7L Answers

7L Sound

7La Making sounds

Student Book

1: 7La Animal sounds (Student Book)

L4 **1** **a** answers may include: talking, beeps at pedestrian crossings
b answers may include: car horns, reversing alarms
L4 **2** humming bird is quieter; humming bird makes noise with wings, not voice; humming bird is not making the noise deliberately
L4 **3** two of: talking/singing/humming; whistling; clapping; belching, passing wind
L4 **4** **a** make the strings vibrate
b use different strings/make the strings different lengths
c pluck the strings harder for louder notes
L4 **5** elephant – low notes are made when large objects vibrate; as an elephant is larger than a mouse, it should be able to make the lowest noises

2: 7La Making sounds (Student Book)

L3 **1** any four animals, such as: whales, lions, elephants, dogs
L4 **2** movements backwards and forwards
L5 **3** **a** 500 Hz **b** The sound will have a higher pitch.
L5 **4** The noise made by the bee hummingbird will have a higher pitch than the noise made by the giant hummingbird because the bee hummingbird's wings move at a higher frequency.
L4 **5** **a** Lower sounds are made when larger objects vibrate, so the one making the lowest sound is likely to be bigger than the other one.
L3 **b** It can hit its chest harder.
L4 **6** Listen to/find recordings of the sounds made by different animals and find the size of the animals. See if there is a link between the size of the animal and the pitch of the sound it makes.

Activity Pack

7La-1 Making sounds

L4 **1** **a** Vibrations
L3 **b** Volume
L3 **c** Pitch
L4 **d** Frequency
L4 **e** Hertz
L4 **f** Amplitude
L4 **2** **a** louder, amplitude, bigger
L4 **b** lower, longer
slowly, lower, lower

7La-2 Changing the pitch

L4 **1** air
L4 **2** The more water, the higher the sound (as there is less air to vibrate).
L4 **3** The same shape bottle, and blow the same way each time.
L4 **4** Longer nails should give lower sounds.
L4 **5** Longer chimes should give lower sounds.
L4 **6** drop all from the same height onto the same surface
L4 **7** Longer pieces of wood should make lower sounds.
L4 **8** Thicker bands should give lower sounds (although this depends on the tension being the same).
L4 **9** When the part of the ruler vibrating is longer, the sound is lower.
L4 **10** The longer the object vibrating, the lower the frequency and the lower the sound.

7La-3 Bird calls

L4 **1** **a** Either mass or length would be appropriate. Wingspan does depend on the 'size' of the bird to some extent, but some birds have long, thin wings whereas a different bird of similar mass might have shorter, deeper wings. So, wingspan does not necessarily indicate the overall size of the bird.
L4 **b** Length – bigger objects make lower sounds when they vibrate, so the length of the bird might indicate the possible length of the vocal folds (birds do not have quite the same mechanism as mammals, but students are not expected to know the details).
Mass – the larger the bird the heavier it is likely to be, so mass is also a reasonably good indicator of overall size.
L4 **c** Suggestions are likely to include taking the mid-point or finding an average.
L4 **2** **a** If pitch depends on size, there should be no birds in the top left and bottom right parts of the table. However this may depend on where students decide to draw the line between large and small birds, and between high and low pitch.
L4 **b** If pitch depends on size, the birds in the two columns will be in the same (or very similar) order.
L4 **3** *Students' own answers*. Suggest looking at birds of different sizes, and several birds for each size category.

L4 **4** Sample results based on the list of birds given on the worksheet. Note that in A results may vary depending on how the birds are divided into large and small, whereas in B rank order may vary as ranking the pitch of the calls is subjective, and may also depend on which recording is used.

A

	Large birds	**Small birds**
High pitch	heron, red kite, buzzard	wren, robin, swift, blackbird
Low pitch	raven, tawny owl	jackdaw

B

In order of size	**In order of pitch**	
wren	red kite	similar pitch
robin	robin	
swift	swift	similar pitch
blackbird	wren	
jackdaw	buzzard	
tawny owl	heron	
raven	blackbird	
red kite	jackdaw	
heron	raven	
buzzard	tawny owl	

L5 **5** Students are likely to find that the hypothesis is not correct – most small birds do have high-pitched calls, but larger birds can have high or low-pitched calls. (In particular, birds of prey often have high-pitched calls.)

L4 **6** Answers may depend on the particular birds investigated, but students should conclude that generally small birds have high-pitched calls, but larger birds can have high or low-pitched calls. Explanations for this could include that the vocal apparatus of a bird needs to be of a certain size to make low notes, but even a large bird can have smaller vocal apparatus/make higher sounds. Thus the lowest sound made by a bird is limited by its size, but not the highest sound.

L4–5 **7** Looking at the correlation between the head size (or throat size) of a bird rather than its overall size/mass would be more relevant.

7La-4 Octaves and frequency

L3 **1** High-pitched sounds are produced by objects that vibrate with a high frequency. Low-pitched sounds are produced by objects that vibrate with a low frequency. Examples of high-pitched sounds are those produced by a piccolo or a squeaking mouse. Examples of low-pitched sounds include thunder and the double bass.

L5 **2** The higher the frequency of the vibrations, the higher the pitch of the sound.

L5 **3 a** 256 Hz and 1024 Hz

L5 **b** 880 Hz and 220 Hz, respectively

L4 **4 a** any two instruments with overlapping frequencies such as flute and violin

L4 **b** examples include bass voice and soprano voice, piccolo and sitar

L4 **c** the harp

L4 **5 a** two octaves

L3 **b** 15 notes

L4 **c** air (and the wood)

7La-5 Cut out the cards

L5 **1** lion, gorilla

2 gorilla

3 grasshopper

4 lion, gorilla, grasshopper, canary

5 grasshopper, canary

6 lion, gorilla

7 pitch, frequency

8 amplitude, loudness, intensity, volume

9 frequency

10 amplitude

11 loudness, volume

12 frequency

7La-6 Describing sounds

L3–4 **1** Across: 3 – low; 5 – high; 6 – amplitude. Down: 1 – volume; 2 – frequency; 4 – pitch; 5 – hertz.

L3 **2 a** hit it harder

L4 **b** The amplitude is larger.

L4 **3 a** X will have a lower pitch.

L5 **b** Y

L5 **c** Shorter objects vibrate with higher frequencies.

7La-7 Different sounds

L4 **1 a** A, C and E

L4 **b** A, D and F

L4 **c** B, C and G

L4 **2** Each test needs to be a fair test, so the variable being investigated must be the only thing that is different between the tubes. So for **1 a**, the tubes are all the same material and same diameter, they only have different lengths.

L4 **3 a** The longer the tube, the lower the frequency (or the shorter the tube, the higher the frequency).

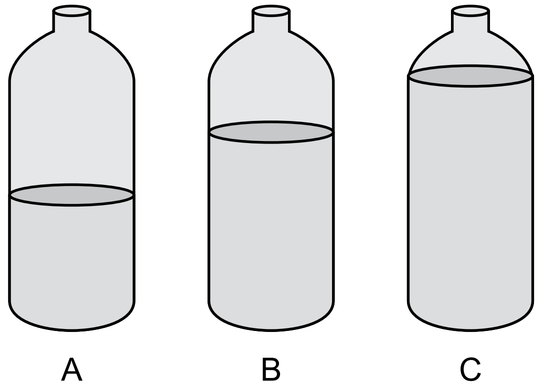
L4 **b** The diameter of the tube does not affect the frequency of the sound it makes.

L4 **c** The material of the tube does not affect the frequency of the sound it makes.

L5 **4** High frequencies make high-pitched notes, so the shortest tubes (A, D and F) will make the highest-pitched note.

L4 **5** Bottle X will make the highest note, because the length of air that can vibrate is shorter.

L4 **6** The exact levels of the water shown do not matter, as long as the relative amounts are correct. Order of notes: A, A, B, B, C, C, B



7La-8 Concert pitch

L4 **1** a group of musicians who play music together

L4 **2** The air inside the oboe makes 440 complete vibrations in one second. That is, the frequency of vibration is 440 Hz.

L4 **3** So that the instruments are playing the correct notes as written by the composer. Failure to do this would lead to the wrong notes being played and an incorrect reproduction of the intended music. It is also important that all the instruments are playing to the same standard, otherwise the music will sound discordant/unharmonic (accept 'not right'!).

L4 **4** The oboe is the instrument that holds its pitch most consistently.

L4 **a** stringed instruments, woodwind, brass and percussion

L4 **5** **b** Stringed instruments – vibrations of the strings, e.g. violins; woodwind – vibrations of air or a reed e.g. flute; brass – vibration of air, e.g. trombone; percussion – vibration of drum skin or vibration of metal, e.g. kettle drum.

L5 **c** percussion

L4 **6** **a** *Students' own responses* (e.g. tuba, bassoon, double bass)

L5 **b** All the instruments produce low-frequency sounds.

L4 **7** **a** French concert pitch in 1859

L4 **b** the audience's favourite concert pitch in 1859

L4 **c** the concert pitch used by Mozart and Handel

L4 **d** the London Philharmonic Orchestra concert pitch in 1896

L4 **e** concert pitch today.

L6 **8** *Students' own responses* (e.g. No, because they used science to work it out. Yes, because they were only trying to change it because existing pitch had been set by the French!)

7Lb Moving sounds

Student Book

1: 7Lb Moving sounds (Student Book)

L5 **1** In solids the particles are close together and held in a fixed arrangement by strong forces. In liquids the particles are close together and held by fairly strong forces but they can move around within the liquid. In gases the particles are a long way apart and can move around freely.

L5 **2** The sound passes through the air in one helmet then through the solid helmets to the air in the second helmet.

L5 **3** X, because the amplitude is greater/the particles are moving further as the wave passes

L6 **4** The particles are closer together so it is easier for the vibrations to be passed on.

L5 **5** **a** There is just one metal in the table and only two other solids. There are not enough examples here to be able to tell whether or not this statement is correct.

L4 **b** Find out the speed of sound in a lot of different metals and in a lot of different non-metallic solids.

L6–7 **6** Your hands/the cone make all the sound waves move in one direction, so they do not spread out as much and the sound will still be loud enough to hear at a greater distance L6. This means the energy is concentrated compared with shouting without the cone/hands, so the sound is louder at a given distance L7.

L5 **7** **a** The disturbance passes along it without the slinky itself moving as a whole, just as vibrations pass through materials without the medium as a whole moving; the vibrations are in the same direction as the wave is travelling, as for sound waves.

L6 **b** Answers may include: it is much larger than the particles that move as sound waves pass; the vibrations/disturbance moves much more slowly than in sound waves; the vibrations are bigger than the vibrations that form sound waves; particles are not rigidly connected to each other like the coils of the slinky.

2: 7Lb Line graphs and scatter graphs (Student Book)

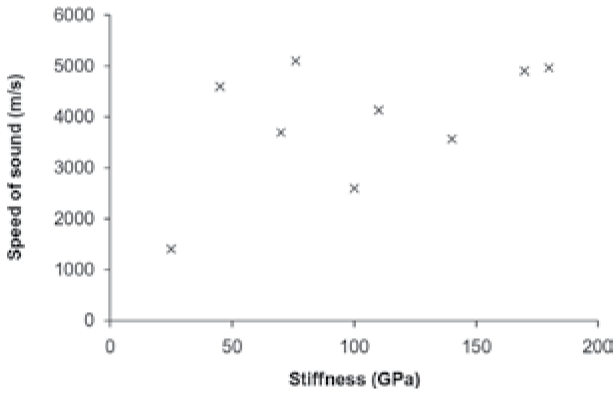
L4 **1** **a** The coil is in its original position. **b** 3 cm

L5 **2** The peaks and troughs would be at the same times but would be closer to the horizontal axis (i.e. have a smaller amplitude).

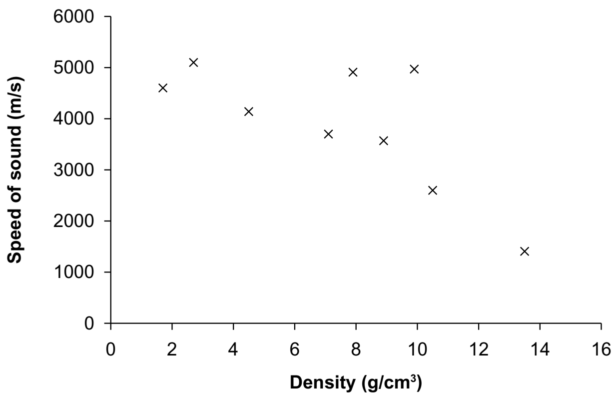
L4 **3** The speed increases as the temperature increases.

L5 **4** Students may have attempted to draw lines of best fit through the points.

a



b



L6 **5** **a** The graph of speed against stiffness shows that there is not a direct relationship (as there was with speed of sound in air and temperature), but that in general the speed of sound increases when the stiffness increases. The graph of speed against density also shows no direct relationship, although in general the greater the density the slower the speed.

L5 **b** Dave was correct, although it is not a simple relationship.

L4 **c** The graphs make it easier to see how the speed changes when the other variables change (or similar answers).

Activity Pack

7Lb-1 Moving sound

L4 **1** C where particles are closer together, F where particles are more spread out.

L4 **2** sound wave – vibrations passing through a solid, liquid or gas

medium – a substance (a solid, liquid or gas)

amplitude – the distance that particles move when a sound wave passes

frequency – the number of waves per second

L4 **3** energy

L3 **4** C, A

7Lb-2 Travelling sound 1

L4 Fill the gaps: wood, stethoscope, hear, gases

L4 Conclusion: solid, gas, solids, gases

7Lb-3 Travelling sound 2

L4 **8** The results do not say anything about the speed of sound, only about how loudly students can hear sounds transmitted through the different materials.

L5 7Lb-4 Particle revision

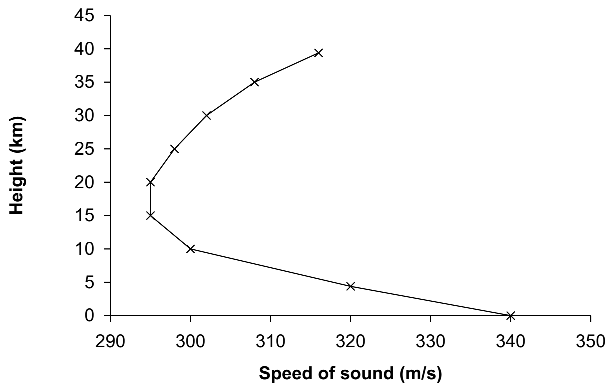
Solid: B, E, H, L

Liquid: A, G, I, K

Gas: C, D, F, J

7Lb-5 Speed of sound in the atmosphere

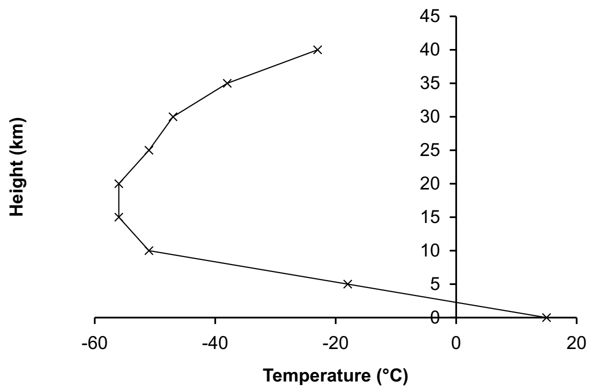
L4 **1** **a**



L4 **b** The speed of sound decreases as you go up to 15 km, then it stays the same to 20 km, and then it starts increasing again as you get higher.

L6 **2** The graphs are different shapes, so there probably is no link between density and the speed of sound.

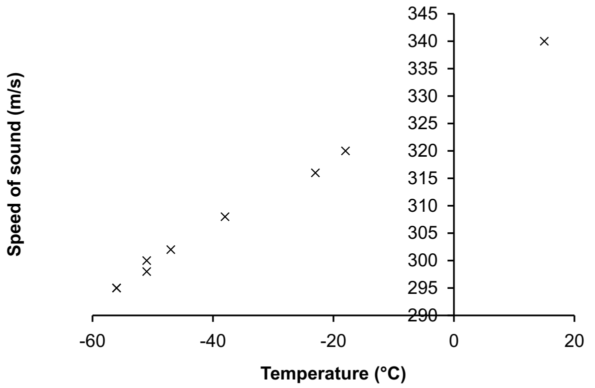
L4 **3**



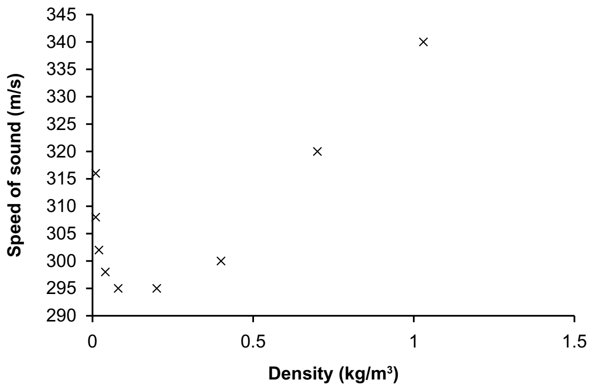
L5 **4** **a** The shapes are similar.

L5 **b** There may be a link between temperature and speed of sound.

L5 5 a



L5 b



L6 6 **a** Yes, as the points on the scatter graph are a straight line.
L6 **b** No, the points do not form a straight line.

7Lb-6 Sound on the move

L4 **1** Sound cannot travel in empty space/sound needs a medium to travel through.
L4 **2** The number of sound waves per second.
L5 **3** double-headed arrow showing particles vibrating in the same direction as wave motion
L3 **4** **a** C
L4 **b** They are closest to the starting gun.
L3 **c** C
L5 **d** Sound spreads out as it travels, so it will be quieter further away (or similar answer).
L4 **5** Flipper. Sound travels faster in water than in air.

7Lb-7 Measuring the speed of sound

L4 **1** The sound has to go from you to the wall and back again.
L5 **2** **a** the 2nd result, as it is an outlier
L5 **b** 0.3025 s
L5 **c** 100 m/0.3025 s = 330.6 m/s
L5 **3** any two reasons from: they may have had more (or less) accurate timing devices; seawater is denser than fresh water; seawater contains dissolved salts; the water in the sea and the lake might have been at different temperatures
L5 **4** time = 16 000 m/1435 m/s = 11.15 s
L6 **5** **a** time = distance/speed = 16 000 km/1500 m/s = 10.67 m/s
L6 **b** distance = 1500 m/s x 5 s = 7500 m (or 7.5 km)

7Lb-8 Mach number

L5 **1** subsonic – less than the speed of sound
supersonic – greater than the speed of sound
shock wave – a sudden change in the properties of the air
Mach number – the ratio between an object's speed relative to the air and the local speed of sound
L4 **2** It is calculated by dividing one speed by another speed, so the units cancel out.
L5 **3** **a** From the graph, speed of sound at 10 000 m = 300 m/s. Mach number = 247/300 = 0.82
L6 **b** At 5000 m the speed of sound is higher. Dividing 247 m/s by a higher speed will give a smaller Mach number (or similar explanation).
L6 **4** **a** The speed of sound changes with altitude, so it is important to use the speed at the same altitude as the aircraft.
L6 **b** The speed of an aircraft over the ground will depend on the speed of the wind as well as the speed of the aircraft through the air. As Mach number is used when considering how air flows around the aircraft, the speed relative to the air is the important value.
L6–7 **5** from graph, speed of sound at 20 000 m = 295 m/s; at 5000 m = 325 m/s
A: Mach 2 = speed of aircraft A/295 m/s so speed of aircraft A = 2 x 295 = 590 m/s
B: Mach 1.5 = speed of aircraft B/325 m/s, so speed of aircraft B = 1.5 x 325 m/s = 487.5 m/s
A is flying fastest relative to the air around it.

7Lc Detecting sounds

Student Book

1: 7Lc Detecting sounds (Student Book)

L4 **1** eardrum, bones, cochlea
L5 **2** **a** electrical signals that travel along nerves
b auditory nerve
L4 **3**

energy transferred by sound → ear → energy transferred by electricity (as nerve impulses)

L4 **4** Loud sounds can damage hearing.
L4–5 **5** Put an object such as a bell inside a box. Measure the sound intensity outside the box with different materials wrapped around the box/stuffed inside the box L4. Students may also explain how to make fair comparisons or suggest repeating the measurements L5.
L4 **6** **a** elephant
b all except owl and elephant
L4 **7** Owls can hear much quieter sounds than humans/their hearing is more sensitive; humans can

hear a greater frequency range than owls/humans can hear higher sounds than owls.

L5 **8** **a** Sound waves enter the ear canal and make the eardrum vibrate. These vibrations are amplified by the ear bones and passed to the cochlea. Tiny hairs in the cochlea detect the vibrations and create impulses which travel to the dog's brain along the auditory nerve.

b any suggestion between 21 000 Hz (21 kHz) and 45 000 Hz (45 kHz)

Activity Pack

7Lc-1 Detecting sound

L4 Labels on the ear, clockwise from top left: ear bones, auditory nerve, cochlea, eardrum, ear canal.
Microphone labels, clockwise from top right: wires, electronics, diaphragm

7Lc-4 Hearing – true or false?

L5 **1** True.
L4 **2** True.
L4 **3** False. The large ear flaps are mainly for cooling. You cannot tell how well an animal hears by the size of its ears.
L5 **4** False. It vibrates when sound waves reach it.
L4 **5** False. Soft/floppy/fluffy materials are good at absorbing sound.
L4 **6** True.
L4 **7** True.
L5 **8** False. The higher the number, the louder the sound.

7Lc-5 Decibel scale

L4–5 whisper – 10 dB, leaves rustling – 20 dB, bird singing – 40 dB, normal conversation – 50 dB, traffic – 70 dB, vacuum cleaner – 80 dB, motorcycle – 100 dB, front row at rock concert – 110 dB, military jet take-off – 130 dB

7Lc-6 Hearing loss

L5 **1** Temporary: A (wax can be removed); B (may go away on its own, or can be cured by draining the fluid); D (eardrum may repair itself); E (antibiotics can be used to cure infection).
Permanent: C (cochlea will not heal itself); D (eardrum may not repair itself); F and G (age-related deterioration is not going to fix itself).
L5 **2** A affects detection.
C affects conversion to electrical signals.
F affects amplification.
G affects transmission of signals to brain.
L5 **3** The liquid in glue ear replaces air in the space around the ear bones. Water resistance is greater than air resistance, and so it is harder for the bones to vibrate when surrounded by the liquid. This reduces the amplification of the vibrations.
L5 **4** As the aircraft ascends the pressure in the cabin falls. This means the air outside the eardrum is at lower pressure than the air behind the eardrum, so the eardrum is pushed out of shape. There is a tube (the Eustachian tube) that connects the back of the nose to the space behind the eardrum, and allows air to pass through it to equalise the pressure each side of the eardrum. Swallowing or sucking a sweet helps this process. When you have a cold the Eustachian tube may become blocked, which will prevent any changes of air pressure being equalised.

7Lc-7 Ears and noise

L4 **1** ear canal, eardrum, bones, cochlea
L5 **2** **a** eardrum
L5 **b** cochlea
L5 **c** bones
L5 **3** **a** Both contain a membrane that vibrates; or the eardrum is like the diaphragm; or both convert sound into electrical signals.
L5 **b** The ear produces nerve impulses; or the microphone produces current in a wire.
L4 **4** **a** elephant
L4 **b** dog, mouse
L4 **5** **a** any frequency between 67 and 1000 Hz
L4 **b** any frequency between 45 000 and 91 000 Hz
L4 **6** soft, fluffy materials

7Lc-8 Gardiner's frogs

L4 **1** They responded to recorded calls, so they must have been able to hear the recordings.
L4 **2** **a** answers could include: to attract mates, to mark a territory, to distract predators
L4 **b** Territorial or predator-distracting calls are not aimed at animals of the same species.
L4 **3** **a** tympanum
L4 **b** ear canal, ear drum, ear bones
L5 **4** **a** Within the middle ear the eardrum converts sound waves into vibrations and the bones amplify the vibrations.
L5 **b** Their skin will reflect most of the sound; or they do not have anything to amplify the sound.
L5 **c** They have thinner tissue between the inside of their mouth and their inner ear than other frog species; and their mouth helps to amplify the sound.
L4 **5** **a** protects them from damage
L4 **b** They help to direct sound into the ear canal.

7Lc-9 Owls and ears

L5 **1** Sound arrives at one ear before the other, and is also louder in that ear.
L6 **2** If their head is very small, the difference in arrival time and intensity between the two ears will also be very small, and may be too small to detect.

L6 **3** Part of locating a sound depends on a difference of arrival time. This is only detectable at the beginning of a sound. If the sound is continuous, such as humming, our direction finding has to rely on intensity differences alone.

L6 **4** **a** The sound is coming from below and right. It is louder in its left ear than its right, the sound is coming from somewhere below the owl. If the sound arrives at its right ear first, then it is to the right of the owl.

L6 **b** The sound will still arrive at the right ear first. It will also be louder in the right ear than the left ear.

L5 **5** By pointing the external ears in different directions it allows the animal to detect prey/predators without moving their heads.

L6 **6** The face acts a bit like a satellite dish, to guide the sound into the ear openings.

7Ld Using sound

Student Book

1: 7Ld Using sound (Student Book)

L3 **1** *Students' own answers*, e.g. asking for breakfast, talking to bus driver, talking to friends, asking teacher a question

L4 **2** warning calls, mating calls, territorial calls

L4 **3** makes tiny bubbles, which loosen dirt when they burst

L5 **4** so they only use their own sounds to help them to navigate/find prey; if they detected another bat's calls by mistake, they could not use it to locate objects

L5 **5** It has detected two objects at different depths (either two groups of fish or fish and the sea bed). The equipment can work out how deep each object is.

L5 **6** **a** Detecting ultrasound lets them know when bats are hunting nearby. It is believed that producing ultrasound can lead to 'jamming' of the bat's sounds, making it more difficult for bats to find them.

b You could check the production of ultrasound by using equipment that can detect ultrasounds and listening while the moths are active. You could check detection by seeing if their behaviour changes when recordings of bats' ultrasounds are produced.

2: 7Ld Remembering (Student Book)

L5 **1** **a** The ear bones amplify the vibrations/make the vibrations bigger.

L4 **b** *Students' own answers*; the best will refer to bigger letters reminding them that the sound is 'bigger'

L4 **2** **a** mnemonic for (ear canal), ear drum, ear bones, cochlea, brain

L5 **b** *Students' own answers*; the flowchart is probably best, as it includes more information and there are two items beginning with 'e' so a mnemonic may not help students to put ear drum and ear bones in the right order

L4–5 **3** *Students' own answers*; the level of the response depends on the amount of detail included with correct links

L5 **4** flowchart similar to the following: dolphin produces ultrasound → sound waves travel outwards → some sound waves reflected by shark → dolphin detects reflected sound waves → dolphin's brain works out where shark is

L4 **5** *Students' own memory aid*; a concept map is likely to be the best option in this case, but students should use whatever method they feel happiest with.

Activity Pack

7Ld-1 Using sound

Humans and animals use sound … for communication.

Sound waves can be transmitted … through materials.

Some materials reflect … or absorb sound.

Energy transferred by sound waves … can be used to clean delicate objects.

Physiotherapists use energy transmitted by sound waves … to relieve pain.

Reflected sound is called … an echo.

Bats and dolphins find prey … using echolocation.

Sonar uses ultrasound … to find the depth of the sea.

7Ld-2 Investigating bats

L4 **1** They conducted experiments that showed that the bats could find their way around in total darkness and when their eyes had been removed or covered. However, when their ears were covered, the bats could no longer navigate, proving that it was their ears they used to find their way around.

L4 **2** **a** Jurine concluded that bats used their ears to navigate.

L4 **b** The bats could find their way around only when their ears were not blocked.

L3 **3** **a** by letter to their Society

L3 **b** email, Internet, journals, conferences, telephone, etc.

L4 **c** so they can learn about new findings, check each other's results and plan their own investigations

L5 **4** From a scientific point of view, Spallanzani's work was useful (although Jurine seems to have managed similar discoveries using hoods instead of blinding the animals). From an ethical perspective, students may state that it is wrong to harm bats by removing their eyes. (It is now against the law to harm bats in the UK.)

L6 **5** Equipment that could detect ultrasounds was not available until then.

L5 **6** Fruit bats (also called flying foxes) eat fruit or nectar and use a good sense of smell to help them to find food, so they do not need echolocation.

L6 **7** Many echolocating bats have specially shaped noses to help focus the sound; they have a muscle that separates their ear bones while they are emitting their ultrasounds which stops them being deafened by their own calls; they have specially shaped ears to help them to locate the direction of the echo.

7Ld-3 Dolphins and sound

L5 **1** The dolphins could still find their way around once their eyes had been covered.

L4 **2** nasal sacs

L5 **3** Dolphins can use ultrasound to find fish that are buried in sand without being able to see them.

L4 **4** If dolphins can see inside a shark's stomach, then they know if the shark will be hungry or not, based on whether the stomach is empty or full. Sharks eat dolphins, so if the reflected sound waves indicate that the stomach is empty, then the dolphins need to swim away.

L5 **5** Dolphins can use ultrasound to find objects in murky water or objects that are buried in mud. These objects would not be easily seen by humans.

L5 **6** *Students' own answers*, but they should be accompanied by reasoning.

7Ld-5 Uses of sound 1

L4 **2** absorbs – takes sound energy in and does not let it out again

transmits – lets energy pass through it

reflects – when waves bounce off something

echo – a sound that has reflected from something

L4 **3** A, because it transmits the least energy (accept absorbs the most energy).

L5 **4** echolocation, B, it reflects the most sound

L4 **5** dolphins

L4 **6** **a** Bats use ultrasounds, which we cannot hear.

L5 **b** so they can hunt in the dark

7Ld-6 Uses of sound 2

L4 **1** **a** absorb – takes in energy and does not let it out again

transmit – allows energy to pass through it

reflect – energy bounces off

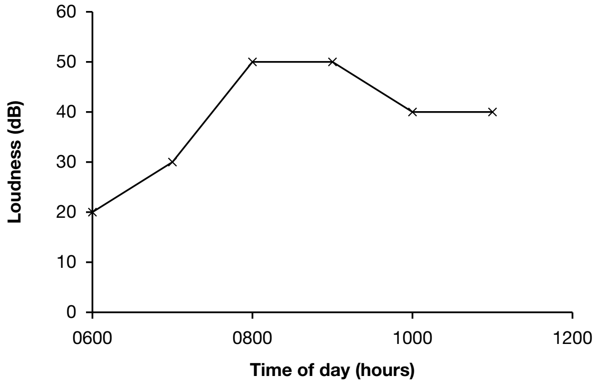
L4 **b** an echo

L4 **2** Material C absorbs 60%; Material A transmits 20%; Material B transmits 10%

L4 **3** **a** correctly drawn bar chart, with bars for the different materials clearly labelled, vertical axis labelled and bars correct lengths

L4 **b** It is easier to make comparisons (or similar sensible answer).

L5 **4** **a**



L4 **b** Material C, as it transmits the smallest amount of energy.

L4 **c** Any line with all points below the ones shown in part **a**.

L4 **5** **a** Bats use ultrasounds that we cannot hear.

L4 **b** so they can hunt in the dark

L5 **c** Material B, as it reflects the most energy.

L5 **6** It is used to find the depth of water or detect things in the water. Ultrasound pulses are sent out and the equipment detects the echoes. It works out the distance to the reflecting object using the time and the speed of sound in the medium.

L5 **7** for cleaning delicate items and in physiotherapy

7Ld-7 Mapping the deep

L6 **1** **a** If the weight continues to be lowered after it has touched the bottom, too much rope will be let out and the measurement will be deeper than the true value.

L6 **b** If the person lowering the weight thinks it has touched the bottom before it really has reached the bottom, then not enough line will have been let out and the measurement will be less than the true value.

L5 **2** If the ship is blown away, the rope will not be going vertically downwards, so there will be more rope let out than there should be and the measurement will be deeper than the true value.

L6 **3** **a** percentage = 3/300 x 100% = 1%

L6 **b** percentage = 3/5000 x 100% = 0.06%

L5 **4** The time for the echo will be shorter than for the true depth, and so the measured depth will be less than the true value.

L5 **5** **a** distance = speed x time = 1500 m/s x 0.4 s = 600 m, water depth = 300 m

(or time for half the journey = 0.2 s, depth = 1500 m/s x 0.2 s = 300 m)

L6 **b** The sound will have travelled further in the measured time, so the real depth will be greater than the measured depth.

L6 c actual distance travelled = 1550 x 0.4 s = 620 m, actual depth = 310 m

percentage error = 10/300 x 100% = 3.3%

L5 6 Speed of sound – for 300 m depth the percentage error from waves is much smaller than that from possible errors in the speed of sound.

L5 7 Some points that could be included in the answer: measurements at the surface will not necessarily provide information about the speed of sound at depth; measurements could be taken at various depths, but this could take a long time.

7Le Comparing waves

Student Book

1: 7Le Comparing waves (Student Book)

L5 **1** In a transverse wave the particles vibrate/move at right angles to the direction in which the wave is travelling. In a longitudinal wave the motion of the particles is along the same direction as the wave is travelling.

L5 **2** up and down

L4 **3 a** some of it is transferred to the water and it spreads out across the surface as waves

L5 **b** drop a heavier stone (as it will have more energy)

L6 **4** the duck furthest from the centre of the ripples; as the ripples spread out there is less energy in each section of wave, so the amplitude will get less

L6 **5** Students can choose either type as the best model but should provide reasons for their choice. These could be: slinky is better as it can model a longitudinal wave; water waves are better as they spread out from a source but the wave in a slinky only travels along the slinky.

L6 **6** Waves can be reflected by the cliffs, so they could be coming from the direction of the sea and from the direction of the cliffs. Some of the waves may be bigger because if the peaks of a wave from the sea and from the cliff occur together their effect will add up and make a bigger wave.

L6–7 **7** Sound waves get smaller faster. Sound waves spread out all around the source, but water waves only spread out along the surface of the water L6. The expanding sound waves form the surface of a sphere and the area of this surface depends on the radius squared. Expanding water waves form the circumference of a circle, whose length depends on the radius. So if the distance from a source is doubled, the intensity of a sound wave will be a quarter and the intensity of a water wave will be half L7.

2: 7Le Animals and noise (Student Book)

L4 **1** Noise makes it harder for birds to hear mating calls, so if some birds do not manage to find mates, then there will be fewer baby birds.

L5 **2 a** Bats use ultrasound to locate their prey. Noise may make it difficult for them to hear the echoes, or may mean they can only detect echoes from closer objects. This will make it more difficult for the bats to find food.

L4 **b** If they cannot find as much food, some bats may die or they may not be able to raise as many young.

L4 **3 a** The sonar sounds are made by a vibrating object. The vibrations spread out through the water as longitudinal waves.

b Sonar uses ultrasound. This is sound that is too high for humans to hear/above the auditory range of humans. Dolphins can hear a wider range of sounds than humans.

L4–5 **c** Dolphins use ultrasound for finding prey. The sonar noises may affect their ability to find prey, may be uncomfortably loud, or may frighten the dolphins so they leave the area. If they have to move away, this means they may have less time for feeding or may have to move to an area with less food.

Activity Pack

7Le-1 Comparing waves

L5 **1** Left-hand wave (from top): crest, amplitude, trough, transverse

Right-hand wave (from top): amplitude, longitudinal

L5 **2** transverse, at right angles, longitudinal, same

energy, water

amplitude, spreading

bigger, no

7Le-2 Spot the mistakes

L4–5 Sound is made by vibrating things. High notes have a high **frequency**, and low notes have a low **frequency**. The frequency is the number of waves per **second** and is measured in hertz. The higher the **amplitude** the more energy the wave is transferring.

Sound waves travel fastest through **solids** and slowest through **gases**. They do not travel at all in space, because space is a **vacuum**.

We hear using our ears. Sound waves make the **eardrum** vibrate, and these vibrations are passed on to the **ear bones** and then to the **cochlea**. Nerve impulses are sent to the brain.

Loud noises can damage our ears. The best materials for sound proofing are **soft, fluffy** materials.

Sounds that are too high for humans to hear are called **ultrasound**. Sounds that are too low for us to hear are called **infrasound**. Dolphins and bats can hear **ultrasound**, and they use this to find prey.

We can use the energy transferred by **ultrasound** in physiotherapy and for cleaning things. Sonar systems use echoes from the sea bed to work out the depth of the sea.

7Le-3 What kind of wave?

L4 **1** Because the particles move up and down (or backwards and forwards) from their initial position.
L5 **2** The graph does not say whether the movement is along the direction of travel of the wave (in which case it would be longitudinal) or at right angles to the direction of travel (in which case it would be transverse).
L5 **3** new line added with same frequency but larger amplitude
L5 **4** new line added with longer wavelength
L5 **5** Longitudinal – it is representing a sound wave, which is a longitudinal wave.
L5 **6** **a** The amplitude would be smaller.
L5 **b** The frequency would be less, or the wavelength would be greater.
L5 **7** It shows that the amplitude of the wave gets less as it travels away from its source.
L6 **8** The wave spreads out all around the source, so the energy is spread out more. Amplitude depends on energy, so the amplitude gets less.

7Le-4 Water and sound waves

L5 **1** **a** water
L4 **b** both
L5 **c** sound
L4 **d** sound
L4 **e** water
L4 **f** both
L4 **g** both
L4 **h** neither
L5 **i** sound
L5 **2** **a** another line drawn showing higher amplitude waves
L5 **b** The amplitude gets smaller.
L6 **3** **a** They make a bigger wave.
L6 **b** There is no wave.

7Le-5 Earthquakes and tsunamis 1

L5 **1** The P-wave. Sound waves are longitudinal waves, and so are P-waves.
L5 **2** **a** The S-wave is a transverse wave, and so are waves on the surface of water.
L5 **b** It is not like a water wave in that S-waves can travel through rocks in all directions, but the water waves only travel along the surface.
L5 **3** Up and down. P-waves travel faster than S-waves, so they will reach the building first. The particles in P-waves move along the same direction as the wave is travelling, so the building will move up and down/in the same direction as the wave is moving.
L4 **4** Sound waves travel much faster through solids than they do through air. The shaking is effectively a sound wave travelling through the rocks.
L5 **5** In Sumatra, because it was the closest place to the location of the earthquake.
L6 **6** Waves spread out as they travel away from their source, so the energy they carry is also spread out. The amplitude of a wave depends on the energy it is transferring, so the heights of the waves also get less as they get further from the source.

7Le-6 Earthquakes and tsunamis 2

L5 **1** The P-wave. Sound waves are longitudinal waves, and so are P-waves.
L5 **2** **a** The S-wave is a transverse wave, and so are waves on the surface of water.
L5 **b** It is not like a water wave in that S-waves can travel through rocks in all directions, but the water waves only travel along the surface.
L4 **3** **a** She heard the bang at the same time as she felt the shaking. If the vibrations causing the bang had come through the air from the location of the earthquake they would have arrived after the shaking, because sound waves travel much faster through solids/rock than they do through the air.
L4 **b** The vibrations travelled through the ground, and the vibrating ground made the air in the house vibrate, which was what Mrs Jones heard as the bang.
L5 **4** **a** 300 J/2 = 150 J/m
L5 **b** 300 J/3 = 100 J/m
L5 **5** In Sumatra, as that is the closest place.
L6 **6** The energy per metre of wave gets less as the wave gets further from the source, because the energy is spread out over a larger circumference. The amplitude of the wave depends on the energy, so the amplitude also gets less as the wave gets further away.
L6 **7** Answers may vary, but should include some of the following points: they are not spreading out freely; in this case, the waves started very close to a string of islands, so some energy might have been reflected; waves also occur on the oceans because of the wind, and this may have affected the size of the tsunami waves; waves may get channelled between islands; the shape of the sea bed might affect the way the waves travel.
L6 **8** **a** 5000 MJ/(2 x 2) = 1250 MJ
L6 **b** 5000 MJ/(3 x 3) = 555 MJ
L6 **9** The energy transfer by the earthquake waves reduces as the square of the distance away from the source.