Science: Grade 7 Pilot

ENGLISH Program

Discipline Overview

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

Science contains a body of established 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 endeavor.

In Manitoba, the K–10 Science education rests on the following five dimensions:

- **Indigenous People within the Natural World** – First Nations, Métis, and Inuit have always engaged in scientific ways of knowing, doing and being; 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, peoples 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.
- **Scientific Knowledge** – 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.
- **Practical Science** – STSE (Science, Technology, Society, and Environment) contexts, measurement, actions and practices, scientific instruments and 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 a sustainable future.
- **Nature of Science** – The purpose, methods, applications, and implications of scientific inquiry; all learners must develop the scientific confidence to navigate the complexities of an information rich environment, including differentiating between legitimate scientific information, pseudoscience, misinformation, and disinformation.

These intertwined dimensions, within which rest a structure of curricular outcomes, put learners on a continuous pathway of increasing scientific literacy. Learners develop their global competencies, which in turn allow them to engage authentically with the curriculum and build enduring understandings of science.

Manitoba

Science is foundational for understanding natural phenomena, solving problems, and in the development of 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 not only fosters responsible citizenship but also nurtures curiosity and encourages interdisciplinary thinking through connections with mathematics, engineering, arts, languages, physical health, and the social sciences.

Course Overview

The Manitoba K–10 science curriculum is constructed with five categories of learning outcomes: Indigenous Peoples within the Natural world, Science Identity, Scientific Knowledge, Practical Science and Nature of Science. Scientific Knowledge and Nature of Science outcomes are organized around building an understanding of fourteen Big Ideas[1] in and about science. Ten Big Ideas in science are addressed via Scientific Knowledge outcomes which are unique to every grade level, while four Big Ideas about science are investigated through the Nature of Science category 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 category, while connecting all students to science inclusively is addressed in the Science Identity category. The Practical Science outcomes emphasize that science is active and participatory.

In **Grade 7**, learners continue to investigate science and bolster science literacy. They study particle interaction, gravity and its effects on orbital objects, energy transfer and ecosystems. The knowledge areas of **matter, fields, energy, space science,** and **life systems** provide a foundation for study. The fundamentals for an active and practical approach to learning and doing science carry on in Grade 7. 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 continue to develop their agency and sense of belonging in science. In Grade 7, they have many opportunities to explore Indigenous ways of knowing, being and doing, including through interacting with local community and land-based learning. The Grades 7–9 band of the NOS outcomes begin with an exploration of the **purpose, method, application,** and **implications** of science. Suggested guiding inquiry questions for the year are:

- What is matter made of?
- What is the role of gravity on Earth and in the solar system?
- How does energy move on Earth, in ecosystems, and through space?

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

1 See BISE document.

Global Competencies in Science

Critical Thinking

Critical thinking in science involves using empirical evidence 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 good information from bad. Thinking critically leads to the discovery of relationships within and between various phenomena. Through scientific critical thinking, theories are formed and tested; they are reinforced, challenged, shifted, or abandoned.

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 judgements 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 involves the exploration of scientific ideas, processes, problems, and issues. Science is a creative process with the goals of generating new ideas, products, processes and producing evidence for well-informed decision making. Scientific thinkers use the best available evidence to build theories to explain phenomena in the physical world, and they create experiments to test those theories. This process may lead to shifts in human understanding, and to new technologies.

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 their knowledge and ideas in innovative ways.
- deepen their understanding of scientific concepts by building on the ideas of their peers and endeavoring to see the world through a variety of lenses.
- create plans and adjust them as needed to experimentally investigate a problem or in product design.
- 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 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 the limitations of perception and natural human biases. Citizenship in science involves participating in a process of peer review and acknowledging that people from all cultures and backgrounds have contributed understandings of the physical world. The world's accumulated scientific knowledge serves to help sustain and better humanity and the environment; it should be ethically gathered, willingly shared, and passed from generation to generation.

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, even those that do not fit their own.
- communicate with their science community in a 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 which 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 which can be learned, and which 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, perseverance, and promotes an understanding of one's place in the natural world.

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 to new evidence.
- value their own voice, build their confidence and embrace their role as life-long science learners.

Collaboration

Collaboration in science involves learning with and from others to elaborate 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 amongst scientists and teams of scientists.

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 towards 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 endeavor. 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 becomes extremely specialized. Communication between fields, and from scientific communities to the public, often requires interpretation by teachers, journalists, and other science communicators.

Learners

- express ideas and organize information clearly and succinctly using appropriate scientific terminology and representations, including uncertainty and error.
- use multiples modes and forms of communication to share scientific ideas, which account for purpose, context, and audience.
- understand how their words and actions shape their identity both in person and 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 in K to 12 Science

Science is about explaining phenomena.

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

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.

Science 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, ethics, or social justice.

Science empowers human agency.

Science fosters curiosity and develops a science identity which supports a lifelong interest and informs decision making and agency in everyday life.

Learning Outcomes

Indigenous Peoples within the Natural World Outcome

SCI.7.INW.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, intersections with Western science, etc.).

Science Identity Outcome

SCI.7.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.

Practical Science Outcomes

Science, Technology, Society and Environment (STSE) Contexts

SCI.7.PS.1 Demonstrate an awareness of the dynamic interplay between science, technology, society, and the environment (STSE), empowering learners to critically evaluate the impacts of scientific and technological advancements on individuals, communities, and ecosystems, and to make informed decision for a sustainable future.

Examples: particle theory and its contribution to science and technology; chemistry of cooking; heat capacity of water and life; historical and modern understanding of the apparent motion of celestial bodies; celestial bodies and various significance and teachings; humans in space; current and future space missions; climate change; heating, cooling and insulating technologies; renewable and non-renewable energy generation; biodiversity and sustainability; conservation and protection of land, water and ecosystems; sustainable resource management; ethnobotany; wildlife-human interactions and coexistence; etc.

Scientific Measurement

SCI.7.PS.2 Demonstrate an understanding of the units, measuring tools, and nature of measurement in science*.

Include:

Tools: calendar, clock, thermometer, ruler, pan balance, balance, volumetric vessels, spring scale, **compass, astrolabe**

Attributes: length, weight, volume, time, temperature, speed, force, **direction, altitude, energy**

Units: length (km, m, cm, mm), weight (kg, g), volume (L, mL), time (h, min, s), temperature (°C), speed (km/h, m/s), force (N), **direction (compass coordinates), altitude (degrees), energy (J)**

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 meaning of SI prefixes and their symbols (micro, milli, centi, deci, deka, hecto, kilo, mega), **understand the purpose, utility, and immutability of the metric system**

* **Bold** indicates items introduced for the first time at this grade level

Action and Practice

SCI.7.PS.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, design and build, etc.

Examples:

- Invite an Elder and Knowledge Keeper to share Indigenous Teachings.
- Follow established safety procedures for working with heating appliances and hot materials (e.g., switch hot plates off immediately after use, use tongs and insulated mitts for carrying hot materials).
- Explain how evidence gathered while investigating states of matter and changes in states of matter supports or refutes the particle theory of matter.
- Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- Use a technological problem-solving process to design, construct, and evaluate a prototype of a device that will provide a solution to a practical problem related to heating or cooling (e.g., cooking food, keeping food warm or cool for an extended period, keeping a shelter warm or cool, keeping a person warm or cool).
- Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- Etc.

Scientific Instruments

SCI.7.PS.4 Demonstrate an understanding of the purpose and functioning of various scientific instruments and materials (considering availability and appropriateness), as well as competence in using them safely.

Examples:

telescope, binoculars, glassware, hot plate, chemical substances, craft and recycled materials, classroom materials, nature materials, logbook, diagrams, charts, graphs, spreadsheets, safety procedures, etc.

Careers, Hobbies and Activities

SCI.7.PS.5 Demonstrate an understanding of the connections between the scientific ideas studied and a range of careers, hobbies, and activities.

Examples:

physicist, astronomer, HVAC technician, heating and cooling engineer, ecologist, dance, sailing, boating, fitness, composting, gardening, traditional practices of hunting, trapping, fishing and picking, stargazing, track and field events, baseball, etc.

Nature of Science Outcomes (7–9 Band)

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

SCI.7.NOS.1 Demonstrate an understanding that empirical data must be systematically collected, and conclusions reviewed, to detect potential errors and minimize bias.

Include: peer review, types of bias

SCI.7.NOS.2 Demonstrate an understanding of the nature of scientific predictions, and how they are tested.

Include: hypothesis, experiment, variable

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

SCI.7.NOS.3 Demonstrate an understanding that models are metaphorical representations of phenomena used to aid understanding or better explain what is happening.

Examples: physical model, mathematical model, simulation, etc.

SCI.7.NOS.4 Demonstrate an 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 to serve human ends.

SCI.7.NOS.5 Demonstrate an understanding that many factors play a role in finding optimal solutions to problems.

Examples: costs, available materials, human effects, environmental effects, etc.

SCI.7.NOS.6 Demonstrate an understanding that finding solutions to problems often involves employing a variety of strategies before an actual solution is created.

Example: drawings, models, mathematical modelling, computer simulations, etc.

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

SCI.7.NOS.7 Demonstrate an understanding that technologies that improve human life can have predictable as well as unforeseen detrimental consequences.

Examples: medicine, improved agriculture and over population; over production and pollution; resources and space depletion, and extinction, etc.

SCI.7.NOS.8 Demonstrate an understanding that sometimes, when detrimental effects of a technology are revealed, the trade-off between the advantages of continuing to use it, and the consequences of continued use must be carefully considered.

Include: fossil fuels and climate change

Knowledge Outcomes

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

SCI.7.SK.1 Demonstrate an understanding of the particle theory of matter and its significance to understanding the properties and behaviors of substances in the three different states of matter.

SCI.7.SK.2 Demonstrate an understanding of how adding or removing energy affects the speed, and therefore, the kinetic energy of particles in matter.

Include: temperature change, state change, conservation of mass during state change, freezing, melting, evaporation, condensation, sublimation

SCI.7.SK.3 Demonstrate an understanding that boiling and melting points are different in different substances due to variations in attraction between the particles that make up the substance.

Fields: Objects can affect other objects at a distance.

SCI.7.SK.4 Demonstrate an understanding that gravity is a universal attractive force between objects, extends infinitely, and increases with the masses of the objects.

SCI.7.SK.5 Demonstrate an understanding that the gravitational force on objects on Earth is observed as a downward force on the object called weight.

Include: mass, Newton (N), weight differences on Moon or other planets

SCI.7.SK.6 Demonstrate an understanding of the role of gravity in the orbits of planets and various satellites.

SCI.7.SK.7 Demonstrate an understanding that tides result from the gravitational interaction between the moon and large bodies of water.

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.7.SK.8 Demonstrate an understanding that when an object is heated, it has more energy than when it is cold.

SCI.7.SK.9 Demonstrate an understanding of the principles of heat transfer from a hot object.

Include: conduction, convection, radiation, thermal equilibrium, thermal insulator, thermal conductor

SCI.7.SK.10 Demonstrate an understanding that many phenomena can be understood in terms of energy exchanges.

Example: weather, growth of plants, etc.

SCI.7.SK.11 Demonstrate an understanding that when energy is transferred from a store, it can make things happen, and energy is ultimately dissipated to the environment as heat in the process.

Include: efficiency

Space Science: Our solar system is a very small part of one of billions of galaxies in the Universe.

SCI.7.SK.12 Demonstrate an understanding of the scale and structure of the solar system and the nature of the bodies it contains.

Include: Sun as central star, eight known planets and their types, orbital distances, Moon, Moon phases, orbit, rotation, revolution, solar and lunar eclipses, sizes of celestial bodies

SCI.7.SK.13 Demonstrate an understanding that the apparent motion of the Sun, Moon and stars is caused by the rotation of Earth.

SCI.7.SK.14 Demonstrate an understanding of the observed motion of planets in relation to background stars.

Include: Earth's rotation and revolution

SCI.7.SK.15 Demonstrate an understanding of the extent of human space exploration and related technologies.

Example: crewed and un-crewed missions, rockets, probes, rovers, satellites, etc.

SCI.7.SK.16 Demonstrate an understanding of the astronomical significance of lines of latitude and longitude.

Include: seasons, time-zones, global climate patterns, equinox, solstice, tropics, equator, Arctic/Antarctic circle

Life Systems: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.

SCI.7.SK.17 Demonstrate an understanding of the concept and nature of a self-sustaining ecosystem.

Example: habitat, population, community, etc.

SCI.7.SK.18 Demonstrate an understanding of photosynthesis.

Include: energy, chlorophyll, glucose

SCI.7.SK.19 Demonstrate an understanding of energy transfer in ecosystems.

Include: Sun, energy loss, food chain, food web, ecological pyramid

SCI.7.SK.20 Demonstrate an understanding of the roles of organisms at various trophic levels, and their importance in sustaining an ecosystem.

Include: producers (autotrophs), consumers (heterotrophs), decomposers

SCI.7.SK.21 Demonstrate an understanding of the nature of competition for resources within an ecosystem.

Example: energy, nutrients, water, space, etc.

SCI.7.SK.22 Demonstrate an understanding of the need for the recycling of nutrients, and the replenishing of energy within ecosystems.

SCI.7.SK.23 Demonstrate an understanding of the potential affects on plants and animals in an ecosystem when conditions change.

Example: loss of food source, loss of habitat, polluted water, climate change, etc.

Curriculum Implementation Resources

Curriculum implementation resources will include supplementary documents to support implementation. Feedback during the pilot phase will guide the development of the Curriculum Implementation Resources section.