

Summary of students' performance by the end of Grade 4

Scientific enquiry

Students make observations and collect data systematically, plan a fair test by deciding how to control variables, and check and repeat observations to improve accuracy. They recognise when conclusions are justified. They construct and interpret two-way tables, bar charts and diagrams to communicate their results. They handle more complex equipment correctly, and measure length, temperature, mass and liquid volume accurately.

Life science

Students recognise the importance of identifying organisms correctly and use simple branching keys to do this. They know that habitats and their inhabitants are diverse and understand why habitats need to be protected. They know that life processes are internally regulated and can be disturbed by injury, illness and inappropriate actions. They recognise the main stages in the life histories of fish, amphibians, reptiles, birds, mammals and insects, and describe the main stages in the reproduction of flowering plants, including seed dispersion. They know the general effects of tobacco, alcohol and drugs on the body. They know that some micro-organisms can cause illness and that good hygiene offers protection against this.

Materials

Students know that there are three states of matter and that each has particular characteristics; they know that ice, water and steam are different forms of the same substance. They measure evaporation rates, identify examples of changes of state in everyday life and know that changes of state are reversible. Students recognise that air is a gaseous material and that it fills spaces between solids. They recognise that gases have mass, can flow and can change their volume. They know that there are many different gases and that many are important to us. They know that metals are an important class of materials and list some uses of common ones. They name the properties of metals that make them useful.

Earth and space

Students know that the Sun casts shadows and that the length of a shadow depends on the time of day; they use this knowledge to make a shadow clock. They investigate how people used to tell the time using sundials. They know the cause of day and night and that the spin of the Earth on its axis causes shadow length and position to change. They know that the Sun is a source of heat and light.

Physical processes

Students know the difference between heat and temperature, measure temperature accurately and know that the temperature of an object rises when it is heated. They know what causes an object to warm up or cool down. They know that some substances are better conductors of heat than others and compare the insulating properties of different materials. They 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.

The balance between scientific enquiry and the subject content strands

The science standards for Grade 4 are grouped into five strands: four content strands – life science, materials, Earth and space, and physical processes – and the scientific enquiry skills strand, which addresses the development of scientific practical and intellectual skills across all the content strands. The teaching of the enquiry skills strand should be an integral part of the teaching of the content strands.

Assessment weightings for Grade 4

There are three general assessment objectives for the science curriculum:

- knowledge and understanding;
- application of knowledge and understanding, analysis and evaluation of information;
- scientific enquiry skills and procedures.

The balance between these three general objectives will vary from grade to grade. As students’ scientific proficiency and experience develops, there should be a greater emphasis on the application of knowledge to solve problems in new situations.

For Grade 4, the weightings of the subject content strands are as follows:

	Life science	Materials	Earth and space	Physical processes
Assessment weighting	30 to 40%	25 to 35%	5 to 15%	30 to 40%

For Grade 4, the weightings of the assessment objectives to be applied to each content strand are as follows:

	Knowledge and understanding	Application, analysis and evaluation	Scientific enquiry skills and procedures
Assessment weighting	35 to 45%	20 to 30%	30 to 40%

Scientific enquiry

By the end of Grade 4, students make observations and collect data systematically, plan a fair test by deciding how to control variables, and check and repeat observations to improve accuracy. They recognise when conclusions are justified. They construct and interpret two-way tables, bar charts and diagrams to communicate their results. They handle more complex equipment correctly, and measure length, temperature, mass and liquid volume accurately.

Students should:

1 Use methods of scientific investigation

- 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.
- 1.2 Design a fair test by identifying key factors to vary.
- 1.3 Understand the importance of accuracy and the need to check observations.
- 1.4 Develop skills of estimation of quantities such as temperature and length.

2 Process and communicate information

- 2.1 Construct and interpret two-way tables.
- 2.2 Express results in the form of bar charts.
- 2.3 Record observations in diagrammatic form and interpret simple diagrams.
- 2.4 Classify data and observations and draw conclusions from the classification.

3 Handle equipment and make measurements

- 3.1 Handle more complex equipment correctly, safely and without damage to carry out experiments.
- 3.2 Use a datalogger to collect data automatically.
- 3.3 Measure length, temperature and the mass and volume of a liquid accurately using appropriate equipment.

Key standards

Key performance standards are shown in shaded rectangles, e.g. 1.3.

Examples of learning exercises

The examples of active learning exercises shown in italics are intended to be illustrative and do not represent the full range of possible exercises.

Cross-references to scientific enquiry skills

Some of the suggested learning exercises are cross-referenced where appropriate to scientific enquiry skills.

Life science

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Students should:

4 Identify organisms correctly

- 4.1** Recognise the importance of correctly identifying organisms and use simple branching tree keys to make correct identifications.

Illustrate the diversity of living things by making a display of a wide range of specimens, models, pictures and drawings of plants and animals.

Enquiry skill 2.3

Use pictures of the same animals with different names to illustrate how misidentification causes difficulties.

Use pictorial and word keys to identify and name common plants and animals.

Construct simple keys and use these to identify common plants and animal.

5 Know that different organisms live in different habitats and that habitats and their inhabitants are diverse

- 5.1** Recognise similarities and differences in terrestrial, marine and freshwater habitats and explain how differences in habitats can determine the organisms that live there.

From field studies or other information sources, make lists (or drawings or sets of pictures) of animals and/or plants found in different places. Students could work in teams and deal with different groups of animals/plants (e.g. birds, insects, mammals, flowering plants, fungi, algae).

From field studies, video clips, photographs or drawings, investigate the features that different habitats have in common and those that are unique.

From field studies, video clips, photographs or drawings, determine the organisms that are common to different habitats and those that are unique to particular habitats.

Match pictures or cards with habitat information to the organisms that live there.

- 5.2** Know that there is a need to protect habitats as changes to habitats can affect the numbers and types of organism that can live there.

Watch video clips of natural and disrupted habitats and observe the diversity and number of organisms they support.

Enquiry skill 1.1

Make field trips to natural and disrupted sites.

Take part in a Qatar conservation project.

6 Know that life processes are internally regulated

6.1 Know that life processes are controlled.

Draw bar charts to show body temperature and water intake and output when at rest and when engaging in vigorous exercise.

Enquiry skill 2.2

6.2 Know that injury, illness and inappropriate actions disturb life processes.

Use a thermometer to measure body temperature.

Enquiry skill 3.3

Study graphs of the body temperatures of healthy and ill people.

Draw charts of the lung capacity of smokers and non-smokers.

Enquiry skill 2.2

7 Know that animals produce offspring that become adults

7.1 Describe the young of some common mammals.

Based on observations, photographs and diagrams, construct descriptions of the young of some common mammals.

Enquiry skills 1.1, 2.2

Visit a farm or animal sanctuary.

7.2 Recognise the young of some common animals other than mammals.

Use observations, photographs and diagrams to match the young with the parents of some common animals.

Enquiry skills 1.1, 2.3

7.3 Recognise the main stages in the life cycles of fish, amphibians, reptiles, birds, mammals and insects.

Use a card-sort exercise to sequence the stages of birth, baby, juvenile, adult, mating, old age and death.

Enquiry skills 1.1, 2.3

Hatch chickens from eggs.

Discuss video clips of life cycles.

Compile charts and discuss the increase in weight and size of human babies over the first years of life.

8 Know the cycle of reproduction of flowering plants

8.1 Describe the main stages in the reproduction of flowering plants.

Examine the structure of several flowers and relate structure to function.

Enquiry skills 1.1, 2.3

Cut open a selection of fruits and examine the seeds.

Plant seeds and observe their germination and growth.

Examine pollen with a hand lens or microscope.

Make a model flower.

8.2 Illustrate ways in which seeds are dispersed.

Make a collection of seeds representative of various forms of dispersal (e.g. wind, animal, explosive).

Enquiry skill 2.3

8.3 Know ways in which plants are pollinated.

9 Be aware of factors affecting health

9.1 Know the general effects of alcohol, tobacco and harmful drugs on humans.

Use a smoking machine to demonstrate the tar in cigarette smoke.

Enquiry skills 1.1, 1.2, 2.4, 3.1

Observe and compare the effects of placing small pieces of liver in water and in alcohol.

ICT opportunity

Use the Internet to gain information on the negative effects of drugs on the body.

Use the Internet as an information source.

10 Recognise that micro-organisms can affect health

10.1 Know that some micro-organisms can cause illness.

Make a chart of illnesses caused by micro-organisms and their symptoms.

Enquiry skill 1.1

Discuss how micro-organisms that cause illness can be controlled.

Debate the motion that micro-organisms are more harmful than helpful.

Examine the newspapers for stories about micro-organisms.

10.2 Know that good hygiene is important in protection from illness caused by micro-organisms.

Demonstrate the spread of micro-organisms by moistening a student's hands with a starch solution. Have the student shake hands with several peers and they with others. Test for the spread of the starch by asking students to rub their hands on white paper tissues to which iodine solution is then added.

Enquiry skill 1.1

Materials

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Students should:

11 Know the characteristics of the states of matter

11.1 Know that there are three states of matter – solid, liquid and gas – and that each state of matter has particular characteristics.

Investigate ice, water and steam to show that they are different states of the same substance and that most other substances undergo the same changes on heating.

Safety

Steam can cause burns.

Pour a given volume of water into several differently shaped containers to show that the volume of liquid is constant but changes shape according to the container.

Enquiry skill 3.3

Show that a liquid such as water finds its own level; it settles in the lowest part of the container. Use or make a container from several containers joined by tubes at the bottom to show that all containers fill to the same depth.

Use a large syringe to show that gases can be compressed but liquids cannot.

11.2 Know that changes of state are reversible.

11.3 Know that liquids can change to gases through evaporation without boiling.

Measure the change of depth of water in a beaker over time, plotting the change graphically. Predict how the shape of the beaker or its place in the classroom or outside will affect evaporation. Test the prediction.

Enquiry skill 2.2

11.4 Identify and explain examples of changes of state in everyday life.

List examples such as clouds forming rain, clothes drying, softening of chocolate.

11.5 Know that the water used in Qatar is made by evaporating seawater and condensing the pure water vapour formed.

11.6 Know and demonstrate that air is a material and that it fills spaces between solids.

Squeeze air out of a sponge under water.

Put some soil from the ground in water and watch the air bubbles rise from it. Speculate on where the air has come from and its importance in the soil.

Make and fly a kite or make and use a parachute. Explain the effect of air on them.

11.7 Recognise that gases flow and change their volume, that they have mass, and that many are important to us.

11.8 Know that gases are often used in a compressed state, as in car tyres and gas cylinders.

Use a tube to connect an inflated balloon to one that is not inflated. Blow up the uninflated balloon by squeezing the inflated one.

Balance two identical balloons inflated to different pressures on scales.

Open a fizzy drink bottle and notice the gas bubbles. Speculate on where they have come from. Notice the difference in taste between a fizzy drink and the same drink when it is flat.

11.9 Know the names of some common gases, such as air, methane, carbon dioxide, and know that methane is a fuel gas found underground in Qatar.

Find out about how methane is obtained out of the ground and stored in Qatar.

Use secondary sources to find out more about where we get gases and what we use them for.

Enquiry skill 1.1

ICT opportunity

Use the Internet as an information resource on gases.

12 Know some of the properties of common metals that make them useful

12.1 Know that metals are an important class of materials and list some of their common uses.

Handle examples of common metals such as steel, aluminium, jewellery and coins.

Make a table showing the uses of well-known metals, particularly uses that can be identified in the classroom and school.

Enquiry skill 2.1

12.2 Know that metals, particularly steel, are useful for making machines that have moving parts, such as cars and aeroplanes, and that steel is used in making buildings.

12.3 Explain the properties of metals that make them useful.

Devise simple experiments for testing the physical properties of different metals.

Create a display that shows how the different uses of metals depend on their properties (e.g. strength, malleability, shiny appearance, ability to conduct electricity).

Consider why steel, which is a form of iron, is very common and has many uses.

Enquiry skill 1.1

Earth and space

By the end of Grade 4, students know that the Sun casts shadows and that the length of a shadow depends on the time of day; they use this knowledge to make a shadow clock. They investigate how people used to tell the time using sundials. They know the cause of day and night and that the spin of the Earth on its axis causes shadow length and position to change. They know that the Sun is a source of heat and light.

Students should:

13 Know how the Sun causes shadows

- 13.1** Know that the Sun is a source of light and that this causes shadows of objects.

Record the pattern of the (apparent) movement of the Sun during the day.

Use a torch and a shadow stick to show how the length of the shadow depends on where the torch is in relation to the stick.

- 13.2** Know how people used to tell the time before the age of clocks.

Use secondary sources to investigate the use of sundials in the past to tell the time.

Investigate other ways of telling the time (e.g. burning candles, falling water or sand).

- 13.3** Explain how the movement of the Earth on its axis causes day and night.

Use models to explain that the apparent movement of the Sun is actually a movement of the Earth.

- 13.4** Know how the spin of the Earth on its axis causes shadow length and position to change such that the length of a shadow depends on the time of day.

Make observations of shadow length systematically at regular intervals throughout the day. Display results graphically.

- 13.5** Know that the Sun is a source of heat as well as light and that this explains the change in temperature between day and night.

Measure the temperature change in the school grounds throughout the day and night. Plot the result graphically.

Enquiry skills 2.4, 3.3

Safety

Looking at the Sun can damage the eyes.

ICT opportunity

Use the Internet as an information source on sundials.

Enquiry skills 1.1, 1.2, 1.3, 2.2

ICT opportunity

Use of a datalogger to record temperature.

Physical processes

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Students should:

14 Distinguish between heat and temperature

- 14.1** Estimate temperature using touch, and measure it accurately using a liquid-in-glass thermometer.

Estimate temperature in different parts of the room and check the estimates with a thermometer.

Enquiry skill 1.4

Use the sense of touch (back of the hand) to estimate the temperature of warm water. Check the estimate with a thermometer.

Monitor the temperature day and night in the classroom, or in the school grounds, using a maximum–minimum thermometer or electronically. Plot a graph of the results.

Enquiry skill 2.2
See Standard 13.5

- 14.2** Know that when the temperature of an object is different from the temperature of its surroundings, heat will move into or out of the object until it is at the same temperature as its surroundings.

At regular intervals, measure the temperature of cold or hot water brought into the classroom. Plot heating or cooling curves.

Enquiry skills 2.1, 3.3

- 14.3** Know that substances differ in their conducting and insulating properties.

Monitor rates of cooling of water in vessels made of different materials.

Enquiry skill 3.1

Devise a fair test for comparing the insulating properties of various materials.

IT opportunity

Devise a test for measuring how well substances conduct heat and classify materials according to how well they do so.

Use a datalogger.

Prepare a class presentation on the insulating properties of different materials.

Enquiry skills 1.2, 3.2

15 Know how sounds are made and how we hear them

- 15.1** Know that sound can vary in loudness and in pitch.

Tour the school and listen for all the different sounds. Describe them in terms of loudness, pitch and pleasantness.

Make objects that make sounds of different pitch and loudness when they are hit or plucked or stroked. Form a band to play them.

Note the relationship between the size of an object making the sound and its pitch.

15.2 Know that sound is a vibration.

Place a piece of paper on the strings of a guitar or a grain of rice on the skin of a drum and watch what happens when a sound is made. Put the tip of a vibrating tuning fork in water. Gently feel the source of a sound with the fingers.

Enquiry skill 1.1

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.

Make a string telephone from a piece of string and two plastic pots and test it.

15.4 Know that having two ears helps us tell where a sound is coming from.

Investigate how well we can detect where sound is coming from with one, and then the other, ear covered.

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.

Devise a fair test to find out which materials are best for muffling sounds.

Enquiry skill 1.2

15.6 Demonstrate echoes and explain them in terms of the speed of sound.

Show echoes by clapping some way from a large wall. Try to measure the time for the echo to reach the ear by clapping again just when the echo arrives each time and estimating the time between claps.

15.7 Show that sounds can travel through liquids and solids as well as through the air.

Listen to the sound of a watch held in the air, and then put it on a table, press your ear against the table and listen again.
