Science: Grade 8

ENGLISH Program

Discipline Overview

Science is systematic exploration, observation, experimentation, and evidence-based reasoning used to build an understanding of the natural world. It emerges from human curiosity and employs creativity, imagination, and intuition to uncover new knowledge.

Science comprises an established body of knowledge and provides a philosophical framework for generating new insight into the natural world. Science is shaped by historical, political, economic, environmental, and societal factors, which are integral to understanding its significance as a valuable human endeavour.

Science is foundational for understanding natural phenomena, solving problems, and developing new technology. Through the study of science, learners become scientifically literate; they expand their knowledge, develop critical thinking and data analysis skills, and learn to evaluate procedures effectively. Scientific literacy equips learners to critically engage with information, make informed decisions, and address complex issues on both personal and societal levels. Science education fosters responsible citizenship, nurtures curiosity, and encourages interdisciplinary thinking through connections with mathematics, engineering, arts, languages, physical health, and the social sciences.

In Manitoba, Kindergarten to Grade 10 science education rests on the following five strands:

- **Indigenous Peoples within the Natural World:** Indigenous Peoples—First Nations, Métis, and Inuit—have always engaged in scientific ways of knowing, being, and doing. All learners of science benefit from developing an understanding of how different Indigenous communities interpret the natural world, apply scientific principles, and create technologies in interrelated and sustainable ways.
- **Science Identity:** Throughout history, people from diverse backgrounds have played roles in the development of science, and all people, societies, and environments are affected by science and technology. All learners must be empowered to see themselves as participants in the collective scientific endeavour.
- **Practical Science:** This strand includes STSE (science, technology, society, and environment) contexts, measurement, actions and practices, scientific instruments, and the awareness of science application in careers, hobbies, and activities. All learners must be equipped with scientific skills and attitudes to take action for the betterment of society and for a sustainable future.

Manitoba

- **Nature of Science:** This strand includes the purpose, methods, applications, and implications of scientific inquiry. All learners must develop the scientific confidence needed to navigate the complexities of an information-rich environment, including differentiating between legitimate scientific information, pseudoscience, misinformation, and disinformation.
- **Scientific Knowledge:** This strand includes information, concepts, principles, theories, and facts that have been acquired, tested, and validated through the systematic process of scientific inquiry. All learners must acquire a fundamental core knowledge base to become scientifically literate citizens.

Scientific Knowledge and Nature of Science learning outcomes are organized around building an understanding of 14 big ideas* in and about science. Ten big ideas in science are addressed via Scientific Knowledge learning outcomes that are unique to every grade level, while four big ideas about science are investigated through the Nature of Science strand in four progressive grade bands. The contribution of different First Nations, Inuit, and Métis groups are studied in the Indigenous Peoples within the Natural World strand, while connecting all learners to science inclusively is addressed in the Science Identity strand. The Practical Science learning outcomes emphasize that science is active and participatory.

These intertwined strands of learning outcomes put learners on a pathway of increasing scientific literacy. Learners develop their global competencies, which allow them to engage authentically with the curriculum and build enduring understandings of science.

Course Overview

In **Grade 8**, learners expand science exploration and further their science literacy. They investigate density, solar energy, Earth's internal structure, and homeostasis. The knowledge areas of **matter, fields, energy, Earth science,** and **life science** provide a foundation for study. An active and practical approach to learning and doing science continues in Grade 8. This includes conducting scientific investigations, furthering tool and measurement skills, exploring science in everyday life, and looking into how science interacts with society and the environment. Learners develop their agency and sense of belonging in science, and explore Indigenous ways of knowing, being, and doing, including through interacting with the local community and learning in nature. The Grades 7 to 9 band of the Nature of Science learning outcomes continues with an exploration of the **purpose, method, application,** and **implications** of science.

Inquiry questions to help guide learning and planning for the year may include the following:

- How do the nature of the particles that make up matter influence the properties of materials?
- How does solar energy travel to Earth, and what effects does it have on the planet?
- How are living things organized at the cellular level?

Please see documents in the curriculum implementation resources section for more information on how to use this curriculum.

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* Harlen, Wynne, editor. *Working with Big Ideas of Science Education*. Science Education Program (SEP) of IAP (InterAcademy Partnership), 2015. Available online at https://www.interacademies.org/publication/working-big-ideas-science-education.

Global Competencies in Science

Critical Thinking

Critical thinking in science involves using evidence based on observation, experience, and experimentation to test ideas, solve problems, and deepen scientific knowledge; critical thinking is an essential aspect of scientific inquiry. Critical thinkers use various processes and wide sources of evidence to distinguish accurate and reliable information from biased information or misinformation. Thinking critically leads to the discovery of relationships within and among various phenomena. Through scientific critical thinking, theories are formed and tested; they are reinforced, challenged, shifted, or abandoned.

When critical thinking as a competency is applied in science, learners

- use strategic, efficient, and effective research skills to find and use reliable sources
- display scientifically valid skepticism when evaluating sources of information for bias, reliability, and relevance
- observe, test, and experiment to explore and connect ideas, patterns, and relationships, using scientific criteria and evidence
- reflect on a position from multiple scientific perspectives and defend, adjust, or change position based on scientific evidence and feedback from peers
- are willing to ask scientifically relevant questions to further their understanding
- make judgments based on the best available scientific evidence, observations, and experiences
- weigh criteria to make ethical scientific decisions when their actions may affect themselves, others, living things, or the environment

Creativity

Creativity in science drives the exploration of scientific ideas, processes, problems, and issues. Science is a deeply creative process aimed at generating new ideas, designing innovative products and processes, and producing evidence to support well-informed decision-making. Scientific thinkers use imagination and evidence to build theories and models that explain phenomena in the physical world, and they design experiments to test those theories. This process may lead to shifts in human understanding and to new technologies.

When creativity as a competency is applied in science, learners

- demonstrate initiative, open-mindedness, inventiveness, flexibility, and a willingness to take prudent risks
- demonstrate curiosity about the natural world, ask scientifically relevant questions, and are comfortable playing with ideas

- employ scientific strategies to solve problems by applying knowledge and ideas in innovative ways
- deepen their understanding of scientific concepts by building on the ideas of their peers and endeavouring to see the world through a variety of lenses
- create plans and adjust them as needed in product design or to experimentally investigate a problem
- test and adapt plans used during inquiry, design, or decision-making processes, and persevere through obstacles to improve

Citizenship

Citizenship in science involves a recognition and an understanding of the consequences of scientific decisions and practices on oneself, others, and the natural world. Scientific approaches to knowledge acquisition recognize the fallibility of human faculties, including natural human biases and the limitations of perception. Citizenship in science involves participating in a process of peer review and acknowledging the breadth and depth of people and cultures that contribute to understanding the physical world. The world's accumulated scientific knowledge serves to help sustain the world. It should be ethically gathered, willingly shared, and passed from generation to generation.

When citizenship as a competency is applied in science, learners

- understand that science often deals with complex issues, on which varying perspectives may exist
- explore the interconnectedness of self, others, and the natural world
- evaluate factors and propose scientifically valid solutions considerate of the well-being of self, others, and the natural world
- welcome diverse scientific viewpoints because they understand that contributions to science come from those with varied backgrounds, experiences, and world views
- are respectful of their peers' perspectives, including those that do not fit their own
- communicate with their science community in responsible, respectful, and inclusive ways
- contribute to the betterment of community both near and far, in doing scientific investigations
- seek equitable solutions to scientific issues that support diversity, inclusivity, and human rights
- make ethical decisions based on evidence, which have a positive and sustainable impact on self, others, and the natural world

Connection to Self

Connection to self in science involves learners developing confidence in their abilities in science and a positive relationship to science. Scientific thinking is a skill that can be developed, and it has valuable applications to daily life. The practice of science involves prudent risk taking, exercising curiosity, analytical evaluation of beliefs, and a willingness to grow and change based on verifiable information. Engaging in scientific practice teaches individual resiliency and perseverance, and promotes an understanding of one's place in the natural world.

When connection to self as a competency is applied in science, learners

- acknowledge their personal interests, strengths, gifts, and challenges in making connections between science and their lives
- come to know factors that shape their scientific identity and to understand that everyone is a scientist
- understand and use strategies to support self-regulation during scientific investigations and when receiving peer feedback
- reflect on their scientific decisions, effort, and experience, and accept that acknowledging feedback from others is part of the scientific process
- set goals to strengthen their scientific learning progress and well-being, as part of the scientific process
- recognize that a scientific understanding of the natural world can instill hope and optimism about the future
- are resilient and persevere through obstacles, recognizing that they will learn from mistakes and build upon their successes
- demonstrate the ability to critically evaluate their own ideas and beliefs, and are open-minded to adapt and change in response to new evidence
- value their own voice, build their confidence, and embrace their role as lifelong science learners

Collaboration

Collaboration in science involves learning with and from others to develop scientific ideas and processes. The process of peer review and the seeking of expert consensus are valued practices in the scientific endeavour. The advancement of science often occurs through collaboration among scientists and teams of scientists.

When collaboration as a competency is applied in science, learners

- seek to understand diverse perspectives, voices, and ideas, seeing these as integral components of the scientific process
- understand that in science, new ideas often build upon the contributions and ideas of others

- value the scientific contributions of others
- participate in the process of asking scientific questions of themselves and others and actively listening to responses
- contribute by working through differences, and show a willingness to compromise or change perspective in response to scientific evidence, as participating members of scientific teams
- collaboratively gather and interpret empirical data, striving for a shared understanding of its scientific meaning
- commit to their role as part of a team with a collective purpose toward a common goal in inquiry, design, and decision-making processes

Communication

Communication in science involves interaction with others to share scientific ideas and information in diverse contexts. The clear communication of scientific information is a vital part of the scientific endeavour. What is communicated as scientific knowledge must be credible, open to interrogation by experts, testable, and verifiable. Scientific communication often conveys information in mathematical, graphical, and technical formats, and must acknowledge the limitations and uncertainties inherent in quantitative empirical investigations. The language and symbols within narrow fields often become extremely specialized. Communication among fields, and from scientific communities to the public, often requires interpretation by teachers, journalists, and other science communicators.

When communication as a competency is applied in science, learners

- express ideas and organize information, including uncertainty and error, clearly and succinctly using appropriate scientific terminology and representations
- use multiple modes and forms of communication, which take into account purpose, context, and audience, to share scientific ideas
- understand how their words and actions shape their identity, whether in person or online
- use their scientific background and context cues to enhance understanding of scientific communications
- seek to understand the scientific perspective of their peers through active listening and questioning
- deepen their understanding of scientific ideas by making connections and building relationship through conversation, discussion, and interaction in a variety of contexts and through varied media
- advocate for themselves and others in constructive and responsible ways to strengthen their scientific community

Enduring Understandings

Science is about explaining phenomena.

Science explains the cause or causes of phenomena observed in the natural world using various scientific practices.

Science is a collective endeavour.

Science is a collective human endeavour that discovers laws, builds models, and formulates theories that best fit the empirical evidence available at a particular time.

Science is interconnected with technology.

In science, there is a symbiotic relationship between scientific understandings and technological developments for the solution of problems.

Science has complex implications.

Science and its applications have ethical, social, personal, economic, political, cultural, and environmental implications, such as considerations of sustainability and social justice.

Science empowers human agency.

Science fosters curiosity that supports the development of a science identity, a lifelong interest in science, and the ability to make informed decisions and have agency in everyday life.

Learning Outcomes

Science learning outcomes are organized into five strands. These strands and learning outcomes are intended to be woven together throughout all learning experiences while supporting the development of global competencies. All strands equally and cohesively build scientific literacy, skills, and attitudes, inclusive of Indigenous ways and knowledge. Teachers can tailor curriculum implementation to the learners' specific interests and needs.

Legend

Include the following = cumpulsory content

Examples/e.g., = suggestions for learning

Learning Outcome Key

Subject ↓ *Strand* ↓

SCI.K.A.1

↑ *Grade Level* ↑ *Learning Outcome*

Strand A: Indigenous Peoples within the Natural World

SCI.8.A.1 Demonstrate an understanding of different First Nations, Métis, and Inuit ways of knowing, being, and doing in relationship with the land and the natural world by exploring Indigenous methods of observing and interpreting the world, applying scientific principles, and creating technologies within local traditional and contemporary cultural contexts (e.g., wholistic, reciprocal, interconnected, and sustainable ways; land-based learning; outdoor learning; intersections with Western science).

Strand B: Science Identity

SCI.8.SI.1 Develop a sense of agency, identity, and belonging in science by

- cultivating natural curiosity about the world
- acquiring scientific skills and fostering scientific attitudes
- building a personal connection to nature
- establishing links between science concepts and personal experience
- recognizing that everyone can contribute to science

Strand C: Practical Science

Science, Technology, Society, and Environment (STSE) Contexts

SCI.8.C.1 Demonstrate an awareness of the dynamic interplay between science, technology, society, and the environment (STSE), thereby being empowered to critically evaluate the impacts of scientific and technological advancements on individuals, communities, and ecosystems, and to make informed decisions for a sustainable future.

Examples: phase changes in everyday contexts (refrigeration technology, food science); phase change and weather (precipitation, cloud formation); solar energy harvesting; various electromagnetic (EM) radiation technologies (radio, cellphone, microwave); Sun safety; effects of tectonics on daily life, including natural disasters and hazards; Indigenous uses of rocks and minerals; human-caused climate change and sustainable alternatives; conservation and protection of land, water, and ecosystems; Indigenous teachings related to water and land; cellular level technologies; lifestyle and cardiovascular health

Scientific Measurement

SCI.8.C.2 Demonstrate an understanding of units, measuring tools, and the nature of measurement in science. (**Bold** indicates items introduced for the first time at this grade level.)

Include the following:

- Tools: thermometer, ruler, pan balance, balance, volumetric vessels, **barometer, spectrometer**
- Attributes: length, mass, volume, time, temperature, speed, force, direction, energy, **density, pressure**
- Units: length (km, m, cm, mm), mass (kg, g), volume (L, mL), time (h, min, s), temperature (°C), speed (km/h, m/s), force (N), energy (J), **density (kg/m^3, g/cm^3), pressure (kPa, Pa)**
- Skills: measure and estimate using standard SI tools and units; select measurement tools; display quantitative data (charts, line graphs, tables, etc.); recognize importance of standard units; convert between SI length, time, and volume units; understand the meaning of SI prefixes and their symbols (micro, milli, centi, deci, deka, hecto, kilo, mega); describe the **definition and relationship between SI units m and kg (historical and modern definitions)**

Action and Practice

SCI.8.C.3 Demonstrate practical scientific skills through safely and actively participating in a variety of scientific practices such as inquiry-based learning experiences, experimentation, scientific observation, data analysis, measurement, debate, communicating scientific information, and designing and building.

Examples:

- Participate in learning experiences that include an Indigenous community member (e.g., Elder, Knowledge Holder, Knowledge Keeper) to share knowledge, experience, or teachings related to the curriculum.
- Conduct a fair test to identify which factors determine whether a given object will float or sink, and discuss reasons why scientists control some variables when conducting a fair test.
- Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- Analyze the design and function of a technology that incorporates electromagnetic radiation (e.g., microwave oven, solar cooker, sun tanning lamp, infrared heat lamp, radio, medical imaging X-ray, blacklight, ultraviolet [UV] fire detector, night vision goggles, infrared thermography, and radar) on the basis of learner-identified criteria such as cost, usefulness, and impact on self, society, and the environment.
- Design and carry out an experiment to demonstrate the function of selectively permeable membranes in cells.
- Identify Workplace Hazardous Materials Information System (WHMIS) symbols that provide information on the safety of substances.

Scientific Instruments

SCI.8.C.4 Demonstrate an understanding of the purpose and function of various scientific instruments and materials (considering availability and appropriateness), as well as competence in using them safely.

Examples:

microscope, prism, glassware, hot plate, chemical substances, craft and recycled materials, classroom materials, materials from nature, logbook, diagrams, charts, graphs, spreadsheets, safety procedures

Careers, Hobbies, and Activities

SCI.8.C.5 Demonstrate an understanding of the connections between the scientific ideas studied and a range of careers, hobbies, and activities.

Examples:

painter, solar energy technician, materials scientist, mechanic, electric vehicle (EV) specialist, medical doctor, gardening, artist, photography, ethnobotany and medicinal use of plants, cooking and baking, hiking, swimming, rowing, rock climbing, hockey

Strand D: Nature of Science (Grades 7 to 9 Band)

Purpose: Science is about finding the cause or causes of phenomena in the natural world.

SCI.8.D.1 Demonstrate the understanding that empirical data must be systematically collected, and conclusions reviewed, to detect potential errors and minimize bias.

Include the following: peer review, types of bias.

SCI.8.D.2 Demonstrate an understanding of the nature of scientific predictions, and how they are tested.

Include the following: hypothesis, experiment, variables.

Method: Scientific explanations, theories, and models are those that best fit the evidence available at a particular time.

SCI.8.D.3 Demonstrate the understanding that models are metaphorical representations of phenomena used to aid understanding or better explain what is happening.

Examples: physical model, mathematical model, simulation

SCI.8.D.4 Demonstrate the understanding that scientific models may be well established (e.g., Solar System model) while others are more tentative (e.g., black hole model).

Application: The knowledge produced by science is used in engineering and technologies to create products and processes.

SCI.8.D.5 Demonstrate the understanding that many factors play a role in finding optimal solutions to problems.

Examples: available materials; effects on humans and other animals; environmental effects; costs

SCI.8.D.6 Demonstrate the understanding that seeking solutions to problems often involves employing a variety of strategies before an actual solution is determined.

Example: drawings, models, mathematical modelling, computer simulations

Implication: Applications of science often have ethical, environmental, social, economic, and political implications.

SCI.8.D.7 Demonstrate the understanding that technologies that improve human life can have predictable as well as unforeseen detrimental consequences.

Examples: medicine; improved agriculture and overpopulation; overproduction and pollution; resources and space depletion; and extinction

SCI.8.D.8 Demonstrate the understanding that sometimes, when detrimental effects of a technology are revealed, the trade-off between the advantages and consequences of continued use must be carefully considered.

Include the following: fossil fuels and climate change; paper usage and biodiversity; cell phones and social health.

Strand E: Scientific Knowledge

Matter: All matter in the universe is made of very small particles.

SCI.8.E.1 Demonstrate an understanding of the nature of density as a physical property of matter.

Include the following: mass, volume, density, d=m/v.

SCI.8.E.2 Demonstrate an understanding of the effect of temperature on density using the particle theory of matter.

Include the following: solids, liquids, gases.

SCI.8.E.3 Demonstrate an understanding of the nature of viscosity as a physical property of a fluid.

Example: viscosity-temperature relationship

SCI.8.E.4 Demonstrate an understanding of the relationship between temperature, volume, and pressure using the particle theory of matter.

Include the following: water, steam, vapor, ice, compressibility.

SCI.8.E.5 Demonstrate an understanding of how the nature of attractions between particles in a substance dictate how much energy is required to cause their temperatures and phases to change.

SCI.8.E.6 Demonstrate the understanding that water has properties caused by the nature of its particles, which make it important to climate and vital to living things.

Include the following: heat capacity, boiling and melting point, liquid and solid density difference, universal solvent, transport, humidity, precipitation.

Fields: Objects can affect other objects at a distance.

SCI.8.E.7 Demonstrate the understanding that energy from the Sun travels through empty space to Earth, where it is absorbed or reflected by the atmosphere, hydrosphere, and lithosphere.

Include the following: radiation, electromagnetic waves, solar spectrum, albedo.

Energy: The total amount of energy in the universe is always the same but can be transferred from one energy store to another during an event.

SCI.8.E.8 Demonstrate an understanding of the nature of solar radiation.

Include the following: electromagnetic waves, visible light, solar spectrum.

SCI.8.E.9 Demonstrate an understanding of various types of electromagnetic radiation with respect to relative energy, frequency, wavelength, and applications.

Examples: photosynthesis, visible light, x-rays, microwaves, radio waves, infrared ultraviolet (UV), Sun safety, mutation

Earth Science: The composition of Earth and its atmosphere and the processes occurring within them shape Earth's surface and its climate.

SCI.8.E.10 Demonstrate an understanding of the physical structure and physical properties of Earth.

Include the following: crust, mantle, outer core, inner core.

SCI.8.E.11 Demonstrate an understanding of the factors contributing to Earth's internal heat.

Examples: residual heat during Earth's formation (accretional heat), nuclear heat, frictional heat)

SCI.8.E.12 Demonstrate the understanding that tectonic activity due to Earth's internal heat leads to various types of geological activity.

Include the following: tectonic plates, continental drift, faults, mountain ranges, earthquakes, volcanoes, geysers, hot springs.

SCI.8.E.13 Demonstrate the understanding that solar energy heats the surface of Earth.

Examples: Sun's radiation energy, transparent atmosphere, albedo, soil thermal properties

SCI.8.E.14 Demonstrate an understanding of the role of water in shaping the features of Earth's surface.

Examples: erosion, deposition, precipitation, flooding, glaciers, ice age, watersheds

SCI.8.E.15 Demonstrate a basic understanding that all energy arriving at Earth from the Sun eventually radiates back into space.

Include the following: energy budget.

SCI.8.E.16 Demonstrate an understanding of how the Sun's radiation provides energy to plants through the process of photosynthesis.

Include the following: chlorophyll, glucose, food chain, food pyramid.

SCI.8.E.17 Demonstrate an understanding of the mechanisms of the greenhouse effect in raising temperatures on Earth.

Include: greenhouse gases, infrared radiation, energy budget, energy balance, atmosphere, natural versus human accelerated greenhouse effect.

Life Science: Organisms are organized on a cellular basis and have a finite life span.

SCI.8.E.18 Demonstrate an understanding of cell theory.

Include the following: all living things are composed of one or more cells; cells are the basic unit of structure and function of any organism; all cells come from pre-existing cells; the activity of an organism depends on the total activity of all its cells.

SCI.8.E.19 Demonstrate the understanding that various types of cells have particular conditions that are ideal for their growth.

SCI.8.E.20 Demonstrate the understanding that cells have specialized structures for particular functions.

Include the following: organelle, cytoplasm, cell membrane, cell wall, nucleus, mitochondria, chloroplast, vacuole.

SCI.8.E.21 Demonstrate an understanding of the structural and functional relationships among cells, tissues, organs, and organ systems.

Include the following: stem cells, specialized cells.

SCI.8.E.22 Demonstrate the understanding that in living things, cells contribute to homeostasis to maintain conditions required for life.

Examples: cellular respiration, pH balance, osmosis, diffusion, selective permeability

SCI.8.E.23 Demonstrate an understanding of the structure and function of the human circulatory system in maintaining homeostasis.

Examples: heart, blood, blood components, blood vessels, oxygen, waste, water, temperature regulation

Curriculum Implementation Resources

Curriculum implementation resources will include supplementary documents to support implementation. This section and the support documents will continue to be updated, so you are encouraged to visit the site regularly.