GRADE 4: Physical processes 1

Sound

UNIT 4P.1
11 hours

About this unit

This unit is the first of two units on physical processes for Grade 4.

The unit is designed to guide your planning and teaching of lessons on physical processes. It provides a link between the standards for science and your lesson plans.

The teaching and learning activities should help you to plan the content and pace of lessons. Adapt the ideas to meet the needs of your class. For consolidation activities, look at the scheme of work for Grade 1.

You can also supplement the activities with appropriate tasks and exercises from your school's textbooks and other resources.

Introduce the unit to children by summarising what they will learn and how this builds on earlier work. Review the unit at the end, drawing out the main learning points, links to other work and 'real life' applications.

Previous learning

To meet the expectations of this unit, students should already know that we use our senses to detect sound and that we hear things with our ears. They should be able to use words to describe what things sound like and to name sound sources. They should be able to devise fair tests based on predictions, recognise when conclusions are justified and identify patterns in their observations. They should be able to collect and organise observations and data in tabular form and draw valid conclusions from them.

Expectations

By the end of the unit, students know that sound is a vibration and can vary in loudness and in pitch. They know that we hear sounds when they travel through the air to our ears, that having two ears helps us tell where a sound is coming from, and that there are sounds that are either too low or too high for us to hear. They know that loud sounds can damage the ears and that people who work where there is a lot of noise should wear ear protectors. They know that sound travels at a certain speed and explain the occurrence of echoes. They show that sounds can travel through liquids and solids as well as through gases such as air. They make observations and collect data systematically, and plan a fair test by deciding how to control variables. They construct and interpret two-way tables and handle more complex equipment correctly.

Students who progress further explain how sound travels to the ear and know why some materials can prevent sound reaching the ears. They explain how to change the loudness and pitch of a sound and how echoes work. They plan and conduct systematic controlled investigations and identify patterns in observations and draw generalised conclusions from them.

Resources

The main resources needed for this unit are:

- drum, 'ud, qanun, daff, castanets, xylophone, tablah , Pan pipes, nay, mijwiz
- tuning fork(s), containers, tins, elastic bands, table-tennis balls
- digital camera
- datalogger
- buzzers/ticking clocks
- foam sheeting, bubble wrap, woollen fabrics, newspaper, furry fabrics wide-necked bottles, string, wire, cotton thread, wool, tubing, metal tray

Key vocabulary and technical terms

Students should understand, use and spell correctly:

- *pitch*, *loudness*, *vibration*, *muffle*, *tuning*
- *quiet*, *soft*, *noise*, *sound*
- *loudness*, *loud*, *tension*, *tight*
- *sound insulator*, *material*
- *travel*, *reflect*
- *ears*

Standards for the unit

Unit 4P.1

11 hours	SUPPORTING STANDARDS	CORE STANDARDS Grade 4 standards	EXTENSION STANDARDS
6 hours **How sounds are made** **5 hours** **Hearing sounds**		4.15.1 Know that sound can vary in loudness and in pitch.	
		4.14.2 Know that sound is a vibration.	
	1.9.1 Use sense of hearing to detect sound.	4.15.3 Know that we hear sounds when they travel to our ears but that there are sounds that are either too low or too high for us to hear.	
	1.9.2 Know which organ we use to detect sound.	4.15.4 Know that having two ears helps us tell where a sound is coming from.	
	1.9.5 Name some common sources of … sound …	4.15.5 Know that loud sounds can damage the ears and that people who work where there is a lot of noise wear ear muffs to protect their ears.	
	1.9.6 Know that having two ears helps us to identify where a sound is coming from.	4.15.6 Demonstrate echoes and explain them in terms of the speed of sound.	
		4.15.7 Show that sounds can travel through liquids and solids as well as through the air.	
	3.1.1 Devise a fair test or comparison and recognise when conclusions are justified.	4.1.1 Outline a simple plan, deciding what evidence should be collected and what conclusions are justified, and collect relevant data and make observations in a systematic manner.	5.1.1 Plan investigations with an understanding of the importance of controlling variables and of collecting an appropriate range of evidence, observations and relevant data in a systematic manner.
	3.1.3 Make systematic observations and identify patterns.	4.1.2 Design a fair test by identifying key factors to vary.	5.1.2 Identify patterns in observations and data, draw appropriate, generalised conclusions and use the data to test predictions.
	3.2.2 Display data and observations in tables.	4.2.1 Construct and interpret two-way tables.	5.2.1 Use simple diagrams and charts to show relationships, chains and processes and to record observations and conclusions.
		4.3.2 Use a datalogger to collect data automatically.	5.2.2 Use ICT methods where appropriate to communicate observations, data and results.

<table>
<tr><th>Objectives</th><th>Possible teaching activities</th><th>Notes</th><th>School resources</th></tr>
<tr><td rowspan="2">6 hours
How sounds are made
Know that sound can vary in loudness and in pitch.
Know that sound is a vibration.</td><td>Take a tour of the school for a sound walk. Challenge students to walk around the school in silence and remember all the different sounds that they could hear for when they get back to the classroom. Ask them to think about what the sounds were like (e.g. loud, quiet, high, low). Back in the classroom, ask students either to tell you all the sounds they heard so that you can make a list, or to draw all of the objects that made the sounds on paper.

Ask students to complete the following table to classify likes and dislikes in relation to everyday sounds.
<table><tr><th>Sounds I like</th><th>Sounds I don’t like</th></tr><tr><td></td><td></td></tr></table>
Discuss why they like some sounds and not others.

Let the students listen to a sound tape and guess the sounds that they can hear.

Ask students how they think sound is made. Encourage them to talk to each other and then share their ideas with the rest of the class. Scribe their ideas and add them to a display in the classroom.</td><td>Many students do not like sounds that hurt their ears. This piece of work can be referred to later in the next part of this unit, relating to safety and hearing.

Sound tapes can be bought from toy shops or you could make one that includes sounds around the school, at home and from the Internet (e.g. jet planes)

Eliciting students’ ideas at the beginning of a topic is important. It also helps students to see how their ideas change as their learning develops.</td><td>Use this column to note your own school’s resources, e.g. textbooks, worksheets.</td></tr>
<tr><td>In the previous activity some students may have suggested that sound is made when something vibrates. This provides an ideal opportunity to focus on the link between sound and vibration.

Ask students to place their fingers across their throat and hum – they should be able to feel the vibrations as they make a noise.

Tell students that sound is made when something vibrates and use the following demonstrations to help develop this idea.
• Place rice on a drum; when the drum is struck, students will be able to see the rice jump because the skin vibrates. (This is also very useful for demonstrating that the louder the sound, the bigger the vibration because the rice jumps higher.)
• Give students an elastic band each and ask them to pluck it. Tell them to look at the vibration and listen to the sound.
• Tap a tuning fork on the side of a desk and then place the tip of the tuning fork gently against a student’s face – they should feel the vibrations of the tuning fork tingling against their cheek and also hear a faint humming sound.</td><td>Students will need many different examples of sound and vibrations. You can also ask them to make sounds using their hands, feet, etc.</td><td>Lesson plan 4.4 ‘Vibrations’</td></tr>
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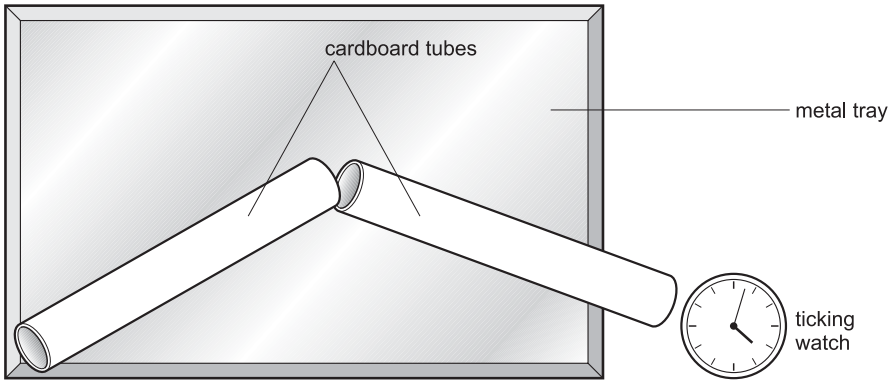
Objectives	Possible teaching activities	Notes	School resources
	• Tap a tuning fork on the side of a desk and then place the tip of the tuning fork in a container of water. The vibrations from the tuning fork will make some of the water splash out of the container. • Tap a tuning fork on the side of a desk and then place it next to a table-tennis ball hanging from a thread. As the tuning fork touches the table-tennis ball, the vibrations from the fork will move the ball. Discuss with students how sounds are made. The easiest approach is to bring in a collection of musical instruments and ask students how the sound is made, for example: • drum – hit, strike; • ‘ud – pluck; • qanun – pluck; • daff – shake, hit; • castanets – hit, bang things together; • xylophone – strike, hit; • tablah – strike, hit; • Pan pipes – blow; • nay – blow; • mijwiz – blow. If possible, invite a musician to show the instruments being played and explain how the musician makes the sound louder, quieter, lower and higher. Allow students to try out the instruments themselves and talk about how the sounds are made. Ask students to draw the instruments and write a sentence beside each drawing. Alternatively, let them take digital photographs and make a class *Big Book on Sound*.		
	Percussion instruments Either demonstrate using a drum, or let students use one themselves, so that they can see how the drum is changed to alter the sound. Show students that to make a louder sound the drum has to be hit harder, so that the vibrations are bigger (place some rice on the drum again to show the vibration). Show students that to make a quieter sound the drum has to be hit softly, so that the vibrations are smaller (place some rice on the drum again). Discuss with students the idea that some sounds are higher and lower – tell them this is called *pitch*. Ask students to make high sounds with their voices and low sounds with their voices. Then ask them to make a loud sound, then a quiet sound. Then, to ensure that they understand the difference between loudness and pitch, ask them to do the following: • make a low loud sound; • make a high quiet sound; • make a high loud sound; • make a low quiet sound.	Some students confuse higher with louder and quieter with lower pitch.	

Objectives	Possible teaching activities	Notes	School resources
	Show students how, when playing a drum, the pitch of the sound is changed by tightening the drum or making it more slack. Allow students to use a drum and change not only how loud they play it but also the pitch. Ask students to draw a picture, or take a digital photograph, of themselves playing a drum and ask them to write a sentence explaining the rule about: • making a loud sound (e.g. the harder you hit the drum, the louder the sound); • making a quiet sound (e.g. the softer you hit the drum, the quieter the sound); • making a high sound (e.g. the tighter the drum, the higher the sound (pitch)); • making a low sound (e.g. the slacker the drum, the lower the sound (pitch)).		
	Stringed instruments Ask students how they think stringed instruments work, and thinking about how drums work, how would a musician do the following: • make a loud sound; • make a quiet sound; • make a high sound; • make a low sound? Give students a tin or a box and some elastic bands to make a string instrument of their own. Challenge them to make different sounds using different elastic bands. Ask them to draw a picture of their instrument and write sentences explaining how to change the sound, for example: • Tightening the elastic band makes the sound higher. • Thick elastic bands make low sounds. Ask them to complete a table like the one below. **What I changed** | **What I think will happen (predict)** | **What happened** [ ] | [ ] | [ ]	An important aspect of sound that students should be able to explain is the relationship between what they do and the sound that is made.	

Objectives	Possible teaching activities	Notes	School resources
	Wind instruments Demonstrate how blowing across the top of a bottle containing water (glass bottles are best) can make a sound. Allow students to explore this activity and, as they try it themselves, find out what happens to the sound as more or less water is added to the bottle. Ask students to think about what they would have to do to change the pitch of the sound. Ask them to complete a table like the one below. <table><tr><th>What I changed</th><th>What I think will happen (predict)</th><th>What happened</th></tr><tr><td></td><td></td><td></td></tr></table> Show students other wind instruments and, if possible, allow them to try to make different sounds with them. Ask them to think about whether the column of air is short or long and how this relates to the sound being made.	**Safety:** Students must use glass bottles with care. Tell them that if any get broken they must not pick up the pieces but should tell an adult. It much easier for students to understand how percussion and stringed instruments work than how wind instruments work. In wind instruments students find it difficult to appreciate that it is the column of air that vibrates and that the longer the column of air, the lower the sound; the shorter the column of air the higher the sound. Many students think that it is the water in the glass bottle that is making the sound. In fact, the water only serves to lengthen or shorten the column of air in the bottle. However, if the bottle is tapped then the sound changes because of the size of the column of water.	
	Provide students with experiences to show that changing the material from which an instrument is made can also change the sound. For example, ask students to make a container drum and to place different materials over it (e.g. plastic, greaseproof paper, foil). Give students containers made of plastic, wood and metal and ask them to make container shakers by placing different kinds of objects (e.g. beads, feathers, pebbles, water or feathers) inside and note how these different materials change the sound their shakers make.	Containers such as washing-up bottles, soft drinks bottles, baby food tins, plastic food containers provide different effects for sound shakers.	
	This activity makes a very good finale to this topic on how sounds are made. Ask students to choose a story, nursery rhyme or a poem and to make sound effects to go with what they have chosen. Tell them they can use a range of materials, instruments, containers, etc., to make the sound effects. This provides a very good opportunity to find out whether students understand how to use a variety of instruments and materials to make different sounds. Give them a set amount of time to make their sound makers, practise their sound effects and then to perform in front of the rest of the class.	Take the opportunity to take digital photographs for the class *Big Book on Sound* and also to allow students to perform in front of a younger audience.	

Objectives	Possible teaching activities	Notes	School resources
5 hours **Hearing sounds** Know that we hear sounds when they travel to our ears but that there are sounds that are either too low or too high for us to hear. Know that having two ears helps us tell where a sound is coming from. Know that loud sounds can damage the ears and that people who work where there is a lot of noise wear ear muffs to protect their ears. Demonstrate echoes and explain them in terms of the speed of sound. Show that sounds can travel through liquids and solids as well as through the air. Outline a simple plan, deciding what evidence should be collected and what conclusions are justified, and collect relevant data and make observations in a systematic manner. Design a fair test by identifying key factors to vary. **[continued]**	Refer students back to discussion in the previous section about how sounds are made. Ask them to think about how they hear sounds, focusing on the idea that we hear sounds with our ears. Ask students to think about why we have two ears instead of just one. Ask one student to make a sound and tell the others to listen to it first using both ears and then using only one ear. Ask them 'What difference does it make? Can you hear the sounds better or less well with one or two ears.' Ask students to think about why our ears are on either side of our heads.	The focus is on the idea that the position of our ears and those of other animals helps us to hear things in the environment.	
	Explain to students that some sounds are too low or too high for humans to hear, and that other animals can hear sounds that we cannot. For example, snakes hear low sounds as do pigeons and elephants, while bats can hear high sounds. Ask students to find out information about animal ears and hearing at home and to bring information to school to put in a special class book.	Students could collect their information about animal ears and hearing and make a special class book. They could include photographs and sentences.	
	Get students to think about sounds that they do not like. Ask them: • What kinds of sounds are they? • Why don't you like them? • Which sounds hurt your ears? • Why do you think the sound hurts your ears? Ask students to draw the objects that make these sounds on paper and to write a sentence explaining why they do not like them, or you could write down their ideas for them. Explain to students that some sounds can be dangerous and that we must look after our ears. Ask them to think of places where the sounds are so loud that they could hurt their ears. Ask them also to think about people who work in environments where sounds are so loud that they need to protect their ears.	In explaining why some sounds are dangerous, refer back to the drum in the previous unit. If a sound is very loud, then the vibration will be very big. Tell them that sometimes it can be so big that it can hurt and even break something called the *eardrum* inside our ears. **Safety**: Explain to students that they should never place anything inside their ear or make a loud sound next to a person's ear.	
	Give students a buzzer and ask them if they think they would be able to hear it if it was, for example, covered by fabric, under water, on the other side of a door or wall. Activities such as this help students to appreciate that sound can travel through air, water and solids. Ask students how they know in everyday life that sound travels through air, water and solids. Give students buzzers and ask them to explore which kind of materials muffle the sound made by the buzzer. Introduce the words *sound insulator* and challenge students to classify materials according to whether they are good or poor sound insulators.	Introduce the idea that some materials muffle or stop sound from travelling and that materials that do this are called *sound insulators*. If students know about electrical insulators and heat insulators, draw comparisons to help students understand the term.	

Objectives	Possible teaching activities	Notes	School resources
[continued] Construct and interpret two-way tables. Use a datalogger to collect data automatically.	The following investigation helps to illustrate how sound can travel through different materials and that some materials are better than others. Show students how to make a simple string telephone. Get students to work in groups and ask different groups to investigate different things about the telephone; for example: • Which material is the best for making a telephone wire? (e.g. wire, string, cotton thread, wool.). • Is a thick wire better than a thin wire for making a telephone? Ask students to make a plan of what they will do. Tell them to think about: • which materials they think they should test; • how they will test the different materials; • what equipment they will need; • how they will test for soundproofing; • how they will make their test fair; • what they will measure; • how they will record their results – what their table will look like. When students have carried out their investigation, challenge them to consider their results and think about: • what their results tell them; • their conclusions; • why they think that some materials are better than others. Ask them which is the best container to use for a telephone (e.g. yoghurt pot, tin can, polystyrene cup).	**Safety:** If using food containers, make sure that they have been thoroughly washed and that sharp edges have been smoothed. If using wire, make sure that students do not walk or run into the wire. Telephones are easily made using two containers joined by a string or wire. If tin cans are used, a hole can be knocked through using a hammer and a nail, but rough edges inside the can must be smoothed to avoid students cutting themselves. Enquiry skills 4.1.1, 4.1.2, 4.2.1	
	Present students with the following problem to solve. Hassan works for a construction company and he often has to visit busy and very noisy building sites. He needs a new set of ear protectors, to make sure that his ears are not damaged by the loud noises of drills and other equipment. Please help Hassan by designing a set of ear protectors and testing the materials that would muffle or stop the sounds from getting to his ears. When you have finished, write him a letter or draw a poster explaining how you carried out your test and what your results were.	This activity offers the opportunity to carry out a fair test investigation; you should focus on the scientific enquiry standards indicated at the beginning of this unit. Enquiry skills 4.1.1, 4.1.2, 4.2.1, 4.3.2	

Objectives	Possible teaching activities	Notes	School resources
	Ask students to make a plan of what they will do. Tell them to think about: • which materials they think they should test; • how they will test the different materials; • what equipment they will need; • how they will test for soundproofing; • how they will make their test fair; • what they will measure (could they use a datalogger to take sound measurements?); • how they will record their results – what their table will look like. When students have carried out their investigation, challenge them to consider their results and think about: • what their results tell them; • their conclusions; • why they think that some materials are better than others.	**ICT opportunity:** In this activity students could use computer dataloggers – sound sensors could be used to record the level of sound coming from a box with a radio in it that is wrapped in different materials, such as paper, bubble wrap, foam sponge, tissue paper. Dataloggers would give students numerical readings, and some would also draw a graph.	
	Challenge students to create a safety poster about looking after our ears and protecting them from loud and dangerous sounds. Challenge students to find out what the speed of sound is and use their knowledge to explain why during a thunderstorm they see the lightning first before they hear the sound.		
	Demonstrate to students how echoes work. Allow them to try it for themselves, using two cardboard tubes, placed at an angle against a metal tray, with quiet sound source (e.g. a ticking watch) at the end of one of the tubes.  Ask students to try to explain what happens to the sound when the watch is ticking and why someone can hear the ticking at the end of the other tube. Ask students where they have heard echoes in everyday life. Encourage them to research echoes at home and bring information to school to place in the class *Big Book on Sound*.	This activity needs a ticking clock or watch or a small radio that is turned down low. In a noisy environment this activity has limited success, so students need to be quiet.	

	Examples of assessment tasks and questions	Notes	School resources
Assessment Set up activities that allow students to demonstrate what they have learned in this unit. The activities can be provided informally or formally during and at the end of the unit, or for homework. They can be selected from the teaching activities or can be new experiences. Choose tasks and questions from the examples to incorporate in the activities.	*Aisha was playing a drum. Explain how the sound is made. Use the words **vibration** and **sound** in your answer.*	The words *vibration* and *sound* are given to students to find out whether they can use the words appropriately.	
	If Aisha wanted to make the sound louder, what would she need to do? Would the vibration be bigger or smaller? *Aisha knows that if she wants to change the pitch of the drum she needs to tighten or loosen the drum skin. What would happen to the pitch of the sound if she tightened the skin? What would happen to the pitch of the sound if she loosened it?*	This could be an activity in which one student demonstrates and the others think about their explanations.	
	Why do humans have two ears and why are they at the side of the head?		
	Here is an elastic-band guitar. Demonstrate four different ways that you can change the sound the elastic-band guitar makes. As you demonstrate, explain what you are doing and how the sound changes.	Give students an elastic-band guitar. They could change the sound by, for example: • using different thickness of elastic band; • tightening the elastic bands; • loosening the elastic bands; • plucking them in different ways.	
	Roza and her group carried out an investigation into which material was best for sound proofing. They wrapped a ticking clock in a series of different materials in turn, and placed it inside a box each time. Here are their results. ***Material*** — ***Volume of sound recorded by computer sensor*** *Paper* — *6* *Cotton wool* — *2* *Aluminium foil* — *7* *Bubble wrap* — *1* a. *Which material was the best for sound proofing? How do you know? What is it about this material that makes it a good sound insulator?* b. *Which material was the worst for sound proofing? How do you know?* c. *What do you think Roza and her group did to make their test fair?*	This can be used to assess several abilities, for example: • to read data in a table; • to draw conclusions; • to suggest a fair test; • to explain why some materials are better sound insulators than others.	
	*Mahmood was under a bridge and he shouted his name and he heard his name echo back. Explain how the echo worked. Use these words in your explanation: **sound**, **travel**, **reflect**, **ears**.*	The words *sound*, *travel*, *reflect* and *ears* are given to students to find out whether they can use the words appropriately.	