Science 4
Properties and Uses of Earth Materials

IMPLEMENTATION DRAFT – October 2019

New Nouveau Brunswick

Website References

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1. Introduction

1.1 Mission and Vision of Educational System

The New Brunswick Department of Education and Early Childhood Development is dedicated to providing the best public education system possible, wherein all students have a chance to achieve their academic best. The mission statement for New Brunswick schools is:

> *Each student will develop the attributes needed to be a lifelong learner, to achieve personal fulfillment and to contribute to a productive, just and democratic society.*

1.2 New Brunswick Global Competencies

New Brunswick Global Competencies provide a consistent vision for the development of a coherent and relevant curriculum. The statements offer students clear goals and a powerful rationale for school work. They help ensure that provincial education systems' missions are met by design and intention. The New Brunswick Global Competencies statements are supported by curriculum outcomes.

New Brunswick Global Competencies are statements describing the knowledge, skills and attitudes expected of all students who graduate high school. Achievement of the New Brunswick Global Competencies prepares students to continue to learn throughout their lives. These Competencies describe expectations not in terms of individual school subjects but in terms of knowledge, skills and attitudes developed throughout the curriculum. They confirm that students need to make connections and develop abilities across subject boundaries if they are to be ready to meet the shifting and ongoing demands of life, work and study today and in the future.

See Appendix 6.1.

1.3 Teaching for Scientific Literacy

The emergence of a highly competitive and integrated global economy, rapid technological innovation, and a growing knowledge base will continue to have a profound impact on people's lives. Advancements in science and technology play an increasingly significant role in everyday life. Science education will be a key element in developing scientific literacy and in building a strong future for New Brunswick's young people.

Science education for the future requires that students learn more than just the basic concepts of science. Students need to be equipped with the skills to be able to use scientific knowledge to identify questions, and to draw evidence-based conclusions to understand and make decisions about the natural world and the changes made to it through human activity. They also need to understand the characteristic features of science as a form of human knowledge and inquiry and be aware of how science and technology shape their world. Lastly, students need to be equipped with attitudes and values to engage in science-related issues as an ethical citizen.

A strong foundation in scientific knowledge and practices will include the development of reasoning and analytical skills, decision and problem-solving skills, flexibility to respond to different contexts and inspire students at all grade levels to develop a critical sense of wonder and curiosity about scientific and technological endeavours. Important to a sustainable future, a foundation in scientific literacy will prepare students to address critically science-related societal, economic, ethical, and environmental issues. These are skills and competencies that are aligned to the New Brunswick Global Competencies.

See appendix 6.2

1.4 Science and the Sustainable Development Goals (aka SDGs and the Global Goals)

Science, Technology, and Innovation (STI) are recognized as the key drivers behind economic growth and prosperity. In the context of the SDGs for achieving, the Global Goals, STI plays a central role. The aim of the 17 Global Goals is to secure a sustainable, peaceful, prosperous, and equitable life on Earth for everyone now and in the future. To create a more sustainable world, and to engage with sustainability issues, learners must become sustainability change-makers. Education, therefore is vital for the achievement of sustainable development. By intentionally connecting classroom learning to these goals, teachers create real-world (relevant) context for students to help them become global citizens and critical thinkers. The concepts and content in this document are aligned learning objectives of specific goals and are identified in this section as well as the Curriculum Organizers and Outcomes section of this document.

Guiding Principles for Science in the Sustainable Development Goals

- Strengthen science education to increase science literacy and capacity-building in science at all levels.
- Recognize science as a universal public good that helps in laying the foundation for a sustainable world and is, therefore, more than a tool for the achievement of the 2030 Agenda for Sustainable Development and its Sustainable Development Goals (SDGs).
- Enhance diversity in science for sustainable development by realizing gender equity in science and by building on the entire spectrum of society, including underrepresented groups and minorities.

- Promote an integrated scientific approach that addresses the social, economic, and environmental dimensions of sustainable development and respecting the diversity of knowledge systems. Building a sustainable world requires overcoming disciplinary boundaries.

The SDGs address the need to activate science at multiple levels and across disciplines to gather and create the necessary knowledge to lay the foundations for practices, innovations, and technologies that address global challenges today, and in the future.

In the Grade 4 Science classroom students will explore and investigate topics related to goals 11 – Sustainable cities and communities, 12 – Responsible consumption and production, 14 – Life on land, and 15 – Life below water. The goals framing the Grade 4 program of study appears in the Curriculum Organizers and Outcomes and are hyperlinked to the corresponding Global Goals webpage.

1.5 Science as a Way of Knowing

An inclusive 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 that are embedded within worldviews.

Indigenous Ways of Knowing

Traditional knowledge is a cumulative body of knowledge, know-how, practices, and representations that is maintained and developed by Indigenous Peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations, and meanings are part of a cultural complex that encompasses language, naming, and classification

systems, resource use practices, ritual, spirituality and worldview (International Council for Science, 2002 as cited by Restoule, 2019).

As an oral culture, Indigenous Knowledge is not written down, contained in textbooks, and stored on shelves for reference or posterity. All things are considered living and spiritual, related and interrelated, and critical to life and living (Cajete, 2000, as cited by Hogue, 2016). Elders are the cultural experts and keepers of knowledge in the traditional stories, in the ceremonies, and in the practices; teaching is mentoring, and learning is doing and applying.

Scientific Knowledge

Like Indigenous ways of knowing, scientific knowledge is a cumulative body of knowledge, know-how, practices, and representations maintained and developed by scientists with extended histories of interaction with the natural environment. To study the natural world, scientists use methods that are empirical, which means that they are grounded in observations and experimentation and are not based on opinions or sentiments. These sophisticated sets of understandings, interpretations, and meanings are part of cultural complexes that encompass language, naming and classification systems, resource use practices, conventions, and worldview. Although there are other ways of knowing that may be important in our personal and cultural lives, scientists rely on evidence and testing, rather than opinion, belief, and other factors.

2. Pedagogical Components

2.1 Pedagogical Guidelines

Diverse Cultural Perspectives

It is important for teachers to recognize and honour the variety of cultures and experiences from which students are approaching their education and the world. It is also important for teachers to recognize their own biases and be careful not to assume levels of physical, social or academic competencies based on gender, culture, or socio-economic status.

Each student's culture will be unique, influenced by their community and family values, beliefs, and ways of viewing the world. Traditional aboriginal culture views the world in a much more holistic way than the dominant culture. Disciplines are taught as connected to one another in a practical context, and learning takes place through active participation, oral communication and experiences. Immigrant students may also be a source of alternate world views and cultural understandings. Cultural variation may arise from the differences between urban, rural and isolated communities. It may also arise from the different value that families may place on academics or athletics, books or media, theoretical or practical skills, or on community and church. Providing a variety of teaching and assessment strategies to build on this diversity will provide an opportunity to enrich learning experiences for all students.

Universal Design for Learning

Universal Design for Learning is a "framework for guiding educational practice that provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways, students are engaged. It also "...reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient." (CAST, 2011).

To build on the established practice of differentiation in education, the Department of Education and Early Childhood Development supports Universal Design for Learning for all students. New Brunswick curricula are created with universal design for learning principles in mind. Outcomes are written so that students may access and represent their learning in a variety of ways, through a variety of modes. Three tenets of universal design inform the design of this curriculum. Teachers are encouraged to follow these principles as they plan and evaluate learning experiences for their students:

- Multiple means of representation: provide diverse learners options for acquiring information and knowledge
- Multiple means of action and expression: provide learners options for demonstrating what they know
- Multiple means of engagement: tap into learners' interests, offer appropriate challenges, and increase motivation

For further information on Universal Design for Learning, view online information at the CAST website, download the UDL reference handout.

UDL is neither curriculum nor a checklist. If it were either one of those things, it would oversimplify the act and professionalism of teaching. As an educator, you have taken courses in pedagogy, classroom management, and theory. You have a collection of tools, resources, and strategies you have learned recently or over the years. The structure of UDL guides you to actively, attentively, and purposely pull from that collection. It also asks you to possibly think differently. The Difference: Because UDL is a framework versus a curriculum, teachers are in full control in designing the learning environment and lessons (p. 4, Design and Deliver).

Loui Lord Nelson (2104) suggests the following reflective questions to support planning (p. 134):

When I plan my lessons do I:

- *Have a clear goal?*
- *Know how I am going to measure whether students have met the goal?*
- *Create activities and assignments that guide students toward the lesson goal?*
- *Create lessons and activities designed with options mentioned under the three principles of Engagement, Representation and Action and Expression?*
- *Create assessments directly related to the lesson's goal?*
- *Create assessments designed with the options listed under Action and Expression?*
- *Use a variety of tools and resources to create my lesson plans?*

Nelson makes the following recommendation:

> *Start small. Choose one focus within the framework. Choose one focus within your practice. Enlist the involvement of other teachers and talk with each other about your experiences. Trade suggestions. Share experiences. Share successes. Watch for change.* (p. 136)

The curriculum has been created to support the design of learning environments and lesson plans that meet the needs of all learners. Specific examples to support Universal Design for Learning for this curriculum can be found in the appendices. The Planning for All Learners Framework will guide and inspire daily planning.

English as an Additional Language Curriculum

Being the only official bilingual province, New Brunswick offers the opportunity for students to be educated in English and/or French through our public education system. The EECD provides leadership from K-12 to assist educators and many stakeholders in supporting newcomers to New Brunswick. English language learners have opportunities to receive a range of instructional support to improve their English language proficiency through an inclusive learning environment. EECD, in partnership with the educational and wider communities offer a solid, quality education to families with school-aged children.

Copyright Matters

Teacher must ensure that they respect the fair dealing provision when accessing and using course resources and materials for instructional purposes. The works of others should not be used without their permission unless the use is permitted by the *Copyright Act*. Teachers are expected to be aware of the copyright status of instructional materials in their possession. The *Copyright Act* permits use of a copyright-protected work without permission from the copyright owner or the payment of copyright royalties under specific conditions.

Consumable materials intended for one-time use in the classroom (i.e. workbooks and exercise sheets) are created with the understanding that each student is to have their own copy. Unless teachers have permission to copy a consumable, copying,

scanning, or printing materials intended for one-time use is strictly prohibited. Copying from instructional materials intended for one-time use without permission exposes the teacher, the school, and the school board to liability for copyright infringement

To learn more about the fair dealing guidelines and the *Copyright Act* visit, the Council of Ministers of Education Canada website at <https://www.cmec.ca/140/Copyright_Matters!.html>.

Cross Curricular Literacy

Literacy occurs across learning contexts and within all subject areas. Opportunities to speak and listen, read and view, and write and represent are present every day -in and out of school.

2.2 Assessment Guidelines

Assessment Practices

Assessment is the systematic gathering of information about what students know and are able to do. Student performance is assessed using the information collected during the evaluation process. Teachers use their professional skills, insight, knowledge, and specific criteria that they establish to make judgments about student performance in relation to learning outcomes. Students are also encouraged to monitor their own progress through self-assessment strategies, such as goal setting and rubrics.

Research indicates that students benefit most when assessment is regular and ongoing and is used in the promotion of learning (Stiggins, 2008). This is often referred to as formative assessment. Evaluation is less effective if it is simply used at the end of a period of learning to determine a mark (summative evaluation).

Summative evaluation is usually required in the form of an overall mark for a course of study, and rubrics are recommended for this task. Sample rubrics templates are referenced in this document, acknowledging teachers may have alternative measures they will apply to evaluate student progress.

Some examples of current assessment practices include:

• Questioning	• Projects and Investigations
• Observation	• Checklists/Rubrics
• Conferences	• Responses to texts/activities
• Demonstrations	• Reflective Journals
• Presentations	• Self and peer assessment
• Role plays	• Career Portfolios
• Technology Applications	

Formative Assessment

Research indicates that students benefit most when assessment is ongoing and is used in the promotion of learning (Stiggins, 2008). Formative assessment is a teaching and learning process that is frequent and interactive. A key component of formative assessment is providing ongoing feedback to learners on their understanding and progress. Throughout the process adjustments are made to teaching and learning.

Students should be encouraged to monitor their own progress through goal setting, co-constructing criteria and other self-and peer-assessment strategies. As students become more involved in the assessment process, they are more engaged and motivated in their learning.

Additional details can be found in the Formative Assessment document.

Summative Assessment

Summative evaluation is used to inform the overall achievement for a reporting period for a course of study. Rubrics are recommended to assist in this process. Sample rubrics templates are referenced in this document, acknowledging teachers may have alternative measures they will apply to evaluate student progress.

For further reading in assessment and evaluation, visit the Department of Education and Early Childhood Development's Assessment and Evaluation site here.

3. Subject Specific Guidelines

3.1 Rationale

Students in Grade 4 continue to build on their awareness of Earth-sky patterns and cycles and to extend their understanding by investigating energy flow, weather, and interactions in natural systems. As students explore their immediate and local environments (ecosystems), they develop a deeper understanding of the effects of the physical environment on the organisms—the plants and animals—that inhabit them.

3.2 Course Description

The focus of science in Grade 4 is to enable students to extend their scientific understanding of place from a local context to larger scale, planet Earth. They should be given opportunities which enable them to build more systematic understanding of Earth materials, exploring and comparing properties and start to make their own decisions about what observations to make and the type of equipment that might be used to carry out an investigation.

In grade 4 students will examine the structure Earth's surface, its properties and materials, investigating their physical characteristics and uses, the forces (natural and human) and energy applied to shape the surface, and effects on people, society and environment. Students demonstrate understanding and explore topics related to Sustainable Development Goals: 11 – Sustainable cities and communities, 12-Responsible consumption and production, 14 – Life on land, and 15 – Life below water.

An interdisciplinary approach to learning that integrates the *Physical Sciences and Earth and Space Sciences*, and is supported by having students: (1) plan and carry out fair tests in which variables are controlled and failure points are considered, to identify aspects of the procedure that can be improved; and (2) define a practical design problem reflecting specified criteria for success and constraints on materials, time or cost.

3.3 Curriculum Organizers and Outcomes

Organizers

Science 4 curriculum has been developed with the three processes of scientific literacy in mind. Students can be considered scientifically literate when they are familiar with, and able to engage in, the following processes within a science context: inquiry, problem-solving, and decision making. Each strand consists of prescribed learning outcomes that share a common focus.

Inquiry

Scientific inquiry involves posing questions and developing explanations for phenomena. While there is general agreement there is no such thing as the scientific method, students require certain skills to participate in the activities of science. Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting data, analysing data, and interpreting data are fundamental to engaging in science. These activities provide students with opportunities to practise the process of theory development in science and understand the nature of science.

Problem-Solving

The process of problem-solving involves seeking solutions to human problems. It consists of proposing, creating, and testing prototypes, products, and techniques to determine the best solution to a given problem.

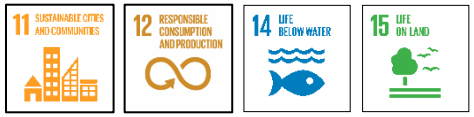
Decision Making

The process of decision making involves determining what we, as citizens, should do or in response to a given situation. Decision-making situations are inherently important and provide a relevant context for engaging in scientific inquiry and/or problem-solving.

Teachers should carry out the inquiry-based approach through hands-on learning that is situated in realistic contexts, so that students can make connections with their own lives and the community in which they live. This way, students will become excited and curious about the concepts and phenomena under study, and they then become motivated to learn.

Global Goals

Students explore concepts and topics related to UN Sustainable Development Goals:



Click on the image to be redirected to the SDG microsite on the subject.

Essential Questions

Essential Questions open doors to student understanding when used to frame instruction and guide learning (McTighe & Wiggins, 2013). They are a pedagogical tool used to stimulate students' curiosity, stimulate thought, activate students' prior knowledge and transform instruction. The EQs listed below will assist in *uncovering* the important ideas, content and processes so that students can make helpful connections and are equipped to transfer their learning in meaningful ways:

1. How do humans change the planet?
2. How do we determine the uses of Earth materials?
3. What on Earth is in your stuff and where on Earth does it come from?
4. What are some of the concerns related to extracting Earth materials sustainably? Design a solution to address a concern.

Outcomes

The New Brunswick Curriculum is stated in terms of general curriculum outcomes, specific curriculum outcomes and achievement indicators. Learning outcomes describe what students are expected to know, understand, be able to do and put into action after the completion of a planned process of learning experiences.

General Curriculum Outcomes (**GCO**) are overarching statements about what students are expected to learn in each strand/sub-strand. The general curriculum outcome for each strand/sub-strand is the same throughout the grades.

Specific Curriculum Outcomes (**SCO**) are statements that identify specific concepts and related skills underpinned by the understanding and knowledge attained by students as required for a given grade.

Learning Outcomes Summary Chart

Scientific Literacy

GCO 1	**Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).**
SCO 1.1	Students will plan investigations by asking questions, making inferences, and selecting and using equipment or technology needed to solve a specific problem in the natural world.
SCO 1.2	Students will collect data by observing and measuring; using tools and methods appropriate for the task.
SCO 1.3	Students will analyse and interpret patterns in data to construct explanations based on evidence from investigations.
SCO 1.4	Students will communicate using writing, drawing pictures, and oral language to express valid conclusions supported by data.

Science Technology Society and Environment (STSE)

GCO 2	**Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology (STSE).**
SCO 2.1	Students will consider factors that support responsible application of scientific and technological knowledge, and demonstrate an understanding of sustainable practices.

GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

4. Curriculum Outcomes

GCO 1	**Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).**

SCO 1.1	**Students will plan investigations asking questions, making inferences, and selecting and using equipment or technology needed to solve a specific problem in the natural world.**

Concepts and Content	**Exemplar "I" statements:**
The Earth's Crust ○ Composition ▪ Outer most layer of the planet ▪ Composed of a variety of igneous, metamorphic and sedimentary rocks ▪ thickest (deepest) in mountain regions ○ Two types of crust ▪ Oceanic (5-10 km) and continental (30-50 km) ○ Cycles: Rock, tectonic, and water Changes in Earth Surface ○ Rapid changes caused by Volcanoes, earthquakes, landslides ○ Slow changes: weathering, erosion, and deposition from water, wind and ice ○ Forces changing Earth's surface Rocks ○ Types of rocks: Sedimentary, igneous and metamorphic ○ Fossils: Evidence of the past Ex. Organisms and environments ○ Formation processes: Solidification of magma, Cooling of lava, Heat and pressure, Weathering, erosion, and deposition. ○ Physical properties: Physical properties such as colour, weight, density, grain size, texture, state (solid), conductors, insulators, solubility in water, mixtures, and solutions	I can ask questions about familiar objects and events that lead to simple investigations. I can make predictions, based on prior knowledge about objects and events. I can identify the measured variable**.** I can identify the variable being changed. I can brainstorm working criteria E.g. specifications, constraints, etc. I can suggest a problem statement for a technological solution. I can suggest steps to conduct a fair test to answer a question. ***Create a personalized set of "I statements" to reflect the learning goals of your lesson.***

GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

Minerals ○ Scientific testing ▪ Crystal structure, Mohs hardness scale, lustre, magnetism, streak, and electrical conductivity ○ Identification of minerals ▪ Multiple properties of a given mineral can help to identify minerals: Ex. Streak, crystal structure, transparency/opaque, hardness, electrical conductor, magnetic, and refractive index Soils ○ Weathering and soil formation: Weathering (breakdown), erosion (transportation), and decomposition of plant and animal remains ○ Physical properties: Texture, colour, porosity, capacity to hold water, ability to support growth of plants Uses of Earth resources ○ Characteristics of natural resources make them useful in products and materials ○ Rocks and minerals ○ Soils ○ Fossil fuels ○ Renewable (Ex. Sunlight, air, plants, animals, and water) versus non-renewable (Ex. Coal, oil, and natural gas)	

Resources

Video	Website	Document
Discovery Channel - How's its made Mining Matters – WHERE Challenge Minerals Industry Human Resources – A career in mining	*Global resources* Earth Learning Idea Geoscience News and Information – Rock Geoscience News and Information – Minerals UN Sustainable Development Goals *Local resources*	STEP Wise Framework Earth Science Literacy Initiative Mining Matters – Core Concepts / Notions du fonds

	Canadian Federation of Earth Sciences New Brunswick Energy and Mines *Careers* Explore a Career in Earth Science? Minerals Industry Human Resources	*Companion documents* *Association of Engineers and Geoscientists New Brunswick (APEG) and EECD, Designing Technological Solutions. [in production]* *The Gaia Project and EECD K-5 Sustainability Education [in production]*

GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

SCO 1.2	**Students will collect data by observing and measuring, using tools and methods appropriate for the task.**
Concepts and Content	**Exemplar "I" statements:**
The Earth's Crust ○ Composition ▪ Outer most layer of the planet ▪ Composed of a variety of igneous, metamorphic and sedimentary rocks ▪ Thickest (deepest) in mountain regions ○ Two types of crust ▪ Oceanic (5-10 km) and continental (30-50 km) ○ Cycles: Rock, tectonic, and water Changes in Earth Surface ○ Rapid changes caused by Volcanoes, earthquakes, landslides ○ Slow changes: weathering, erosion, and deposition from water, wind and ice ○ Forces changing Earth's surface Rocks ○ Types of rocks: Sedimentary, igneous and metamorphic ○ Fossils: Evidence of the past Ex. Organisms and environments ○ Formation processes: Solidification of magma, Cooling of lava, Heat and pressure, Weathering, erosion, and deposition. ○ Physical properties: Physical properties such as colour, weight, density, grain size, texture, state (solid), conductors, insulators, solubility in water, mixtures, and solutions Minerals ○ Scientific testing ▪ Crystal structure, Mohs hardness scale, lustre, magnetism, streak, and electrical conductivity ○ Identification of minerals	I can suggest a plan for how to carry out an inquiry. I can carry out a procedure to test a prediction, answer a question / solve a problem. I can use materials and equipment to test predictions to answer the question. I can use materials and equipment to create a solution to the problem statement. I can collect data using various methods. I can use tools and materials to build a prototype. I can record data using formal measurements (where appropriate). I can use descriptive words to record my observations. ***Create a personalized set of "I statements" to reflect the learning goals of your lesson.***

GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

▪ Multiple properties of a given mineral can help to identify minerals: Ex. Streak, crystal structure, transparency/opaque, hardness, electrical conductor, magnetic, and refractive index Soils ○ Weathering and soil formation: Weathering (breakdown), erosion (transportation), and decomposition of plant and animal remains ○ Physical properties: Texture, colour, porosity, capacity to hold water, ability to support growth of plants Uses of Earth resources ○ Characteristics of natural resources make them useful in products and materials ○ Rocks and minerals ○ Soils ○ Fossil fuels ○ Renewable (Ex. Sunlight, air, plants, animals, and water) versus non-renewable (Ex. Coal, oil, and natural gas)	

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GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

SCO 1.3	**Students will analyse and interpret patterns in data to construct explanations based on evidence from investigations.**
Concepts and Content	**Exemplar "I" statements:**
The Earth's Crust ○ Composition ▪ Outer most layer of the planet ▪ Composed of a variety of igneous, metamorphic and sedimentary rocks ▪ thickest (deepest) in mountain regions ○ Two types of crust ▪ Oceanic (5-10 km) and continental (30-50 km) ○ Cycles: Rock, tectonic, and water Changes in Earth Surface ○ Rapid changes caused by Volcanoes, earthquakes, landslides ○ Slow changes: weathering, erosion, and deposition from water, wind and ice ○ Forces changing Earth's surface Rocks ○ Types of rocks: Sedimentary, igneous and metamorphic ○ Fossils: Evidence of the past Ex. Organisms and environments ○ Formation processes: Solidification of magma, Cooling of lava, Heat and pressure, Weathering, erosion, and deposition. ○ Physical properties: Physical properties such as colour, weight, density, grain size, texture, state (solid), conductors, insulators, solubility in water, mixtures, and solutions Minerals ○ Scientific testing ▪ Crystal structure, Mohs hardness scale, lustre, magnetism, streak, and electrical conductivity ○ Identification of minerals	I can represent observations using drawings, digital technologies, or simple text I can create simple labelled drawings, tables, bar graphs, or other formats to represent data I can classify object and events according to one or more properties. I can compare my observations with those of others. I can identify new questions that result from investigations. I can review ideas / useful information that can be used to answer initial question. I can review ideas / useful information that can be used to solve a problem. ***Create a personalized set of "I statements" to reflect the learning goals of your lesson.***

GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

▪ Multiple properties of a given mineral can help to identify minerals: Ex. Streak, crystal structure, transparency/opaque, hardness, electrical conductor, magnetic, and refractive index Soils ○ Weathering and soil formation: Weathering (breakdown), erosion (transportation), and decomposition of plant and animal remains ○ Physical properties: Texture, colour, porosity, capacity to hold water, ability to support growth of plants Uses of Earth resources ○ Characteristics of natural resources make them useful in products and materials ○ Rocks and minerals ○ Soils ○ Fossil fuels ○ Renewable (Ex. Sunlight, air, plants, animals, and water) versus non-renewable (Ex. Coal, oil, and natural gas)	

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GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

SCO 1.4	**Students will communicate valid conclusions supported by data in writing, by drawing pictures, and through verbal discussion.**
Concepts and Content	**Exemplar "I" statements:**
The Earth's Crust ○ Composition ▪ Outer most layer of the planet ▪ Composed of a variety of igneous, metamorphic and sedimentary rocks ▪ thickest (deepest) in mountain regions ○ Two types of crust ▪ Oceanic (5-10 km) and continental (30-50 km) ○ Cycles: Rock, tectonic, and water Changes in Earth Surface ○ Rapid changes caused by Volcanoes, earthquakes, landslides ○ Slow changes: weathering, erosion, and deposition from water, wind and ice ○ Forces changing Earth's surface Rocks ○ Types of rocks: Sedimentary, igneous and metamorphic ○ Fossils: Evidence of the past Ex. Organisms and environments ○ Formation processes: Solidification of magma, Cooling of lava, Heat and pressure, Weathering, erosion, and deposition. ○ Physical properties: Physical properties such as colour, weight, density, grain size, texture, state (solid), conductors, insulators, solubility in water, mixtures, and solutions Minerals ○ Scientific testing ▪ Crystal structure, Mohs hardness scale, lustre, magnetism, streak, and electrical conductivity ○ Identification of minerals	I can connect explanation to scientific knowledge and experience / technological knowledge and experience. I can use appropriate conventions, and science and technology vocabulary that others understand. I can communicate procedure, result, and conclusion a variety of media. I can communicate how the problem was solved using a variety of media. I can respond to the ideas of others and acknowledge their contribution. I can discuss my observations and ideas using methods appropriate to the audience. ***Create a personalized set of "I statements" to reflect the learning goals of your lesson.***

GCO 1: Students will develop the skills required for scientific and technological inquiries, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions (scientific literacy).

▪ Multiple properties of a given mineral can help to identify minerals: Ex. Streak, crystal structure, transparency/opaque, hardness, electrical conductor, magnetic, and refractive index Soils ○ Weathering and soil formation: Weathering (breakdown), erosion (transportation), and decomposition of plant and animal remains ○ Physical properties: Texture, colour, porosity, capacity to hold water, ability to support growth of plants Uses of Earth resources ○ Characteristics of natural resources make them useful in products and materials ○ Rocks and minerals ○ Soils ○ Fossil fuels ○ Renewable (Ex. Sunlight, air, plants, animals, and water) versus non-renewable (Ex. Coal, oil, and natural gas)	

Resources

Video	**Website**	**Document**
Discovery Channel - How's its made Mining Matters – WHERE Challenge Minerals Industry Human Resources – A career in mining	*Global resources* Earth Learning Idea Geoscience News and Information – Rock Geoscience News and Information – Minerals UN Sustainable Development Goals *Local resources* Canadian Federation of Earth Sciences New Brunswick Energy and Mines *Careers* Explore a Career in Earth Science? Minerals Industry Human Resources	STEP Wise Framework Earth Science Literacy Initiative Mining Matters – Core Concepts / Notions du fonds *Companion documents* *Association of Engineers and Geoscientists New Brunswick (APEG) and EECD, Designing Technological Solutions. [in production]* *The Gaia Project and EECD K-5 Sustainability Education [in production]*

GCO 2: Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology (STSE).

GCO 2	**Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology (STSE).**

SCO 2.1	**Students will consider factors that support responsible application of scientific and technological knowledge and demonstrate an understanding of sustainable practices.**
Concepts and Content	**Exemplar "I" statements:**
Sustainability ○ Conservation ○ Stewardship ▪ Earth Science Literacy Big Ideas 7 and 9 Safety ○ Practices for scientific inquiry / technological inquiry ○ Personal Protective Equipment (PPE)	I can describe ways of using Earth's materials to make useful objects. I can identify interactions between humans and Earth that are sustainable. I can describe how Earth's materials are replenished. I can identify human behaviours that can lead to responsible use of Earth materials. I can consider the criteria for a solution that lessens the impact of natural and human forces on the landscape. I can identify effects of the chosen solution on people and the environment considering criteria. I can explore career pathways based on my interests. I can distinguish between scientific facts, beliefs and opinions when answering scientific question / seeking a solution to a technological problem. I can safely use equipment while carrying out an inquiry. I can safely use tools used to build a prototype.

GCO 2: Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology (STSE).

	I can know and practice safety rules when carrying out field studies. I can identify behaviours that will keep myself and others safe. ***Create a personalized set of "I statements" to reflect the learning goals of your lesson.***

Resources

Video	**Website**	**Document**
Discovery Channel - How's its made Mining Matters – WHERE Challenge Minerals Industry Human Resources – A career in mining Earth Science Literacy Videos - Big Idea 7 - Big Idea 9	*Global resources* Earth Learning Idea Earth Science Week Geoscience News and Information – Rock Geoscience News and Information – Minerals UN Sustainable Development Goals *Local resources* Canadian Federation of Earth Sciences New Brunswick Energy and Mines *Careers* Explore a Career in Earth Science? Minerals Industry Human Resources	STEP Wise Framework Earth Science Literacy Initiative Mining Matters – Core Concepts / Notions du fonds *Companion documents* *Association of Engineers and Geoscientists New Brunswick (APEG) and EECD, Designing Technological Solutions. [in production]* *The Gaia Project and EECD K-5 Sustainability Education [in production]*

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6. Appendices

6.1 New Brunswick Global Competencies

Critical Thinking and Problem-Solving	Innovation, Creativity, and Entrepreneurship	Self-Awareness and Self-Management
• Engages in an inquiry process to solve problems • Acquires, processes, interprets, synthesizes, and critically analyzes information to make informed decisions (i.e., critical and digital literacy) • Selects strategies, resources, and tools to support their learning, thinking, and problem-solving • Evaluates the effectiveness of their choices • Sees patterns, makes connections, and transfers their learning from one situation to another, including real-world applications • Analyzes the functions and interconnections of social, ecological, and economic systems • Constructs, relates and applies knowledge to all domains of life, such as school, home, work, friends, and community • Solves meaningful, real-life, and complex problems by taking concrete steps to address issues and design and manage projects • Formulates and expresses questions to further their understanding, thinking, and problem-solving	• Displays curiosity, identifies opportunities for improvement and learning, and believes in their ability to improve • Views errors as part of the improvement process • Formulates and expresses insightful questions and opinions to generate novel ideas • Turns ideas into value for others by enhancing ideas or products to provide new-to-the-world or improved solutions to complex social, ecological, and economic problems or to meet a need in a community • Takes risks in their thinking and creating • Discovers through inquiry research, hypothesizing, and experimenting with new strategies or techniques • Seeks and makes use of feedback to clarify understanding, ideas, and products • Enhances concepts, ideas, or products through a creative process	• Has self-efficacy, sees themselves as learners, and believes that they can make life better for themselves and others • Develops a positive identity, sense of self, and purpose from their personal and cultural qualities • Develops and identifies personal, educational, and career goals, opportunities, and pathways • Monitors their progress • Perseveres to overcome challenges • Adapts to change and is resilient in adverse situations • Aware of, manages, and expresses their emotions, thoughts, and actions in order to understand themselves and others • Manages their holistic well-being (e.g., mental, physical, and spiritual) • Accurately self-assesses their current level of understanding or proficiency • Advocates for support based on their strengths, needs, and how they learn best • Manages their time, environment, and attention, including their focus, concentration, and engagement

Collaboration	Communication	Sustainability and Global Citizenship
• Participates in teams by establishing positive and respectful relationships, developing trust, and acting interdependently and with integrity • Learns from and contributes to the learning of others by co-constructing knowledge, meaning, and content • Assumes various roles on the team and respects a diversity of perspectives • Addresses disagreements and manages conflict in a sensitive and constructive manner • Networks with a variety of communities/groups • Appropriately uses an array of technology to work with others • Fosters social well-being, inclusivity, and belonging for themselves and others by creating and maintaining positive relationships with diverse groups of people • Demonstrates empathy for others in a variety of contexts	• Expresses themselves using the appropriate communication tools for the intended audience • Creates a positive digital identity • Communicates effectively in French and/or English and/or Mi'kmaq or Wolastoqey through a variety of media and in a variety of contexts • Gains knowledge about a variety of languages beyond their first and additional languages • Recognizes the strong connection between language and ways of knowing the world • Asks effective questions to create a shared communication culture, attend to understand all points of view, express their own opinions, and advocate for ideas	• Understands the interconnectedness of social, ecological, and economic forces, and how they affect individuals, societies, and countries • Recognizes discrimination and promotes principles of equity, human rights, and democratic participation • Understands Indigenous worldviews, traditions, values, customs, and knowledge • Learns from and with diverse people, develop cross-cultural understanding • Understands the forces that affect individuals and societies • Takes action and makes responsible decisions that support social settings, natural environments, and quality of life for all, now and in the future • Contributes to society and to the culture of local, national, global, and virtual communities in a responsible, inclusive, accountable, sustainable, and ethical manner • Participates in networks in a safe and socially responsible manner.
Foundation of Literacy and Numeracy		

6.2 Science and Global Competencies

Critical Thinking and Problem Solving

Science learning environments should engage cognitive processes to understand and resolve problems situated in meaningful, real-world experiences. Learners:

- pose questions in the search of explanations of phenomena;
- seek answers to questions through experimentation and research;
- carry out a plan of action—gathering evidence by observation and manipulating materials and equipment;
- seek solutions to address scientific and technological needs of society through research and experimentation;
- evaluate solutions to technological problems or tasks; and,
- apply science process skills in a variety of contexts— connected to science, technology, society, and the environment (STSE).

Innovation, Creativity, and Entrepreneurship

Science learning needs to take place in creative environments to connect inquiry to the discovery of new ideas or concepts, to generate novel approaches, innovative products, or processes, and to solve complex problems. Learners:

- focus and extend curiosities about the natural world;
- view science and technology as creative human endeavours that are comparable and complementary to other creative endeavours, such as the arts and literature;
- demonstrate the understanding of ethical issues related to the use of science and technology in local and global contexts; and,
- prepare for potential science-related careers or further other science-related interests.

Self-Awareness and Self-Management

Science learning experiences should support student agency in the process of learning, to engage self-reflection and thinking about thinking (meta-cognition), to promote lifelong learning, and to transfer these lessons to an ever-changing world. Learners:

- develop a sense of interpersonal responsibilities, an openness to diversity, and a respect for multiple perspectives while engaging collaborative activity related to real-life problems;
- instill desire for lifelong learning and the refinement of their learning skills;
- acquire skills necessary to live and work in society that is shaped by science and technology;
- appreciate the role and contribution of science in their lives and demonstrate awareness of its limits and impacts;
- develop a continuing interest in the study of science;
- assess and manage potential dangers in science and technology contexts; and,
- develop a positive attitude toward safety.

Collaboration

Science learning experiences should provide students with opportunities to participate in learning teams; face-to-face and virtual, to learn from and with others. Learners:

- develop a sense of interpersonal responsibilities, an openness to diversity, and a respect for multiple perspectives while engaging collaborative activity related to real-life problems;
- realize that cooperative efforts generally produce the quickest and most effective results for sharing of knowledge of skills; and,
- develop respect for multiple perspectives.

Communication

Science learning environments should foster opportunities to communicate effectively in oral, written, and/or digital form through a variety of contexts to deepen and facilitate learning. Learners:

- present information clearly, logically and accurately for a variety of audiences;
- demonstrate knowledge of scientific facts and relationships through words, numbers, images, symbols, graphs, and charts; and,
- reflect on and express their own ideas, learning and perceptions of scientific concepts and principles.

Sustainability and Global Citizenship

Science learning opportunities should engage students in local and global concepts and initiatives, while demonstrating responsibility and ethical citizenship in real and virtual world settings. Learners:

- foster the kind of intelligent respect for nature that should inform decisions on the uses of scientific knowledge and technological developments;
- develop responsibility in the application of science and technology in relation to society and the natural environment;
- consider issues related to sustainability from local, regional, and global levels;
- examine the relationship between the biophysical environment and the behaviors needed to develop effective solutions to global problems; and,
- appreciate the role and contribution of science in their lives and be aware of its limits and impacts.

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