Science lessons for Grade 7

Lessons in this section

Using these lesson plans

These sample lessons for Grade 7 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 7. 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 60 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 60 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.

7.1 Food chains

Objectives

- Construct food chains.

Preparation

You will need some pictures of animals and some coloured paper.

Introduction

The source of food

Start this lesson by asking students what they have eaten recently. Ask:

Q When did you last eat?

Q What did you have to eat?

Q Where did it come from?

Clearly you will get a variety of answers and most students will report that their food came from shops and markets. A few may report that it came from farms or the sea or from gardens. The point that you want to establish here is that all the food they eat comes from animals or plants, directly or indirectly, and that the animals they eat also need food. Just as they eat plants and animals, so do other animals. By the end of the lesson they will know more about these feeding relationships.

Main activity

Vocabulary list

carnivore
consumer
food chain
herbivore
omnivore
predator
prey
primary
producer
scavenger
secondary
tertiary

Resources

Resource 7.1

What eats what?

Continue the lesson by showing pictures of some farm or wild animals or write their names on the board. Ask the class to give you the names of some other animals and tell you about what they eat:

Q Can you give me the names of some animals you know?

Q What do these animals eat?

Q What about animals we have in our country?

Q What do they eat?

Discuss the answers and use your own knowledge to divide the animals up into three groups: those that eat only plants, those that eat other animals or parts of other animals and those that eat both animals and plants. Concentrate on wild animals and distinguish between animals that hunt and kill other animals for food and those that eat animals or parts of animals that have died or been killed.

Q Does anyone know the names of these groups of animals?

Build on the answers from the class and introduce and define the terms *carnivore*, *herbivore* and *omnivore* and give an example of each. Ask students to note these.

Q Are all carnivores hunters?

Discuss the answers and the reasoning behind them. Remind the class that at one time humans were hunter-gatherers but we now farm animals. The only large-scale hunting of animals for food by humans is marine fishing. Much modern hunting is recreational. Introduce the terms *predator*, *prey* and *scavenger* to describe the carnivore relationships. Students need to make a note of these terms.

Energy flow

Present the class with five large cards on which are written one of the following terms: 'wheat plants', 'wheat grains', 'flour', 'bread' and 'student'. Ask for someone to place these in order and pin the ordered cards to the board. Ask the class:

Q Does anyone want to change the order?

If anyone does, then change the order until everyone is satisfied. Then ask:

Q Why do you all want the cards in this order?

Discuss the answers and develop the idea that the order from wheat to student represents a flow of energy from the plant to the person.

Now present a second set of cards with the words 'grass', 'cow', 'milk' and 'cheese' written on them and repeat the exercise. Again, the purpose is to establish that there is a flow of energy along the order.

Conclude this part of the lesson by writing the following words on the board and asking students to work individually to place them in order: 'bees', 'flowers', 'honey' and 'nectar'. Students should then pair up and compare their results.

This would be a good point to draw attention to the fact that all the orders of cards started with a green plant and that humans depend on green plants for their food.

Producers and consumers

More terminology now needs to be introduced. Students need to be given the words *producer* and *consumer*. These should be defined in terms of food production and consumption (*not* energy production). Starting at the bottom of the board, build up the diagram as shown below line-by-line, explaining what you are doing as you progress:

animals	tertiary producer	secondary consumer
animals	secondary producer	primary consumer
green plants	primary producer	

Ask students to copy the diagram and add further levels.

This part of the lesson should be concluded by adding the trophic levels to the above diagram.

Natural food chains

This part of the lesson uses a textbook example of a food chain but you should provide students with experience of constructing and interpreting additional food chains representative of feeding relationships between plants and animals in Qatar. Starting with plant leaves at the bottom of the board, draw the following food chain. Point out that the energy flow is upwards from the leaves to the hawk and that this is a standard way of presenting a food chain. The completed diagram should be the copied by students and should be the focus for interaction with the class. You should start by asking for students to come out and label the primary producer and the primary consumer. Other students could be asked to label the other trophic levels.

hawk

⇑

small mammal

⇑

beetle

⇑

plant leaves

You should ask questions about the effect of changes to the numbers of the organisms in the food chain and discuss the answers.

Q What would happen if all the hawks were poisoned?

You should discuss the impact of an increase in the small mammal population and the knock-on effects on the beetles.

Q What would happen if another organism preyed on the small mammals?

Here you will need to discuss the impact on the hawks and whether they would find another source of food or decrease in number as there would not be enough food to sustain them.

Q What would happen if a drought killed most of the plants that provided food for the beetles?

In discussing responses to this question, the fact that the plants are at the very bottom of the food chain is highly significant; anything that affects the plants will have an impact on all the organisms above them.

Q What would happen if a disease killed off half the beetle population?

Here it is important to discuss whether halving the beetle population would result in half the number of small mammals and half the number of hawks or if it would have little effect, as there would be less competition for food.

Discussion here should also highlight the sensitive nature of a food chain and to illustrate that one small change can have a large impact on several organisms.

Conclude the main part of the lesson by handing out **Resource 7.1** and asking students to construct their own food chains using the information provided on it.

Consolidation

Distribute some small pieces of paper of four different colours (e.g. green, blue, yellow and red), one to each student. Tell the holders of the green papers that they are primary producers, the blue that they are primary consumers, the yellow that they are secondary consumers and the red that they are tertiary consumers. Ask students to form themselves into a series of food chains. Get each person to declare what organism they represent. Discuss situations that form food chains and those that do not.

Other tasks

Additional food chain charts could be produced and students asked to interpret these.

As a homework activity, students could be asked to research the marine food chain of Qatar.

Summary for students

- Feeding relationships of organisms can be displayed in a food chain.
- Food chains start with a green plant as the primary producer.
- Animals are carnivores, herbivores or omnivores.
- Primary consumers eat plants and secondary and tertiary consumers eat animals.
- Predators hunt and kill their prey for food but scavengers feed on animals that are already dead.
- A change to the number of organisms in one part of a food chain affects all other organisms in the chain.

Notes

Answers to the questions on Resource 7.1 are as follows.

Habitat 1

microscopic plants ⇒ water fleas ⇒ small fish ⇒ big carnivorous fish

or

microscopic plants ⇒ water fleas ⇒ big carnivorous fish

If the big fish decrease in number the small fish could increase in number and/or the remaining big fish could get even bigger.

Habitat 2

grass ⇒ rabbits ⇒ hawk

The producer will be destroyed and the rabbits and hawk will have to find another source of food if they are to survive.

Habitat 3

leaves ⇒ beetles ⇒ small shrews ⇒ owl

If a hawk were to prey on the small shrews, then there would be fewer for the owls and they would seek a new source of food and/or reduce in number. The fewer shrews would result in more beetles.

7.2 Moving particles

Objectives

- Know that solids remain the same volume and shape, that liquids remain the same volume but take up the shape of the container, and that gases expand to fill any container they are placed in.
- Explain, in terms of the particle model, a variety of common phenomena, such as the evaporation of a pool of water, thermal expansion, the compressibility of gases and the regular growth of crystals in a saturated solution.

Introduction

Vocabulary

attraction
boiling
condensing
evaporating
freezing
gas
kinetic energy
liquid
melting
solid
vibration

This is a consolidation lesson at the end of a series of lessons on the kinetic particle model of matter.

First question the class to remind students about evidence of how particles move in solids, liquids and gases. Start with a solid and recall an experiment that showed that a copper rod got longer when it was heated. Students should remember that as the copper particles were heated they vibrated more and needed more space (always refer to particles at this stage and not to atoms and molecules, which have not been properly defined yet).

Q What happened to the metal rod when we heated it?

Q Can you explain why it expanded?

Q How are the particles in the copper moving?

Secondly, ask the class about the movement of particles in a liquid and how the way they move can explain the properties of a liquid. The two important ideas here are that the particles can move around as well as vibrate but they remain attracted to each other and touching each other.

Q What happens to the particles in a liquid when we pour the liquid?

Q What happens to the volume of the liquid when we pour it?

Q How are the particles in a liquid moving?

Thirdly, recall blowing up a balloon (or repeat it) and ask the class about the movement of air particles in the balloon. The important ideas here are that the particles have enough energy (and so have a high velocity) to move independently of each other and that collisions with the inside of the balloon cause the balloon to expand and the rubber to be tightly stretched.

Q Why is the balloon rubber tight?

Q How are the air particles in the balloon moving?

Let the balloon go.

Q What is happening to the air particles in the balloon now?

Main activity

Simulating particles

Whole-class activity. Time: 10 minutes.

Ask half the class to come to an area cleared at the front. Tell them that they are particles in a block of ice and that you are going to do something to the ice. Tell them to form two rows of particles touching each other. Remind them that they are vibrating but not moving around. If they are not moving correctly, ask those remaining seated to advise them what they should be doing.

Now tell them that they are very cold (say –40ºC) but they are slowly warming up. Describe their temperature as it increases. Allow those seated to advise them on their movement.

Continue this process with statements such as:

Now you are at –5ºC.

Now you are at –1ºC.

Now you are at 0ºC.

You are still at 0ºC.

Now you in a beaker warming up: 20ºC; 30ºC …

Now I am tipping the beaker slightly.

Now I am heating the beaker more: 60; 70 …

Now I can see a little steam coming from the water: 80; 90 …

Now you are at 100ºC.

You are still at 100ºC.

Ask the group to return to their seats.

Ask if the particles' movements were always correct? The class will probably realise that there were mistakes.

Did the solid expand? Remind the particles that not all of them will 'melt' at the same time; some will start moving before the others. Were the liquid particles moving around but always within the same volume and in contact with each other? As the liquid was heated, only a few particles would 'evaporate', not all of them. At the boiling point not all the particles would leave the liquid at once.

Ask the other half of the class to come to the front and try to repeat the process without mistakes. The seated students can call out any mistakes.

Draw attention to an important distinction by asking questions such as:

Q What is the difference between evaporation and boiling?

Some students may be able to answer. If they do not, carefully explain that, at any temperature, some particles will have more energy than others and will be moving faster. A few will be moving fast enough to escape from the attraction of other particles in the liquid. When the liquid is heated at its boiling point, all the particles will get enough energy to escape.

Consolidation

Resources

Resource 7.2

Sit the class down and give out **Resource 7.2**. This contains questions asking students to explain some common observations in terms of particle movement. If necessary, they may complete it for homework.

Summary for students

- As solids are heated, their particles vibrate faster and require more room.
- When the solid melts to a liquid, the particles have enough energy to move around but they do not have enough energy to move apart.
- Some particles in a liquid are moving faster than others and they may have enough energy to leave the liquid. This causes the liquid to evaporate.
- Particles in a gas move around freely and randomly.
- Pressure in a balloon is caused by particles hitting the inside of the balloon.

7.3 Change in pH during neutralisation

Objectives

- Know that the pH scale is a measure of the acidity of an aqueous solution and that the pH of a solution can be determined by universal indicator colour changes.
- Know that acids and alkalis react with each other and that the process is called neutralisation.
- Plan investigations, controlling variables and collecting an appropriate range of evidence, identify patterns in observations and data, draw appropriate generalised conclusions and test predictions.
- Display data using appropriate graphical methods, such as diagrams, pie charts, bar charts and line graphs.

Preparation

Purchase a bottle of clear vinegar. Try the experiment before the lesson to determine the optimum size of a 'spatulaful' of lime to neutralise the vinegar completely in about 6–10 additions.

Safety

Safety spectacles should be worn.

Introduction

Resources

Vinegar
Test-tubes in a holder
Glass rod
pH paper
Sodium hydrogen carbonate

This is the final lesson in the Grade 7 unit on acidity as it builds on all the work covered in the standards on acidity in this grade. Question the class to recall the concepts of pH and neutralisation.

Q Do you remember what the pH of an acid like vinegar might be?

Someone will propose an answer of around three.

Q How can we test the vinegar to find out?

Someone will suggest using an indicator such as pH paper. Demonstrate it in front of the class.

Q What will happen to the pH of vinegar if we add a lot of alkali to it?

Someone should suggest that it will rise. Even if they do not, demonstrate it by adding a very small amount of sodium hydrogen carbonate, not enough to neutralise it. Test the pH, which will still be acidic.

Q Why has the pH not changed?

Someone will probably suggest that you have not used enough.

Q How much will I need?

Someone will suggest that you need quite a lot. Add more, enough to complete the neutralisation, and retest. The solution will have a pH of around 11 or 12.

Explain to students that they will now do the same experiment neutralising the vinegar with lime (or sodium hydrogen carbonate – but see below) but adding just a small bit at a time to find out how the pH changes during the neutralisation. You should refer to the substance to be added as 'lime' rather than 'calcium hydroxide' because at this stage the chemical name is confusing and meaningless to most students.

Main activity

Following the pH change during neutralisation

Resources

per group

- 50 cm^3 beaker
- Stirring rod
- Spatula
- Vinegar
- Water
- Lime (calcium hydroxide)
- pH paper

per student

- Graph paper
- Resource 7.3

Students should work in groups of up to four. Time: about 45 minutes.

Give out **Resource 7.3**. Demonstrate how to prepare the diluted vinegar, how to add the lime and how to test the pH by making a spot on the paper from a drop on the end of the stirring rod. Explain to students why they must not add too much lime each time and why they must add *the same amount* of lime each time.

Ask them to make a table in their books like the one on the sheet. This is individual work, not group work.

Circulate around the class to check that students are conducting the experiment with care and accuracy. In particular, ensure that the spatulafuls of lime they are using are the same size for each addition and that they are not too large (they should use the small end of a Nuffield spatula).

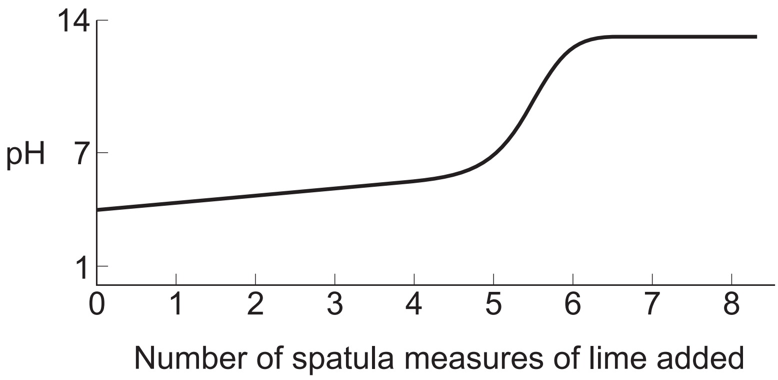
Ask groups to continue the experiment until the pH is around 12 and has been so for about three additions.

Give help where needed with the drawing of appropriate axes for the graph. This could be done, if necessary, by addressing the whole class and demonstrating on the board.

Assist, where necessary, with entering the points on the graph and joining them up appropriately. Discuss whether they should join up every point or whether they should construct a smooth curve following the general trend of the points. Explain how the latter will eliminate experimental error.

Consolidation

Bring the class together and construct a curve on the board using one set of results. It will be something like the plot shown below.



Ask questions that address the shape of the curve?

Q Why does the pH rise only slowly at first?

Q What happens between additions 5 and 6?

Q Why does the pH stay around 12 for the last three additions?

Q How many spatulas of lime will exactly neutralise the vinegar?

Students will give a variety of answers; direct them toward the correct ones, which are summarised in the box below. The last question above is a summary question to see if they have understood the process. The answer (in this experiment) is five and a half.

Ask a further general question:

Q Did anyone notice anything else that happened during the experiment?

Try to help explain any observations that students might make. For example, someone may say that the solution turned white. This is because the product of neutralisation (called calcium ethanoate) is insoluble. An important observation that someone might report is that the liquid in the beaker became warm. Discuss why this might happen. Refer them to earlier experiments involving combustion, which is a chemical reaction that gives out heat. Note that this neutralisation also gives out heat. (If sodium hydrogen carbonate is used instead of lime, there will be a slight cooling; this is one of the reasons why it is better to use calcium hydroxide for this experiment.)

Summary for students

- Vinegar is an acid that can be neutralised with an alkali such as lime.
- When the alkali is added, there is not much change in the pH because the added alkali is neutralised and the pH is that of the acid that remains.
- When all the acid has been neutralised, the pH rises rapidly to that of the excess alkali.
- Further addition of alkali does not change the pH much.

7.4 Geological timescale

Objectives

- Know that Earth's history can be conveniently divided into periods categorised by particular geological and climatic conditions and by the nature of the things that were living during the periods.
- Use secondary evidence and information selectively and critically.
- Use diagrams and pictures to communicate observations, data, results and conclusions.

Preparation

This lesson will require a long continuous sheet of paper that will be stuck to three sides of the classroom wall. This can be made by sticking together 45 sheets of A4 (landscape), or by using a roll of 45 paper towels, or it can be cut from a roll of unused newsprint. Newspaper publishers always have lengths of newsprint that are left on the end of a roll, which they often give to schools.

Introduction

Vocabulary

amphibian
bacteria
dinosaur
geological age
invertebrate
mammal
primate
reptile
timescale
vertebrate

The main purpose of this lesson is to provide a correct relative perspective of the age of the Earth compared with the relatively short time since the appearance of humans. It should also show that the dinosaurs, even though they died out, were an extremely successful group of animals, surviving for much longer than humans have been on Earth. Evidence for the geological timescale is not part of the lesson but some reference can be made to rock strata and fossils. Students will know about sedimentary rocks and that they contain fossil remains of plants and animals, including those that lived in the sea.

Start by questioning students about the age of things around them:

Q How old are you? How old is the oldest person that you know?

Q When was your grandfather / great-grandfather born?

Q How long ago did the earliest person you have ever heard of live?

Place these incidents on a timescale on the board. Introduce the idea of something that lived much further in the past using a picture or a model of a dinosaur.

Q When did animals like this (dinosaur) **live on the Earth?**

Q When did the dinosaurs die out?

Dinosaurs inhabited the Earth from around 240 million years ago until they became extinct around 65 million years ago.

Q Were there humans around at the time of the dinosaurs?

Many students may think that there were. There were not.

Q When did humans first appear on Earth?

The answer to this is about half a million years ago.

Ask the class to think about whether they could make a timescale on an ordinary sheet of paper that shows both the time when humans have inhabited the Earth and the time of the dinosaurs. They should realise that their own period will be so small at the end of the scale that it will be thinner than the last pencil line on the scale.

This should lead into the main activity, which is to create a geological timescale showing the full 4500 million years since the Earth was first formed.

Main activity

Resources

Roll of paper about 15 m long
Marker pens
Sheets of A4 paper
Access to books on fossils or to the Internet

Making a geological timescale display

Students should work in groups of up to four, each group with a set task. Time: 45 minutes. The lesson results in a display that can be added to over a period of weeks.

Plan this activity with the class. One group will make the geological timescale on a 15 m piece of paper, labelling it every 100 million years, working backwards from the present day, which is zero. Each 100 million years should take up about 33 cm (or one page of A4 landscape) so the total length of paper to cover 4500 million years is about 15 m. This group could divide the timescale into the eons, and the eras and periods for the Phanerozoic eon. (*Note:* These names are not necessary, but students often enjoy finding out these words and some, such as 'Jurassic', are well known. The two early eons could be combined and called 'pre-Cambrian'. See the notes below.)

The other groups will set their own tasks after looking at books about the fossil record or searching the Internet. They will each take a specific period in geological history and make a small display about it using secondary information. They must agree the period they will prepare a display about with you so that all groups are covering different periods. Displays may be about topics such as:

- the appearance of humans;
- the first mammals (or reptiles, amphibians, birds, fish, etc.);
- the first vertebrates;
- the time of the dinosaurs;
- the first flowering plants;
- the first plants;
- the first bacteria;
- the origins of the Qatar gas field;
- the last ice age;
- the formation of the Earth.

Add the displays to the timescale, using paper arrows to show the approximate period covered by each of them.

Consolidation

Bring the class together and ask each group to do a short presentation on their part of the display. Further additions to the display can be made over the subsequent weeks using pictures from the Internet, photographs of fossils, etc.

Other tasks

Faster students can be asked to find out about mass extinctions of life. Examples are at the end of the Cambrian, the end of the Permian (a massive extinction wiping out around 95% of all species) and the one that wiped out the dinosaurs at the end of the Jurassic period. Students should research evidence for what caused these extinctions.

Summary for students

- The geological timescale extends back around 4500 million years.
- The period in which humans have inhabited the Earth is very small compared with the age of the Earth – only about half a million years.
- The geological history of the Earth can be divided up into periods characterised by different kinds of life forms and we know about these life forms from fossils.
- The best-known life forms of the past are the dinosaurs, a very successful group of animals that populated the Earth from around 240 million years ago to about 65 million years ago.
- The Qatar gas field was formed from organisms that lived and died in the sea during the carboniferous period, which lasted for over 50 million years around 350 million years ago.

Notes

Geological periods

There are several different systems of classifying past geological periods. The best-known one, due originally to a geologist called Harland, is shown in the table below. The numbers are millions of years ago. Heavy lines mark the ends of eras.

Period	From	To
Quaternary	1.6	present
Tertiary	65	1.6
Cretaceous	144	65
Jurassic	205	144
Triassic	248	205
Permian	290	248
Carboniferous	360	290
Devonian	408	360
Silurian	440	408
Ordovician	510	440
Cambrian	570	510
Precambrian	4500	570