



Curriculum Framework Cambridge Lower Secondary Science 0893

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Cambridge Lower Secondary Progression Tests will be available from 2022.
Cambridge Lower Secondary Checkpoint tests will be available from 2023.



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1 Why choose this Curriculum Framework?

Key benefits

The Cambridge Lower Secondary Science curriculum supports your learners in developing life-long curiosity about the natural world and enables them to seek scientific explanations to the phenomena around them.

Learners develop a holistic approach to science by considering scientific thinking and practical skills alongside knowledge and understanding which is vital for explaining the world around us. This approach provides learners with the knowledge and skills they require to access and excel at science in later phases of education.

A unique feature of the Cambridge Lower Secondary Science curriculum is a strand called Science in Context which supports you in demonstrating the relevance of science to your learners. Improving learners' awareness of science in the world around them develops their sense that 'science is for me' and starts learners on a journey of connecting themselves to the subject.

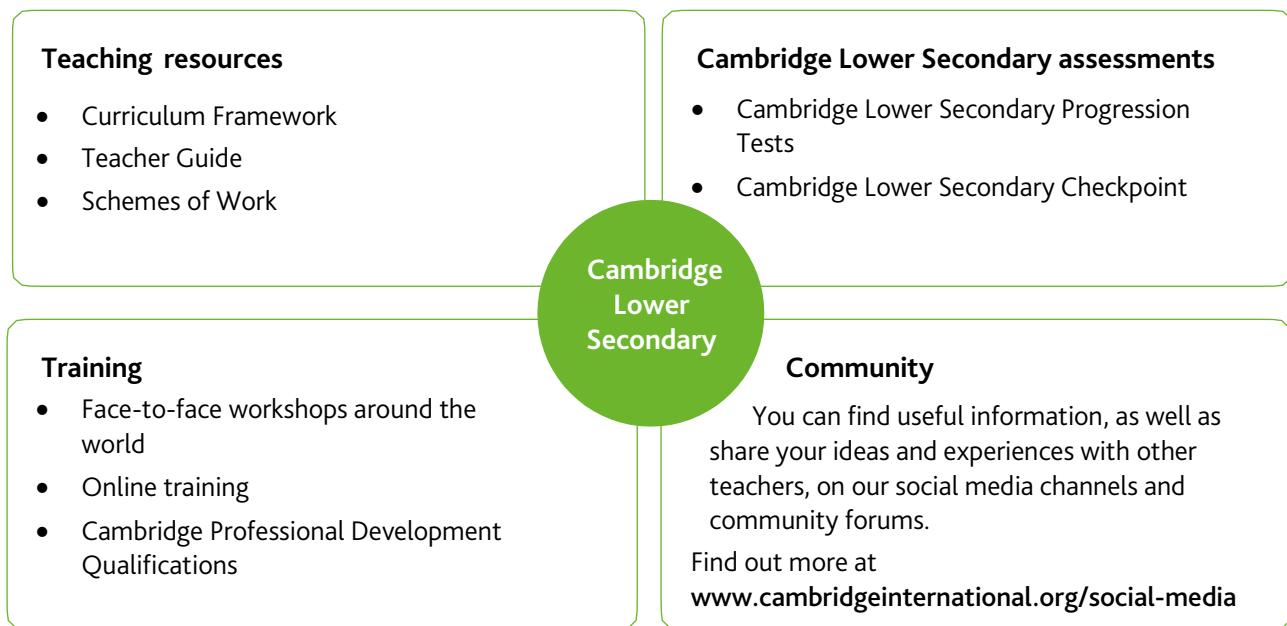
Alongside Science in Context, the whole structure of the *Cambridge Lower Secondary Science Curriculum Framework* is designed to support and enable effective teaching of science within and across the lower secondary stages. You are provided with clearly sequenced strands of science skills and knowledge that will enable learners to describe, explain and investigate the world around them at an age appropriate level.

Learners will systematically develop their scientific knowledge through the strands Biology, Chemistry, Physics and Earth and Space while developing scientific practices through the Thinking and Working Scientifically strand. An understanding of science through these strands of study gives learners knowledge and skills to prepare them for the future and to make informed choices. This includes considering sustainability issues and meeting the challenges facing our environment.

Supporting teachers

We provide a wide range of practical resources, detailed guidance, innovative training and professional development so that you can give your learners the best possible experience of Cambridge Lower Secondary Science.

You will find most of these resources on the Cambridge Lower Secondary support site (<https://lowersecondary.cambridgeinternational.org>). Ask the Cambridge coordinator or exams officer in your school if you do not already have a log-in for this support site.



Progression through the Cambridge Pathway

We have designed Cambridge Lower Secondary Science to support learners to develop the skills required for success in their lower secondary education and to progress to the next stage of the Cambridge Pathway. The *Curriculum Framework* is typically for learners aged 11 to 14, but it may be appropriate to use it for slightly different ages to suit your context.

You can download more information on progression from the Cambridge Lower Secondary support site.

Teaching time

For guidance, this *Curriculum Framework* is based on learners having 90 hours for science in each stage. To support teaching Cambridge International suggests you provide 3 hours of science teaching a week. Your actual number of teaching hours may vary according to your context.

Assessment

We provide assessments designed to complement this *Curriculum Framework* for Stages 7 to 9. You can find more information on assessing Cambridge Lower Secondary Science on the Cambridge Lower Secondary support site.

The Science in Context strand will not be directly assessed by Cambridge International. You can find more information on assessing Cambridge Lower Secondary Science on the Cambridge Lower Secondary support site.

2 Curriculum overview

Aims

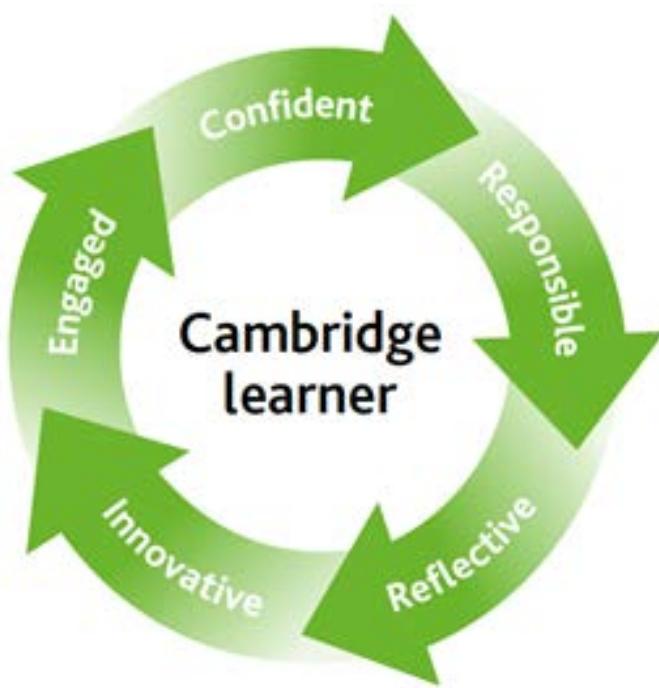
Following the Cambridge Lower Secondary programme helps learners to lay the foundations for lifelong learning, including:

- curiosity about the world around them and enthusiasm for learning
- knowledge, understanding and skills that can be applied in and across subjects
- effective and confident communication skills, including in English
- understanding of their personal and local context, as well as having global awareness.

In Cambridge Lower Secondary Science, learners:

- build curiosity and fascination about the world to stimulate their interest about science
- first meet foundational scientific concepts, that then develop through the Cambridge Pathway
- develop their scientific skills so they can become increasingly independent when questioning and investigating phenomena
- begin to understand that scientific models are used to understand and explain phenomena
- recognise that scientific understanding changes over time
- link science to real world contexts that are personal, local, national and global, identifying the relevance of science to the modern world.

The Cambridge approach encourages learners to be:



Cambridge Lower Secondary Science supports learners to become:

Responsible – They are responsible for themselves and for working collaboratively with others when investigating science. They understand how the application of science can have impacts on others and on the environment. They appreciate the role science has in the modern world, including in their communities.

Innovative – They are able to use their scientific skills and understanding to adapt to new, unfamiliar and future challenges. They are flexible and critical thinkers when studying scientific phenomena.

Confident – They are secure in their scientific understanding of the world, confident in working with scientific information and ideas and ready to challenge their own thinking. They are able to present their findings and defend their conclusions as well as respect those of others.

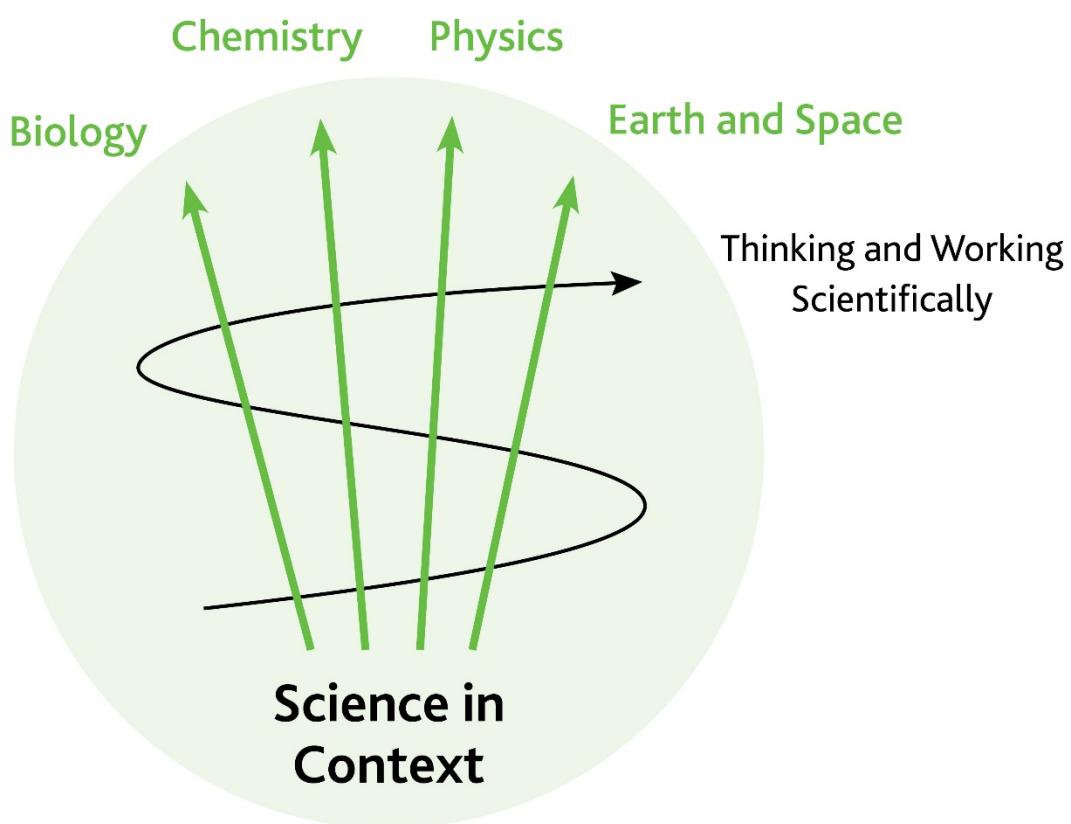
Engaged – They are curious and want to deepen their scientific understanding. They are keen to develop their ability to do science and are open to new ideas. They are able to use science to participate constructively in society and the economy by make informed choices involving science, at personal, local, national and global levels.

Reflective – They are reflective as scientists, able to review their understanding of the world and discover more. They are concerned with the process of science as well as the products of science and develop skills to allow them to investigate science independently.

Overview of the strands

This *Curriculum Framework* provides a comprehensive set of learning objectives for Cambridge Lower Secondary Science. These give a structure for teaching and learning and a reference against which learners' attainment and skills development can be checked.

We have divided the learning objectives into main areas called 'strands' which run through every stage. Each strand is further divided into 'sub-strands'. Sub-strands are based around the key concepts of each strand. Sub-strands help to identify progression and are useful when designing long-term plans, medium-term plans and other teaching resources.



In science there are three categories of strands all of which support learners in understanding and investigating natural phenomena and providing a foundation for developing future scientific skills, knowledge and attitudes:

1. A skill strand – Thinking and Working Scientifically
2. Content strands – Biology, Chemistry, Physics, and Earth and Space
3. A context strand – Science in Context

Thinking and Working Scientifically

This strand relates to the development of scientific skills and covers three core scientific approaches:

- **Models and representations:** Scientists use models and representations to represent objects, systems and processes. They help scientists explain and think about scientific ideas that are not visible or are abstract. Scientists can then use their models and representations to make predictions or to explain observations. Cambridge Lower Secondary Science includes learning objectives about models and representations because they are central to learners' understanding of science. They also prepare learners for the science they will encounter later in their education.
- **Scientific enquiry:** Learners need to develop scientific enquiry skills around the purpose and planning of experiments and investigations, evidence collection, analysis, making evaluations and conclusions. These skills enable learners to investigate the world around them and relate their scientific knowledge to observable and testable phenomena.
- **Practical work:** Learners require good skills of observation, measurement and equipment handling. These skills enable learners to collect accurate and reliable data within investigation work. The development of practical work and the skills associated with it supports the collection of data.

The content strands

Biology is the study of living things and how they interact with each other. Learners develop understanding about life processes, including how the structure and development of cells and systems allows them to maintain these processes, and ecosystems.

Chemistry is the study of matter. Matter takes the form of materials that are made up of substances. Learners develop understanding of atoms, elements and compounds including how substances interact and understand the properties of different substances.

Physics is the study of the interaction of matter and energy. Learners develop understanding about energy and forces, how light and sound behave, and how magnets, including electromagnets, interact.

Earth and Space covers the study of the planet Earth, the wider Solar System and beyond. Learners develop understanding about how the Earth's structure is linked to natural phenomena including how the atmosphere and climate are linked. They also develop their understanding of the universe outside of Earth by considering the wider Solar System and beyond.

Science in Context

This strand provides a framework of statements to help learners study and understand the learning objectives within the other five science strands in a context relevant to them. Learners recognise how the science curriculum relates to the real world by linking concepts and processes learned in the classroom to scientists and their work, science phenomena, and ideas and events relevant to their age and experience. In Cambridge Lower Secondary learners should start to consider the wider role and impact of science at a regional, national, international and global level.

Overview of teaching approaches

The Cambridge Lower Secondary Science curriculum offers great flexibility through its three strand categories approach: skills strand, content strand and context strand.

The three types of strands are designed to support each other in every stage of learning to provide learners with a holistic science education. For example, learners are able to develop the skills within *Thinking and Working Scientifically* while they learn the content within the four content strands which can be taught through contexts supported by the *Science in Context* strand.

Science is a practical subject and teaching of science should include opportunities for learners to observe and carry out practical work. You can find more information and ideas for teaching and learning activities, including how the three categories of strand work together, in the *Cambridge Lower Secondary Science Teacher Guide and Schemes of Work* available on the Lower Secondary support site (<https://lowersecondary.cambridgeinternational.org>).

The *Teacher Guide* will support you to plan and deliver lessons using effective teaching and learning approaches.

The *Scheme of Work* for each stage of Cambridge Lower Secondary Science contains:

- suggested units showing how the learning objectives in the *Curriculum Framework* can be grouped and ordered
- at least one suggested teaching activity for each learning objective
- a list of subject-specific language that will be useful for your learners
- common misconceptions
- sample lesson plans.

You do not need to use the ideas in the *Schemes of Work* to teach Cambridge Lower Secondary Science. They are designed to indicate the types of activities you might use, and the intended depth and breadth of each learning objective. These activities are not designed to fill all the teaching time for this stage. You should use other activities with a similar level of difficulty, for example, those from endorsed resources.

The *Teacher Guide* will support you to plan and deliver lessons using effective teaching and learning approaches.

We work with a range of publishers to provide high-quality endorsed resources to support our *Curriculum Frameworks*. In order to provide choice for Cambridge International Schools, we encourage publishers to develop resources with varying approaches. There is no requirement for endorsed textbooks to follow the teaching order suggested in the Cambridge Lower Secondary *Schemes of Work*. If a resource is endorsed, you can be confident that all the learning objectives are covered.

Health and safety

An essential part of this curriculum is that learners develop skills in scientific enquiry. This includes collecting primary data by experiment. Scientific experiments are engaging and provide opportunities for first-hand exploration of phenomena. However, they must, at all times, be conducted with the utmost respect for safety, specifically:

- It is the responsibility of the teacher in charge to adhere and conform to any national, regional and school regulation in place with respect to safety of scientific experimentation.
- It is the responsibility of the teacher in charge to make a risk assessment of the hazards involved with any particular class or individual when undertaking a scientific experiment that conforms to these regulations.

Cambridge International takes no responsibility for the management of safety for individual published experiments or for the management of safety for the undertaking of practical experiments in any given location. Cambridge International only endorses support material in relation to curriculum content and is not responsible for the safety of activities contained within it. The responsibility for the safety of all activities and experiments remains with the school.

Animal welfare and the use of animals in science

Throughout biology, learners study a variety of living things, including animals. As part of the University of Cambridge, Cambridge International shares the approach that good animal welfare and good science work together.

Learners should have opportunities to observe animals in their natural environment. This should be done responsibly and not in a way that could cause distress or harm to the animals or damage to the environment.

If living animals are brought into schools then the teacher must ensure that any national, regional and school regulations are followed regarding animal welfare. In all circumstances, the teacher responsible must ensure all animals have:

- a suitable environment, including being housed with, or apart from, other animals (as required for the species)
- a suitable diet
- the opportunity to exhibit normal behaviour patterns
- protection from pain, injury, suffering and disease.

There is no requirement for learners to participate in, or observe, animal dissections for Cambridge Lower Secondary. Although dissection can provide a valuable learning opportunity, some learners decide not to continue studying biology because they dislike animal dissection. Several alternatives are available to dissection (such as models and diagrams) which you should consider during your planning.

If you decide to include animal dissection then animal material should be obtained from premises licensed to sell them for human or pet consumption, or from a reputable biological supplier. This approach helps to ensure animal welfare standards and also decreases the risk from pathogens being present in the material. Neither you nor your learners should kill animals for dissection.

When used, fresh material should be kept at 5 °C or below until just before use. Frozen material should be defrosted slowly (at 5 °C) without direct heat. All fresh or defrosted material should be used within 2 days. Preserved animal materials should only be handled when wearing gloves and in a well-ventilated room.

The responsibility for ensuring the welfare of all animals studied in science remains with the school.

Teaching human reproduction

It is expected that schools will have their own sex education policy set within their national legislative framework and drawn up in consultation with parents. We are aware that these policies will be distinct and varied due to the diversity in tradition and culture found over our global network of schools. For this reason, the focus of the Cambridge Lower Secondary Science curriculum is factual and covers genetics, inheritance, fusion of gametes and fetal development.

It does not address attitudes and values or personal and social skills as we expect each school to make a judgement on how these aspects of sex education are addressed within their wider curriculum framework obligations.

3 Learning objectives by stage

Overview of learning objectives

There are learning objectives for each of Stages 7 to 9. All the learning objectives in each stage provide clear progression from the previous stage and to the subsequent stage.

To enable effective progression in your teaching, you need to be familiar with the progression of skills across stages. This will help you to build on prior learning in every stage. The progression of learning objectives across Stages 7 to 9 is available on the Lower Secondary support site (<https://lowersecondary.cambridgeinternational.org>).

Learning objective codes

Each learning objective has a unique code, e.g. **9Bs.01**. These codes appear in the *Schemes of Work, Teacher Guide* and other Cambridge Lower Secondary resources. Each learning objective code includes:

- the stage number, e.g. **9Bs.01**
- a reporting code that appears in the feedback reports for tests and reflects the sub-strand titles, e.g. **9Bs.01**
- a number reflecting the order of the learning objectives in the sub-strand for the stage, e.g. **9Bs.01**.

Stage 7

Thinking and Working Scientifically

Models and representations

- **7TWSm.01** Describe the strengths and limitations of a model.
- **7TWSm.02** Use symbols and formulae to represent scientific ideas.

Scientific enquiry: purpose and planning

- **7TWSp.01** Identify whether a given hypothesis is testable.
- **7TWSp.02** Describe how scientific hypotheses can be supported or contradicted by evidence from an enquiry.
- **7TWSp.03** Make predictions of likely outcomes for a scientific enquiry based on scientific knowledge and understanding.
- **7TWSp.04** Plan a range of investigations of different types, while considering variables appropriately, and recognise that not all investigations can be fair tests.
- **7TWSp.05** Know the meaning of hazard symbols, and consider them when planning practical work.

Carrying out scientific enquiry

- **7TWSa.01** Sort, group and classify phenomena, objects, materials and organisms through testing, observation, using secondary information, and making and using keys.
- **7TWSa.02** Decide what equipment is required to carry out an investigation or experiment and use it appropriately.
- **7TWSa.03** Evaluate whether measurements and observations have been repeated sufficiently to be reliable.
- **7TWSa.04** Take appropriately accurate and precise measurements, explaining why accuracy and precision are important.
- **7TWSa.05** Carry out practical work safely.
- **7TWSa.06** Evaluate a range of secondary information sources for their relevance and know that some sources may be biased.
- **7TWSa.07** Collect and record sufficient observations and/or measurements in an appropriate form.

Scientific enquiry: analysis, evaluation and conclusions

- **7TWSa.01** Describe the accuracy of predictions, based on results, and suggest why they were or were not accurate.
- **7TWSa.02** Describe trends and patterns in results, including identifying any anomalous results.
- **7TWSa.03** Make conclusions by interpreting results and explain the limitations of the conclusions.
- **7TWSa.04** Evaluate experiments and investigations, and suggest improvements, explaining any proposed changes.
- **7TWSa.05** Present and interpret observations and measurements appropriately.

Biology

Structure and function

- **7Bs.01** Understand that all organisms are made of cells and microorganisms are typically single celled.
- **7Bs.02** Identify and describe the functions of cell structures (limited to cell membrane, cytoplasm, nucleus, cell wall, chloroplast, mitochondria and sap vacuole).
- **7Bs.03** Explain how the structures of some specialised cells are related to their functions (including red blood cells, neurones, ciliated cells, root hair cells and palisade cells).
- **7Bs.04** Describe the similarities and differences between the structures of plant and animal cells.
- **7Bs.05** Understand that cells can be grouped together to form tissues, organs and organ systems.

Life processes

- **7Bp.01** Describe the seven characteristics of living organisms.
- **7Bp.02** Discuss reasons for classifying viruses as living or non-living.
- **7Bp.03** Describe a species as a group of organisms that can reproduce to produce fertile offspring.
- **7Bp.04** Use and construct dichotomous keys to classify species and groups of related organisms.

Ecosystems

- **7Be.01** Know and describe the ecological role some microorganisms have as decomposers.
- **7Be.02** Construct and interpret food chains and webs which include microorganisms as decomposers.

Chemistry

Materials and their structure

- **7Cm.01** Understand that all matter is made of atoms, with each different type of atom being a different element.
- **7Cm.02** Know that the Periodic Table presents the known elements in an order.
- **7Cm.03** Know metals and non-metals as the two main groupings of elements.
- **7Cm.04** Describe the differences between elements, compounds and mixtures, including alloys as an example of a mixture.
- **7Cm.05** Describe a vacuum as a space devoid of matter.
- **7Cm.06** Describe the three states of matter as solid, liquid and gas in terms of the arrangement, separation and motion of particles.
- **7Cm.07** Use the particle model to represent elements, compounds and mixtures.

Properties of materials

- **7Cp.01** Understand that all substances have chemical properties and physical properties.
- **7Cp.02** Understand that the acidity or alkalinity of a substance is a chemical property and is measured by pH.
- **7Cp.03** Use indicators (including Universal Indicator and litmus) to distinguish between acidic, alkaline and neutral solutions.
- **7Cp.04** Use tests to identify hydrogen, carbon dioxide and oxygen gases.
- **7Cp.05** Describe common differences between metals and non-metals, referring to their physical properties.
- **7Cp.06** Understand that alloys are mixtures that have different chemical and physical properties from the constituent substances.
- **7Cp.07** Use the particle model to explain the difference in hardness between pure metals and their alloys.

Changes to materials

- **7Cc.01** Identify whether a chemical reaction has taken place through observations of the loss of reactants and/or the formation of products which have different properties to the reactants (including evolving a gas, formation of a precipitate or change of colour).
- **7Cc.02** Explain why a precipitate forms, in terms of a chemical reaction between soluble reactants forming at least one insoluble product.
- **7Cc.03** Use the particle model to describe chemical reactions.
- **7Cc.04** Describe neutralisation reactions in terms of change of pH.

Physics

Forces and energy

- **7Pf.01** Describe changes in energy that are a result of an event or process.
- **7Pf.02** Know that energy tends to dissipate and in doing so it becomes less useful.
- **7Pf.03** Describe gravity as a force of attraction between any two objects and describe how the size of the force is related to the masses of the objects.
- **7Pf.04** Understand that there is no air resistance to oppose movement in a vacuum.

Light and sound

- **7Ps.01** Describe the vibration of particles in a sound wave and explain why sound does not travel in a vacuum.
- **7Ps.02** Explain echoes in terms of the reflection of sound waves.

Electricity and magnetism

- **7Pe.01** Use a simple model to describe electricity as a flow of electrons around a circuit.
- **7Pe.02** Describe electrical conductors as substances that allow electron flow and electrical insulators as substances that inhibit electron flow.
- **7Pe.03** Know how to measure the current in series circuits.
- **7Pe.04** Describe how adding components into a series circuit can affect the current (limited to addition of cells and lamps).
- **7Pe.05** Use diagrams and conventional symbols to represent, make and compare circuits that include cells, switches, lamps, buzzers and ammeters.

Earth and Space

Planet Earth

- **7ESp.01** Describe the model of plate tectonics, in which a solid outer layer (made up of the crust and uppermost mantle) moves because of flow lower in the mantle.
- **7ESp.02** Describe how earthquakes, volcanoes and fold mountains occur near the boundaries of tectonic plates.
- **7ESp.03** Know that clean, dry air contains 78% nitrogen, 21% oxygen and small amounts of carbon dioxide and other gases, and this composition can change because of pollution and natural emissions.

Cycles on Earth

- **7ESc.01** Describe the water cycle (limited to evaporation, condensation, precipitation, water run-off, open water and groundwater).

Earth in space

- **7ESs.01** Describe how planets form from dust and gas, which are pulled together by gravity.
- **7ESs.02** Know that gravity is the force that holds components of the Solar System in orbit around the Sun.
- **7ESs.03** Describe tidal forces on Earth as a consequence of the gravitational attraction between the Earth, Moon and Sun.
- **7ESs.04** Explain how solar and lunar eclipses happen.

Science in Context

- **7SIC.01** Discuss how scientific knowledge is developed through collective understanding and scrutiny over time.
- **7SIC.02** Describe how science is applied across societies and industries, and in research.
- **7SIC.03** Evaluate issues which involve and/or require scientific understanding.
- **7SIC.04** Describe how people develop and use scientific understanding, as individuals and through collaboration, e.g. through peer-review.
- **7SIC.05** Discuss how the uses of science can have a global environmental impact.

Stage 8

Thinking and Working Scientifically

Models and representations

- **8TWSm.01** Describe what an analogy is and how it can be used as a model.
- **8TWSm.02** Use an existing analogy for a purpose.
- **8TWSm.03** Use symbols and formulae to represent scientific ideas.

Scientific enquiry: purpose and planning

- **8TWSp.01** Identify whether a given hypothesis is testable.
- **8TWSp.02** Describe how scientific hypotheses can be supported or contradicted by evidence from an enquiry.
- **8TWSp.03** Make predictions of likely outcomes for a scientific enquiry based on scientific knowledge and understanding.
- **8TWSp.04** Plan a range of investigations of different types, while considering variables appropriately, and recognise that not all investigations can be fair tests.
- **8TWSp.05** Make risk assessments for practical work to identify and control risks.

Carrying out scientific enquiry

- **8TWSa.01** Sort, group and classify phenomena, objects, materials and organisms through testing, observation, using secondary information, and making and using keys.
- **8TWSa.02** Decide what equipment is required to carry out an investigation or experiment and use it appropriately.
- **8TWSa.03** Evaluate whether measurements and observations have been repeated sufficiently to be reliable.
- **8TWSa.04** Take appropriately accurate and precise measurements, explaining why accuracy and precision are important.
- **8TWSa.05** Carry out practical work safely, supported by risk assessments where appropriate.
- **8TWSa.06** Evaluate a range of secondary information sources for their relevance and know that some sources may be biased.
- **8TWSa.07** Collect and record sufficient observations and/or measurements in an appropriate form.

Scientific enquiry: analysis, evaluation and conclusions

- **8TWSa.01** Describe the accuracy of predictions, based on results, and suggest why they were or were not accurate.
- **8TWSa.02** Describe trends and patterns in results, including identifying any anomalous results.
- **8TWSa.03** Make conclusions by interpreting results and explain the limitations of the conclusions.
- **8TWSa.04** Evaluate experiments and investigations, and suggest improvements, explaining any proposed changes.
- **8TWSa.05** Present and interpret observations and measurements appropriately.

Biology

Structure and function

- **8Bs.01** Identify ball-and-socket and hinge joints, and explain how antagonistic muscles move the bones at a hinge joint.
- **8Bs.02** Describe the components of blood and their functions (limited to red blood cells transporting oxygen, white blood cells protecting against pathogens and plasma transporting blood cells, nutrients and carbon dioxide).
- **8Bs.03** Describe how the structure of the human respiratory system is related to its function of gas exchange (in terms of lung structure and the action of the diaphragm and intercostal muscles) and understand the difference between breathing and respiration.
- **8Bs.04** Describe the diffusion of oxygen and carbon dioxide between blood and the air in the lungs.

Life processes

- **8Bp.01** Identify the constituents of a balanced diet for humans as including protein, carbohydrates, fats and oils, water, minerals (limited to calcium and iron) and vitamins (limited to A, C and D), and describe the functions of these nutrients.
- **8Bp.02** Understand that carbohydrates and fats can be used as a store of energy in animals, and animals consume food to obtain energy and nutrients.
- **8Bp.03** Discuss how human growth, development and health can be affected by lifestyle, including diet and smoking.
- **8Bp.04** Know that aerobic respiration occurs in the mitochondria of plant and animal cells, and gives a controlled release of energy.
- **8Bp.05** Know and use the summary word equation for aerobic respiration (glucose + oxygen -> carbon dioxide + water).

Ecosystems

- **8Be.01** Identify different ecosystems on the Earth, recognising the variety of habitats that exist within an ecosystem.
- **8Be.02** Describe the impact of the bioaccumulation of toxic substances on an ecosystem.
- **8Be.03** Describe how a new and/or invasive species can affect other organisms and an ecosystem.

Chemistry

Materials and their structure

- **8Cm.01** Describe the Rutherford model of the structure of an atom.
- **8Cm.02** Know that electrons have negative charge, protons have positive charge and neutrons have no charge.
- **8Cm.03** Know that the electrostatic attraction between positive and negative charge is what holds together individual atoms.
- **8Cm.04** Know that purity is a way to describe how much of a specific chemical is in a mixture.

Properties of materials

- **8Cp.01** Understand that the concentration of a solution relates to how many particles of the solute are present in a volume of the solvent.
- **8Cp.02** Describe how paper chromatography can be used to separate and identify substances in a sample.

Changes to materials

- **8Cc.01** Use word equations to describe reactions.
- **8Cc.02** Know that some processes and reactions are endothermic or exothermic, and this can be identified by temperature change.
- **8Cc.03** Describe the reactivity of metals (limited to sodium, potassium, calcium, magnesium, zinc, iron, copper, gold and silver) with oxygen, water and dilute acids.
- **8Cc.04** Know that reactions do not always lead to a single pure product and that sometimes a reaction will produce an impure mixture of products.
- **8Cc.05** Describe how the solubility of different salts varies with temperature.
- **8Cc.06** Understand that some substances are generally unreactive and can be described as inert.

Physics

Forces and energy

- **8Pf.01** Calculate speed ($\text{speed} = \text{distance} / \text{time}$).
- **8Pf.02** Interpret and draw simple distance / time graphs.
- **8Pf.03** Describe the effects of balanced and unbalanced forces on motion.
- **8Pf.04** Identify and calculate turning forces ($\text{moment} = \text{force} \times \text{distance}$).
- **8Pf.05** Explain that pressure is caused by the action of a force, exerted by a substance, on an area ($\text{pressure} = \text{force} / \text{area}$).
- **8Pf.06** Use particle theory to explain pressures in gases and liquids (qualitative only).
- **8Pf.07** Describe the diffusion of gases and liquids as the intermingling of substances by the movement of particles.

Light and sound

- **8Ps.01** Describe reflection at a plane surface and use the law of reflection.
- **8Ps.02** Describe refraction of light at the boundary between air and glass or air and water in terms of change of speed.
- **8Ps.03** Know that white light is made of many colours and this can be shown through the dispersion of white light, using a prism.
- **8Ps.04** Describe how colours of light can be added, subtracted, absorbed and reflected.

Electricity and magnetism

- **8Pe.01** Describe a magnetic field, and understand that it surrounds a magnet and exerts a force on other magnetic fields.
- **8Pe.02** Describe how to make an electromagnet and know that electromagnets have many applications.
- **8Pe.03** Investigate factors that change the strength of an electromagnet.

Earth and Space

Planet Earth

- **8ESp.01** Know that the reason the Earth has a magnetic field is that the core acts as a magnet.
- **8ESp.02** Identify renewable resources (including wind, tidal and solar power, and bioplastics) and non-renewable resources (including fossil fuels), and describe how humans use them.

Cycles on Earth

- **8ESc.01** Understand that there is evidence that the Earth's climate exists in a cycle between warm periods and ice ages, and the cycle takes place over long time periods.
- **8ESc.02** Understand that the Earth's climate can change due to atmospheric change.
- **8ESc.03** Describe the difference between climate and weather.

Earth in space

- **8EsSs.01** Describe a galaxy in terms of stellar dust and gas, stars and planetary systems.
- **8EsSs.02** Describe asteroids as rocks, smaller than planets, and describe their formation from rocks left over from the formation of a planetary system.

Science in Context

- **8SIC.01** Discuss how scientific knowledge is developed through collective understanding and scrutiny over time.
- **8SIC.02** Describe how science is applied across societies and industries, and in research.
- **8SIC.03** Evaluate issues which involve and/or require scientific understanding.
- **8SIC.04** Describe how people develop and use scientific understanding as individuals and through collaboration, e.g. through peer-review.
- **8SIC.05** Discuss how the uses of science can have a global environmental impact.

Stage 9

Thinking and Working Scientifically

Models and representations

- **9TWSm.01** Understand that models and analogies reflect current scientific evidence and understanding and can change.
- **9TWSm.02** Describe some important models, including analogies, and discuss their strengths and limitations.
- **9TWSm.03** Use symbols and formulae to represent scientific ideas.

Scientific enquiry: purpose and planning

- **9TWSp.01** Suggest a testable hypothesis based on scientific understanding.
- **9TWSp.02** Describe examples where scientists' unexpected results from enquiries have led to improved scientific understanding.
- **9TWSp.03** Make predictions of likely outcomes for a scientific enquiry based on scientific knowledge and understanding.
- **9TWSp.04** Plan a range of investigations of different types to obtain appropriate evidence when testing hypotheses.
- **9TWSp.05** Make risk assessments for practical work to identify and control risks.

Carrying out scientific enquiry

- **9TWSa.01** Sort, group and classify phenomena, objects, materials and organisms through testing, observation, using secondary information, and making and using keys.
- **9TWSa.02** Decide what equipment is required to carry out an investigation or experiment and use it appropriately.
- **9TWSa.03** Decide when to increase the range of observations and measurements, and increase the extent of repetition, to give sufficiently reliable data.
- **9TWSa.04** Take appropriately accurate and precise measurements, explaining why accuracy and precision are important.
- **9TWSa.05** Carry out practical work safely, supported by risk assessments where appropriate.
- **9TWSa.06** Make an informed decision whether to use evidence from first-hand experience or secondary sources.
- **9TWSa.07** Collect, record and summarise sufficient observations and measurements, in an appropriate form.

Scientific enquiry: analysis, evaluation and conclusions

- **9TWSa.01** Evaluate the strength of the evidence collected and how it supports, or refutes, the prediction.
- **9TWSa.02** Describe trends and patterns in results, identifying any anomalous results and suggesting why results are anomalous.
- **9TWSa.03** Make conclusions by interpreting results, explain the limitations of the conclusions and describe how the conclusions can be further investigated.
- **9TWSa.04** Evaluate experiments and investigations, including those by others, and suggest improvements, explaining any proposed changes.
- **9TWSa.05** Present and interpret results, and predict results between the data points collected.

Biology

Structure and function

- **9Bs.01** Describe the pathway of water and mineral salts from the roots to the leaves in flowering plants, including absorption in root hair cells, transport through xylem and transpiration from the surface of leaves.
- **9Bs.02** Describe the structure of the human excretory (renal) system and its function (limited to kidneys filtering blood to remove urea, which is excreted in urine).
- **9Bs.03** Know that chromosomes contain genes, made of DNA, and that genes contribute to the determination of an organism's characteristics.

Life processes

- **9Bp.01** Describe the fusion of gametes to produce a fertilised egg with a new combination of DNA.
- **9Bp.02** Describe the inheritance of sex in humans in terms of XX and XY chromosomes.
- **9Bp.03** Describe variation within a species and relate this to genetic differences between individuals.
- **9Bp.04** Describe the scientific theory of natural selection and how it relates to genetic changes over time.
- **9Bp.05** Know that plants require minerals to maintain healthy growth and life processes (limited to magnesium to make chlorophyll and nitrates to make protein).
- **9Bp.06** Know that photosynthesis occurs in chloroplasts and is the process by which plants make carbohydrates, using the energy from light.
- **9Bp.07** Know and use the summary word equation for photosynthesis (carbon dioxide + water -> glucose + oxygen, in the presence of light and chlorophyll).
- **9Bp.08** Discuss how fetal development is affected by the health of the mother, including the effect of diet, smoking and drugs.

Ecosystems

- **9Be.01** Describe what could happen to the population of a species, including extinction, when there is an environmental change.

Chemistry

Materials and their structure

- **9Cm.01** Understand that the structure of the Periodic Table is related to the atomic structure of the elements and the Periodic Table can be used to predict an element's structure and properties.
- **9Cm.02** Understand that a molecule is formed when two or more atoms join together chemically, through a covalent bond.
- **9Cm.03** Describe a covalent bond as a bond made when a pair of electrons is shared by two atoms (limited to single bonds).
- **9Cm.04** Describe an ion as an atom which has gained at least one electron to be negatively charged or lost at least one electron to be positively charged.
- **9Cm.05** Describe an ionic bond as an attraction between a positively charged ion and a negatively charged ion.

Properties of materials

- **9Cp.01** Understand that the groups within the Periodic Table have trends in physical and chemical properties, using group 1 as an example.
- **9Cp.02** Describe how the density of a substance relates to its mass in a defined volume.
- **9Cp.03** Calculate and compare densities of solids, liquids and gases.
- **9Cp.04** Know that elements and compounds exist in structures (simple or giant), and this influences their physical properties.

Changes to materials

- **9Cc.01** Use word equations and symbol equations to describe reactions (balancing symbol equations is not required).
- **9Cc.02** Identify examples of displacement reactions and predict products (limited to reactions involving calcium, magnesium, zinc, iron, copper, gold and silver salts).
- **9Cc.03** Describe how to prepare some common salts by the reactions of metals with acids, and metal carbonates with acids, and purify them, using filtration, evaporation and crystallisation.
- **9Cc.04** Describe the effects of concentration, surface area and temperature on the rate of reaction, and explain them using the particle model.
- **9Cc.05** Understand that in chemical reactions mass and energy are conserved.

Physics

Forces and energy

- **9Pf.01** Use density to explain why objects float or sink in water.
- **9Pf.02** Describe the difference between heat and temperature.
- **9Pf.03** Know that energy is conserved, meaning it cannot be created or destroyed.
- **9Pf.04** Know that thermal energy will always transfer from hotter regions or objects to colder ones, and this is known as heat dissipation.
- **9Pf.05** Describe thermal transfer by the processes of conduction, convection and radiation.
- **9Pf.06** Explain cooling by evaporation.

Light and sound

- **9Ps.01** Draw and interpret waveforms, and recognise the link between loudness and amplitude, pitch and frequency.
- **9Ps.02** Use waveforms to show how sound waves interact to reinforce or cancel each other.

Electricity and magnetism

- **9Pe.01** Describe how current divides in parallel circuits.
- **9Pe.02** Know how to measure current and voltage in series and parallel circuits, and describe the effect of adding cells and lamps.
- **9Pe.03** Calculate resistance (resistance = voltage / current) and describe how resistance affects current.
- **9Pe.04** Use diagrams and conventional symbols to represent, make and compare circuits that include cells, switches, resistors (fixed and variable), ammeters, voltmeters, lamps and buzzers.

Earth and Space

Planet Earth

- **9ESp.01** Explain the movement of tectonic plates in terms of convection currents.
- **9ESp.02** Explain why the jigsaw appearance of continental coasts, location of volcanoes and earthquakes, fossil record and alignment of magnetic materials in the Earth's crust are all evidence for tectonic plates.

Cycles on Earth

- **9ESc.01** Describe the carbon cycle (limited to photosynthesis, respiration, feeding, decomposition and combustion).
- **9ESc.02** Describe the historical and predicted future impacts of climate change, including sea level change, flooding, drought and extreme weather events.

Earth in space

- **9ESs.01** Describe the consequences of asteroid collision with the Earth, including climate change and mass extinctions.
- **9ESs.02** Describe the evidence for the collision theory for the formation of the Moon.
- **9ESs.03** Know that nebulae are clouds of dust and gas, and can act as stellar nurseries.

Science in Context

- **9SIC.01** Discuss how scientific knowledge is developed through collective understanding and scrutiny over time.
- **9SIC.02** Describe how science is applied across societies and industries, and in research.
- **9SIC.03** Evaluate issues which involve and/or require scientific understanding.
- **9SIC.04** Describe how people develop and use scientific understanding as individuals and through collaboration, e.g. through peer-review.
- **9SIC.05** Discuss how the uses of science can have a global environmental impact.

4 Glossary

This glossary is provided to support your understanding of the content of this *Curriculum Framework*. The definitions are intended to be sufficient to guide an informed reader.

Analogy – a comparison between one thing and another for the purpose of explanation which acts as a model for a scientific idea or concept.

Breathing – the process of air moving into and out of the lungs due to the contraction and relaxation of the diaphragm and intercostal muscles. This definition is specific to breathing in mammals, including humans.

Climate – the general weather conditions in an area over a long period of time.

Diagram – a scientific representation of a concept, experiment or observation.

Experiment – a specific procedure carried out to support, disprove or validate all, or part of, a scientific hypothesis. Experiments are often part of a wider investigation but not always.

Hypothesis – a scientific theory or proposed explanation made on the basis of evidence which can be further tested.

Investigation – a method of acquiring scientific knowledge based on a starting question. A scientific investigation often involves experiments but not always, e.g. using secondary sources of information to carry out a literature review.

Learning objective - statements from the *Curriculum Framework* of the expectations of knowledge, understanding and skills that learners will develop; they provide a structure for teaching and learning, and a reference against which to check learners' ability and skills development.

Material – a type of substance or common mixture of substances. For example, wood is a material, although it is made of a mixture of substances. Metal is often a material type, although there are many metals.

Mixture – a sample which contains more than one substance or material.

Model – demonstrate scientific understanding of a concept through the use of a scientific model. For example, making a paper skeleton models a human skeleton and how the different bones are arranged. Drawing multiple diagrams of particles in a solid demonstrates understanding of how particles in a solid behave.

Object – a visible and tangible item composed of one or more materials and/or substances.

Representation – a way of showing scientific understanding of phenomena by means of diagrams, equations (word or symbol) or other models.

Respiration – a biochemical process which involving the release of energy through the reaction of oxygen with complex organic substances, such as carbohydrates.

Scheme of Work – support materials for each stage of Cambridge Lower Secondary Science. Each *Scheme of Work* contains a suggested long-term plan, a medium-term plan with suggested activities and sample short-term (lesson) plans.

Strand – a collection of learning objectives in the *Curriculum Framework* that forms an area of learning.

Substance – matter which is composed of a single thing. For example, oxygen is a substance, but air is a mixture. Iron is a substance, but steel is made of iron mixed with other substances; steel is therefore a material and not a single substance.

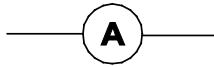
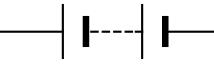
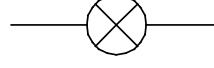
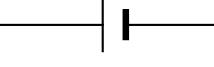
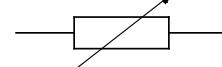
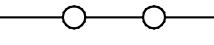
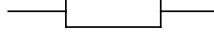
Teacher Guide – the document providing support in using the *Curriculum Framework* to plan and deliver lessons using effective teaching and learning approaches.

Weather – the conditions in the air above the Earth such as wind, rain or temperature over a particular area at a particular time.

5 Appendix

Electrical symbols

Learners are expected to be able to recall and use the standard electrical symbols listed below.

Ammeter		Junction of conductors	
Battery of cells		Lamp	
Buzzer		Open switch	
Cell		Variable resistor	
Closed switch		Voltmeter	
Fixed resistor		Wire	

Hazard symbols

Learners are expected to be able to recall and recognise the hazard symbols listed below as part of Cambridge Lower Secondary science.

Acutely toxic		Corrosive	
Flammable		Hazardous to the environment	
Moderate hazard		Health hazard	

Symbols and units for physical quantities

Learners should be able to give the symbols for the following physical quantities and, where indicated, state the units in which they are measured.

Learners should be familiar with the following multipliers: m milli, c centi, k kilo, M mega.

Quantity	Expected symbols	Expected units
Length (used for length, height and width)	l, h, w	mm, cm, m, km
Area	A	m^2, cm^2
Volume	V	ml, l, cm^3, m^3
Weight	W	N
Mass	m, M	g, kg
Time	t	s, min, h
Force	F	N
Gravitational field strength	g	N/kg
Temperature	T	$^\circ\text{C}$
Distance	s, d	cm, m, km
Density	ρ	$\text{g/cm}^3, \text{kg/m}^3$
Speed	u, v	cm/s, m/s, km/h
Energy	E	J, kJ, MJ
Pressure	p	N/m^2
Frequency	f	Hz, kHz
Amplitude	A	mm, cm, m
Wavelength	λ	mm, cm, m
Angle of incidence	i	Degree ($^\circ$)
Angle of reflection, refraction	r	Degree ($^\circ$)
Voltage	V	V, mV
Current	I	A, mA
Resistance	R	V/A, Ω
Mass concentration	No symbol is required in Cambridge Lower Secondary Science	$\text{g/cm}^3, \text{kg/m}^3$
Moment	M	Nm

Table of formulae

Learners should be able to recall and use the following formulae:

Formulae	Word form	Symbol form (if required)
Aerobic respiration	glucose + oxygen \rightarrow carbon dioxide + water	
Photosynthesis	carbon dioxide + water \rightarrow glucose + oxygen, in the presence of light and chlorophyll	
Speed	speed = distance / time	$v = s / t$ or $v = d / t$
Moment	moment = force \times distance	$M = Fs$ or $M = Fd$
Pressure	pressure = force / area	$p = F / A$
Density	density = mass / volume	$\rho = m / V$
Resistance	resistance = voltage / current	$R = V / I$

Learners should be aware of and be able to use the following formulae:

Formulae	Word form
Mass concentration	Mass concentration of a solute in solution = mass of the solute / volume of the mixture

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
Tel: +44 (0)1223 553554 Fax: +44 (0)1223 553558
Email: info@cambridgeinternational.org www.cambridgeinternational.org

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