Ministry of Education

Saskatchewan Curriculum

Science

7

2009

Science 7
ISBN 978-1-926631-08-0
1. Study and teaching (Middle school) - Saskatchewan - Curricula. 2. Competency-based education - Saskatchewan.
Saskatchewan. Ministry of Education. Curriculum and E-Learning. Science and Technology Unit.

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The Ministry of Education also wishes to thank many others who contributed to the development of this curriculum:

- former Science Reference Committee members
- First Nations Elders and teachers
- university faculty members
- other educators and reviewers.

Introduction

Science is a Required Area of Study in Saskatchewan's Core Curriculum. The provincial requirement for Grade 7 Science is 150 minutes of instruction per week (Saskatchewan Learning, 2007).

The purpose of this curriculum is to outline the provincial requirements for Grade 7 Science. This curriculum provides the intended learning outcomes that Grade 7 students are expected to achieve in science by the end of the year. Indicators are included to provide the breadth and depth of what students should know and be able to do in order to achieve the learning outcomes.

This renewed curriculum reflects current science education research, updated technology, and recently developed resources, and is responsive to changing demographics within the province. This curriculum is based on the Pan-Canadian Protocol for Collaboration on School Curriculum Common Framework of Science Learning Outcomes K to 12 (Council of Ministers of Education, Canada [CMEC], 1997).

Inquiry into authentic student questions generated from student experiences is the central strategy for teaching science.
(National Research Council [NRC], 1996, p. 31)

The philosophy and spirit of science education in Saskatchewan is reflected in this curriculum, in the resources developed to support the new curriculum, and in materials designed and utilized to support curriculum implementation. In addition, the philosophy for science education builds on and supports the concept of Core Curriculum in Saskatchewan.

This curriculum includes the following information to support science instruction in Saskatchewan schools:

- connections to Core Curriculum, including the Broad Areas of Learning and Cross-curricular Competencies
- the K-12 aim and goals for science education
- characteristics of an effective science program
- Grade 7 Science outcomes and indicators
- sample assessment and evaluation criteria related to outcomes in science
- connections with other areas of study
- a glossary.

Using this Curriculum

Outcomes are statements of what students are expected to know and be able to do by the end of a grade in a particular area of study. The outcomes provide direction for assessment and evaluation, and for program, unit, and lesson planning.

Outcomes describe the knowledge, skills, and understandings that students are expected to attain by the end of a particular grade.

Critical characteristics of an outcome include the following:

- focus on what students will learn rather than what teachers will teach
- specify the skills and abilities, understandings and knowledge, and/or attitudes students are expected to demonstrate
- are observable, assessable, and attainable
- are written using action-based verbs and clear professional language (educational and subject-related)
- are developed to be achieved in context so that learning is purposeful and interconnected
- are grade and subject specific
- are supported by indicators which provide the breadth and depth of expectations
- have a developmental flow and connection to other grades where applicable.

Indicators are a representative list of the types of things a student should know or be able to do if they have attained the outcome.

Indicators are representative of what students need to know and/or be able to do in order to achieve an outcome. Indicators represent the breadth and the depth of learning related to a particular outcome. The list of indicators provided in the curriculum is not an exhaustive list. Teachers may develop additional and/or alternative indicators but those teacher-developed indicators must be reflective of and consistent with the breadth and depth that is defined by the given indicators.

Within the outcomes and indicators in this curriculum, the terms "including", "such as", and "e.g.," commonly occur. Each term serves a specific purpose:

- The term "including" prescribes content, contexts, or strategies that students must experience in their learning, without excluding other possibilities. For example, an indicator might say that students are to describe methods used to separate the components of mechanical mixtures and solutions, including mechanical sorting, filtration, evaporation, distillation, magnetism, and chromatography. This means that, although other methods of separating mechanical mixtures and solutions can be explored and described, it is mandatory that the six methods listed be included.

- The term "such as" provides examples of possible broad categories of content, contexts, or strategies that teachers or students may choose, without excluding other possibilities. For example, an indicator might include the phrase "such as R-value, cost, and resistance to water and air infiltration" as examples of different criteria used to evaluate the efficiency of different types of home insulation. This statement provides teachers and students with possible methods to consider, while not excluding other methods.
- Finally, the term "e.g.," offers specific examples of what a term, concept, or strategy might look like. For example, an indicator might include the phrase "e.g., potash, gold, diamond, salt, uranium, copper, and graphite" to refer to the types of primary mineral resources found in Saskatchewan.

Although the outcomes and indicators in the science curriculum are organized by units, teachers may organize their instruction using interdisciplinary or transdisciplinary themes. There is no requirement for teachers to structure instruction into four distinct science units.

Core Curriculum

Core Curriculum is intended to provide all Saskatchewan students with an education that will serve them well regardless of their choices after leaving school. Through its various components and initiatives, Core Curriculum supports the achievement of the Goals of Education for Saskatchewan. For current information regarding Core Curriculum, please refer to *Core Curriculum: Principles, Time Allocations, and Credit Policy* (Saskatchewan Learning, 2007).

The Broad Areas of Learning and Cross-curricular Competencies connect the specificity of the areas of study and the day-to-day work of teachers with the broader philosophy of Core Curriculum and the Goals of Education for Saskatchewan.

Broad Areas of Learning

There are three Broad Areas of Learning that reflect Saskatchewan's Goals of Education. Science education contributes to student achievement of the Goals of Education through helping students achieve knowledge, skills, and attitudes related to these Broad Areas of Learning.

Developing Lifelong Learners

Developing lifelong learners is related to the following Goals of Education:
- *Basic Skills*
- *Lifelong Learning*
- *Self Concept Development*
- *Positive Lifestyle.*

Students engaged in constructing and applying science knowledge naturally build a positive disposition towards learning. Throughout their study of science, students bring a natural curiosity about the natural and constructed world which provides the motivation to discover and explore their personal interests more deeply. By sharing their learning experiences with others, in a variety of contexts, students develop skills that support them as lifelong learners.

Developing a Sense of Self and Community

Developing a sense of self and community is related to the following Goals of Education:
- *Understanding & Relating to Others*
- *Self Concept Development*
- *Positive Lifestyle*
- *Spiritual Development.*

Students develop and strengthen their personal identity as they explore connections between their own understanding of the natural and constructed world and perspectives of others, including scientific and Indigenous perspectives. Students develop and strengthen their understanding of community as they explore ways in which science can inform individual and community decision making on issues related to the natural and constructed world.

Developing Engaged Citizens

Developing engaged citizens is related to the following Goals of Education:
- *Understanding & Relating to Others*
- *Positive Lifestyle*
- *Career and Consumer Decisions*
- *Membership in Society*
- *Growing with Change.*

As students explore connections between science, technology, society, and the environment, they experience opportunities to contribute positively to the environmental, economic, and social sustainability of local and global communities. Students reflect and act on their personal responsibility to understand and respect their place in the natural and constructed world, and make personal decisions that contribute to living in harmony with others and the natural world.

Cross-curricular Competencies

The Cross-curricular Competencies are four interrelated areas containing understandings, values, skills, and processes which are considered important for learning in all areas of study. These competencies reflect the Common Essential Learnings and are intended to be addressed in each area of study at each grade level.

Developing Thinking

K-12 Goals for Developing Thinking:
- *thinking and learning contextually*
- *thinking and learning creatively*
- *thinking and learning critically.*

Learners construct knowledge to make sense of the world around them. In science, students develop understanding by building and reflecting on their observations and what is already known by themselves and others. By thinking contextually, creatively, and critically, students develop deeper understanding of various phenomena in the natural and constructed world.

Developing Identity and Interdependence

This competency addresses the ability to act autonomously in an interdependent world. It requires the learner to be aware of the natural environment, of social and cultural expectations, and of the possibilities for individual and group accomplishments. Interdependence assumes the possession of a positive self-concept and the ability to live in harmony with others and with the natural and constructed world. In science, students examine the interdependence among living things within local, national, and global environments and consider the impact of individual decisions on those environments.

K-12 Goals for Developing Identity and Interdependence:
- *understanding, valuing, and caring for oneself*
- *understanding, valuing, and caring for others*
- *understanding and valuing social, economic, and environmental interdependence and sustainability.*

Developing Literacies

Literacies are multi-faceted and provide a variety of ways, including the use of various language systems and media, to interpret the world and express understanding of it. Literacies involve the evolution of interrelated knowledge, skills, and strategies that facilitate an individual's ability to participate fully and equitably in a variety of roles and contexts – school, home, and local and global communities. In science, students collect, analyze, and represent ideas and understanding of the natural and constructed world in multiple forms.

K-12 Goals for Developing Literacies:
- *developing knowledge related to various literacies*
- *exploring and interpreting the world through various literacies*
- *expressing understanding and communicating meaning using various literacies.*

Developing Social Responsibility

Social responsibility is how people positively contribute to their physical, social, cultural, and educational environments. It requires the ability to participate with others in accomplishing shared or common goals. This competency is achieved by using moral reasoning processes, engaging in communitarian thinking and dialogue, and taking social action. Students in science examine the impact of scientific understanding and technological innovations on society.

K-12 Goals for Developing Social Responsibility:
- *using moral reasoning processes*
- *engaging in communitarian thinking and dialogue*
- *taking social action.*

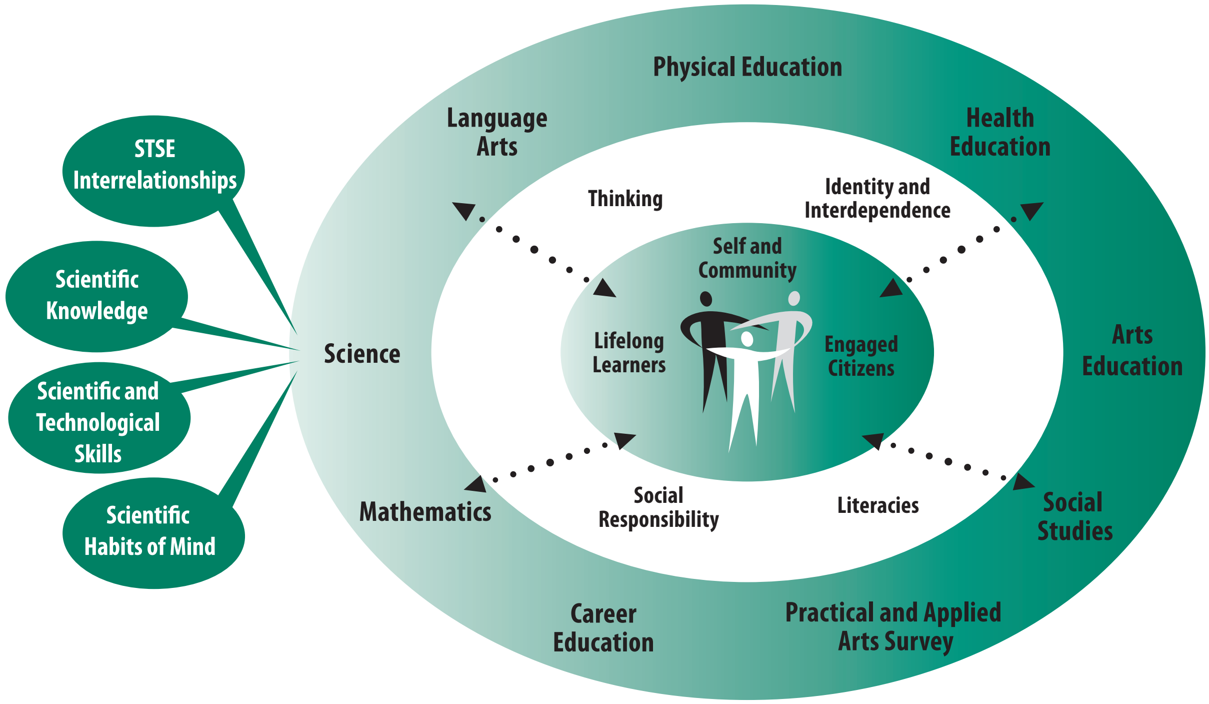
Aim and Goals

The aim of K-12 science education is to enable all Saskatchewan students to develop scientific literacy. Scientific literacy today embraces Euro-Canadian and Indigenous heritages, both of which have developed an empirical and rational knowledge of nature. A Euro-Canadian way of knowing about the natural and constructed world is called science, while First Nations and Métis ways of knowing nature are found within the broader category of Indigenous knowledge.

Diverse learning experiences based on the outcomes in this curriculum provide students with many opportunities to explore, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment (STSE) that will affect their personal lives, their careers, and their future.

Goals are broad statements identifying what students are expected to know and be able to do upon completion of the learning in a particular area of study by the end of Grade 12. The four goals of K-12 science education are to:

- **Understand the Nature of Science and STSE Interrelationships** – Students will develop an understanding of the nature of science and technology, their interrelationships, and their social and environmental contexts, including interrelationships between the natural and constructed world.
- **Construct Scientific Knowledge** – Students will construct an understanding of concepts, principles, laws, and theories in life science, in physical science, in earth and space science, and in Indigenous Knowledge of nature; and then apply these understandings to interpret, integrate, and extend their knowledge.
- **Develop Scientific and Technological Skills** – Students will develop the skills required for scientific and technological inquiry, problem solving, and communicating; for working collaboratively; and for making informed decisions.
- **Develop Attitudes that Support Scientific Habits of Mind** – Students will develop attitudes that support the responsible acquisition and application of scientific, technological, and Indigenous knowledge to the mutual benefit of self, society, and the environment.



Inquiry

Inquiry learning provides students with opportunities to build knowledge, abilities, and inquiring habits of mind that lead to deeper understanding of their world and human experience. Inquiry is more than a simple instructional method. It is a philosophical approach to teaching and learning, grounded in constructivist research and methods, which engages students in investigations that lead to disciplinary, interdisciplinary, and transdisciplinary understanding.

Inquiry builds on students' inherent sense of curiosity and wonder, drawing on their diverse backgrounds, interests, and experiences. The process provides opportunities for students to become active participants in a collaborative search for meaning and understanding.

Middle years students who are engaged in inquiry in science should be able to:

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.

Inquiry is intimately connected to scientific questions – students must inquire using what they already know and the inquiry process must add to their knowledge.
(NRC, 2000, p. 13)

- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make the relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.

(NRC, 1996, pp. 145, 148)

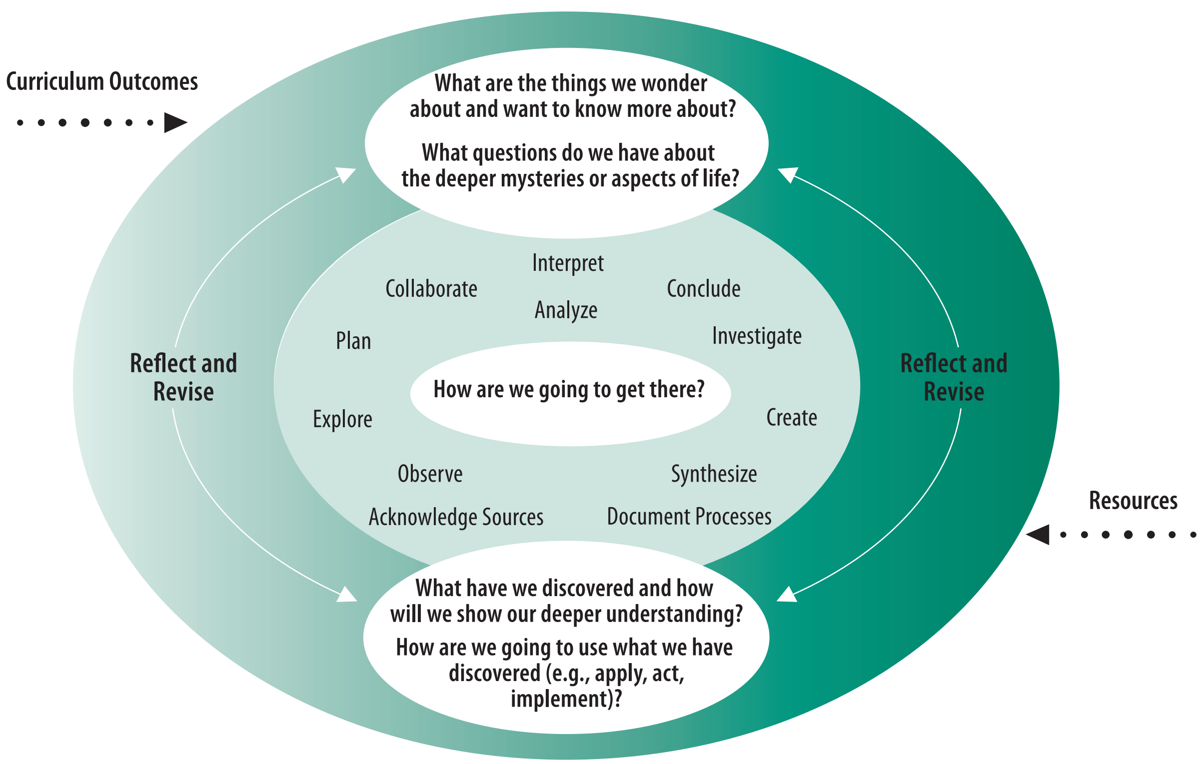
Students do not come to understand inquiry simply by learning words such as "hypothesis" and "inference" or by memorizing procedures such as "the steps of the scientific method".

(NRC, 2000, p. 14)

An important part of any inquiry process is student reflection on their learning and the documentation needed to assess the learning and make it visible. Student documentation of the inquiry process in science may take the form of works-in-progress, reflective writing, journals, reports, notes, models, arts expressions, photographs, video footage, or action plans.

Inquiry learning is not a step-by-step process, but rather a cyclical process, with various phases of the process being revisited and rethought as a result of students' discoveries, insights, and construction of new knowledge. Experienced inquirers will move back and forth among various phases as new questions arise and as students become more comfortable with the process. The following graphic shows various phases of the cyclical inquiry process.

Constructing Understanding Through Inquiry



Inquiry focuses on the development of questions to initiate and guide the learning process. These questions are formulated by teachers and students to motivate inquiries into topics, problems, and issues related to curriculum content and outcomes.

Well-formulated inquiry questions are broad in scope and rich in possibilities. Such questions encourage students to explore, observe, gather information, plan, analyze, interpret, synthesize, problem solve, take risks, create, conclude, document, reflect on learning, and develop new questions for further inquiry.

Creating Questions for Inquiry in Science

In science, teachers and students can use the four learning contexts as curriculum entry points to begin their inquiry; however, the process may evolve into transdisciplinary learning opportunities, as reflective of the holistic nature of our lives and interdependent global environment.

Good science inquiry provides many entry points – ways in which students can approach a new topic – and a wide variety of activities during student work.
(Kluger-Bell, 2000, p. 48)

It is essential to develop questions that are evoked by student interests and have potential for rich and deep learning. These questions are used to initiate and guide the inquiry and give students direction for investigating topics, problems, ideas, challenges, or issues under study.

The process of constructing questions for deep understanding can help students grasp the important disciplinary or transdisciplinary ideas that are situated at the core of a particular curricular focus or context. These broad questions lead to more specific questions that can provide a framework, purpose, and direction for the learning activities in a lesson, or series of lessons, and help students connect what they are learning to their experiences and life beyond school.

Essential questions that lead to deeper understanding in science should:
- *center on objects, organisms, and events in the natural world*
- *connect to science concepts outlined in the curricular outcomes*
- *lend themselves to empirical investigation*
- *lead to gathering and using data to develop explanations for natural phenomena.*

(NRC, 2000, p. 24)

Questions give students some initial direction for uncovering the understandings associated with a unit of study. Questions can help students grasp the big disciplinary ideas surrounding a focus or context and related themes or topics. They provide a framework, purpose, and direction for the learning activities in each unit and help students connect what they are learning to their experiences and life beyond the classroom. They also invite and encourage students to pose their own questions for deeper understanding.

Students should recognize that science is often unable to answer "why" questions; in these instances, scientists rephrase their inquiries into "how" questions.

An Effective Science Education Program

An effective science education program supports student achievement of learning outcomes through:

- foundations of scientific literacy
- learning contexts
- explanations, evidence, and modelling in science
- laboratory work
- safety
- technology in science
- science challenges.

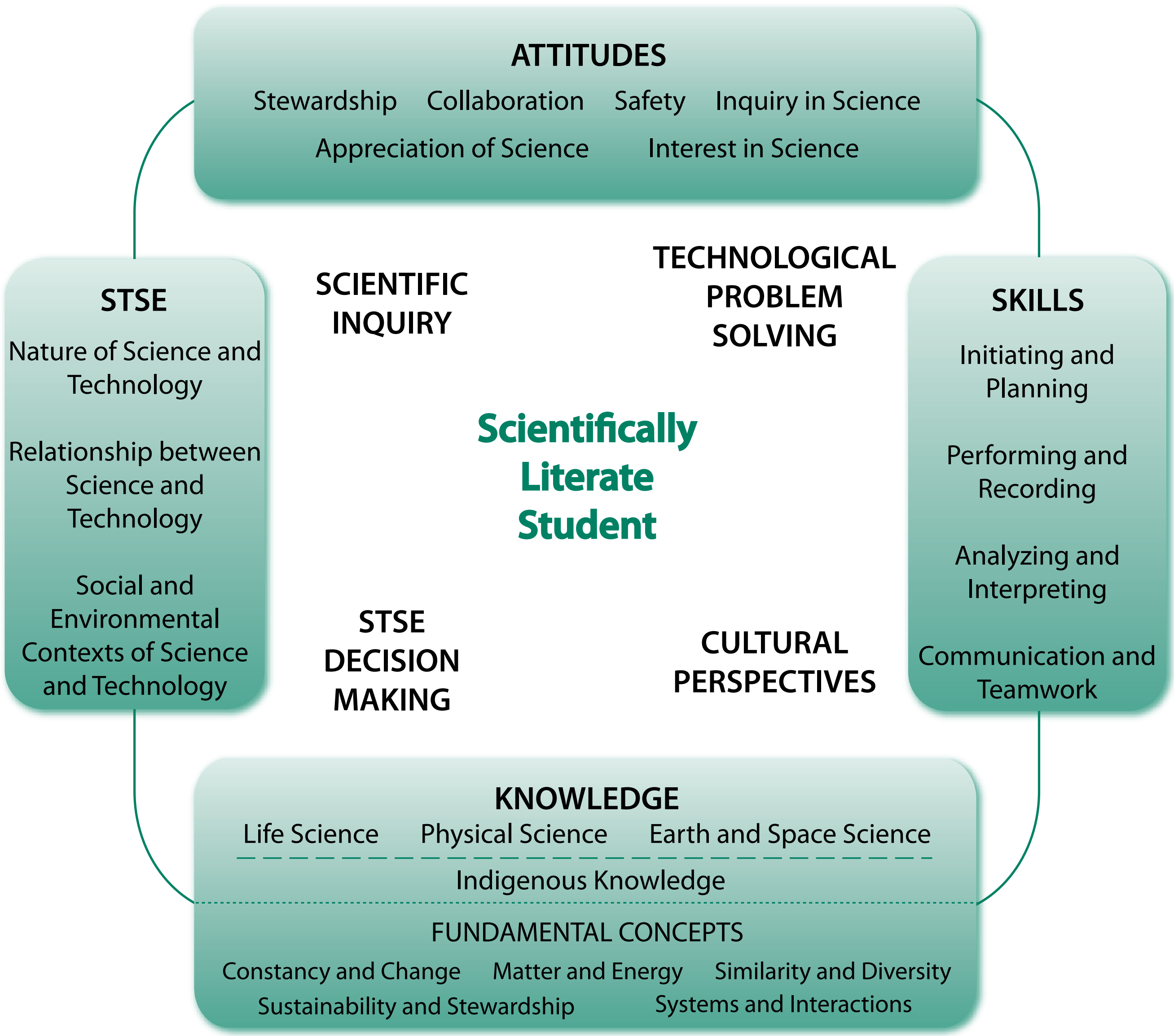
All science outcomes and indicators emphasize one or more foundations of scientific literacy; these represent the "what" of the curriculum. The learning contexts represent different processes for engaging students in achieving curricular outcomes; they are the "how" of the curriculum. The four units of study at each grade serve as an organizing structure for the curriculum.

Scientists construct models to support their explanations based on empirical evidence. Students need to engage in similar processes through authentic laboratory work. During their investigations, students must follow safe practices in the laboratory, as well as in regard to living things.

Technology serves to extending our powers of observation and to support the sharing of information. Students should use a variety of technology tools for data collection and analysis, for visualization and imaging, and for communication and collaboration, throughout the science curriculum.

To achieve the vision of scientific literacy outlined in this curriculum, students must increasingly become engaged in the planning, development, and evaluation of their own learning activities. In the process, students should have the opportunity to work collaboratively with others, to initiate investigations, to communicate findings, and to complete projects that demonstrate learning. Teachers and students may also choose to engage in science challenge activities as a means of achieving learning outcomes.

Scientific Literacy Framework



Foundations of Scientific Literacy

The K-12 goals of science education parallel the foundation statements for scientific literacy described in the *Common Framework of Science Learning Outcomes K to 12* (CMEC, 1997). These four foundation statements delineate the critical aspects of students' scientific literacy. They reflect the wholeness and interconnectedness of learning and should be considered interrelated and mutually supportive.

Foundation 1: Science, Technology, Society, and the Environment (STSE) Interrelationships

This foundation is concerned with understanding the scope and character of science, its connections to technology, and the social context in which it is developed. This foundation statement should be considered the driving force of scientific literacy. Three major dimensions address this foundation.

Nature of Science and Technology

Science is a social and cultural activity anchored in a particular intellectual tradition. It is one way of knowing nature, based on curiosity, imagination, intuition, exploration, observation, replication, interpretation of evidence, and consensus making over this evidence and its interpretation. More than most other ways of knowing nature, science excels at predicting what will happen next, based on its descriptions and explanations of natural and technological phenomena. Science-based ideas are continually being tested, modified, and improved as new ideas supersede existing ideas. Technology, like science, is a creative human activity, but is concerned with solving practical problems that arise from human/social needs, particularly the need to adapt to the environment and to fuel a nation's economy. New products and processes are produced by research and development through the processes of inquiry and design.

Relationships between Science and Technology

Historically, the development of technology has been strongly linked to the development of science, with each making contributions to the other. While there are important relationships and interdependencies, there are also important differences. Where the focus of science is on the development and verification of knowledge; in technology, the focus is on the development of solutions, involving devices and systems that meet a given need within the constraints of the problem. The test of science knowledge is that it helps us explain, interpret, and predict; the test of technology is that it works – it enables us to achieve a given purpose.

Social and Environmental Contexts of Science and Technology

The history of science shows that scientific development takes place within a social context that includes economic, political, social, and cultural forces along with personal biases and the need for peer acceptance and recognition. Many examples can be used to show that cultural and intellectual traditions have influenced the focus and methodologies of science, and that science, in turn, has influenced the wider world of ideas. Today, societal and environmental needs and issues often drive research agendas. As technological solutions have emerged from previous research, many of the new technologies have given rise to complex social and environmental issues which are increasingly becoming part of the political agenda. The potential of science, technology, and Indigenous knowledge to inform and empower decision making by individuals, communities, and society is central to scientific literacy in a democratic society.

Foundation 2: Scientific Knowledge

This foundation focuses on the subject matter of science including the theories, models, concepts, and principles that are essential to an understanding of the natural and constructed world. For organizational purposes, this foundation is framed using widely accepted science disciplines.

Life Science

Life science deals with the growth and interactions of life forms within their environments in ways that reflect the uniqueness, diversity, genetic continuity, and changing nature of these life forms. Life science includes the study of topics such as ecosystems, biological diversity, organisms, cell biology, biochemistry, diseases, genetic engineering, and biotechnology.

Physical Science

Physical science, which encompasses chemistry and physics, deals with matter, energy, and forces. Matter has structure, and its components interact. Energy links matter to gravitational, electromagnetic, and nuclear forces in the universe. The conservation laws of mass and energy, momentum, and charge are addressed in physical science.

Earth and Space Science

Earth and space science brings local, global, and universal perspectives to student knowledge. Earth, our home planet, exhibits form, structure, and patterns of change as do our surrounding solar system and the physical universe beyond. Earth and space science includes such fields of study as geology, hydrology, meteorology, and astronomy.

Traditional and Local Knowledge

A strong science program recognizes that modern science is not the only form of empirical knowledge about nature and aims to broaden student understanding of traditional and local knowledge systems. The dialogue between scientists and traditional knowledge holders has an extensive history and continues to grow as researchers and practitioners seek to better understand our complex world. The terms "traditional knowledge", "Indigenous Knowledge", and "Traditional Ecological Knowledge" are used by practitioners worldwide when referencing local knowledge systems which are embedded within particular worldviews. This curriculum uses the term "Indigenous Knowledge" and provides the following definitions to show parallels and distinctions between Indigenous knowledge and scientific knowledge.

Indigenous Knowledge

"Traditional [Indigenous] knowledge is a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations and meanings are part and parcel of a cultural complex that encompasses language, naming and classification systems, resource use practices, ritual, spirituality and worldview" (International Council for Science, 2002).

Scientific Knowledge

Similar to Indigenous knowledge, scientific knowledge is a cumulative body of knowledge, know-how, practices, and representations maintained and developed by people (scientists) with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations, and meanings are part and parcel of cultural complexes that encompass language, naming and classification systems, resource use practices, ritual, and worldview.

Fundamental Ideas – Linking Scientific Disciplines

A useful way to create linkages among science disciplines is through fundamental ideas that underlie and integrate different scientific disciplines. Fundamental ideas provide a context for explaining, organizing, and connecting knowledge. Students deepen their understanding of these fundamental ideas and apply their understanding with increasing sophistication as they progress through the curriculum from Kindergarten to Grade 12. These fundamental ideas are identified in the following chart.

Constancy and Change	The ideas of constancy and change underlie understanding of the natural and constructed world. Through observations, students learn that some characteristics of materials and systems remain constant over time whereas other characteristics change. These changes vary in rate, scale, and pattern, including trends and cycles, and may be quantified using mathematics, particularly measurement.
Matter and Energy	Objects in the physical world are comprised of matter. Students examine materials to understand their properties and structures. The idea of energy provides a conceptual tool that brings together many understandings about natural phenomena, materials, and the process of change. Energy, whether transmitted or transformed, is the driving force of both movement and change.
Similarity and Diversity	The ideas of similarity and diversity provide tools for organizing our experiences with the natural and constructed world. Beginning with informal experiences, students learn to recognize attributes of materials that help to make useful distinctions between one type of material and another, and between one event and another. Over time, students adopt accepted procedures and protocols for describing and classifying objects encountered, thus enabling students to share ideas with others and to reflect on their own experiences.
Systems and Interactions	An important way to understand and interpret the world is to think about the whole in terms of its parts and alternately about its parts in terms of how they relate to one another and to the whole. A system is an organized group of related objects or components that interact with one another so that the overall effect is much greater than that of the individual parts, even when these are considered together.
Sustainability and Stewardship	Sustainability refers to the ability to meet our present needs without compromising the ability of future generations to meet their needs. Stewardship refers to the personal responsibility to take action in order to participate in the responsible management of natural resources. By developing their understanding of ideas related to sustainability, students are able to take increasing responsibility for making choices that reflect those ideas.

Foundation 3: Scientific and Technological Skills and Processes

This foundation identifies the skills and processes students develop in answering questions, solving problems, and making decisions. While these skills and processes are not unique to science, they play an important role in the development of scientific and technological understanding and in the application of acquired knowledge to new situations. Four broad skill areas are outlined in this foundation. Each area is developed further at each grade level with increasing scope and complexity of application.

Initiating and Planning

These are the processes of questioning, identifying problems, and developing preliminary ideas and plans.

Performing and Recording

These are the skills and processes of carrying out a plan of action, which involves gathering evidence by observation and, in most cases, manipulating materials and equipment. Gathered evidence can be documented and recorded in a variety of formats.

Analyzing and Interpreting

These are the skills and processes of examining information and evidence, organizing and presenting data so that they can be interpreted, interpreting those data, evaluating the evidence, and applying the results of that evaluation.

Communication and Teamwork

In science and technology, as in other areas, communication skills are essential whenever ideas are being developed, tested, interpreted, debated, and accepted or rejected. Teamwork skills are also important because the development and application of ideas rely on collaborative processes both in science-related occupations and in learning.

Foundation 4: Attitudes

This foundation focuses on encouraging students to develop attitudes, values, and ethics that inform a responsible use of science and technology for the mutual benefit of self, society, and the environment. This foundation identifies six categories in which science education can contribute to the development of scientific literacy.

Both scientific and Indigenous knowledge systems place value on attitudes, values, and ethics. These are more likely to be presented in a holistic manner in Indigenous knowledge systems.

Appreciation of Science

Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural, and ethical events.

Interest in Science

Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school, and in the community.

Inquiry in Science

Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge.

Collaboration

Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school.

Stewardship

Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment.

Safety

Students engaged in science and technology activities will be expected to demonstrate a concern for safety and doing no harm to themselves or others, including plants and animals.

Learning Contexts

Learning contexts provide entry points into the curriculum that engage students in inquiry-based learning to achieve scientific literacy. Each learning context reflects a different, but overlapping, philosophical rationale for including science as a Required Area of Study:

- The **scientific inquiry** learning context reflects an emphasis on understanding the natural and constructed world using systematic empirical processes that lead to the formation of theories that explain observed events and that facilitate prediction.

- The **technological problem solving** learning context reflects an emphasis on designing and building to solve practical human problems similar to the way an engineer would.

- The **STSE decision making** learning context reflects the need to engage citizens in thinking about human and world issues through a scientific lens in order to inform and empower decision making by individuals, communities, and society.

- The **cultural perspectives** learning context reflects a humanistic perspective that views teaching and learning as cultural transmission and acquisition (Aikenhead, 2006).

Each learning context is identified using a two or three letter code. One or more of these codes are listed under each outcome as a suggestion regarding which learning context or contexts most strongly support the intent of the outcome.

These learning contexts are not mutually exclusive; thus, well-designed instruction may incorporate more than one learning context. Students need to experience learning through each learning context at each grade; it is not necessary, nor advisable, for each student to attempt to engage in learning through each learning context in each unit. Learning within a classroom may be structured to enable individuals or groups of students to achieve the same curricular outcomes through different learning contexts.

A choice of learning approaches can also be informed by recent well-established ideas on how and why students learn:

- Learning occurs when students are treated as a community of practitioners of scientific literacy.
- Learning is both a social and an individual event for constructing and refining ideas and competences.
- Learning involves the development of new self-identities for many students.
- Learning is inhibited when students feel a culture clash between their home culture and the culture of school science.

Scientific Inquiry [SI]

Inquiry is a defining feature of the scientific way of knowing nature. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations. Inquiry is a multifaceted activity that involves:

- making observations, including watching or listening to knowledgeable sources
- posing questions or becoming curious about the questions of others
- examining books and other sources of information to see what is already known
- reviewing what is already known in light of experimental evidence and rational arguments
- planning investigations, including field studies and experiments
- acquiring the resources (financial or material) to carry out investigations
- using tools to gather, analyze, and interpret data
- proposing critical answers, explanations, and predictions
- communicating the results to various audiences.

By participating in a variety of inquiry experiences that vary in the amount of student self-direction, students develop competencies necessary to conduct inquiries of their own – a key element to scientific literacy.

> *Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work.*
> *(National Research Council, 1996, p. 23)*

Technological Problem Solving [TPS]

The essence of the technological problem solving learning context is that students seek answers to practical problems. This process is based on addressing human and social needs and is typically addressed through an iterative design-action process that involves steps such as:

- identifying a problem
- identifying constraints and sources of support
- identifying alternative possible solutions and selecting one on which to work
- planning and building a prototype or a plan of action to resolve the problem
- testing and evaluating the prototype or plan.

By participating in a variety of technological and environmental problem-solving activities, students develop capacities to analyze and resolve authentic problems in the natural and constructed world.

> *Technological design is a distinctive process with a number of defined characteristics; it is purposeful; it is based on certain requirements; it is systematic; it is iterative; it is creative; and there are many possible solutions.*
> *(International Technology Education Association, 2000, p. 91)*

To engage with science and technology toward practical ends, people must be able to critically assess the information they come across and critically evaluate the trustworthiness of the information source.
(Aikenhead, 2006, p. 2)

STSE Decision Making [DM]

Scientific knowledge can be related to understanding the relationships among science, technology, society, and the environment. Students must also consider values or ethics, however, when addressing a question or issue. STSE decision making involves steps such as:

- clarifying an issue
- evaluating available research and different viewpoints on the issue
- generating possible courses of action or solutions
- evaluating the pros and cons for each action or solution
- identifying a fundamental value associated with each action or solution
- making a thoughtful decision
- examining the impact of the decision
- reflecting back on the process of decision making.

Students may engage with STSE issues through research projects, student-designed laboratory investigations, case studies, role playing, debates, deliberative dialogues, and action projects.

For First Nations people, the purpose of learning is to develop the skills, knowledge, values and wisdom needed to honour and protect the natural world and ensure the long-term sustainability of life.
(Canadian Council on Learning, 2007, p. 18)

Cultural Perspectives [CP]

Students should recognize and respect that all cultures develop knowledge systems to describe and explain nature. Two knowledge systems which are emphasized in this curriculum are First Nations and Métis cultures (Indigenous knowledge) and Euro-Canadian cultures (science). In their own way, both of these knowledge systems convey an understanding of the natural and constructed worlds, and they create or borrow from other cultures technologies to resolve practical problems. Both knowledge systems are systematic, rational, empirical, dynamically changeable, and culturally specific.

For the Métis people, learning is understood as a process of discovering the skills, knowledge and wisdom needed to live in harmony with the Creator and creation, a way of being that is expressed as the 'Sacred Act of Living a Good Life.'
(Canadian Council on Learning, 2007, p. 22)

Cultural features of science are, in part, conveyed through the other three learning contexts, and when addressing the nature of science. Cultural perspectives on science can also be taught in activities that explicitly explore Indigenous knowledge or knowledge from other cultures.

Addressing cultural perspectives in science involves:

- recognizing and respecting knowledge systems that various cultures have developed to understand the natural world and technologies they have created to solve human problems

- recognizing that science, as one of those knowledge systems, evolved within Euro-Canadian cultures
- valuing place-based knowledge to solve practical problems
- honouring protocols for obtaining knowledge from a knowledge keeper, and taking responsibility for knowing it.

By engaging in explorations of cultural perspectives, scientifically literate students begin to appreciate the worldviews and belief systems fundamental to science and to Indigenous knowledge.

Explanations, Evidence, and Models in Science

Science is a way of understanding the natural world using internally consistent methods and principles that are well-described and understood by the scientific community. The principles and theories of science have been established through repeated experimentation and observation and have been refereed through peer review before general acceptance by the scientific community. Acceptance of a theory does not imply unchanging belief in a theory, or denote dogma. Instead, as new data become available, previous scientific explanations are revised and improved, or rejected and replaced. There is a progression from a hypothesis to a theory using testable, scientific laws. Many hypotheses are tested to generate a theory. Only a few scientific facts are considered natural laws (e.g., the Law of Conservation of Mass).

Scientists use the terms *laws*, *theories*, and *hypotheses* to describe various types of scientific explanations about phenomena in the natural and constructed world. These meanings differ from common usage of the same terms.

- Law – A law is a generalized description, usually expressed in mathematical terms, that describes some aspect of the natural world under certain conditions.
- Theory – A theory is an explanation for a set of related observations or events that may consist of statements, equations, models, or a combination of these. Theories also predict the results of future observations. A theory becomes a theory once the explanation is verified multiple times by different groups of researchers. The procedures and processes for testing a theory are well-defined within each scientific discipline, but they vary between disciplines. No amount of evidence proves that a theory is correct. Rather, scientists accept theories until the emergence of new

The terms "law", "theory", and "hypothesis" have special meaning in science.

evidence that the theory is unable to adequately explain. At this point, the theory is discarded or modified to explain the new evidence. Note that theories never become laws; theories explain laws.

- Hypothesis – A hypothesis is a tentative, testable generalization that may be used to explain a relatively large number of events in the natural world. It is subject to immediate or eventual testing by experiments. Hypotheses must be worded in such a way that they can be falsified. Hypotheses are never proven correct, but are supported by empirical evidence.

Scientific models are constructed to represent and explain certain aspects of physical phenomenon. Models are never exact replicas of real phenomena; rather, models are simplified versions of reality, generally constructed in order to facilitate study of complex systems such as the atom, climate change, and biogeochemical cycles. Models may be physical, mental, or mathematical or contain a combination of these elements. Models are complex constructions that consist of conceptual objects and processes in which the objects participate or interact. Scientists spend considerable time and effort building and testing models to further understanding of the natural world.

When engaging in the processes of science, students are constantly building and testing their own models of understanding of the natural world. Students may need help in learning how to identify and articulate their own models of natural phenomena. Activities that involve reflection and metacognition are particularly useful in this regard. Students should be able to identify the features of the physical phenomena their models represent or explain. Just as importantly, students should identify which features are not represented or explained by their models. Students should determine the usefulness of their model by judging whether the model helps in understanding the underlying concepts or processes. Ultimately, students realize that different models of the same phenomena may be needed in order to investigate or understand different aspects of the phenomena.

Laboratory Work

Laboratory work is often at the centre of scientific research; as such, it should also be an integral component of school science. The National Research Council (2006, p. 3) defines a school laboratory investigation as an experience in the laboratory, the classroom, or the field that provides students with opportunities to interact directly with natural phenomena or with data collected by others using tools, materials, data collection techniques, and models. Laboratory experiences should be designed so that all students – including students with academic and physical challenges – are able to authentically participate in and benefit from those experiences.

Laboratory activities help students develop scientific and technological skills and processes including:

- initiating and planning
- performing and recording
- analyzing and interpreting
- communication and teamwork.

Laboratory investigations also help students understand the nature of science, specifically that theories and laws must be consistent with observations. Similarly, student-centered laboratory investigations help to emphasize the need for curiosity and inquisitiveness as part of the scientific endeavour. The National Science Teachers Association [NSTA] position statement *The Integral Role of Laboratory Investigations in Science Instruction* (2007) provides further information about laboratory investigations.

Ideally, laboratory work should help students to understand the relationship between evidence and theory, develop critical thinking and problem-solving skills, as well as develop acceptable scientific attitudes.
(Di Giuseppe, 2007, p. 54)

A strong science program includes a variety of individual, small, and large group laboratory experiences for students. Most importantly, the laboratory experience needs to go beyond conducting confirmatory "cook-book" experiments. Similarly, computer simulations and teacher demonstrations are valuable but should not serve as substitutions for hands-on student laboratory activities.

Assessment and evaluation of student performance must reflect the nature of the laboratory experience by addressing scientific and technological skills. As such, the results of student investigations and experiments do not always need to be written up using formal laboratory reports. Teachers may consider alternative formats such as narrative lab reports for some experiments. The narrative lab report enables students to tell the story of their process and findings in a less structured format than a typical lab report.

In a narrative lab report, students answer four questions:

- What was I looking for?
- How did I look for it?
- What did I find?
- What do these findings mean?

The answers are written in an essay format rather than using the structured headings of Purpose, Procedure, Hypothesis, Data, Analysis, and Conclusion that are typically associated with a formal lab report. For some investigations, teachers may decide it is sufficient for students to write a paragraph describing the significance of their findings.

Safety

Safety in the classroom is of paramount importance. Other components of education (resources, teaching strategies, facilities) attain their maximum utility only in a safe classroom. To create a safe classroom requires that a teacher be informed, aware, and proactive and that the students listen, think, and respond appropriately.

Safety cannot be mandated solely by rule of law, teacher command, or school regulation. Safety and safe practice are an attitude.

Safe practice in the laboratory is the joint responsibility of the teacher and students. The teacher's responsibility is to provide a safe environment and to ensure the students are aware of safe practice. The students' responsibility is to act intelligently based on the advice which is given and which is available in various resources.

Kwan and Texley (2003) suggest that teachers, as professionals, consider four Ps of safety: prepare, plan, prevent, and protect. The following points are adapted from those guidelines and provide a starting point for thinking about safety in the science classroom:

- **Prepare**
  - Keep up to date with your personal safety knowledge and certifications.
  - Be aware of national, provincial, division, and school level safety policies and guidelines.
  - Create a safety contract with students.

- **Plan**
  - Develop learning plans that ensure all students learn effectively and safely.
  - Choose activities that are best suited to the learning styles, maturity, and behaviour of all students and that include all students.
  - Create safety checklists for in-class activities and field studies.

- **Prevent**
  - Assess and mitigate hazards.
  - Review procedures for accident prevention with students.

   - Teach and review safety procedures with students, including the need for appropriate clothing.
   - Do not use defective or unsafe equipment or procedures.
   - Do not allow students to eat or drink in science areas.

- **Protect**
   - Ensure students have sufficient protective devices, such as safety glasses.
   - Demonstrate and instruct students on the proper use of safety equipment and protective gear.
   - Model safe practice by insisting that all students, visitors, and yourself use appropriate protective devices.

The definition of safety includes consideration of the well-being of all components of the biosphere, such as plants, animals, earth, air, and water. From knowing what wild flowers can be picked to considering the disposal of toxic wastes from chemistry laboratories, the safety of our world and our future depends on our actions and teaching in science classes. It is important that students practise ethical, responsible behaviours when caring for and experimenting with live animals. For further information, refer to the NSTA position statement *Responsible Use of Live Animals and Dissection in the Science Classroom* (2008).

Safety in the science classroom includes the storage, use, and disposal of chemicals. The Workplace Hazardous Materials Information System (WHMIS) regulations under the Hazardous Products Act govern storage and handling practices of chemicals in schools. All school divisions must comply with the provisions of the Act. Chemicals should be stored in a safe location according to chemical class, not just alphabetically. Appropriate cautionary labels must be placed on all chemical containers and all school division employees using hazardous substances should have access to appropriate Materials Safety Data Sheets. Under provincial WHMIS regulations, all employees involved in handling hazardous substances must receive training by their employer. Teachers who have not been informed about or trained in this program should contact their Director of Education. Further information related to WHMIS is available through Health Canada and the Saskatchewan Ministry of Advanced Education, Employment and Labour.

WHMIS regulations govern storage and handling practices of chemicals in schools.

The Chemical Hazard Information Table in Safety in the Science Classroom (Alberta Education, 2005) provides detailed information including appropriateness for school use, hazard ratings, WHMIS class, storage class, and disposal methods for hundreds of chemicals.

Technology in Science

> *Technology should be used to support learning in science when:*
> - *it is pedagogically appropriate*
> - *it makes scientific views more accessible*
> - *it helps students to engage in learning that otherwise would not be possible.*
>
> *(Flick & Bell, 2000)*

Technology-based resources are essential for instruction in the science classroom. Technology is intended to extend our capabilities and, therefore, is one part of the teaching toolkit. Individual, small group, or class reflection and discussions are required to connect the work with technology to the conceptual development, understandings, and activities of the students. Choices to use technology, and choices of which technologies to use, should be based on sound pedagogical practices, especially those which support student inquiry. These technologies include computer technologies as described below and non-computer based technologies.

Some recommended examples of using computer technologies to support teaching and learning in science include:

- **Data Collection and Analysis**
  - Data loggers permit students to collect and analyze data, often in real-time, and to collect observations over very short or long periods of time, enabling investigations that otherwise would be impractical.
  - Databases and spreadsheets can facilitate the analysis and display of student-collected data or data obtained from scientists.

- **Visualization and Imaging**
  - Simulation and modeling software provide opportunities to explore concepts and models which are not readily accessible in the classroom, such as those that require expensive or unavailable materials or equipment, hazardous materials or procedures, levels of skills not yet achieved by the students, or more time than is possible or appropriate in a classroom.
  - Students may collect their own digital images and video recordings as part of their data collection and analysis or they may access digital images and video online to help enhance understanding of scientific concepts.

- **Communication and Collaboration**
  - The Internet can be a means of networking with scientists, teachers, and other students by gathering information and data, posting data and findings, and comparing results with students in different locations.
  - Students can participate in authentic science projects by contributing local data to large-scale web-based science inquiry projects such as Journey North (www.learner.org/north) or GLOBE (www.globe.gov).

Science Challenges

Science challenges, which may include science fairs, science leagues, Science Olympics, Olympiads, or talent searches, should be considered as instructional methods suitable for students to undertake in any unit, across units, or in conjunction with other subject areas. Teachers may incorporate science challenge activities as an integral component of the science program or treat them similar to other extracurricular activities such as school sports and clubs. If science challenges are undertaken as a classroom activity, teachers should consider these guidelines, adapted from the NSTA position statement *Science Competitions* (1999):

- Student and staff participation should be voluntary and open to all students.
- Emphasis should be placed on the learning experience rather than the competition.
- Science competitions should supplement and enhance other learning and support student achievement of curriculum outcomes.
- Projects and presentations should be the work of the student, with proper credit given to others for their contributions.
- Science competitions should foster partnerships among students, the school, and the science community.

Science challenge activities may be conducted solely at the school level, or with the intent of preparing students for competition in one of the regional science fairs, perhaps as a step towards the Canada Wide Science Fair. Although students may be motivated by prizes, awards, and the possibility of scholarships, teachers should emphasize that the importance of doing a science fair project includes attaining new experiences and skills that go beyond science, technology, or engineering. Students learn to present their ideas to an authentic public that may consist of parents, teachers, and the top scientists in a given field.

Science fair projects typically consist of:

- An experiment, which is an original scientific experiment with a specific, original hypothesis. Students should control all important variables and demonstrate appropriate data collection and analysis techniques.
- A study, which involves the collection of data to reveal a pattern or correlation. Studies can include cause and effect relationships and theoretical investigations of the data.

Studies are often carried out using surveys given to human subjects.

- An innovation, which deals with the creation and development of a new device, model, or technique in a technological field. These innovations may have commercial applications or be of benefit to humans.

Youth Science Foundation Canada (www.ysf.ca) provides further information regarding science fairs in Canada.

Outcomes and Indicators

Life Science – Interactions within Ecosystems (IE)
IE7.1 Relate key aspects of Indigenous knowledge to their understanding of ecosystems.
IE7.2 Observe, illustrate, and analyze living organisms within local ecosystems as part of interconnected food webs, populations, and communities.
IE7.3 Evaluate biogeochemical cycles (water, carbon, and nitrogen) as representations of energy flow and the cycling of matter through ecosystems.
IE7.4 Analyze how ecosystems change in response to natural and human influences, and propose actions to reduce the impact of human behaviour on a specific ecosystem.

Physical Science – Mixtures and Solutions (MS)
MS7.1 Distinguish between pure substances and mixtures (mechanical mixtures and solutions) using the particle model of matter.
MS7.2 Investigate methods of separating the components of mechanical mixtures and solutions, and analyze the impact of industrial and agricultural applications of those methods.
MS7.3 Investigate the properties and applications of solutions, including solubility and concentration.

Physical Science – Heat and Temperature (HT)
HT7.1 Assess the impact of past and current heating and cooling technologies related to food, clothing, and shelter on self, society, and the environment.
HT7.2 Explain how understanding differences between states of matter and the effect of heat on changes in state provide evidence for the particle theory.
HT7.3 Investigate principles and applications of heat transfer via the processes of conduction, convection, and radiation.

Earth and Space Science – Earth's Crust and Resources (EC)
EC7.1 Analyze societal and environmental impacts of historical and current catastrophic geological events, and scientific understanding of movements and forces within Earth's crust.
EC7.2 Identify locations and processes used to extract Earth's geological resources and examine the impacts of those locations and processes on society and the environment.
EC7.3 Investigate the characteristics and formation of the surface geology of Saskatchewan, including soil, and identify correlations between the surface geology and past, present, and possible future land uses.

Life Science: Interactions within Ecosystems (IE)

All outcomes in this unit contribute to the development of all K-12 science goals.

Outcomes	Indicators
IE7.1 Relate key aspects of Indigenous knowledge to their understanding of ecosystems. ***[CP]***	a. Gather information about traditional Indigenous practices with respect to the relationships and connections between people and their ecological environment. b. Examine key aspects of Indigenous knowledge and First Nations and Métis people's practices that contribute to understanding of ecosystems and the interactions of their components. c. Provide specific examples of Indigenous knowledge in understanding the components of their ecosystems. d. Describe the ways that traditional Indigenous knowledge about respect and responsibility for the land, self, and others has been transmitted over many years, including the oral tradition.
IE7.2 Observe, illustrate, and analyze living organisms within local ecosystems as part of interconnected food webs, populations, and communities. ***[SI]***	a. Illustrate the ecological organization of life within the biosphere, using specific examples of species, populations, communities, ecosystems, and biomes. b. Provide examples of ecosystems of varying sizes and locations, including their biotic and abiotic components. c. Conduct a field study to observe, record (using sketches, notes, tables, photographs, and/or video recordings), and identify biotic and abiotic components of a local ecosystem. d. Show respect for all forms of life when examining ecosystems. e. Examine the biotic and abiotic components of distant ecosystems using photographs, videos, or online resources. f. Choose and use appropriate instruments (e.g., magnifying glass, thermometer, light meter, hand-held microscope, and digital camera) safely, effectively, and accurately to observe and illustrate biotic and abiotic components of ecosystems. g. Compile and display ecological data to illustrate the various interactions that occur among biotic and abiotic components of ecosystems. h. Identify strengths and weaknesses of different methods of collecting and displaying ecological data (e.g., compare field observations of an ecosystem with observations from a video or television program, compare a food chain with a food web).

Outcomes	Indicators
IE7.2 continued	i. Classify organisms in a variety of ecosystems as producers, consumers, or decomposers and further classify consumers as herbivores, carnivores, or omnivores. j. Interpret interdependence within natural systems by constructing food chains and food webs to illustrate the interactions among producers, consumers, and decomposers in a particular ecosystem. k. Construct a classification key, using appropriate scientific terminology, which will enable classmates to differentiate between producers, consumers, and decomposers. l. Provide examples of organizations in Canada that support scientific research related to ecosystems (e.g., environmental conservation groups, federal and provincial government departments, agricultural and marine institutes, universities, and colleges).
IE7.3 Evaluate biogeochemical cycles (water, carbon, and nitrogen) as representations of energy flow and the cycling of matter through ecosystems.	a. Illustrate how energy is supplied to and flows through a food web using the concept of ecological pyramids (e.g., pyramid of energy, pyramid of numbers, and pyramid of biomass). b. Model the carbon, nitrogen, and water cycles to illustrate how matter cycles through ecosystems. c. Analyze the strengths and limitations of models in science generally, and then apply these criteria to evaluate the efficacy of a student model of a biogeochemical cycle. d. Explain the role of decomposers in recycling matter in an ecosystem. e. Describe examples of how scientists collect evidence, search for patterns and relationships in data, and propose explanations to further the development of scientific knowledge about energy and matter flow in ecosystems. f. Design and conduct an experiment to investigate the conditions essential for the growth of plants (e.g., determine whether nutrients in soil are sufficient to support plant growth, determine the influence of sunlight or other forms of light on plant growth). g. Consider observations and ideas from a variety of sources during investigations and before drawing conclusions related to biogeochemical cycles. h. Describe how energy passes through ecosystems during the processes of photosynthesis and cellular respiration. i. Identify and evaluate potential impacts on energy flow and the cycling of matter by the removal of one or more living organisms from a specific ecosystem.

Outcomes	Indicators
IE7.3 continued	j. Provide examples of scientific knowledge that have resulted in the development of technologies designed to assist in managing aspects of ecosystems (e.g., understanding the effect of nitrogen, phosphorus, and potassium on plant growth led to the production of specific formulations of fertilizers, knowledge of how micro-organisms help break down matter led to the development of composting bins).
IE7.4 Analyze how ecosystems change in response to natural and human influences, and propose actions to reduce the impact of human behaviour on a specific ecosystem. ***[DM, CP]***	a. Identify evidence of ecological succession in ecosystems, using the concepts of pioneer species, climax community, primary succession, and secondary succession, and by identifying changes in plant and animal life in the ecosystem. b. Propose ecological questions to investigate arising from practical problems and issues (e.g., "What is the impact of clearing land for farming?", "How could a community prolong the life of its landfill site?", "How could a community reduce the amount of garbage it produces?", "What is the impact of a sports field being constructed in a particular location?"). c. Predict what a specific ecosystem (e.g., clear-cut forest, abandoned sports field, abandoned farm yard, abandoned rail line, ditch, driveway, or sidewalk) will look like in the future (e.g., 5, 10, and 25 years) based on characteristics of the area and long-term changes observed in similar ecosystems. d. Identify and refine questions and problems related to the effects of natural or human influences on a particular ecosystem. e. Select and synthesize information from various sources to develop a response to specific questions related to natural or human influences on a particular ecosystem. f. Propose a course of action or defend a given position on a local ecological issue or problem related to natural or human influences on a particular ecosystem, taking into account scientific, societal, technological, and environmental factors. g. Be sensitive and responsible in maintaining a balance between human needs and a sustainable environment by considering both immediate and long-term effects of their course of action or stated position. h. Provide specific examples to illustrate that scientific and technological activities related to ecosystems take place in a variety of individual or group settings, locally and globally, and by men and women from a variety of cultural backgrounds (e.g., individual and community gardening, impact studies done by environmental engineers, and research done by teams of international scientists).

Physical Science: Mixtures and Solutions (MS)

All outcomes in this unit contribute to the development of all K-12 science goals.

Outcomes	Indicators
MS7.1 Distinguish between pure substances and mixtures (mechanical mixtures and solutions) using the particle model of matter. ***[SI, CP]***	a. Examine a variety of objects and materials, and record qualitative (e.g., colour, texture, and state of matter) and quantitative (e.g., density, melting point, and freezing point) physical properties of those objects in a chart or data table. b. Describe the characteristics of pure substances, mechanical mixtures, and solutions. c. Construct a graphic organizer for the classification of matter that includes mixtures, pure substances, elements, compounds, mechanical mixtures, and solutions. d. Classify common substances (e.g., Kool-Aid, vinegar, bubble bath, soft drinks, juice, chocolate chip cookies, salad dressings, hand lotion, shampoos, tea, bread, soil, and concrete) as pure substances, mechanical mixtures, or solutions. e. Listen to and consider the ideas of classmates when classifying materials as pure substances or mixtures. f. Create mechanical mixtures and solutions using common materials and compare the physical properties of the original materials and the resultant mixture or solution. g. State the four main ideas of the particle model of matter. h. Create models and/or physical representations that depict the nature of particles in pure substances, mechanical mixtures, and solutions according to the particle model of matter. i. Analyze the usefulness of personally constructed representations of particles and the strengths and limitations of models in science generally. j. Generate questions related to differences between mixtures and solutions and rephrase in a testable form (e.g., rephrase a question such as "How sweet is iced tea?" to "What is the most iced tea that can be dissolved in 500 mL of water at 23°C?").

Outcomes	Indicators
MS7.2 Investigate methods of separating the components of mechanical mixtures and solutions, and analyze the impact of industrial and agricultural applications of those methods. ***[SI, TPS]***	a. Describe methods used to separate the components of mechanical mixtures and solutions, including mechanical sorting, filtration, evaporation, distillation, magnetism, and chromatography. b. Trace the historical development of a technology or process used to separate mixtures (e.g., settling, sifting, filtering, fusion, distillation, and chromatography). c. Describe common household examples of technologies that are used to separate components of mechanical mixtures or solutions (e.g., kitchen strainer, oil and air filters). d. Design and conduct an experiment to determine the effectiveness and/or efficiency of one or more methods of separating mechanical mixtures and solutions. e. Report the strengths and limitations of a chosen experimental design to determine the effectiveness and/or efficiency of one or more methods of separating mechanical mixtures and solutions. f. Use tools and apparatus (e.g., safety glasses, glassware, and Bunsen burners) safely when conducting investigations into methods of separating mixtures. g. Demonstrate knowledge of WHMIS standards by using proper techniques for handling and disposing of lab materials and following warning label symbols, including common household product symbols, when separating mixtures. h. Describe the scientific principles underlying a past or present industrial technology designed to separate mixtures (e.g., petroleum refining, sewage treatment plant, recycling station, combine, and cream separator). i. Discuss intended and unintended consequences of a particular industrial or agricultural technology or process used for separating materials. j. Use a technological problem-solving process to design, construct, and evaluate a prototype of a process or device for separating a mechanical mixture or solution (e.g., purifying drinking water, separating household waste). k. Identify new questions and problems that arise from what was learned about solutions and mixtures (e.g., “Are there mixtures that cannot be separated?”, “What techniques are used to remove pollutants from air and water?”), including questions that science cannot answer.

Outcomes	Indicators
MS7.3 Investigate the properties and applications of solutions, including solubility and concentration. ***[SI, DM]***	a. Provide examples of solid, liquid, and gaseous solutions and identify which substance is the solute and which is the solvent in each solution. b. Describe the characteristics of solutions using the terms solute, solvent, soluble, and insoluble, based on the particle model of matter. c. Create and describe the concentration of student-prepared dilute, concentrated, saturated, and supersaturated solutions using those qualitative terms and quantitative measurements (e.g., parts per million [ppm], g/L, and g/100 mL). d. Value accuracy, precision, and honesty when collecting and reporting data related to concentrations of solutions. e. Investigate the factors that determine how quickly a solute dissolves in a solvent. f. Gather and interpret information from various resources (e.g., nutrition labels on foods, newspaper or magazine articles) related to solutions and concentrations of solutions. g. Design and implement an experiment to investigate the effect of temperature on the solubility of a solution. h. Predict the solubility of a solute by interpolating or extrapolating from student-generated solubility curves. i. Analyze the effects of technological inventions or processes related to solutions (e.g., water softeners, water treatment plants, solution mining, agricultural sprays, insecticides, bleaches, and drain cleaners) on self, community, and the environment. j. Research how various science disciplines and engineering fields study and apply scientific knowledge related to solutions.

Physical Science: Heat and Temperature (HT)

All outcomes in this unit contribute to the development of all K-12 science goals.

Outcomes	Indicators
HT7.1 Assess the impact of past and current heating and cooling technologies related to food, clothing, and shelter on self, society, and the environment. ***[TPS, DM, CP]***	a. Illustrate the historical development and the underlying scientific principles of technologies designed to address practical problems regarding human heating and cooling needs for food, shelter, and clothing (e.g., oven mitts, survival suits, air conditioning, central heating, thermos, refrigerators, stoves, heaters, home insulation, fleece jackets, and toques). b. Communicate questions, ideas, intentions, plans, and results of inquiries related to heat transmission using lists, notes in point form, sentences, data tables, graphs, drawings, oral language, and other means. c. Analyze the impact of the design and function of a heating- or cooling-related technology on self and society. d. Compare, in qualitative terms, the heat capacities of some common materials, including water, and explain how heat capacity influences choices of materials used in the development of technologies related to clothing, food, and shelter. e. Evaluate the efficiency of different types of home insulation (e.g., sod, straw bales, fibreglass, cellulose, mineral wool, polystyrene, and polyurethane foam) with respect to criteria such as R-value, cost, and resistance to water and air infiltration. f. 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). g. Assess the design of a personally constructed heating or cooling prototype using collaboratively developed criteria. h. Provide examples of problems related to heating and cooling that arise at home, in an industrial setting, or in the environment, that cannot be solved using scientific and technological knowledge. i. Create a photo journal of science- and technology-based careers in the community related to heating and cooling, such as heating systems and equipment contractors, and boiler engineers.

Outcomes	Indicators
HT7.2 Explain how understanding differences between states of matter and the effect of heat on changes in state provide evidence for the particle theory. ***[SI]***	a. Provide examples from daily life that illustrate the effects of heating and cooling on solids, liquids, and gases. b. Conduct experiments to determine the effects of changes in temperature on solids, liquids, and gases. c. Construct and label a heating curve for water, using student-collected data, indicating states of matter and changes of state. d. Create a visual or dramatic representation to explain changes of state of matter (e.g., melting, freezing, evaporation, condensation, and sublimation) according to the particle model of matter. e. Choose appropriate instruments (e.g. alcohol thermometer, temperature probe, and thermocouple) and use them safely, effectively, and accurately for collecting temperature data when investigating states of matter and changes of state. f. Trace the historical development of different scales (e.g., Kelvin, Celsius, Fahrenheit, and Rankine) and instruments used to measure temperature (e.g., liquid-in-glass thermometers, bi-metallic strips, digital thermometers, liquid crystal thermometers, thermocouples, and computer sensors) and discuss the need for standardized measurements of temperature. g. Distinguish between heat and temperature using the concept of kinetic energy and the particle model of matter. h. Explain how evidence gathered while investigating states of matter and changes in states of matter supports or refutes the particle theory of matter.
HT7.3 Investigate principles and applications of heat transfer via the processes of conduction, convection, and radiation. ***[SI]***	a. Demonstrate and explain how heat is transferred by the processes of conduction, convection, and radiation in solids, liquids, and gases. b. Construct a visual or dramatic representation of heat transfer via conduction in a solid. c. Model convection currents in fluids (liquid or gas) and discuss the effectiveness of the model. d. Assess the impacts on self, society, and the environment, of conduction, convection, and radiation in the natural and constructed world (e.g., heating over cities, temperature layers in lakes, thunderstorms, radiant heaters, refrigerators, and convection currents in air or water). e. Evaluate applications of technologies designed to enhance or restrict the transfer of heat energy via conduction, convection, or radiation (e.g., metal frying pans, radiant heaters, home insulation, ovens, convection ovens, thermoses, winter parkas, and heat exchangers) using student-developed criteria.

Outcomes	Indicators
HT7.3 continued	f. Design and carry out an experiment to determine differences in the ability of various surfaces to absorb and reflect radiant heat. g. Select appropriate methods and tools for collecting and displaying data and information related to radiant heat. h. Demonstrate safe and responsible work practices, including keeping the work area uncluttered with only appropriate materials present when investigating heat transfer via conduction, convection, and radiation.

Earth and Space Science: Earth's Crust and Resources (EC)

All outcomes in this unit contribute to the development of all K-12 science goals.

Outcomes	Indicators
EC7.1 Analyze societal and environmental impacts of historical and current catastrophic geological events, and scientific understanding of movements and forces within Earth's crust. ***[SI]***	a. Trace the development of plate tectonics theory as an explanation for movement of Earth's lithosphere in light of new geological evidence, including knowledge of tectonic plates and movement at plate boundaries. b. Provide examples of past theories and ideas, including cultural mythology, that explain geological phenomena such as volcanic activity, earthquakes, and mountain building. c. Construct a visual representation of the composition of Earth, including the crust, upper and lower mantle, core, and inner core. d. Create models or simulations of the processes of mountain formation and the folding and faulting of Earth's surface, including movements at diverging, converging, and transform plate boundaries. e. Describe societal and environmental impacts of some catastrophic geological events, including earthquakes, tsunamis, and volcanic eruptions, which have occurred on or near Earth's surface and predict the impacts of future events. f. Work cooperatively with group members to research catastrophic geological events and integrate individual findings into a chronological model or time scale of major events in Earth's geological history. g. Organize data on the geographical and chronological distribution of earthquakes, tsunamis, and volcanic eruptions to determine patterns and trends in data and relationships among variables.

Outcomes	Indicators
EC7.1 continued	h. Explain the operation of tools scientists use to measure and describe the effects of catastrophic geological events, including earthquakes and volcanoes (e.g., seismograph, Mercalli intensity scale, and Richter magnitude scale). i. Provide examples of how science and technology affect self and community through understanding, predicting, and minimizing the effects of catastrophic geological events (e.g., earthquake resistant construction, earthquake and tsunami preparedness, and minimizing climatic effects of volcanic eruptions).
EC7.2 Identify locations and processes used to extract Earth's geological resources and examine the impacts of those locations and processes on society and the environment. ***[SI, DM, CP]***	a. Identify questions to investigate arising from practical problems and issues related to the study of Earth's geological resources (e.g., "What types of rocks are best for cement-making or road construction?" and "What are some environmental concerns related to open-pit mining?"). b. Distinguish between rocks and minerals using physical samples, pictures, and/or video recordings and identify the minerals most often found in rocks in Saskatchewan and around the world (e.g., quartz, calcite, feldspar, mica, hornblende). c. Classify rocks and minerals based on physical properties such as colour, hardness, cleavage, lustre, and streak. d. Identify locations of Saskatchewan's primary mineral resources (e.g., potash, gold, diamond, salt, uranium, copper, and graphite) and their primary uses. e. Relate processes used to extract primary mineral resources in Saskatchewan (e.g., open-pit mining, underground mining, and solution mining) to the location, type, and depth of the resource. f. Provide examples of technologies used to further scientific research related to extracting geological resources (e.g., satellite imaging, magnetometer, and core sample drilling). g. Evaluate different approaches taken to answer questions, solve problems, and make decisions when searching for geological resources within Earth (e.g., trial-and-error prospecting versus core sampling). h. Provide examples of Canadian contributions to the scientific understanding and technological developments related to surface and sub-surface geology and mining, and identify societal and economic factors that drive such exploration and research.

Outcomes	Indicators
EC7.2 continued	i. Suggest solutions to economic and environmental issues related to the extraction of geological resources in Saskatchewan (e.g., managing mine tailings and pollutants; reclaiming open pit mining sites; ecological impact of pipelines; resource depletion; maintaining water quality; and increasing urbanization). j. Identify uses for rocks and minerals, such as healing, recuperative powers, and ceremonies, which include ideas not explained by science. k. Research Saskatchewan careers directly and indirectly related to resource exploration.
EC7.3 Investigate the characteristics and formation of the surface geology of Saskatchewan, including soil, and identify correlations between surface geology and past, present, and possible future land uses. ***[DM, SI]***	a. Model the processes of formation of the three major types of rocks: sedimentary, igneous, and metamorphic. b. Explain how geologists use the fossil record to provide evidence of geological history. c. Construct a visual representation of the rock cycle (e.g., formation, weathering, sedimentation, and reformation) and relate this representation to the surface geology of Saskatchewan and Canada. d. Develop and use a classification key for rocks based on physical characteristics and method of formation. e. Describe examples of mechanical and chemical weathering of rocks. f. Differentiate between weathering and erosion, and explain the role of water in each process. g. Document the natural surface geological features of the local environment and provide explanations for the origin of those features. h. Relate mechanical (e.g., wind and water), chemical (e.g., acid rain and rusting), and biological (e.g., lichens, mosses, and tree roots) weathering processes to the formation of soils. i. Collect, with permission, and examine samples of local soils to determine their physical properties (e.g., colour, odour, texture, presence of organic matter, pore size, and air and water holding capacity). j. Classify soil samples according to their characteristics (e.g., sand, loam, and clay composition) and research ways to enrich soils for specific uses (e.g., vegetable garden, road building, dam construction, waste management, and sports field). k. Identify predominant soil types (e.g., black, dark brown, brown, and grey) and corresponding land uses in Saskatchewan.

l. Assess environmental and economic impacts of past and current land use practices in Saskatchewan (e.g., agriculture, urban development, recreation, and road construction), and describe intended and unintended consequences of those practices on self, society, and the environment, including soil degradation.

Assessment and Evaluation of Student Learning

Assessment and evaluation require thoughtful planning and implementation to support the learning process and to inform teaching. All assessment and evaluation of student achievement must be based on the outcomes in the provincial curriculum.

Assessment involves the systematic collection of information about student learning with respect to:
- achievement of provincial curriculum outcomes
- effectiveness of teaching strategies employed
- student self-reflection on learning.

Evaluation compares assessment information against criteria based on curriculum outcomes for the purpose of communicating to students, teachers, parents/caregivers, and others about student progress and to make informed decisions about the teaching and learning process. Reporting of student achievement must be in relation to curriculum outcomes.

There are three interrelated purposes of assessment. Each type of assessment, systematically implemented, contributes to an overall picture of an individual student's achievement.

Assessment for learning involves the use of information about student progress to support and improve student learning, inform instructional practices, and:
- is teacher-driven for student, teacher, and parent use
- occurs throughout the teaching and learning process, using a variety of tools
- engages teachers in providing differentiated instruction, feedback to students to enhance their learning, and information to parents in support of learning.

Assessment as learning actively involves student reflection on learning, monitoring of her/his own progress, and:
- supports students in critically analyzing learning related to curricular outcomes
- is student-driven with teacher guidance
- occurs throughout the learning process.

Assessment of learning involves teachers' use of evidence of student learning to make judgements about student achievement and:
- provides opportunity to report evidence of achievement related to curricular outcomes
- occurs at the end of a learning cycle, using a variety of tools
- provides the foundation for discussions on placement or promotion.

Connections with Other Areas of Study

Although some learning outcomes or subject area knowledge may be better achieved through discipline-specific instruction, deeper understanding may be attained through the integration of the disciplines. Some outcomes for each area of study complement each other and offer opportunities for subject-area integration. Integrating science with another area of study can help students develop in a holistic manner by addressing physical, emotional, mental, and spiritual dimensions.

By identifying a particular context to use as an organizer, the outcomes from more than one subject area can be achieved and students can make connections across areas of study. Integrated, interdisciplinary instruction, however, must be more than just a series of activities. An integrated approach must facilitate students' learning of the related disciplines and understanding of the conceptual connections. The learning situations must achieve each individual subject area's outcomes and ensure that in-depth learning occurs. If deep understanding is to occur, the experiences cannot be based on superficial or arbitrarily connected activities (Brophy & Alleman, 1991, p. 66). The outcomes and activities of one area of study must not be obscured by the outcomes or activities of another area of study (Education Review Office, 1996, p. 13).

There are many possibilities for the integration of science and other subject areas. In doing this integration, however, teachers must be cautious to not lose the integrity of any of the subjects. Integration gives students experiences with transfer of knowledge and provides rich contexts in which the students are able to make sense of their learning. Following are just a few of the ways in which science can be integrated into other subject areas (and other subject areas into science) at grade seven.

Arts Education

The conceptual focus for Grade 7 Arts Education is "Place". This focus includes investigations of relationships between the arts and the land; local geography; regional, urban, and/or rural environments. Connections between arts education and science may include:

- Create arts expressions using First Nations stories and Indigenous knowledge of ecosystems as inspiration for the work.
- Create visual art works using student observations of living organisms within local ecosystems (e.g., sketches and photographs).

- Create instrumental and/or vocal soundscapes to represent the changing patterns and interconnected cycles observed in ecosystems.
- Analyze how traditional arts, world music instruments, and dance often have deep connections to the local environments and interconnected ecosystems (e.g., Australian digeridoos, Inuit throat singing, beading, First Nations drums and flutes).
- Create dance compositions inspired by science concepts such as conduction, convection, and radiation.
- Create a contextual drama involving a historical or current catastrophic geological event.
- Use the surface geology of Saskatchewan as inspiration for art works.
- Analyze and interpret art works by artists who use Saskatchewan geology as inspiration (e.g., Patterned Ground mural by visual artist Lorne Beug, Grasslands Dance Project by choreographer Bill Coleman).

Career Education

Areas of study such as science can provide the context for student awareness of transferability of emerging knowledge and skills to career pathways and their connections to community. Two specific examples of connections between science and career education at grade seven include:

- Investigate science and technology-related occupations and workplaces that require an understanding of ecosystems and the natural world, the changing environment, as well as geology and the science of soil.
- Use the results of their investigations into science to support exploration of possible personal life and work plans in career education.

English Language Arts (ELA)

As students gather and evaluate information, construct and refine knowledge, and share what they know with a variety of audiences, they use and develop their language skills. The environment/technology context in English language arts can provide students an opportunity to learn and apply science knowledge. Some specific examples of connections between ELA and science at grade seven include:

- Throughout the science curriculum, students should view, listen to, read, comprehend, and respond to a variety of texts, including fiction, non-fiction, videos, websites, and summarize the main ideas and supporting details of those texts.

- Students should understand that the structure of science textbooks differs from the structure of other types of texts. By gaining an understanding of that structure, students will be able to read those texts efficiently and effectively for a variety of purposes, including gathering information, following directions, understanding information, and for enjoyment.
- Students should present the results of their science inquiries using a variety of text forms, including expository, informational, and procedural texts (e.g., document the processes of extracting resources from the earth), descriptive texts (e.g., write a field journal of the observations of biotic and abiotic components in an ecosystem), and persuasive texts (e.g., make an argument for or against the use of a particular domestic heating or cooling technology).
- Students should reflect on and critique their choices of grade-appropriate strategies for communicating their science learning.

Health Education

Connections can often be found between the topics in health education and science, although students may conduct their inquiries into these topics from different disciplinary "worlds". A specific example of the connection between these areas of study at grade seven is:

- Analyzing how ecosystems change in response to natural and human influences, and proposing actions to reduce the impact of human behaviour on a specific ecosystem makes students understand the importance of nurturing harmonious relationships between humans and their environment.

Mathematics

A key connection between mathematics and science is the search for patterns and relationships in the natural and constructed world. Inquiries in science provide opportunities for students to collect, analyze, and display data, which require the application of a variety of mathematical skills, understandings, and processes, including measuring, counting, and data analysis skills. When students construct mathematical and physical models in science to represent and explain natural phenomena, they apply mathematical skills related to number and probability. Some specific examples of these connections in grade seven include:

- Collect, organize, and display data related to catastrophic geological events, rocks, and minerals.
- Construct and analyze tables of values and graphs when conducting experiments to explore the conditions that are favourable for plant growth.
- Determine sums and differences of integers when examining the effects of heat on states of matter.
- Demonstrate their understanding of percents when determining concentrations of solutions.
- Use experimental probabilitistic understandings to make predictions about the impact of natural and human-induced changes made within ecosystems

Physical Education

Both science and physical education involve understanding of the human movement in a variety of environment, albeit within different disciplinary "worlds". Understanding scientific principles related to how and where the body moves is of importance in both science and physical education. Two specific examples of connections between these areas of study at grade seven include:

- Student investigations into the problems and issues regarding land use can contribute to an understanding of the influences that may affect options for active living in a community.
- When students propose actions to reduce the impact of human behaviour on a specific ecosystem in science, they can consider how participation in alternate environment movement activities might influence and be influenced by these actions.

Social Studies

The content of social studies and science can often be used to connect the two areas of study, particularly with respect to connections between the environment and all living things, including humans. This connection is emphasized through the STSE (Science-Technology-Society-Environment) foundation of scientific literacy and the STSE Decision Making learning context. Some specific examples of these connections in grade seven include:

- Explore the relationship between the ecosystems students study and the location and distribution of human populations and communities.

- Examine the impact of the natural environment on human habitation and the impact of human habitation on natural environments.
- Draw conclusions about the relationship between natural resources and the lifestyle of populations.

Glossary

Abiotic refers to the non-living components of an ecosystem.

The **atmosphere** is the layer of gases surrounding Earth.

A **biogeochemical cycle** is a representation of the flow of matter through the biotic and abiotic components of ecosystems.

A **biome** is a large area with a similar climate that supports the same type of vegetation.

The **biosphere** is the entire global ecological system including all living things and their interactions with elements of the lithosphere, hydrosphere, and atmosphere.

Biotic refers to the living components of an ecosystem.

The **carbon cycle** is the biogeochemical cycle that shows how carbon cycles through Earth's biosphere, atmosphere, and hydrosphere.

Carnivores are animals that feed on other animals or animal parts.

Cellular respiration is the process by which plants release chemical energy stored in food.

Changes of state (e.g., condensation, deposition, evaporation, freezing, melting, and sublimation) are changes in matter from one form to that which occurs when heat is added or removed.

Chemical weathering is the breaking down of rocks and minerals by chemical reactions.

Chromatography is the process of separating components in a mixture as they travel through a material.

A **climax community** is a generally stable community that contains a wide range of species.

A **community** is a collection of populations of different species interacting with each other in the same place.

A **concentrated** solution contains a relatively large amount of solute compared to the maximum amount that could dissolve.

Concentration is the mass of solute that is dissolved in a certain volume of solvent and is measured in parts per million (ppm), g/L, or g/100mL.

Condensation is the change of state of a substance from a gas to a liquid.

Conduction is the flow of heat energy between substances that are in direct contact.

Consumers are living things, including all animals, which rely on other living things for food.

Convection is the flow of heat energy that involves moving liquid or gas particles.

A **convection current** is the pattern of moving liquid or gas when heat energy is added at one point.

Converging plate boundaries occur where two tectonic plates slide towards each other forming a subduction zone or a continental collision.

The **core** is the centre of Earth's interior and is composed of iron and nickel.

The **crust** is the solid outer layer of Earth's interior that is composed of igneous, sedimentary, and metamorphic rocks.

Cultural perspectives is the learning context that reflects a humanistic perspective which views teaching and learning as cultural transmission and acquisition.

Decomposers are living things that consume dead organisms.

A **dependent variable** is something that can be measured and whose value may change as a result of an experiment.

Deposition is the change of state of a substance from a gas to a solid without forming a liquid.

A **dilute** solution contains a relatively small amount of solute compared to the maximum amount that could dissolve.

Distillation is the process of separating components in a mixture based on their boiling points.

Diverging plate boundaries occur where two tectonic plates slide away from each other.

Ecological succession refers to the predictable and orderly changes in the composition or structure of an ecological community.

An **ecosystem** consists of all the biotic factors such as plants, animals, and micro-organisms, functioning together with abiotic factors of a particular environment.

Erosion is the process by which particles of rock and soil are loosened and moved elsewhere by wind, water, ice, or gravity.

Evaporation is the change of state of a substance from a liquid to a gas.

A **fair test** is an experiment that has been planned and controlled so that only one variable is changed at a time.

Faulting is the cracking of Earth's crust where there is movement along the two sides of the crack.

Filtration is the process of separating liquid or gaseous mixtures using a substance such as filter paper that contains tiny holes which trap solid particles.

Folding is the bending or curving of rocks that were initially horizontal due to plastic deformation.

A **food chain** is a model that shows the pathway of energy from one living thing to another in an ecosystem.

A **food web** is a model that shows several interconnected food chains within an ecosystem.

Fossils are the preserved traces or remains of plants, animals, and other organisms that lived long ago.

The **fossil record** is made up of all the fossils of species that have lived on Earth.

Freezing is the change of state of a substance from a liquid to a solid.

An **independent variable** is something that can be changed by an experimenter to cause an effect.

Heat is the transfer of energy between objects that have different temperatures.

Heat capacity is a measure of the ability of a substance to hold or release heat.

A **heating curve** is a graphical representation of the temperature of a substance as it is heated at a constant rate.

Herbivores are animals that feed on plants.

The **hydrosphere** is the part of Earth containing water.

Igneous rock is formed by the cooling and solidification of molten or partially molten magma.

Insoluble means a substance is not capable of dissolving, or dissolves only slightly, in a solvent.

Kinetic energy is the energy a moving object has because of its motion.

The **lithosphere** is the solid outer layer of Earth which contains the crust and upper mantle.

The **mantle** is the middle layer of Earth's interior that lies between the crust and the core.

Mass is the amount of matter in an object and is measured in kg.

Matter is anything that has mass and occupies space.

A **mechanical mixture** is a mixture composed of two or more substances in which the different substances are clearly visible.

Mechanical weathering is the breaking down of rocks and minerals by physical forces such as wind, water, heat, ice, and pressure.

Melting is the change of state of a substance from a solid to a liquid.

Metamorphic rock is formed by the transformation of existing sedimentary, igneous, or other metamorphic rock due to extreme heat and pressure in Earth's interior.

Minerals are naturally occurring solids formed through geological processes that have definite chemical compositions and crystalline structures.

A **mixture** is two or more substances which are combined physically but not chemically.

The **nitrogen cycle** is the biogeochemical cycle that shows how nitrogen cycles through Earth's biosphere, atmosphere, and hydrosphere.

Omnivores are animals that feed on both animals and plants.

The **particle theory of matter** is a scientific theory that explains the behaviour of matter.

Photosynthesis is the process by which plants use light energy, carbon dioxide, and water to make their own food.

A **pioneer species** is the first species to be established in a certain habitat.

Plate boundaries are locations where two tectonic plates meet.

Plate tectonics is a theory which describes the large scale motion of Earth's lithosphere.

A **population** is the collection of all individuals of the same species living in a certain place at the same time.

Primary succession is the formation of a new community in what was a barren habitat.

Producers are living things capable of making their own food, including all green plants.

Pure substances contain only one type of matter.

A **pyramid of biomass** shows the amount of biomass of organisms present at each trophic level in a given ecosystem.

A **pyramid of energy** shows the amount of energy available in the bodies of the organisms present at each trophic level in a given ecosystem.

A **pyramid of numbers** shows the number of organisms present at each trophic level in a given ecosystem.

Qualitative physical properties are those that can be observed but not measured, such as colour, texture, and smell.

Quantitative physical properties are those that can be measured, such as mass, volume, and melting point.

Radiation is the flow of heat energy in the form of waves.

The **rock cycle** is a series of events through which rock changes over time between igneous, sedimentary, and metamorphic forms.

Rocks are naturally occurring solid aggregates of minerals and mineral particles.

A **saturated solution** is a solution in which no more solute can dissolve at a certain temperature.

Scientific inquiry is the learning context that reflects an emphasis on understanding the natural and constructed world using systematic empirical processes that lead to the formation of theories that explain observed events and that facilitate prediction.

Scientific literacy is an evolving combination of the knowledge of nature, skills, processes, and attitudes students need to develop inquiry, problem-solving, and decision-making abilities, to become lifelong learners, and to maintain a sense of wonder about and responsibility towards the natural and constructed world

Secondary succession is the formation of a new community in a community that had been destroyed or greatly changed.

Sedimentary rock is formed by the building up of layers of solid fragments or the precipitation of minerals from solution.

Settling is the process of separating components in a mixture using gravity or centrifugal motion.

Sifting is the process of separating components in a mixture based on particle size.

Soil is the naturally occurring mixture of mineral and organic matter that forms the loose covering on Earth's surface.

Solubility is a measure of the maximum amount of solute that is able to dissolve in a given amount of solvent to form a saturated solution.

Soluble means a substance is capable of dissolving in a solvent.

A **solute** is the substance that dissolves in a solvent to form a solution.

A **solution** is a mixture composed of two or more substances in which the different substances are not visible.

A **solvent** is a liquid or gas that dissolves a solute to form a solution.

A **species** is a basic unit of biological classification which consists of living things that can reproduce and produce fertile offspring.

States of matter are the forms in which matter can exist (e.g., solid, liquid, and gas).

STSE decision making is the learning context that reflects the need to engage citizens in thinking about human and world issues through a scientific lens in order to inform and empower decision making by individuals, communities, and society.

STSE, which stands for Science-Technology-Society and the Environment, is the foundation of scientific literacy that is concerned with understanding the scope and character of science, its connections to technology, and the social context in which it is developed.

Sublimation is the change of state of a substance from a solid to a gas without forming a liquid.

A **supersaturated solution** is a solution that contains more solute than can normally dissolve at a certain temperature.

Technological problem solving is the learning context that reflects an emphasis on designing and building to solve practical human problems.

Tectonic plates are separate and distinct components of Earth's lithosphere which are in slow but continual movement.

Temperature is a measure of the average kinetic energy of the particles in a substance.

Transform plate boundaries occur where tectonic plates slide past each other along transform faults.

The **water cycle** is the biogeochemical cycle that shows how water cycles through Earth's biosphere, atmosphere, and hydrosphere.

Weathering is the breaking down of rocks and minerals through mechanical, chemical, and biological processes.

WHMIS is an acronym that stands for Workplace Hazardous Materials Information Systems.

References

Aikenhead, G. S. (2006). *Science education for everyday life: Evidence-based practice*. New York, NY: Teachers College Press.

Alberta Education. (2005). *Safety in the science classroom*. AB: Author.

Brophy, J. & Alleman, J. (1991). A caveat: Curriculum integration isn't always a good idea. *Educational Leadership*, 49, 66.

Canadian Council on Learning. (2007). *Redefining how success is measured in First Nations, Inuit and Métis learning, Report on learning in Canada 2007*. Ottawa: Author.

Council of Ministers of Education, Canada. (1997). *Common framework of science learning outcomes K to 12*. Toronto, ON: Author.

Di Giuseppe, M. (Ed). (2007). *Science education: A summary of research, theories, and practice: A Canadian perspective*. Toronto, ON: Thomson Nelson.

Education Review Office. (1996). *Science in schools – Implementing the 1995 science curriculum* (5). Wellington: Crown Copyright.

Flick, L. & Bell, R. (2000). Preparing tomorrow's science teachers to use technology: Guidelines for science educators. *Contemporary Issues in Technology and Teacher Education*, 1, 39-60.

International Council for Science. (2002). *ICSU series on science for sustainable development No 4: Science, traditional knowledge and sustainable development*.

International Technology Education Association. (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA: National Science Foundation.

Kluger-Bell, B. (2000). *Recognizing inquiry: Comparing three hands-on teaching techniques*. In Inquiry – Thoughts, Views, and Strategies for the K-5 Classroom (Foundations - A monograph for professionals in science, mathematics and technology education. Vol. 2). Washington, DC: National Science Foundation.

Kwan, T. & Texley, J. (2003). *Inquiring safely: A guide for middle school teachers*. Arlington, VA: NSTA Press.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy Press.

National Research Council. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. Washington, DC: National Academy Press

National Research Council. (2006). *America's lab report: Investigations in high school science*. Washington, DC: National Academy Press.

National Science Teachers Association (NSTA). 1999. *NSTA position statement: Science competitions*. Available online at http://www.nsta.org/about/positions/competitions.aspx.

National Science Teachers Association (NSTA). 2007. *NSTA position statement: The integral role of laboratory investigations in science instruction*. Available online at http://www.nsta.org/about/positions/laboratory.aspx.

National Science Teachers Association (NSTA). 2008. *NSTA position statement: Responsible use of live animals and dissection in the science classroom*. Available online at http://www.nsta.org/about/positions/animals.aspx.

Saskatchewan Learning. (2007). *Core curriculum: Principles, time allocations, and credit policy*. SK: Author.

Suggested Reading

Aikenhead, G.S. & Ogawa, M. (2007). Indigenous knowledge and science revisited. *Cultural Studies of Science Education*, 2(3), 539-591.

Allen, R. (2007). *The essentials of science, grades 7-12: Effective curriculum, instruction, and assessment*. Alexandria, VA: ASCD.

American Association for the Advancement of Science, Project 2061. (1994). *Benchmarks for scientific literacy*. Washington, DC: Author.

American Association for the Advancement of Science, Project 2061. (2001). *Atlas of scientific literacy, Volume 1*. Washington, DC: Author.

American Association for the Advancement of Science, Project 2061. (2007). *Atlas of scientific literacy, Volume 2*. Washington, DC: Author.

Atkin, J.M. & Coffey, J.E. (Eds.). (2003). *Everyday assessment in the science classroom*. Arlington, VA: NSTA Press.

Bell, R.L., Gess-Newsome, J., & Luft, J. (Eds.). (2008). *Technology in the secondary science classroom*. Arlington, VA: NSTA Press.

British Columbia Ministry of Education. (2003). *Science safety resource manual*. BC: Author.

Cajete, G.A. (1999). *Igniting the sparkle: An indigenous science education model*. Skyland, NC: Kivaki Press.

Douglas, R., Klentschy, M.P., Worth, K., & Binder, W. (Eds.). (2006). *Linking science and literacy in the K-8 classroom*. Arlington, VA: NSTA Press.

Gilbert, S. & Watt Iron, S. (2003). *Understanding models in earth and space science*. Arlington, VA: NSTA Press.

Hammerman, E. & Musial, D. (2008). *Integrating science with mathematics & literacy: New visions for learning and assessment* (2nd ed). Thousand Oaks, CA: Corwin Press.

Kwan, T. & Texley, J. (2002). *Exploring safely: A guide for elementary teachers*. Arlington, VA: NSTA Press.

Kwan, T. ,Texley, J., & Summers, J. (2004). *Investigating safely: A guide for high school teachers*. Arlington, VA: NSTA Press.

LaMoine, L.M., Biehle, J.T., & West, S.S. (2007). *NSTA guide to planning school science facilities* (2nd ed). Arlington, VA: NSTA Press.

Michell, H., Vizina, Y., Augusta, C., & Sawyer. J. (2008). *Learning Indigenous science from place*. (2008). Aboriginal Education Research Centre, University of Saskatchewan.

National Research Council. (2007). *Taking science to school: Learning and teaching science in grades K-8*. Committee on Science Learning, Kindergarten through Eighth Grade. Richard A. Duschl, Heidi A. Schweingruber, and Andrew A. Shouse, Editors. Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Saul, W.E. (Ed.). (2004). *Crossing borders in literacy and science instruction: Perspectives on theory and practice*. Arlington, VA: NSTA Press.

Feedback Form

The Ministry of Education welcomes your response to this curriculum and invites you to complete and return this feedback form.

Document Title: **Grade 7 Science Curriculum**

1. Please indicate your role in the learning community

   ☐ parent ☐ teacher ☐ resource teacher

   ☐ guidance counsellor ☐ school administrator ☐ school board trustee

   ☐ teacher librarian ☐ school community council member

   ☐ other ____

   What was your purpose for looking at or using this curriculum?

2. a) Please indicate which format(s) of the curriculum you used:

   ☐ print

   ☐ online

   b) Please indicate which format(s) of the curriculum you prefer:

   ☐ print

   ☐ online

3. How does this curriculum address the needs of your learning community or organization? Please explain.

4. Please respond to each of the following statements by circling the applicable number.

The curriculum content is:	Strongly Agree	Agree	Disagree	Strongly Disagree
appropriate for its intended purpose	1	2	3	4
suitable for your use	1	2	3	4
clear and well organized	1	2	3	4
visually appealing	1	2	3	4
informative	1	2	3	4

5. Explain which aspects you found to be:

   Most useful:

   Least useful:

7. Additional comments:

7. Optional:

   Name: ______________________________

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Thank you for taking the time to provide this valuable feedback.

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