protect your ears?

   A Turn your headphones up to hide the noise.

   B Move away from the noise.

   C Stay close, because it does not hurt.

   Answer at the back of the book.

5. **From an earlier chapter**

   Why must nothing be pushed into the ear canal?

   A The thin eardrum at the end can be hurt.

   B It is fine if you push gently.

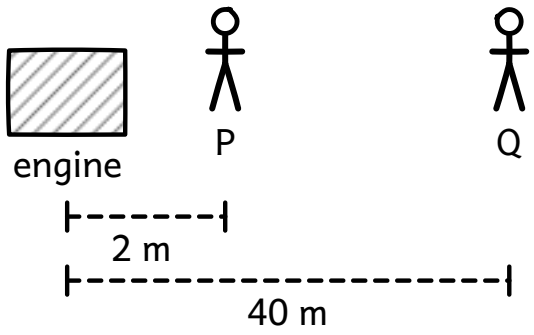
   C The tube leads straight to the brain.

   Answer at the back of the book.

6. Name three ways to protect your ears from loud noise.

   Answer at the back of the book.

7. Look at the picture. Both people stand by the engine for a long time. Whose ears are safer?



   A Person P, because ears get used to loud noise

   B Both are the same, because the noise does not hurt

   C Neither, because every noise harms ears

   D Person Q, who is further away

   Answer at the back of the book.

8. Diego hears a very loud noise often for years. What may happen to his hearing?

   A It always gets better by itself.

   B Only old people lose their hearing.

   C Nothing, if the noise never hurts.

   D It can get worse for ever.

   Answer at the back of the book.

9. Priya listens to music with headphones. A friend beside her can hear the music. What should she do?

   A Turn it up, so she hears it clearly.

   B Nothing, because music cannot harm ears.

   C Turn it down.

   Answer at the back of the book.

KEEP IT

Copy this into your exercise book.

Thick, soft things muffle sound best. Very loud noise can harm hearing for ever, with no pain. Ringing is a warning. Move away, cover your ears, keep headphones low.

Draw: A clock in a thick wrap, an arrow, and a person. Write count steps.

Key words, A to Z

Every key word in this book, what it means, and the chapter that teaches it.

ear canal
the tube that leads sound into the ear. S2.7.7

eardrum
thin skin at the end of the ear canal. It vibrates when sound reaches it. S2.7.7

echo
sound that bounces back from a hard surface. S2.7.3

empty space
a place with no air at all. Sound cannot travel there. S2.7.2

hard surface
a hard, flat face that bounces sound back, such as a wall. S2.7.3

inner ear
the part deep inside the ear. It sends messages along a nerve to the brain. S2.7.7

muffle
to make a sound quieter. S2.7.8

noise
sound we do not want. Some noise is very loud. S2.7.8

note
a steady sound you can sing or hum. S2.7.6

outer ear
the part of the ear you see. It collects sound. S2.7.7

pitch
how high or low a note is. S2.7.6

slack
loose, so it sags. S2.7.4

solid
keeps its own shape. S2.7.2

take in
to soak up sound instead of bouncing it back. S2.7.3

tight
pulled straight, with no sag. S2.7.4

vibrate
to move back and forth very fast. S2.7.1

vibration
the fast movement back and forth. S2.7.1

voice box
the part of your neck that vibrates when you talk. S2.7.1

volume
how loud or quiet a sound is. S2.7.5

Answers

S2.7.1. Sounds come from vibrations

1. **Something that vibrates**

   Every sound starts with a vibration. A drum skin, a string or a voice box all vibrate.

   - **If you chose A:** A still thing makes no sound. A sound starts when something moves back and forth.
   - **If you chose B:** Warmth does not make a sound. A vibration does.

2. **A buzz from my voice box**

   Your voice box vibrates when you hum. Your fingers feel the vibration.

   - **If you chose B:** Your voice box vibrates when you hum. Your fingers feel it.
   - **If you chose C:** No air comes out through the skin of your throat. The buzz you feel is your voice box.

3. **The sound makes the paper vibrate, and the paper shakes the rice.**

   The vibration is too fast to see. The rice grains show it.

   - **If you chose A:** The paper looks still, but it vibrates too fast to see. That moves the rice.
   - **If you chose C:** The rice did not make the sound. It was moved by the paper.

4. **It moves back and forth very fast. This makes a sound.**

   A plucked string vibrates. The vibration sends out sound.

5. **A string between two posts. Dashed lines show it bent up and bent down.**

   A string moves back and forth. The dashed lines show the two ends of its movement.

6. **It stops, because the skin cannot vibrate.**

   A sound lasts only while something vibrates. A hand on the skin stops the vibration.

   - **If you chose A:** Every sound needs a vibration. Hold the skin still and the sound stops.
   - **If you chose B:** His hand holds the skin still. A still skin cannot make a sound.
   - **If you chose C:** A hand does not store sound. The skin stops vibrating, so no sound is made.

7. **The free end, Q**

   The free end is not held, so it moves back and forth. That vibration makes the buzz.

   - **If you chose A:** The part pressed on the table is held still. It cannot move.
   - **If you chose B:** A solid can vibrate too. The free end moves up and down very fast.

8. **The string moving back and forth very fast**

   The string vibrates. It moves too fast to follow, so it looks blurred.

   - **If you chose B:** You cannot see sound. You see the string, which moves too fast to follow.
   - **If you chose C:** There is still one string. It moves so fast that it seems to be in many places.

S2.7.2. Sound travels

1. **Air, water and solids**

   Each bit of air, water or solid passes the vibration on. In empty space there is nothing to pass it on.

   - **If you chose A:** You hear most sounds through air. Sound also goes through water and through a table.
   - **If you chose C:** Empty space has no air. The vibration has nothing to pass it on.

2. **The table passes the vibration on better than air does.**

   A solid carries the vibration well. Her ear on the table gets more of it.

   - **If you chose A:** Sound does go through air. You hear it. The table just passes it on better.
   - **If you chose B:** The tap made the sound. The table only passes the vibration on.

3. **3 km**

   Sound goes about 1 km in 3 seconds. So divide the seconds by 3.

   - **If you chose B:** You used the number of seconds as the km. Divide the seconds by 3.
   - **If you chose C:** You multiplied the seconds by 3. Divide them by 3 instead.

4. **About 18 seconds**

   Sound takes about 3 seconds for each km. So 6 km takes about 3 × 6 = 18 seconds.

5. **There is no air to pass the vibration on.**

   Sound passes a vibration from one bit of matter to the next. In empty space there is nothing to do that.

6. **Vibrating**

   Every sound starts with something that vibrates. The skin is the drum's vibrating part.

   - **If you chose A:** A drum skin looks still. But it moves back and forth too fast to see. Go to S2.7.1.
   - **If you chose C:** Cooling has nothing to do with sound. A sound starts with a vibration. Go to S2.7.1.

7. **Iron**

   Iron has the biggest number. Of the three, sound goes fastest through iron.

   - **If you chose A:** Air has the smallest number. You hear most sounds through air, but sound is slowest there.
   - **If you chose B:** Water is faster than air, but iron has a bigger number still.
   - **If you chose C:** The numbers are not the same. Sound goes faster through some things than others.

8. **The ringing fades away, because the air has gone.**

   Sound needs air, water or a solid to pass it on. Take the air out and the sound fades.

   - **If you chose B:** Sound needs something to pass the vibration on. With no air, it cannot reach you.
   - **If you chose C:** The bell still shakes. But the air that carries the shake to you has gone.

S2.7.3. Echoes

1. **Sound that bounces back from a hard surface**

   The sound hits a hard surface and bounces back. You hear it a second time.

   - **If you chose A:** A quiet clap makes an echo too. An echo is about bouncing, not about loudness.
   - **If you chose B:** An echo is your own sound coming back. No second person is needed.

2. **A small room with thick curtains and cushions**

   Soft things take in sound. Less sound bounces back, so there are fewer echoes.

   - **If you chose B:** Hard walls bounce sound back. This room has many echoes.
   - **If you chose C:** A hard roof bounces the sound back down. A high roof can even give a later echo. Soft things take sound in.

3. **1 second**

   The sound goes 170 metres there and 170 metres back. That is 340 metres. At 340 metres each second, it takes 1 second.

   - **If you chose A:** That is the time to reach the wall. The sound must come back too.
   - **If you chose C:** You may have divided 340 by 170. Divide the whole trip, 340 metres, by 340 metres each second.

4. **The echo comes back so fast that it joins the clap.**

   A separate echo needs a wall about 17 m away or more. A near wall gives an echo that joins the sound.

   - **If you chose A:** It does bounce sound. The echo is there, but it joins the clap.
   - **If you chose B:** A quiet clap makes an echo too. Here the echo comes back too fast to hear apart.

5. **It makes clicks and listens for the echoes.**

   The clicks bounce off the fish and come back as echoes. The dolphin hears where the fish are.

   - **If you chose A:** The dolphin sends out its own clicks. The echoes from the fish tell it where they are.
   - **If you chose B:** A dolphin does not make light. It uses sound and echoes.
   - **If you chose C:** A dolphin does not find fish by smell. It sends out clicks and listens for echoes.

6. **Yes. Sound travels through water.**

   A vibration can pass through water. It goes faster there than in air.

   - **If you chose A:** Sound also goes through water and solids. It goes faster in water than in air. Go to S2.7.2.

7. **All bats can see. Many also use echoes in the dark.**

   Bats are not blind. Many use squeaks and echoes to find insects.

   - **If you chose B:** No bat is blind. Every kind has eyes that work.
   - **If you chose C:** Echoes work well in the dark. That is when most bats hunt.

S2.7.4. A string telephone

1. **A tight string can pass the vibration along.**

   The vibration runs along a tight string. A slack string soaks it up.

   - **If you chose A:** No sound runs inside the string. The string vibrates. A slack string soaks up the vibration.
   - **If you chose B:** A slack string still holds the cups. It just does not carry the vibration.
   - **If you chose C:** A tight string does not change your voice. It only passes the vibration along.

2. **The tight string vibrates.**

   The cup bottom shakes the string. Then the string shakes the far cup.

   - **If you chose B:** The vibration must pass along the string first. The far cup shakes last.
   - **If you chose C:** The string does not fill up. It shakes and passes the shaking on.

3. **The string cannot vibrate where it is pressed.**

   A pinched or pressed string cannot shake. The vibration stops there.

   - **If you chose A:** A string does not store sound. It passes vibrations on, and a pressed place cannot shake.
   - **If you chose C:** Sound does go through solids like a tight string. The pressed place stops the vibration. Go to S2.7.2.

4. **Walk 3 metres further apart.**

   The string is 10 metres long. He is 7 metres away. 10 − 7 = 3, so he walks 3 metres further.

5. **It vibrates.**

   Your voice makes the air vibrate. The air makes the cup bottom vibrate.

   - **If you chose B:** It looks still, but it vibrates too fast to see. Every sound comes from a vibration. Go to S2.7.1.
   - **If you chose C:** Cooling has nothing to do with it. Your voice makes the cup bottom vibrate. Go to S2.7.1.

6. **Two cups joined by a tight string. Dashed lines show the string moving. An arrow goes from the first cup to the second.**

   The vibration starts at the first cup bottom. It runs along the tight string to the far cup.

7. **The string buzzing, because it vibrates.**

   The string passes the sound on by vibrating. A light touch feels that buzz.

   - **If you chose A:** The sound does not run inside the string. The string itself shakes, and his fingers feel it.
   - **If you chose C:** A voice does not pull. It shakes the string, and he feels a buzz.

8. **Telephone P**

   The string of P is tight, so it passes the vibration on. The string of Q sags.

   - **If you chose A:** The string of Q sags. A slack string soaks up the vibration.
   - **If you chose B:** A string that sags soaks up the vibration. Only the straight string passes it on well.

S2.7.5. Loud and quiet

1. **The band moves further, and the sound is louder.**

   A bigger vibration makes a louder sound.

   - **If you chose A:** A louder sound comes from a bigger move. The band moves further.
   - **If you chose B:** A hard pluck makes a bigger move, not a higher note. The note stays the same.
   - **If you chose C:** A bigger move does not make a lower note. The note stays the same.

2. **Band P**

   P has the tall wave. A tall wave is a big vibration, so the sound is louder.

   - **If you chose A:** Both waves have the same number of bumps. But P is taller. Its vibration is bigger, so it is louder.
   - **If you chose C:** Q has a short wave. A short wave is a small vibration and a quiet sound.

3. **The sound spreads out over a bigger space.**

   The same sound is shared over more space. Each part gets less.

   - **If you chose B:** The bell rings the same. Ana moved, so the sound she gets is smaller.
   - **If you chose C:** The note stays the same. Only the volume gets smaller.

4. **The note**

   The size of the move changes the volume. It does not change the note.

   - **If you chose A:** The hard pluck is louder, so the volume changes.
   - **If you chose B:** A hard pluck moves the band further. That is why it is louder.

5. **Her throat shaking**

   Her voice box vibrates when she hums. That vibration makes the sound.

   - **If you chose A:** Every sound comes from something that vibrates. Her throat shakes when she hums. Go to S2.7.1.
   - **If you chose C:** Air alone does not buzz. The buzz is the voice box shaking. Go to S2.7.1.

6. **The quiet wave is short. The loud wave is tall. Both have the same number of bumps.**

   A bigger vibration makes a taller wave and a louder sound. The note does not change.

7. **Sipho, because the sound has not spread out as far.**

   Sipho is nearer. The sound is shared over less space there, so it is louder.

   - **If you chose B:** The bell rings the same, but the sound spreads out. Each part of it gets weaker with distance.
   - **If you chose C:** The sound does not grow. It spreads over more space, so each part gets less.

8. **Pluck it harder.**

   A harder pluck makes a bigger vibration. A bigger vibration makes a louder sound.

   - **If you chose A:** Plucking more often does not make one sound louder. A harder pluck does.
   - **If you chose B:** A tighter band shakes faster. That changes the note, not the volume.

S2.7.6. High and low notes

1. **It gets higher, because the band shakes faster.**

   A tight band shakes faster. Faster vibrations make a higher note.

   - **If you chose A:** A tighter band shakes faster, not slower. A faster shake makes a higher note.
   - **If you chose B:** A tighter band changes how fast it shakes. A louder sound needs a bigger pluck. Go to S2.7.5.

2. **Band Q**

   Q has more bumps in the same space. It shakes faster, so its note is higher.

   - **If you chose B:** P has fewer bumps. Fewer bumps means slower shakes and a lower note.
   - **If you chose C:** Both waves are the same height, so they are equally loud. But Q has more bumps, so its note is higher.

3. **The bottle with more water**

   More water is harder to shake. It shakes slower, so the note is lower.

   - **If you chose A:** Less water is lighter to shake. So tapping it gives the higher note. You may be thinking of blowing across the top.
   - **If you chose C:** The water changes how fast the bottle shakes. The two notes are different.

4. **The bottle with more water**

   More water leaves less air. Less air shakes faster, so the note is higher.

   - **If you chose A:** Less water leaves more air. A bigger space of air shakes slower, so the note is lower. You may be thinking of tapping.
   - **If you chose B:** The water changes how much air is left to shake. The two notes are different.
   - **If you chose C:** Blowing harder makes a louder sound, not a higher note. The air left in the bottle sets the note.

5. **It stays the same, and the sound is louder.**

   The size of the move changes the volume. How fast the band shakes changes the note.

   - **If you chose A:** A bigger move makes a louder sound, not a higher note. Go to S2.7.5.
   - **If you chose C:** A hard pluck does not change the note. It changes the volume. Go to S2.7.5.

6. **The low note wave has a few bumps. The high note wave has many bumps. Both are the same height.**

   A high note shakes faster. So more bumps fit in the same space.

7. **String Q**

   The short string shakes faster, so its note is higher.

   - **If you chose A:** More length makes a string shake more slowly. A long string gives a lower note.
   - **If you chose B:** Length changes how fast a string shakes. A short string shakes faster.

8. **The big drum**

   A big drum shakes more slowly than a small one. A slower shake gives a lower note.

   - **If you chose B:** A small drum shakes faster, so its note is higher. Big things shake more slowly.
   - **If you chose C:** Size changes how fast the skin shakes. The big drum shakes slower, so its note is lower.

S2.7.7. How we hear

1. **Part R**

   Part R is thin skin at the end of the ear canal. It vibrates when sound reaches it.

   - **If you chose A:** Part P is the wide funnel. It is the outer ear, and it collects sound.
   - **If you chose C:** Part Q is the tube. It is the ear canal. The eardrum is at its end.

2. **Air that shakes**

   Sound in the air is air that shakes. The shaking air goes along the canal to the eardrum.

   - **If you chose B:** The nerve is deeper in. It carries messages after the eardrum has shaken.
   - **If you chose C:** The tiny bones are behind the eardrum. The canal comes first.

3. **His hand helps collect more sound.**

   The cupped hand works like a bigger outer ear. More sound is led into the ear canal.

   - **If you chose A:** A hand makes no sound. It only collects more of the sound that is there.
   - **If you chose B:** The hand does not hear. It leads more sound to the outer ear.

4. **There is nothing to pass the vibration on.**

   Sound passes on through air, water and solids. Empty space has none of these.

   - **If you chose A:** Speed is not the reason. Sound needs air, water or a solid to pass it on. Go to S2.7.2.
   - **If you chose B:** Cold is not the reason. With no air, nothing carries the vibration. Go to S2.7.2.
   - **If you chose C:** Size is not the reason. Sound needs air, water or a solid to pass it on. Go to S2.7.2.

5. **The outer ear only collects sound. Messages go to the brain.**

   Sound shakes the eardrum and the bones. A nerve then sends messages to the brain.

   - **If you chose A:** The outer ear collects sound. Hearing happens when messages reach the brain.
   - **If you chose B:** The eardrum only vibrates. It passes the shake on.

6. **A wide funnel for the outer ear. A tube for the ear canal. A thick bar at the end for the eardrum. Arrows go in along the tube.**

   Sound goes in at the outer ear and along the canal. It makes the eardrum vibrate.

7. **Part S**

   Part S is the inner ear. It gets the shake from the tiny bones.

   - **If you chose A:** Part T is the three tiny bones. They pass the shake on to the inner ear.
   - **If you chose B:** Part Q is the ear canal. It leads sound to the eardrum.
   - **If you chose C:** Part R is the eardrum. It is thin skin at the end of the canal.

8. **Ask a grown up or a health worker for help.**

   The eardrum is thin and can be hurt. Never push anything into the ear. Ask for help.

   - **If you chose B:** Never push anything into your ear canal. The thin eardrum can be hurt.
   - **If you chose C:** Something stuck in an ear should not be left there. A grown up or health worker can take it out safely.

S2.7.8. Noise and our ears

1. **A thick towel**

   A thick, soft towel takes in the vibrations. You hear less of the sound.

   - **If you chose A:** Thin paper takes in very little sound. Thick, soft, fluffy things muffle best.
   - **If you chose B:** With nothing round the clock, nothing takes in the sound.

2. **8 steps**

   With nothing, it is 10 steps. With the thick towel, it is 2. So 8 steps fewer.

3. **It is a warning that his ears have had too much.**

   Ringing after a noise warns that it may have harmed his hearing.

   - **If you chose B:** Harm can happen with no pain. Ringing is the warning.
   - **If you chose C:** Loud noise does not make ears stronger. Ringing warns of harm.

4. **Move away from the noise.**

   Moving away makes the noise quieter by the time it reaches you.

   - **If you chose A:** That adds more noise to your ears. Keep headphones low.
   - **If you chose C:** Noise can harm with no pain. Move away.

5. **The thin eardrum at the end can be hurt.**

   The ear canal ends at the eardrum, which is thin skin.

   - **If you chose B:** Even gentle pushing can hurt the thin eardrum. Go to S2.7.7.
   - **If you chose C:** The canal ends at the eardrum. The tiny bones and inner ear are behind it. Go to S2.7.7.

6. **Move away. Cover your ears or use ear plugs. Keep headphones low.**

   Each one makes the noise quieter before it reaches your eardrum.

7. **Person Q, who is further away**

   The noise is quieter far from the engine. Q gets less of it, so Q's ears are safer.

   - **If you chose A:** Ears do not get used to it. Loud noise keeps harming them, and the harm can last for ever.
   - **If you chose B:** Harm can happen with no pain. The noise is louder near the engine. P is at more risk.
   - **If you chose C:** Quiet sounds do not harm ears. Very loud noise does, and moving away makes it quieter.

8. **It can get worse for ever.**

   Very loud noise can harm the inside of the ear for good.

   - **If you chose A:** Harm from very loud noise does not always heal. It can last for ever.
   - **If you chose B:** Loud noise can harm the hearing of anyone, young or old.
   - **If you chose C:** Harm can happen with no pain. That is why ears need care before it hurts.

9. **Turn it down.**

   If a friend can hear it, the music is too loud. Keep headphones low.

   - **If you chose A:** Louder music for a long time can harm hearing for good. Turn it down.
   - **If you chose B:** Loud music for a long time can harm hearing, with no pain.

About this book

For learners who can read short sentences and make a few sounds with things at home. In many schools this fits children of about 8 to 10, and older learners can use it too. Activities use rice, a tin or bowl, paper, cups, string, rubber bands and bottles of water. A learner can work alone: every exercise has its answer and the reason for it.

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This book is free. You may read it, print it, copy it and share it with anyone.

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