

# Science lessons for Grade 4

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## Lessons in this section

### Life science

- 1 Seed dispersal
- 2 Micro-organisms and illness

### Earth and space

- 3 Investigating the length of shadows

### Physical processes

- 4 Vibrations

Resource sheets for the lessons

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## Using these lesson plans

These sample lessons for Grade 4 are suitable for use with a whole class. The lessons are single examples to illustrate different teaching and learning activities. They are not intended to be taught as a sequence. They are drawn from different topics and points in the teaching year to show spread rather than sequence.

The objectives for the lessons are drawn from the standards for Grade 4. The relevant standards are shown in the lesson plans.

The lesson plans indicate any safety issues relevant to the lessons. They also provide equipment lists and any short- and long-term preparation required by the lessons. Some of the plans include notes that provide additional information relevant to the teaching of the lesson that may not be readily accessible elsewhere.

Most of the lessons are organised in three parts: an introduction to the lesson, a main activity, and a final phase to help students to reflect on the lesson and consolidate their learning. As part of the introduction, you should outline the purpose of the lesson, drawing out for students what they will learn and how this builds on previous work. In the final part of the lesson, you will need to establish the key learning points, what students need to remember and what they will go on to learn next. There is no expectation that students should copy out the key learning points in their exercise books.

The lesson plans do not include homework tasks because the lessons are single examples taken out of sequence. You will need to provide this, since homework is an important part of a lesson.

Each lesson plan has enough material to support about 45 minutes of teaching. You may need to supplement the activities with simpler or more challenging tasks if the

students in your class have a range of attainment. You could choose from activities in textbooks or from your own resources. If you wish, different tasks can be given to different groups of students, according to their needs.

For some classes there may be too much material in the lesson plan for 45 minutes. In this case, you could designate one of the activities in the lesson as homework, or carry it forward to the next lesson. Be selective about which activity to cut – it does not have to be the last one merely because it comes at the end.

Most lessons will involve the teaching of scientific enquiry standards as well content standards. One of lessons in this grade, lesson 4.3 ‘Investigating the length of shadows’, offers a good opportunity for this and also illustrates a procedure for assessing mastery of the skill of drawing a bar chart.

# 4.1

# Seed dispersal

## Objectives

- Illustrate ways in which seeds are dispersed.
- Record observations in diagrammatic form.

## Preparation

You may have to prepare for this lesson many months in advance by making a collection of seeds to illustrate various dispersal mechanisms. Such a collection can be built up over time and retained for use over several years. In addition to specimens you should also have available a wide range of illustrations of examples of seed dispersal seen in plants in Qatar and elsewhere. You will also need a portrayal of a plant in flower and in seed. At appropriate times of the year some of the work in this lesson could be done outdoors in the school grounds or area around the school. It could also form an activity on a field excursion. Appropriate arrangements will need to be made.

## Safety

In this lesson students will handle seeds and related plant structures. It is important that you know if any student is allergic to the materials you have selected for study and that you take appropriate action. Be aware that your students may have a nut allergy. Make sure that students wash their hands thoroughly after the activities.

## Introduction

### Vocabulary

flower  
fruit  
seed

### Resources

An apple, orange or other fruit  
Illustrations of plants in flower and seed

Start this lesson by showing students an apple or an orange (or some other fruit with seeds). Ask them if they like the fruit and if there are any parts that they do not like and throw away. They may respond that they do not like the seeds. At this point you should cut the fruit in half and expose the seeds. You should take out the seeds and show them to the class. Ask the class:

**Q What are these structures?**

**Q What is their purpose?**

Discuss students' answers and establish that the structures are the seeds of the plant and that if these seeds are planted they could grow into a new plant. Ask the class:

**Q What other plants have seeds?**

**Q What is their purpose?**

Collect students' knowledge of plants that have seeds and make a list of these on the board. You may wish to show and hand round examples of seeds that we eat, such as rice, peas and beans. You may also have to tell students that it is not just the fruits that we eat that have seeds. Show the class pictures of plants in flower and in seed. Get them to use this information and their experience to answer the following questions:

**Q What happens to the flowers of plants after they have bloomed?**

**Q What have you noticed about flowering plants after they have flowered?**

Discuss students' answers and explain that, after plants have flowered, part of the plant becomes a container for seeds. Some of these containers become fruits that we can eat. Make sure that they know that plants that flower in gardens and in the wild also produce seeds. Establish if any students have grown plants from seeds and if so get them to tell the class about this.

Now get the class to consider flowering plants growing in the wild and establish the idea of seed dispersal by asking questions such as:

**Q What happens to the seeds of plants that grow in the wild or in gardens?**

**Q What would happen if seeds fell from plants to the ground below?**

Discuss students' answers and explain that if all seeds fell to the ground beneath the parent plant and these seeds grew, then it could lead to overcrowding and/or depletion of soil nutrients or water, or alternatively the young growing plants could be overshadowed by the parent plant and not develop fully.

Bring the introduction to an end by declaring that in the lesson students are going to study ways in which seeds of flowering plants are spread.

## Main activity

### Vocabulary

flower  
seed

### Resources

Collection of specimens to illustrate seed dispersal  
Collection of illustrations depicting seed dispersal

### Activity 1 Determining mechanisms of seed dispersal

*Students should work in groups of about four.*

You should arrange the room so that there are as many 'stations' as groups, so that there is just one group at a time working at each station. Each station should have some specimens and illustrations depicting forms of seed dispersal. These should be labelled with the name of the plant or seed. As far as possible, the stations should be different. Each group should start at one station and on your instruction move to another station, until all groups have visited all the different stations. At each station students should examine and sketch the specimens and illustrations and decide on the mechanism of seed dispersal. Provide students with a table like the one below to record their decisions.

Dispersal mechanism	Examples
Wind	
Animal	
Explosive	
Water	

When students have completed their observations and sketches and filled in the table of dispersal mechanisms, gather the class together in a plenary and discuss their observations and decisions on dispersal mechanisms. Students should not be expected to have determined correctly all the mechanisms and it is important here that any errors are corrected and that students understand the relationship between structure and function. You could approach this by asking questions such as:

**Q Which seeds are dispersed by wind?**

**Q What structures help seeds to be dispersed by wind? (hairs, wings)**

**Q What seeds are dispersed by animals?**

**Q What structures help seeds to be dispersed by animals? (hooks, fruits)**

**Q What other ways are seeds dispersed? (water, explosive mechanisms)**

Try to involve as many students as possible and consolidate correct responses on the board using illustrations as appropriate.

## Activity 2 How are seeds dispersed?

*Students should work in groups of about four.*

For this activity, show the class a series of specimens or illustrations that they have not yet met (you could use a reference textbook) or write descriptions of seeds or fruits on the board. The idea here is that students should apply their new knowledge to determine the mechanism of seed dispersal by considering the structure of the seed or fruit. Students should discuss their responses in their groups. Ask each group to report their agreed dispersal mechanism for each specimen or illustration and to explain the reasons for their choice. Where groups disagree, you should encourage a reconsideration of the evidence.

Bring the activity to an end by reinforcing the main dispersal mechanisms and referring students to texts where they can find further illustrations and explanations. If possible, try to point to examples from Qatar.

### Consolidation

In the final section of the lesson ask a student to give a description (orally or by drawing on the board) of an imaginary seed. The rest of the class then has to determine how it is dispersed. This could be repeated several times.

### Other tasks

Students could be asked to make their own seed collection or to contribute to a class collection. If the class makes a collection, this could be added to the resources for use in future teaching.

### Summary for students

- Seeds are dispersed mostly by wind and by animals; some have explosive mechanisms and a few are dispersed by water.
- Seeds have structures that aid their dispersal.
- Seeds dispersed by wind have hairs or wings.
- Seeds dispersed by animals have hooks or are contained within fruits.

### Notes

This lesson should help students to record observations in diagrammatic form.

## 4.2

# Micro-organisms and illness

### Objectives

- Know that some micro-organisms can cause illness.
- Express results in the form of bar charts.

### Preparation

Gather photographs, drawings or other images that illustrate the symptoms of some illnesses caused by micro-organisms and find appropriate texts and reference books for students to use in the lesson. Access to the Internet would be of value to students, if that is possible, and news stories about micro-organisms causing illness would also be useful.

### Safety

There are no special safety issues related to this lesson but you need to be aware that some students may be sensitive to discussing illnesses that they or their relatives or friends have experienced.

### Introduction

#### Vocabulary

illness  
symptoms

#### Being ill

Start the lesson by asking if anyone has ever been ill. Go on to ask students to describe the symptoms of their illness and to suggest what made them unwell. Ask questions such as:

- Q Have any of you ever been unwell?
- Q Describe how it felt to be unwell?
- Q What helped you to get better?
- Q What do you think caused you to be unwell?

Try to collect answers from several students. Use the board to list the most common illnesses and draw up a bar chart of the most common illnesses experienced by the class. Make the point that illness is common and that, while being ill is unpleasant, people recover from most common illnesses and that this is often aided by medicine and good care. End this section of the lesson by telling the class that the rest of the lesson will be concerned with the causes of some illnesses.

### Main activity

#### Vocabulary

bacteria  
fungi  
infection  
micro-organism  
virus

#### Resources

Images of symptoms of illnesses caused by micro-organisms

### The unseen enemy

#### Activity 1 Micro-organisms

Explain to the class that some illnesses are caused by a malfunction of some of the organs in their body. An example would be diabetes, which is common in Qatar. Other examples are heart disease and cancer. Continue by explaining that other illnesses are caused by tiny organisms that get onto or into the body (infection). These organisms increase in number and disrupt the functioning of the body, often by producing poisons. Here it is important to indicate that these organisms are too small to be seen by the unaided eye and are called micro-organisms. It will be hard for students to visualise the size of micro-organisms; to help, ask them to make the smallest dot they can on a piece of paper and then guess how many micro-

organisms could fit onto the dot. They will be surprised to know that it could be as many as a million.

Ask the class if anyone has ever had a sore throat and if they were given medicine. Get respondents to tell the class how the medicine helped them. Continue by explaining that medicines can help in two ways: they relieve the symptoms of illness and they destroy the invading micro-organisms. There may be some students who have been ill and got better without needing to take any medication. It is important to make clear that in many cases the body is able to overcome illness without the use of medicine but that medicines help the natural process of recovery.

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### Activity 2 Symptoms of microbial invasion

In the next part of the lesson students should be given the opportunity to use resources to study the symptoms of various illnesses caused by micro-organisms. This might be done as a whole-class activity but may be better as small group project work. It is not the intention that students learn the symptoms of illnesses caused by specific organisms but that they gain an appreciation of the range of illnesses and symptoms. The Internet could also be used. The approach taken and the time devoted to this will depend on the resources available. Students should be encouraged to discuss the various symptoms and to appreciate the impact of micro-organisms on life.

A good way to end the main part of the lesson is to illustrate the three main forms of illness-causing micro-organisms – bacteria, fungi and viruses – and give examples of the illnesses they cause. A table such as the one below could form the focus for a class discussion.

Micro-organism	Fungus	Bacterium	Virus
Illness caused	athlete's foot ringworm	tonsillitis TB	flu polio common cold measles AIDS

Use the discussion to help students recognise that symptoms are specific to particular micro-organisms. You should end by telling students that science has helped to overcome many illnesses. Chemicals can kill fungi and bacteria that invade the body, and can also alleviate the symptoms of illness. People can now be protected from some serious illness caused by viruses (e.g. polio). Emphasise that protection is better than cure and that good hygiene, a balanced diet and a healthy life style are important in fighting infection by micro-organisms.

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### Consolidation

Ask a member of the class to come to the front and report on the symptoms of an illness that they have had or have learned about in the lesson. The class must then decide if it is caused by a micro-organism and suggest if this is a fungus, bacterium or virus. An alternative would be to write descriptions of symptoms on cards and ask volunteers to read these out. Repeat this several times with different students and different illnesses.

End the lesson by reinforcing the idea that a number of illnesses are caused by micro-organisms too small to be seen by the unaided eye but that many of these can be prevented and cured by appropriate medication.

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## Other tasks

As a homework activity students could find out what are the most common illnesses in their family and how these have been treated.

### Summary for students

- Some illnesses are caused by micro-organisms.
- Micro-organisms are too small to be seen by the unaided eye.
- Bacteria, fungi and viruses are types of micro-organism that cause illness.
- Infection by micro-organisms results in symptoms specific to the micro-organism.
- Science has led to the development of medicines to alleviate the symptoms of illness caused by micro-organisms and to provide cures and preventive measures.
- Good hygiene, a balanced diet and a healthy life style are important in fighting infection by micro-organisms.

## Notes

Students do not need to learn the names of specific micro-organisms.

## 4.3

# Investigating the length of shadows

### Objectives

- Know that shadow length and position change depending on the time of day.
- Make observations in a systematic manner.
- Express results in the form of a bar chart.

### Introduction

#### Vocabulary

Sun  
Earth  
shadow  
metre  
centimetre

#### Resources

Torch  
Globe  
Metre ruler or tape  
measure

This lesson is unusual. It starts in one period and is completed in another, one or two days later. In between, students carry out measurements on shadow length throughout a whole day. They could do it at home on a Saturday.

The two science enquiry skills are important objectives. Students must realise the importance of being systematic in making observations, which should be made exactly on the hour; the measurement should be accurate and checked by several people.

This lesson should start early in the morning.

Recall previous work on the causes of shadows and the causes of night and day. Use a globe and a torch to remind students of the positions of the Sun and the Earth.

#### Q How did you make shadows in sunlight?

Students will be able to answer this. They could do so by demonstrating shadows near the window if the sun is shining into the classroom.

#### Q Who can come and show us how night and day are caused?

Choose two students if there are no volunteers. They should demonstrate day and night with the globe and torch. Get others to help if they make mistakes. Ask some further questions to ensure they know that day and night are caused by the rotation of the Earth:

#### Q Does the Sun move during the day?

#### Q How does the Earth move during the day?

The class should now be asked for suggestions on how to measure the length of a shadow. First find out if they can use a metre ruler (recall Grade 2 work).

#### Q Who can show us how we measure how long something is?

Ask a volunteer to come and measure the length of an object such as a desk. Ask others to assist if necessary.

### Main activity

#### Resources (per group)

Several sticks  
Metre ruler or tape  
measure  
Watch

### Measuring the length of the shadow of a stick

*Students should work individually or in groups of two or three. Time: several sessions of around 5 minutes throughout the morning.*

Take the class outside to look at several sticks placed in the ground in the sun. If possible, take them outside very close to an exact hour early in the morning, so that they can continue to take measurements every hour on the hour.

**Q Where is the shadow of the stick?**

**Q Who will measure the shadow of a stick?**

**Q What time is it now?**

The class can watch while one student correctly demonstrates measuring the shadow length. Ask the class to help the volunteer, if necessary. Give more rulers or tape measures to other students so that many can measure shadow length.

Return to the classroom and write down the length of the shadow of each stick on the board or on a sheet of paper. Write down the time next to the length.

Prepare the groups for measuring and writing down the shadow length every hour. They will need a table in which they can write the results. Either photocopy one for them or help them make one in their books.

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Ask students to measure the length of the shadow of the same stick every hour, on the hour, and write the length and time in the table. Check, where possible, that they are doing it correctly.

A day later, after the measurements have been made, discuss with the class what is happening to the length of the shadow. Start with open questions, such as:

**Q What is happening to the length of the shadow during the day?**

If this does not provide a good answer, ask closed questions, such as:

**Q Does the shadow get longer or shorter during the morning?**

The answer will be that it gets shorter.

**Q Why does the shadow get shorter during the morning?**

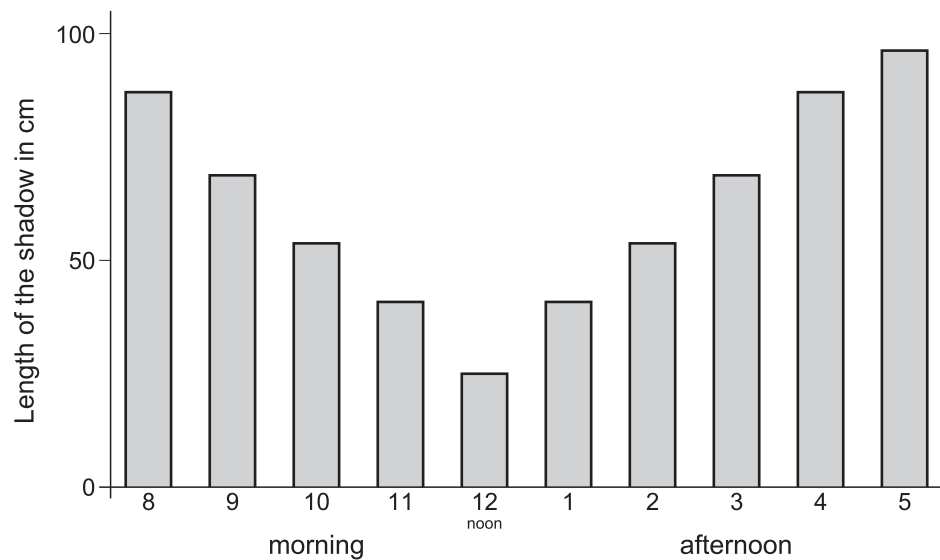
The answer will be that the Sun gets higher in the sky through the morning. Demonstrate this with a torch and a stick in the classroom. Move the torch to show the shadow getting shorter.

Set a task for Saturday at home. Take the same measurements but for a whole day. If the task is written down on a worksheet they can enlist the help of their parents.

## Consolidation

Later, after a full set of results has been obtained, call the class together. Ask students to make a block graph in their books of the shadow length during the day. They will need help with the scale – a good scale is one millimetre in their books for one centimetre of the real shadow. Have a set of results available for anyone who might not have done the homework for a good reason. The graph should look something like the figure opposite.

Ask students to show on their graphs when the Sun is highest in the sky and the two times when it is lowest in the sky. Put the two phrases on the board for them to copy. Circulate around the class and help those who find it difficult.



### Summary for students

- The shadow of a stick gets shorter when the Sun is higher in the sky and longer when the Sun is lower.

## Notes

### Assessing skills

This work involves a number of skills. Skills should be assessed from time to time. They should be assessed using clear assessment criteria that can be justified. It is not easy to write criteria for 10 marks; a simple method is to mark out of 5 and have defined criteria for 1, 3 and 5 marks. The intervening 2 or 4 marks can be awarded when there is doubt that the solution fully justifies the criteria for 3 or 5 marks. An example is shown below.

*Skill: Displaying results in a bar chart*

- |         |  |
|---------|--|
| 1 mark  | Some measurements represented accurately. No axes labelled.  |
| 3 marks | More than half the measurements accurately and neatly displayed. At least one axis correctly labelled. |
| 5 marks | All measurements displayed accurately and neatly. Both axes labelled.                                  |

# 4.4

# Vibrations

## Objectives

- Know that sound is a vibration.
- Know that sounds can vary in loudness and in pitch.

## Preparation

Collect objects, such as bottles, that can be used to make interesting sounds. Many of these will be needed, so you could ask students to collect them and bring them to school.

Find a musical instrument, such as a guitar, that can be used as a demonstration aid.

Borrow a drum or make one from a tin and a sheet of plastic or leather.

## Introduction

### Vocabulary

drum  
high  
hit  
loud  
low  
soft  
stroke

This is the opening lesson in the section on sound. Start with something to attract the attention of the class, such as playing a drum, or several drums of different pitch, softly and loudly (or asking one or two of the students to play them).

Encourage students to talk about the sounds and how they are made, asking questions to elicit words that describe the sound. Ask closed questions such as:

**Q Does the drum sound high or low? Does it sound loud or soft?**

Or ask open questions such as:

**Q What does the drum sound like? What kind of sound does the drum make?**

**Q Which drum made the highest sound? Why did it make the highest sound?**

Ask questions that elicit phrases that describe how the sound is made.

**Q How do we make the sound? What did we do to the drum? How did we make a loud / soft sound?**

## Main activity

### Resources

Rice grains  
Drum  
Guitar

## Show that sound is a vibration

### Activity 1 Studying the vibration of a drum skin or guitar string

*Teacher demonstration or work in large groups, depending on resources.*

*Time: about 10 minutes.*

Place some grains of rice on the drum skin and tap it gently. Watch what happens to the rice. What happens when the drum is tapped harder?

Place some small pieces of folded paper over a guitar string and pluck it. Watch what happens to the paper. What happens when the string is plucked harder?

Ask questions to elicit a description of what happened to the rice (or the paper) and to suggest reasons why it happened. Start with more open questions and move to more closed ones:

**Q What did the rice do when we hit the drum?**

**Q Did all the rice jump up?**

**Q Which rice jumped up highest?**

**Q Did the rice move once only or did it continue to move for a short time after we hit the drum?**

**Q Can you see the vibration without using the rice?**

This last question is important as it leads to activity 3 below.

**Resources (per group)**

Plastic ruler, 30 cm

**Activity 2 Studying the vibration of a plastic ruler**

*Students should work in groups of about four. Time: about 5 minutes.*

Hold the plastic ruler firmly against the desktop with about half of it protruding over the edge. Make the protruding bit vibrate by plucking it downwards. Change the length that is protruding and note the change in the sound when it is plucked.

Ask questions to draw out the fact that the longer the ruler, the lower the sound it makes and the slower it vibrates. Start by asking an open question and then ask closed ones if the answer is not clear:

**Q Why did the ruler make a sound?**

**Q How did the sound change when the ruler got shorter?**

**Q How did the vibration change when the ruler got shorter?**

From the two activities students should develop the following intuitive associations:

- small objects – high sounds – fast vibrations;
- large objects – low sounds – slow vibrations.

These are causal relationships: small objects cause high sounds by vibrating quickly; larger objects cause low sounds by vibrating slowly.

**Resources**

Bottles

Access to water

**Activity 3 Studying vibrations that we cannot see**

*Students should work in the same groups. Time: about 15–20 minutes.*

In this activity students study the sounds made by bottles containing varying amounts of water when they are struck. They should be allowed to experiment freely with different sizes of bottle and different amounts of water. Demonstrate briefly with one bottle. Give students enough time to investigate the effect of filling the bottles with water. They should not be given much guidance; allow them to find out as much as possible by themselves. You could, however encourage some to blow across the top of the bottle and listen to the sound made.

At the end of the session allow students to explain what they have found out. Make notes on the board of the more significant points. They may need helping questions such as:

**Q How did you make the bottle produce different sounds?**

**Q What happened to the sound when you put water in the bottles?**

**Q Did all sizes of bottle make the same sound?**

Follow lines of questioning that lead to the conclusion that putting water into the bottles made them produce higher notes. This is as far as most students can be taken but some might think back to the relationship ‘small object – higher note’ and be brought to realise that what is getting small is the ‘empty’ bit of the bottle. The smaller the column of air in the bottle, the higher the note.

Question them further but do not come to any conclusions at this stage:

**Q Was the sound caused by a vibration?**

**Q If we cannot see a vibration, does it mean that nothing is vibrating?**

Keep the bottles with water in them for more work later.

### Resources

Tuning fork  
Bowl of water

### Activity 4 More vibrations that we cannot see

*Teacher demonstration. Time: about 5 minutes.*

Make the tuning fork sound. Place it base-down on a hollow desk to amplify the sound. Ask whether it is vibrating. There will be various responses. An additional line of questioning might be to ask how we could find out whether it was vibrating and students might suggest a number of things that could be done to test this. Follow their leads if possible. They will be able to feel the vibrations (particularly if they put the end very carefully next to a sensitive part of their body, such as the back of their hand or their cheek (do not allow them to touch their lips or teeth with it for health reasons)).

Whether or not students suggest it, carefully place the ends of the fork next to the surface of the water in the bowl. The water will splash, showing that the fork was moving.

### Consolidation

Bring the class together and question them about the main conclusions from each activity. Summarise them on the board (see ‘Summary for students’ below):

Explain the word ‘cause’ in these sentences and say that scientists try to look for the causes of what they see or hear.

### Other tasks

#### Resources

String  
Tins  
Pipes of hollow wood or plastic  
Other objects that make sounds  
Resource 4.1

### A class band

Allow the class to experiment using different objects to make sounds in different ways, by hitting, stroking or plucking. Ask them to bring objects that make interesting sounds to school and encourage them to work together to play tunes on their objects.

### A sound crossword

Additional language exercises are useful when science is taught through the medium of English as a second language. **Resource 4.1** may be handed out near the end of the lesson and completed at home. Crosswords such as this can be generated quickly using software available online. Answers are given in the notes below.

### Summary for students

- Vibrating object *cause* sounds.
- Small objects vibrate faster than large ones.
- Faster vibrations *cause* higher sounds than slower ones.
- Some vibrations are too fast for us to see and they *cause* high sounds.
- The loudness of the sound depends on how hard the object is hit and how big the vibration is.

## Vibrating air columns

Many objects, such as the bottles, make a musical sound that is caused by the air column inside them vibrating. The note they produce always depends on the length of the column. A note the same pitch as ‘middle C’ on the piano is produced by a column about 80 cm long. Some bright students may realise that there is a numerical relationship between the height of the air column in a bottle and the note it produces; if the height of the column is halved, the note produced is an octave higher. The same rule applies to the note produced by a stretched string, as long as the tension in the string remains the same.

The column of air must be set vibrating somehow. Hitting the bottle is one way. Another way is to blow across the top of the bottle. This is how the sound is generated in the flute. Other wind instruments have a reed at one end of the column that is placed in the player’s mouth and made to vibrate. Trumpet players make the air column vibrate by pursing their lips in the mouthpiece of the instrument so that the air is set vibrating as it is squeezed through their lips. Many pipes and whistles have a strip of material, often metal, shaped to a sharp edge, that the air is forced onto to start it vibrating. No matter how the sound is made, the pitch of the note is determined by the length of the column of air inside the instrument.

### Crossword answers

#### *Down*

1 piano

2 pitch

4 vibration

5 bottles

6 guitar

#### *Across*

3 marimba

4 voicebox

7 ear

8 wire

9 skin

10 drum

