

Summary of students' performance by the end of Grade 6

Scientific enquiry

Students conduct systematic investigations, make predictions from and identify patterns in data and observations, and consider whether evidence supports a conclusion, prediction or hypothesis. They recognise patterns in results and perform calculations with data. They know when to use bar charts and line graphs to express discontinuous and continuous data and can interpret such graphs. They use a variety of methods, including ICT, to communicate their results. They measure accurately, using the correct units, the mass and volume of solids and liquids. They make simple models. They use specialised equipment correctly, including a simple microscope.

Life science

Students classify animals and plants into their major groups. They know that cells are the fundamental building blocks of living organisms and that cells can have specialised features for specific functions. They list the main organs of animals and parts of plants and their functions. They differentiate between internal and external fertilisation. They understand the changes that occur during puberty. They describe the overall anatomy of the human digestive system. They know the structure of a human tooth and can explain the functions of different teeth. They know how to care for their teeth. They understand how to protect food from contamination by micro-organisms and that good hygiene will help protect them from microbial illness.

Materials

Students recognise that the rate of dissolving is affected by various factors, that some solids are more soluble than others and that there are many useful solvents. They know that dissolving can be used to separate a soluble from an insoluble solid using filtration and evaporation and that crystallisation is used to obtain pure samples of substances from solution. They list everyday examples of filtration. They distinguish between reversible and irreversible changes. They know that mixing materials together or heating materials can cause them to change temporarily or permanently. They understand that reversible, temporary, changes are usually physical, whereas irreversible, permanent, changes are usually chemical and new materials are formed.

Earth and space

Students know that the Sun and stars are light sources but that the Moon is an illuminated object that reflects light from the Sun. They know the shape and approximate relative sizes of the Sun, the Earth and the Moon. They know that the revolution of the Moon around the Earth causes the phases of the Moon. They know the causes of the tides and of eclipses. They know that the Earth orbits the Sun once every year, why the Sun appears higher in the sky in the summer than in the winter, and how this causes the summer to be hotter than the winter.

Physical processes

Students know that there are two kinds of forces: contact forces and those

that act at a distance. They recognise all bodies exert gravitational attraction and that the Earth's force of gravity on a mass of 1 kg is approximately 10 N towards the centre of the Earth. They distinguish between mass and weight. They know that a force on an object can cause it to move or change shape. They know that there is often more than one force acting on a body and that when forces on a moving object are unbalanced, the object will speed up or slow down. They recall that air and water resistance are forms of friction and know that the terminal velocity of a falling body is reached when the forces on it are balanced. They represent the forces acting on a body with arrows that point in the direction of the force. Students know that light travels very fast in straight lines. They know that we see illuminated bodies by reflected light and that shiny objects reflect light better than dull objects. They recall that objects placed in front of a light source create shadows and know that white light is composed of light of different colours.

The balance between scientific enquiry and the subject content strands

The science standards for Grade 6 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 6

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 6, 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 6, 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

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Students should:

1 Use methods of scientific investigation

- 1.1 Plan investigations, controlling variables and collecting an appropriate range of evidence, identify patterns in observations and data, draw appropriate generalised conclusions and test predictions.
- 1.2 Consider the extent to which evidence justifies a conclusion or supports a prediction or hypothesis.
- 1.3 Turn questions into forms that can be investigated and plan the investigation.

2 Process and communicate information

- 2.1 Use a range of methods, such as description, diagrams, pictures, tables and charts, using ICT methods where appropriate, to communicate observations, data, results and conclusions.
- 2.2 Know when to use bar charts and when to use line graphs to represent discontinuous and continuous data and be able to interpret such graphs.
- 2.3 Draw carefully labelled diagrams that show relationships, processes and observations.
- 2.4 Carry out simple calculations using experimental data and recognise patterns in the results.

3 Handle equipment and make measurements

- 3.1 Make models from everyday materials to help explain scientific phenomena and technological solutions.
- 3.2 Measure accurately, using the correct units, the mass and volume of solids and liquids.
- 3.3 Select and use specialised equipment correctly, safely and without damage to carry out experiments.
- 3.4 Use a simple microscope.

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

By the end of Grade 6, students classify animals and plants into their major groups. They know that cells are the fundamental building blocks of living organisms and that cells can have specialised features for specific functions. They list the main organs of animals and parts of plants and their functions. They differentiate between internal and external fertilisation. They understand the changes that occur during puberty. They describe the overall anatomy of the human digestive system. They know the structure of a human tooth and can explain the functions of different teeth. They know how to care for their teeth. They understand how to protect food from contamination by micro-organisms and that good hygiene will help protect them from microbial illness.

Students should:

4 Classify animals and plants into the major groups of organisms

- 4.1 Place an animal into its major vertebrate (fish, amphibian, reptile, bird, mammal) or invertebrate (single cell, coelenterate, arthropod (e.g. crustacean and insect), echinoderm, flatworm, mollusc, round worm, segmented worm) taxonomic group.

Using specimens, models, photographs and drawings, compare the features of various types of vertebrates and invertebrates.

Enquiry skill 1.2

Use a simple branching key to identify the group to which an animal belongs.

Given descriptions of unknown animals, use knowledge and/or a simple branching tree key to place each in the appropriate taxonomic group.

Record the groups of animals seen on a field trip.

- 4.2 Place a plant into its major flowering (dicotyledon, monocotyledon) or non-flowering (algae, conifer, fern, fungi, liverwort, moss) taxonomic group.

Given specimens or descriptions of unknown plants, use a simple branching key to place each in the appropriate taxonomic group.

Enquiry skill 1.2

Plant the seeds of different plants and observe their growth.

Make a collection of algae from specimens washed up on the seashore.

- 4.3 Know which major groups of plants and animals are most abundant in Qatar.

5 Know that living organisms are made up of cells

- 5.1 Know that living organisms are made up of cells.

Prepare slides of cheek cells and onion epidermis and examine them under the microscope.

Enquiry skills 1.2, 3.4

Use photographs and drawings to illustrate a range of cells.

- 5.2 Know that cells have cytoplasm, a nucleus and a cell membrane and that plant cells have a cell wall.

Draw diagrams of cells from microscope observations.

Enquiry skills 2.1, 3.4

- 5.3** Know that some cells are structured for specialised functions.

Use a microscope to examine prepared slides of specialised cells of animals (e.g. nerve cells, muscle cells, sperm cells) and plants (e.g. xylem cells, phloem cells, palisade cells).

Enquiry skills 1.2, 3.4

Use a microscope to examine prepared slides of tissues of animals (e.g. brain tissue, muscle tissue) and plants (e.g. stem tissue, leaf tissue).

- 5.4** Know that collections of cells with the same function form tissues (such as muscle) and that organs (such as the stomach) are made of tissues of different types.

- 5.5** Know that cells grow in size and increase in number by dividing in two.

6 Know the functions of organs of animals and parts of plants

- 6.1** Know the names of the main organs of vertebrates that are responsible for circulation (heart, blood vessels), food processing (stomach, liver and intestines), gas exchange (lungs, gills), locomotion (fins, legs, wings) reproduction (ovaries, testes), sensitivity (brain, nerves, sense organs) and waste removal (kidneys).

Examine specimens, models, charts, photographs and drawings, and identify the key organs.

Enquiry skill 1.1

- 6.2** Differentiate between internal and external fertilisation; know that animals that have internal fertilisation have organs specialised for this purpose.

Observe video clips of animals laying eggs and using external fertilisation (e.g. amphibians, fish) and of animals mating and using internal fertilisation (e.g. birds, mammals).

Enquiry skill 1.1

- 6.3** Know the parts of flowering plants that are responsible for anchorage (roots), circulation (xylem and phloem), gas exchange (stomata), food production (leaves and stems), reproduction (flowers) and waste removal (stomata).

Examine specimens, models, charts, photographs and drawings and identify the key organs.

Enquiry skills 1.1, 3.4

Dissect flowers of several plant species.

Use a microscope to examine prepared slides of transverse sections of roots, stems and leaves.

- 6.4** Be able to locate, identify and compare the relative size of the main internal organs of humans (brain, lungs and windpipe, heart, thyroid, salivary glands, oesophagus, stomach, liver, gall bladder, pancreas, spleen, large and small intestine, kidneys, bladder, uterus, ovaries).

7 Understand puberty

- 7.1** Understand that during puberty the body changes to enable reproduction and that this also results in the development of secondary sexual characteristics.

View and discuss suitable videos.

8 Know the simple anatomy of the human digestive system

- 8.1** Identify and describe the general structure of the human digestive system and know how the mouth, salivary glands, oesophagus, stomach, liver, gall bladder, pancreas, large and small intestine, and anus are connected.

Use specimens, models, charts and dissection to examine the anatomy of the digestive system.

Enquiry skills 1.1, 3.1

- 8.2 Know that blood carries dissolved food to cells of the body.
- 8.3 Know the differences in structure of arteries, veins and capillaries.
- 8.4 Know that the heart is a four-chambered muscular organ that pumps blood to the lungs and round the body.

9 Know about the structure, function and care of human teeth

- 9.1 Know that humans grow two sets of teeth.

Do a survey to determine how many students have their first and how many have their second teeth.

Enquiry skills 1.1, 2.4

- 9.2 Describe the structure of a tooth as consisting of enamel, dentine and pulp and know that teeth are connected to the blood and nervous systems.

Examine teeth or model teeth.

Enquiry skill 1.2

- 9.3 Know the names and normal numbers of the types of human teeth (molars, premolars canines and incisors) and explain how they are adapted for their functions.

Match pictures of teeth with functions.

Enquiry skill 1.2

- 9.4 Know the causes of tooth decay and how the risk of this can be avoided by good oral hygiene.

Place some teeth in dilute acid and some in water and compare them after a few days.

Enquiry skills 1.1, 1.2, 1.3

Measure the pH of different toothpastes and relate this to function.

Enquiry skills 1.2, 1.3, 3.3

Compare teeth that have been kept in water and fizzy drink.

Enquiry skills 1.1, 1.3

- 9.5 Compare the dentition of humans with that of other animals and explain the differences in terms of diet.

10 Know about harmful micro-organisms

- 10.1 Know that if left unprotected, most foods will be contaminated by micro-organisms in the air and become unfit to eat.

Leave some moist bread in the open for a few days then compare its appearance with a similar piece kept beside it but in an airtight bag.

Enquiry skills 1.1, 1.2

- 10.2 Understand that some micro-organisms can cause human illness and that regular washing and good food hygiene can reduce the risk of such illness.

Using agar plates, try to grow micro-organisms from unwashed and washed hands and compare the results.

Enquiry skills 1.2, 1.3

- 10.3 Find out about common human diseases caused by micro-organisms.

Use reference sources to make a list of common human diseases caused by micro-organisms. Indicate those that are prevalent in Qatar.

Materials

By the end of Grade 6, students recognise that the rate of dissolving is affected by various factors, that some solids are more soluble than others and that there are many useful solvents. They know that dissolving can be used to separate a soluble from an insoluble solid using filtration and evaporation and that crystallisation is used to obtain pure samples of substances from solution. They list everyday examples of filtration. They distinguish between reversible and irreversible changes. They know that mixing materials together or heating materials can cause them to change temporarily or permanently. They understand that reversible, temporary, changes are usually physical, whereas irreversible, permanent, changes are usually chemical and new materials are formed.

Students should:

11 Understand solubility

- 11.1** Recognise that the rate of dissolving is affected by several factors, such as heat, particle size and stirring.

Design a fair test to compare rate of dissolving under different conditions. Express the results graphically in a line graph.

Enquiry skill 2.2

- 11.2** Know that some solids are more soluble in a solvent than others and that there is always a limit to the amount of solute that will dissolve.

Design a test to compare the solubility of different substances in water.

- 11.3** Know that a solute can often be recovered by evaporating the solvent, which can then be recovered by condensing it.

Show that the condensate contains no solute by leaving a little on a piece of glass to evaporate.

- 11.4** Separate insoluble solids from a liquid by filtration and state everyday examples of filtration, such as coffee making, sewage works and water purification.

Use filtration to separate a mixture of water and sand.

Enquiry skill 3.3

Make and test a sand filter to purify dirty water.

Enquiry skill 3.1

Separate sand from salt by a combining the processes of solution, filtration and evaporation.

- 11.5** Use crystallisation to obtain pure samples of a solute from a solution.

'Grow' crystals of ionic solids such as copper sulfate, alum and common salt.

- 11.6** Know that there are many useful solvents (common ones are water, methylated spirit and petrol) and that these do not always mix with each other.

Show that some liquids, such as oil, do not mix with water, but others, such as ethanol, do.

Show that some solids that dissolve in water do not dissolve in methylated spirits, and vice versa.

12 Distinguish between temporary and permanent changes

- 12.1** Distinguish between reversible and irreversible changes and know that reversible ones are physical and irreversible ones involve chemical changes in which new substances are formed.

Refer back to activities done in earlier years on changing materials and classify the changes as temporary or permanent. Examples are changing the shape of a lump of clay by making a pot (temporary); then changing the clay again by firing the pot (permanent).

- 12.2** Know that when substances are added to water, some will react while others either dissolve or remain suspended.

Mix a number of different substances with water (e.g. salt, sand, plaster of Paris, antacid powder, baking powder, flour) and then attempt to recover the original solute. Try other mixtures (e.g. dissolve sodium bicarbonate in vinegar) to test for chemical changes. List evidence, such as the escape of gas, that suggests that a change cannot be reversed.

Enquiry skill 1.2

- 12.3** Know that heating can bring about temporary, physical, changes in some materials and permanent, chemical, changes in others. Distinguish between heating and burning.

Classify all the changes investigated in these exercises as chemical or physical.

Heat with a flame a variety of substances including some common chemicals (e.g. copper sulfate, copper carbonate, sodium chloride) and some everyday materials (e.g. sugar, flour, egg, paper, wood, ice, various metals). Show that when materials are only heated they can often be recovered but materials burn they are changed permanently.

Enquiry skill 1.1

Enquiry skill 1.1

Safety

Wear eye protection during chemical investigations.

Construct a concept map around reversible and irreversible changes using process words as well as substances.

Earth and space

By the end of Grade 6, students know that the Sun and stars are light sources but that the Moon is an illuminated object that reflects light from the Sun. They know the shape and approximate relative sizes of the Sun, the Earth and the Moon. They know that the revolution of the Moon around the Earth causes the phases of the Moon. They know the causes of the tides and of eclipses. They know that the Earth orbits the Sun once every year, why the Sun appears higher in the sky in the summer than in the winter, and how this causes the summer to be hotter than the winter.

Students should:

13 Know some of the consequences of the movement of the Earth and the Moon

- 13.1** Know that the Sun and stars are light sources and that the Sun is the source of our daylight.

During a field trip into the desert away from towns, note that we can see stars at night, especially when there is no Moon in the sky.

- 13.2** Explain that we see the Moon at night because it is an illuminated object that reflects light from the Sun.

Draw diagrams to show how the light from the Sun can be reflected from the Moon to our eyes. Discuss why we cannot usually see the Moon during the day.

- 13.3** Know that the Sun, the Earth and the Moon are all roughly spherical objects in space and know their approximate relative sizes.

Make a scale model of the Earth–Moon–Sun system (from a pea, a bead and a football).

Make a display of pictures of the Moon, the Sun and the Earth from space.

Investigate how scientists in the past described the movements of the Sun, the Earth and the Moon.

- 13.4** Know that the Moon revolves around the Earth once every 28 days and show how this causes the phases of the Moon.

Model the rotation of the Moon and the spinning of the Earth using a torch and objects such as an orange (or a model globe) and a table-tennis ball to show day and night and the phases of the Moon.

Keep a diary showing, by a drawing, the phase of the Moon each day.

Discuss the Islamic calendar based on the phases of the Moon and why it differs from the more widely used calendar in which a month is no longer the time of one rotation of the Moon.

- 13.5** Know that the gravitational attraction of the Moon and the Sun on the Earth's seas causes the tides.

Measure distances between the high and low tide over a period of a month, by measuring how far they are from a marked position on the shore.

- 13.6** Know the causes of eclipses of the Sun and the Moon.

Make a model to show eclipses of the Sun and the Moon.

Use the Internet to find when the next eclipses are due and where they can be seen.

- 13.7** Know that the Earth orbits the Sun once every year.

Show how the calendar has evolved around this observation and how the months in a modern calendar are approximations to the lunar month adjusted so that there are exactly 12 months in the year.

- 13.8** Understand why the Sun is higher in the sky during the summer than in the winter and why it is hotter in summer than in winter.

Use a globe to show the tilt in axis of the Earth and how this causes the position of the Sun in the sky to be different in winter and summer.

Use a torch in a dark room to show that the area illuminated is smaller (and therefore the light and heat from it is more concentrated) when the torch shines directly down on a bench than when it shines at angle.

Keep a diary at home of the position of the Sun when it rises and sets over the whole year.

Enquiry skill 3.1

ICT opportunity

Use the Internet to obtain pictures of the Moon, Sun and Earth.

Enquiry skill 3.1

Enquiry skill 1.3

Enquiry skill 3.1

IT opportunity

Use the Internet as an information source.

See Standard 13.4

Enquiry skills 1.1, 3.1

Physical processes

By the end of Grade 6, students know that there are two kinds of forces: contact forces and those that act at a distance. They recognise all bodies exert gravitational attraction and that the Earth's force of gravity on a mass of 1 kg is approximately 10 N towards the centre of the Earth. They distinguish between mass and weight. They know that a force on an object can cause it to move or change shape. They know that there is often more than one force acting on a body and that when forces on a moving object are unbalanced, the object will speed up or slow down. They recall that air and water resistance are forms of friction and know that the terminal velocity of a falling body is reached when the forces on it are balanced. They represent the forces acting on a body with arrows that point in the direction of the force. Students know that light travels very fast in straight lines. They know that we see illuminated bodies by reflected light and that shiny objects reflect light better than dull objects. They recall that objects placed in front of a light source create shadows and know that white light is composed of light of different colours.

Students should:

14 Distinguish between contact forces and those that act at a distance

14.1 Distinguish between forces that act at a distance (such as gravity, magnetism and electrostatic force) and contact forces.

Classify the different kinds of forces that have been encountered so far (e.g. push, pull, strain, friction, air resistance, water resistance, gravity, magnetism), noting which require contact and which act at a distance.

14.2 Know that all bodies exert a gravitational attraction which is stronger close to the body than further away and that the force of gravity on the surface of the Earth on a mass of 1 kg is approximately 10 N.

Use a forcemeter to establish the force of gravity acting on objects of known mass.

14.3 Distinguish between mass and weight.

Investigate the effect on the length of an elastic band of hanging different weights on it. Plot a graph of the results and try to identify any trends.

Consider and compare the force of gravity on humans on Earth, in the International Space Station and on the Moon. Look at pictures or videos from the space station that illustrate weightlessness.

Work out the weight of an object of known mass on Earth, in space and on the Moon (where gravity is one-sixth of that on Earth).

Enquiry skills 1.3, 2.2

ICT opportunity

Obtain video clips of weightlessness from the Internet.

15 Identify the effects of forces

15.1 Know that a force on a stationary object can cause it to move or to change shape and that a force on a moving object can cause it to change direction, or speed.

15.2 Realise that there is often more than one force acting on a body and that these are balanced if the body is stationary.

15.3 Know that an object at rest on the ground has two equal and opposite forces acting on it.

Hang an object from a string and then from a rubber band. Note that the object is not moving so the forces acting on it are balanced. Discuss the effect of the two forces (tension and weight) on the string and the rubber band.

15.4 Know that when forces on an object are unbalanced, there is a resultant force on it that can cause it to change its shape, speed or direction of movement.

15.5 Know that air resistance and water resistance are forms of friction that affect the speed of objects moving through the air or the water, and know that the terminal velocity of a falling body is reached when the forces acting on it are balanced.

Investigate how different ways of folding an A4 piece of paper affects the time it takes it to fall to the ground. Consider reasons for the differences.

Enquiry skill 1.3

Measure the terminal velocity of a small ball falling in different liquids.

Enquiry skill 1.1

15.6 Represent the forces acting on a body with arrows that point in the direction of the force.

16 Understand the properties of light

16.1 Know that light moves in straight lines and, in consequence, objects placed in front of a light source create shadows.

Make a single hole in each of three pieces of cardboard, put the pieces of cardboard in a line, one behind the other, and show that light can only travel through all three holes when the holes are in a straight line.

Show, by drawing, how shadows form; represent light rays as straight lines.

Enquiry skill 2.3

16.2 Know that light has a velocity that is very high.

Discuss some of the consequences of the speed of light, such as the time delay between seeing an event that causes a sound and hearing the sound (e.g. thunder and lightning).

16.3 Know that we see light sources because light travels from them to our eyes and that we see objects that are not light sources because they are illuminated by light sources and light is reflected into our eyes.

Classify bright objects around the school, and in the sky, as light sources or illuminated objects.

16.4 Know that objects can absorb or reflect the light that shines on them, that shiny objects reflect light better than dull objects and that dark objects reflect less light than light coloured objects.

Show, using diagrams, the difference between the reflection by a shiny object and by a dull object.

Measure the intensity of light reflected by shiny and dull objects.

List objects (e.g. mirror, paper, shiny and rough wood, painted surface) according to how well they reflect an image and the beam of light from a torch.

ICT opportunity

Use electronic detectors to measure light intensity.

16.5 Know that white light is composed of light of different colours.

Make a spectrum on the ceiling of the classroom by reflecting light from the Sun using a mirror in a bowl of water placed at an angle to the water surface. Name the colours.

Make a circular spinner from cardboard and a matchstick. Colour segments with the colours of the spectrum. Show how it appears to turn white as it spins.

16.6 Know that coloured objects reflect only their colour and absorb other colours when illuminated in white light.

Illuminate a coloured object in light of different colours and note what colour it appears to be.

