Science 3

Curriculum Guide 2017

Newfoundland Labrador

Education and Early Childhood Development

Department of Education and Early Childhood Development Mission Statement

The Department of Education and Early Childhood Development will improve provincial early childhood learning and the K-12 education system to further opportunities for the people of Newfoundland and Labrador.

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Section One: Newfoundland and Labrador Curriculum

Introduction

There are multiple factors that impact education: technological developments, increased emphasis on accountability, and globalization. These factors point to the need to consider carefully the education students receive.

The Newfoundland and Labrador Department of Education and Early Childhood Development believes that curriculum design with the following characteristics will help teachers address the needs of students served by the provincially prescribed curriculum:

- Curriculum guides must clearly articulate what students are expected to know and be able to do by the time they graduate from high school.
- There must be purposeful assessment of students' performance in relation to the curriculum outcomes.

Outcomes Based Education

The K-12 curriculum in Newfoundland and Labrador is organized by outcomes and is based on *The Atlantic Canada Framework for Essential Graduation Learning in Schools* (1997). This framework consists of Essential Graduation Learnings (EGLs), General Curriculum Outcomes (GCOs), Key Stage Curriculum Outcomes (KSCOs) and Specific Curriculum Outcomes (SCOs).

Essential Graduation Learnings
(common to all subject areas)

General Curriculum Outcomes
(unique to each subject area)

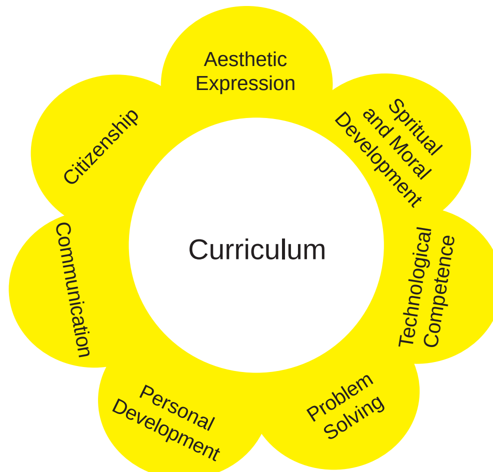
Key Stage Learning Outcomes
(met by end of grades 3,6,9 and 12)

Specific Curriculum Outcomes
(met within each grade level and subject area)

Essential Graduation Learnings

EGLs provide vision for the development of a coherent and relevant curriculum. They are statements that offer students clear goals and a powerful rationale for education. The EGLs are delineated by general, key stage, and specific curriculum outcomes.

EGLs describe the knowledge, skills, and attitudes expected of all students who graduate from high school. Achievement of the EGLs will prepare students to continue to learn throughout their lives. EGLs describe expectations, not in terms of individual subject areas, but in terms of knowledge, skills, and attitudes developed throughout the K-12 curriculum. They confirm that students need to make connections and develop abilities across subject areas if they are to be ready to meet the shifting and ongoing demands of life, work, and study.



Aesthetic Expression – Graduates will be able to respond with critical awareness to various forms of the arts and be able to express themselves through the arts.

Citizenship – Graduates will be able to assess social, cultural, economic, and environmental interdependence in a local and global context.

Communication – Graduates will be able to use the listening, viewing, speaking, reading and writing modes of language(s), and mathematical and scientific concepts and symbols, to think, learn and communicate effectively.

Problem Solving – Graduates will be able to use the strategies and processes needed to solve a wide variety of problems, including those requiring language, and mathematical and scientific concepts.

Personal Development – Graduates will be able to continue to learn and to pursue an active, healthy lifestyle.

Spiritual and Moral Development – Graduates will demonstrate understanding and appreciation for the place of belief systems in shaping the development of moral values and ethical conduct.

Technological Competence – Graduates will be able to use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems.

Curriculum Outcomes

Curriculum outcomes are statements that articulate what students are expected to know and be able to do in each program area in terms of knowledge, skills, and attitudes.

Curriculum outcomes may be subdivided into General Curriculum Outcomes, Key Stage Curriculum Outcomes, and Specific Curriculum Outcomes.

General Curriculum Outcomes (GCOs)

Each program has a set of GCOs which describe what knowledge, skills, and attitudes students are expected to demonstrate as a result of their cumulative learning experiences within a subject area. GCOs serve as conceptual organizers or frameworks which guide study within a program area. Often, GCOs are further delineated into KSCOs.

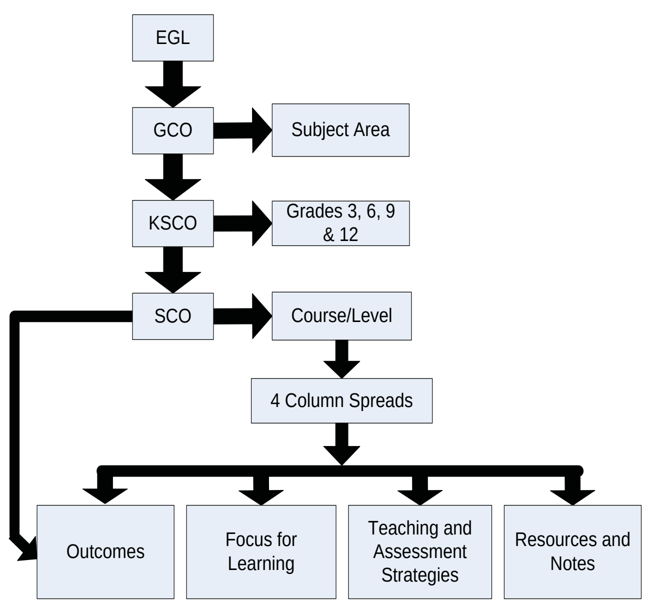
Key Stage Curriculum Outcomes (KSCOs)

Key Stage Curriculum Outcomes (KSCOs) summarize what is expected of students at each of the four key stages of grades three, six, nine, and twelve.

Specific Curriculum Outcomes (SCOs)

SCOs set out what students are expected to know and be able to do as a result of their learning experiences in a course, at a specific grade level. In some program areas, SCOs are further articulated into delineations. *It is expected that all SCOs will be addressed during the course of study covered by the curriculum guide.*

EGLs to Curriculum Guides



Context for Teaching and Learning

Teachers are responsible to help students achieve outcomes. This responsibility is a constant in a changing world. As programs change over time so does educational context. Several factors make up the educational context in Newfoundland and Labrador today: inclusive education, support for gradual release of responsibility teaching model, focus on literacy and learning skills in all programs, and support for education for sustainable development.

Inclusive Education

Valuing Equity and Diversity

Effective inclusive schools have the following characteristics: supportive environment, positive relationships, feelings of competence, and opportunities to participate. (The Centre for Inclusive Education, 2009)

All students need to see their lives and experiences reflected in their school community. It is important that the curriculum reflect the experiences and values of all genders and that learning resources include and reflect the interests, achievements, and perspectives of all students. An inclusive classroom values the varied experiences and abilities as well as social and ethno-cultural backgrounds of all students while creating opportunities for community building. Inclusive policies and practices promote mutual respect, positive interdependencies, and diverse perspectives. Learning resources should include a range of materials that allow students to consider many viewpoints and to celebrate the diverse aspects of the school community.

Differentiated Instruction

Differentiated instruction is a teaching philosophy based on the premise that teachers should adapt instruction to student differences. Rather than marching students through the curriculum lockstep, teachers should modify their instruction to meet students' varying readiness levels, learning preferences, and interests. Therefore, the teacher proactively plans a variety of ways to 'get it' and express learning. (Carol Ann Tomlinson, 2008)

Curriculum is designed and implemented to provide learning opportunities for all students according to abilities, needs, and interests. Teachers must be aware of and responsive to the diverse range of learners in their classes. Differentiated instruction is a useful tool in addressing this diversity.

Differentiated instruction responds to different readiness levels, abilities, and learning profiles of students. It involves actively planning so that the process by which content is delivered, the way the resource is used, and the products students create are in response to the teacher's knowledge of whom he or she is interacting with. Learning environments should be flexible to accommodate various learning preferences of the students. Teachers continually make decisions about selecting teaching strategies and structuring learning activities that provide all students with a safe and supportive place to learn and succeed.

Planning for Differentiation

Create a dynamic classroom	• present authentic and relevant communication situations • manage routines and class organization • provide realistic and motivating classroom experiences
Vary teaching strategies	• allow students to construct meaning and connect, collaborate and communicate with each other in a positive learning community • form essential links between the text and the students
Respond to student differences	• allow students to make relevant and meaningful choices • provide students ownership of learning goals • empower students through a gradual release of responsibility • allow students multiple ways to demonstrate their learning

Differentiating the Content

Differentiating content requires teachers to pre-assess students to identify those who require prerequisite instruction, as well as those who have already mastered the concept and may therefore apply strategies learned to new situations. Another way to differentiate content is to permit students to adjust the pace at which they progress through the material. Some students may require additional time while others will move through at an increased pace and thus create opportunities for enrichment or more indepth consideration of a topic of particular interest.

Teachers should consider the following examples of differentiating content:

- Meet with small groups to reteach an idea or skill or to extend the thinking or skills.
- Present ideas through auditory, visual, and tactile means.
- Use reading materials such as novels, websites, and other reference materials at varying reading levels.

Differentiating the Process

Differentiating the process involves varying learning activities or strategies to provide appropriate methods for students to explore and make sense of concepts. A teacher might assign all students the same product (e.g., presenting to peers) but the process students use to create the presentation may differ. Some students could work in groups while others meet with the teacher individually. The same assessment criteria can be used for all students.

Teachers should consider flexible grouping of students such as whole class, small group, or individual instruction. Students can be grouped according to their learning styles, readiness levels, interest areas, and/or the requirements of the content or activity presented. Groups should be formed for specific purposes and be flexible in composition and short-term in duration.

Teachers should consider the following examples of differentiating the process:

- Offer hands-on activities for students.
- Provide activities and resources that encourage students to further explore a topic of particular interest.
- Use activities in which all learners work with the same learning outcomes but proceed with different levels of support, challenge, or complexity.

Differentiating the Product

Differentiating the product involves varying the complexity and type of product that students create to demonstrate learning outcomes. Teachers provide a variety of opportunities for students to demonstrate and show evidence of what they have learned.

Teachers should give students options to demonstrate their learning (e.g., create an online presentation, write a letter, or develop a mural). This will lead to an increase in student engagement.

Differentiating the Learning Environment

The learning environment includes the physical and the affective tone or atmosphere in which teaching and learning take place, and can include the noise level in the room, whether student activities are static or mobile, or how the room is furnished and arranged. Classrooms may include tables of different shapes and sizes, space for quiet individual work, and areas for collaboration.

Teachers can divide the classroom into sections, create learning centres, or have students work both independently and in groups. The structure should allow students to move from whole group, to small group, pairs, and individual learning experiences and support a variety of ways to engage in learning. Teachers should be sensitive and alert to ways in which the classroom environment supports their ability to interact with students.

Teachers should consider the following examples of differentiating the learning environment:

- Develop routines that allow students to seek help when teachers are with other students and cannot provide immediate attention.
- Ensure there are places in the room for students to work quietly and without distraction, as well as places that invite student collaboration.
- Establish clear guidelines for independent work that match individual needs.
- Provide materials that reflect diversity of student background, interests, and abilities.

The physical learning environment must be structured in such a way that all students can gain access to information and develop confidence and competence.

Meeting the Needs of Students with Exceptionalities

All students have individual learning needs. Some students, however, have exceptionalities (defined by the Department of Education and Early Childhood Development) which impact their learning. The majority of students with exceptionalities access the prescribed curriculum. For details of these exceptionalities see www.gov.nl.ca/edu/k12/studentsupportservices/exceptionalities.html

Supports for these students may include

1. Accommodations
2. Modified Prescribed Courses
3. Alternate Courses
4. Alternate Programs
5. Alternate Curriculum

For further information, see Service Delivery Model for Students with Exceptionalities at www.cdli.ca/sdm/

Classroom teachers should collaborate with instructional resource teachers to select and develop strategies which target specific learning needs.

Meeting the Needs of Students who are Highly Able
(includes gifted and talented)

Some students begin a course or topic with a vast amount of prior experience and knowledge. They may know a large portion of the material before it is presented to the class or be capable of processing it at a rate much faster than their classmates. All students are expected to move forward from their starting point. Many elements of differentiated instruction are useful in addressing the needs of students who are highly able.

Teachers may

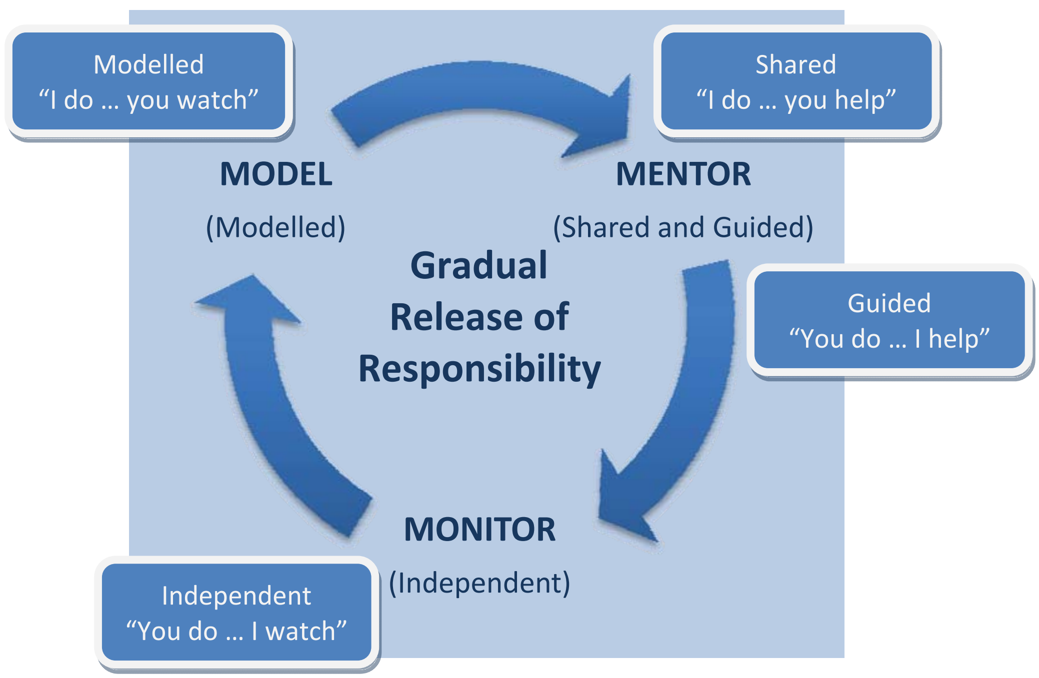
- assign independent study to increase depth of exploration in an area of particular interest;
- compact curriculum to allow for an increased rate of content coverage commensurate with a student's ability or degree of prior knowledge;
- group students with similar abilities to provide the opportunity for students to work with their intellectual peers and elevate discussion and thinking, or delve deeper into a particular topic; and
- tier instruction to pursue a topic to a greater depth or to make connections between various spheres of knowledge.

Highly able students require the opportunity for authentic investigation to become familiar with the tools and practices of the field of study. Authentic audiences and tasks are vital for these learners. Some highly able learners may be identified as gifted and talented in a particular domain. These students may also require supports through the Service Delivery Model for Students with Exceptionalities.

Gradual Release of Responsibility

Teachers must determine when students can work independently and when they require assistance. In an effective learning environment, teachers choose their instructional activities to model and scaffold composition, comprehension, and metacognition that is just beyond the students' independence level. In the gradual release of responsibility approach, students move from a high level of teacher support to independent work. If necessary, the teacher increases the level of support when students need assistance. The goal is to empower students with their own learning strategies, and to know how, when, and why to apply them to support their individual growth. Guided practice supports student independence. As a student demonstrates success, the teacher should gradually decrease his or her support.

Gradual Release of Responsibility Model



Literacy

"Literacy is the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts. Literacy involves a continuum of learning in enabling individuals to achieve their goals, to develop their knowledge and potential, and to participate fully in their community and wider society". To be successful, students require a set of interrelated skills, strategies and knowledge in multiple literacies that facilitate their ability to participate fully in a variety of roles and contexts in their lives, in order to explore and interpret the world and communicate meaning. (The Plurality of Literacy and its Implications for Policies and Programmes, 2004, p.13)

Literacy is

- a process of receiving information and making meaning from it; and
- the ability to identify, understand, interpret, communicate, compute, and create text, images, and sounds.

Literacy development is a lifelong learning enterprise beginning at birth that involves many complex concepts and understandings. It is not limited to the ability to read and write; no longer are we exposed only to printed text. It includes the capacity to learn to communicate, read, write, think, explore, and solve problems. Individuals use literacy skills in paper, digital, and live interactions to engage in a variety of activities:

- Analyze critically and solve problems.
- Comprehend and communicate meaning.
- Create a variety of texts.
- Make connections both personally and inter-textually.
- Participate in the socio-cultural world of the community.
- Read and view for enjoyment.
- Respond personally.

These expectations are identified in curriculum documents for specific subject areas as well as in supporting documents, such as *Cross-Curricular Reading Tools* (CAMET).

With modelling, support, and practice, students' thinking and understandings are deepened as they work with engaging content and participate in focused conversations.

Reading in the Content Areas

The focus for reading in the content areas is on teaching strategies for understanding content. Teaching strategies for reading comprehension benefits all students as they develop transferable skills that apply across curriculum areas.

When interacting with different texts, students must read words, view and interpret text features, and navigate through information presented in a variety of ways including, but not limited to

Advertisements	Movies	Poems
Blogs	Music videos	Songs
Books	Online databases	Speeches
Documentaries	Plays	Video games
Magazine articles	Podcasts	Websites

Students should be able to interact with and comprehend different texts at different levels.

There are three levels of text comprehension:

- Independent level – Students are able to read, view, and understand texts without assistance.
- Instructional level – Students are able to read, view, and understand most texts but need assistance to fully comprehend some texts.
- Frustration level – Students are not able to read or view with understanding (i.e., texts may be beyond their current reading level).

Teachers will encounter students working at all reading levels in their classrooms and will need to differentiate instruction to meet their needs. For example, print texts may be presented in audio form, physical movement may be associated with synthesizing new information with prior knowledge, or graphic organizers may be created to present large amounts of print text in a visual manner.

When interacting with information that is unfamiliar to students, it is important for teachers to monitor how effectively students are using strategies to read and view texts:

- Analyze and think critically about information.
- Determine importance to prioritize information.
- Engage in questioning before, during, and after an activity related to a task, text, or problem.
- Make inferences about what is meant but not said.
- Make predictions.
- Synthesize information to create new meaning.
- Visualize ideas and concepts.

Learning Skills for Generation Next

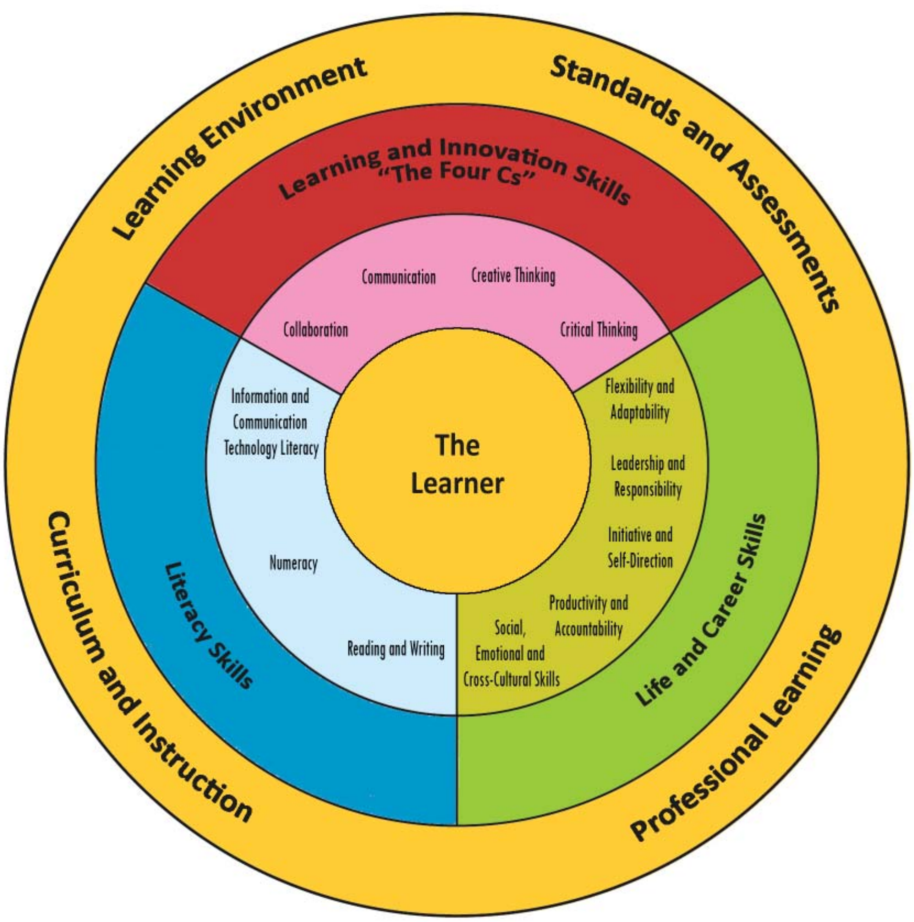
Generation Next is the group of students who have not known a world without personal computers, cell phones, and the Internet. They were born into this technology. They are digital natives.

Students need content and skills to be successful. Education helps students learn content and develop skills needed to be successful in school and in all learning contexts and situations. Effective learning environments and curricula challenge learners to develop and apply key skills within the content areas and across interdisciplinary themes.

Learning Skills for Generation Next encompasses three broad areas:

- Learning and Innovation Skills enhance a person's ability to learn, create new ideas, problem solve, and collaborate.
- Life and Career Skills address leadership, and interpersonal and affective domains.
- Literacy Skills develop reading, writing, and numeracy, and enhance the use of information and communication technology.

The diagram below illustrates the relationship between these areas. A 21st century curriculum employs methods that integrate innovative and research-driven teaching strategies, modern learning technologies, and relevant resources and contexts.



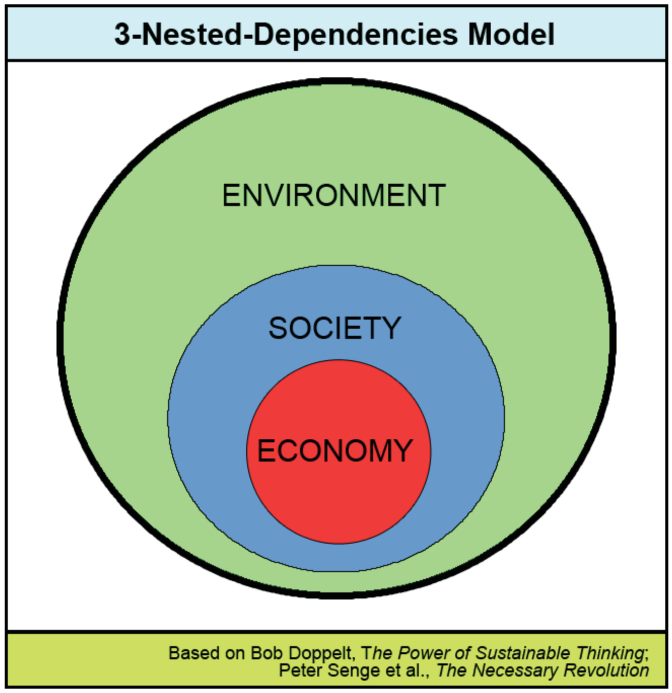
Support for students to develop these abilities and skills is important across curriculum areas and should be integrated into teaching, learning, and assessment strategies. Opportunities for integration of these skills and abilities should be planned with engaging and experiential activities that support the gradual release of responsibility model. For example, lessons in a variety of content areas can be infused with learning skills for Generation Next by using open-ended questioning, role plays, inquiry approaches, self-directed learning, student role rotation, and Internet-based technologies.

All programs have a shared responsibility in developing students' capabilities within all three skill areas.

Education for Sustainable Development

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". (Our Common Future, 43)

Sustainable development is comprised of three integrally connected areas: economy, society, and environment.



As conceived by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) the overall goal of Education for Sustainable Development (ESD) is to integrate the knowledge, skills, values, and perspectives of sustainable development into all aspects of education and learning. Changes in human behaviour should create a more sustainable future that supports environmental integrity and economic viability, resulting in a just society for all generations.

ESD involves teaching *for* rather than teaching *about* sustainable development. In this way students develop the skills, attitudes, and perspectives to meet their present needs without compromising the ability of future generations to meet their needs.

Within ESD, the knowledge component spans an understanding of the interconnectedness of our political, economic, environmental, and social worlds, to the role of science and technology in the development of societies and their impact on the environment. The skills necessary include being able to assess bias, analyze consequences of choices, ask questions, and solve problems. ESD values and perspectives include an appreciation for the interdependence of all life forms, the importance of individual responsibility and action, an understanding of global issues as well as local issues in a global context. Students need to be aware that every issue has a history, and that many global issues are linked.

Assessment and Evaluation

Assessment

Assessment is the process of gathering information on student learning.

How learning is assessed and evaluated and how results are communicated send clear messages to students and others about what is valued.

Assessment instruments are used to gather information for evaluation. Information gathered through assessment helps teachers determine students' strengths and needs, and guides future instruction.

Teachers are encouraged to be flexible in assessing student learning and to seek diverse ways students might demonstrate what they know and are able to do.

Evaluation involves the weighing of the assessment information against a standard in order to make a judgement about student achievement.

Assessment can be used for different purposes:

1. Assessment *for* learning guides and informs instruction.
2. Assessment *as* learning focuses on what students are doing well, what they are struggling with, where the areas of challenge are, and what to do next.
3. Assessment *of* learning makes judgements about student performance in relation to curriculum outcomes.

1. Assessment for Learning

Assessment *for* learning involves frequent, interactive assessments designed to make student learning visible. This enables teachers to identify learning needs and adjust teaching accordingly. Assessment *for* learning is not about a score or mark; it is an ongoing process of teaching and learning:

- Pre-assessments provide teachers with information about what students already know and can do.
- Self-assessments allow students to set goals for their own learning.
- Assessment *for* learning provides descriptive and specific feedback to students and parents regarding the next stage of learning.
- Data collected during the learning process from a range of tools enables teachers to learn as much as possible about what a student knows and is able to do.

2. Assessment as Learning

Assessment *as* learning involves students' reflecting on their learning and monitoring their own progress. It focuses on the role of the student in developing metacognition and enhances engagement in their own learning. Students can

- analyze their learning in relation to learning outcomes,
- assess themselves and understand how to improve performance,
- consider how they can continue to improve their learning, and
- use information gathered to make adaptations to their learning processes and to develop new understandings.

3. Assessment of Learning

Assessment *of* learning involves strategies designed to confirm what students know in terms of curriculum outcomes. It also assists teachers in determining student proficiency and future learning needs. Assessment *of* learning occurs at the end of a learning experience and contributes directly to reported results. Traditionally, teachers relied on this type of assessment to make judgements about student performance by measuring learning after the fact and then reporting it to others. Used in conjunction with the other assessment processes previously outlined, assessment *of* learning is strengthened. Teachers can

- confirm what students know and can do;
- report evidence to parents/guardians, and other stakeholders, of student achievement in relation to learning outcomes; and
- report on student learning accurately and fairly using evidence obtained from a variety of contexts and sources.

Involving Students in the Assessment Process

Students should know what they are expected to learn as outlined in the specific curriculum outcomes of a course as well as the criteria that will be used to determine the quality of their achievement. This information allows students to make informed choices about the most effective ways to demonstrate what they know and are able to do.

It is important that students participate actively in assessment by co-creating criteria and standards which can be used to make judgements about their own learning. Students may benefit from examining various scoring criteria, rubrics, and student exemplars.

Students are more likely to perceive learning as its own reward when they have opportunities to assess their own progress. Rather than asking teachers, "What do you want?", students should be asking themselves questions:

- What have I learned?
- What can I do now that I couldn't do before?
- What do I need to learn next?

Assessment must provide opportunities for students to reflect on their own progress, evaluate their learning, and set goals for future learning.

Assessment Tools

In planning assessment, teachers should use a broad range of tools to give students multiple opportunities to demonstrate their knowledge, skills, and attitudes. The different levels of achievement or performance may be expressed as written or oral comments, ratings, categorizations, letters, numbers, or as some combination of these forms.

The grade level and the activity being assessed will inform the types of assessment tools teachers will choose:

Anecdotal Records	Photographic Documentation
Audio/Video Clips	Podcasts
Case Studies	Portfolios
Checklists	Presentations
Conferences	Projects
Debates	Questions
Demonstrations	Quizzes
Exemplars	Role Plays
Graphic Organizers	Rubrics
Journals	Self-assessments
Literacy Profiles	Tests
Observations	Wikis

Assessment Guidelines

Assessments should measure what they intend to measure. It is important that students know the purpose, type, and potential marking scheme of an assessment. The following guidelines should be considered:

- Collect evidence of student learning through a variety of methods; do not rely solely on tests and paper and pencil activities.
- Develop a rationale for using a particular assessment of learning at a specific point in time.
- Provide descriptive and individualized feedback to students.
- Provide students with the opportunity to demonstrate the extent and depth of their learning.
- Set clear targets for student success using learning outcomes and assessment criteria.
- Share assessment criteria with students so that they know the expectations.

Evaluation

Evaluation is the process of analyzing, reflecting upon, and summarizing assessment information, and making judgements or decisions based on the information gathered. Evaluation is conducted within the context of the outcomes, which should be clearly understood by learners before teaching and evaluation take place. Students must understand the basis on which they will be evaluated and what teachers expect of them.

During evaluation, the teacher interprets the assessment information, makes judgements about student progress, and makes decisions about student learning programs.

Section Two: Curriculum Design

Rationale

The vision of science education in Newfoundland and Labrador is to develop scientific literacy.

> *Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem solving, and decision making abilities; to become lifelong learners; and to maintain a sense of wonder about the world around them.*

To develop scientific literacy, students require diverse learning experiences which provide opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment that will affect their personal lives, careers, futures.

Science education which strives for scientific literacy must engage students in science inquiry, problem solving, and decision making.

Science Inquiry

Science inquiry involves posing questions and developing explanations for phenomena. While there is general agreement that 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, analyzing data, and interpreting data are fundamental to engaging in science. These skills are often represented as a cycle which involves the posing of questions, the generation of possible explanations, and the collection of evidence to determine which of these explanations is most useful in accounting for the phenomenon under investigation. Teachers should engage students in science inquiry activities to develop these skills.

Problem Solving

Problem solving involves seeking solutions to human problems. It may be represented as a cycle consisting of the proposing, creating, and testing of prototypes, products, and techniques in and attempt to reach an optimum solution to a given problem. The skills involved in this cycle facilitate a process which has different aims and procedures from science inquiry. Students should be given opportunities to propose, perform, and evaluate solutions to problem solving or technological tasks.

Decision Making

Decision making involves determining what we should do in a particular context or in response to a given situation. Increasingly, the types of problems that we deal with, both individually and collectively, require an understanding of the processes and products of science and technology. The process of decision making involves identification of the problem or situation, generation of possible solutions or courses of action, evaluation of the alternatives, and a thoughtful decision based on the information available. Students should be actively involved in decision making situations. While important in their own right, decision making situations also provide a relevant context for engaging in science inquiry and/or problem solving.

Curriculum Outcomes Framework

The basis of the curriculum outcomes framework are the general curriculum outcomes (GCOs). Four general curriculum outcomes have been identified to delineate the four critical aspects of students' scientific literacy: science, technology, society, and the environment (STSE), skills, knowledge, and attitudes. These four GCOs are common to all science courses.

General Curriculum Outcomes

GCO 1: Science, Technology, Society, and the Environment

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.

GCO 2: Skills

Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

GCO 3: Knowledge

Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

GCO 4: Attitudes

Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

Key Stage Curriculum Outcomes

Key stage curriculum outcomes (KSCOs) align with the GCOs and summarize what students are expected to know and be able to do by the end of Science 3.

Please note that for Science Kindergarten to Science 3, key stage curriculum outcomes for GCO 1 and GCO 3 are combined under one heading STSE/Knowledge.

GCO 1/3: STSE/Knowledge

By the end of Science 3, students will be expected to

- investigate objects and events in their immediate environment, and use appropriate language to develop understandings and to communicate results
- demonstrate and describe ways of using materials and tools to help answer science questions and to solve practical problems
- describe how science and technology affect their lives and those of people and other living things in their community
- undertake personal actions to care for the immediate environment and contribute to responsible group decisions

GCO 2: Skills

By the end of Science 3, students will be expected to

- ask questions about objects and events in the immediate environment and develop ideas about how those questions might be answered
- observe and explore materials and events in the immediate environment and record the results
- identify patterns and order in objects and events studied
- work with others and share and communicate ideas about their explorations

GCO 4: Attitudes

By the end of Science 3, students will be expected to

- recognize the role and contribution of science in their understanding of the world
- show interest in and curiosity about objects and events within their immediate environment
- willingly observe, question, and explore
- consider their own observations and ideas when drawing a conclusion
- appreciate the importance of accuracy
- be open-minded while exploring and investigating
- work with others in exploring and investigating
- be sensitive to the needs of other people, other living things, and the local environment
- show concern for their safety and that of others while exploring and investigating

Specific Curriculum Outcomes

Specific curriculum outcomes (SCOs) align with the KSCOs and describe what students should know and be able to do at the end of each course. They are intended to serve as the focus for the design of learning experiences and assessment tasks.

SCOs are organized into units for each course.

Course Overview

The vision of scientific literacy sets out the need for students to acquire science-related skills, knowledge, and attitudes, and emphasizes that this is best done through the study and analysis of the interrelationships among science, technology, society, and the environment.

Science 3 SCOs are organized into four units:

- Exploring Soils
- Materials and Structures
- Invisible Forces
- Plant Growth and Changes

Suggested Yearly Plan

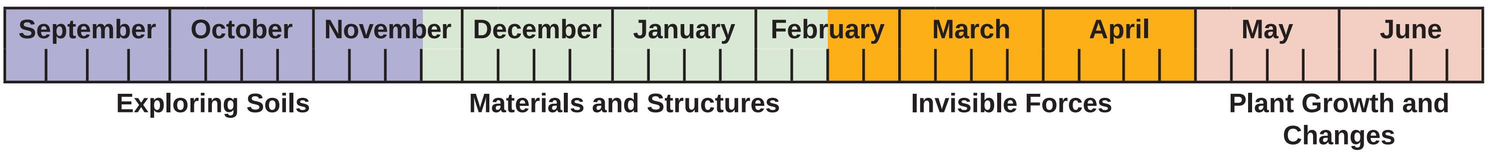
The order in which the units appear in the Science 3 curriculum guide is the recommended sequence.

Unit 1 - Exploring Soils

Unit 2 - Materials and Structures

Unit 3 - Invisible Forces

Unit 4 - Plant Growth and Changes



How to Use the Four Column Curriculum Layout

Outcomes

Column one contains specific curriculum outcomes (SCO) and accompanying delineations where appropriate. The delineations provide specificity in relation to key ideas.

Outcomes are numbered in ascending order

Delineations are indented and numbered as a subset of the originating SCO.

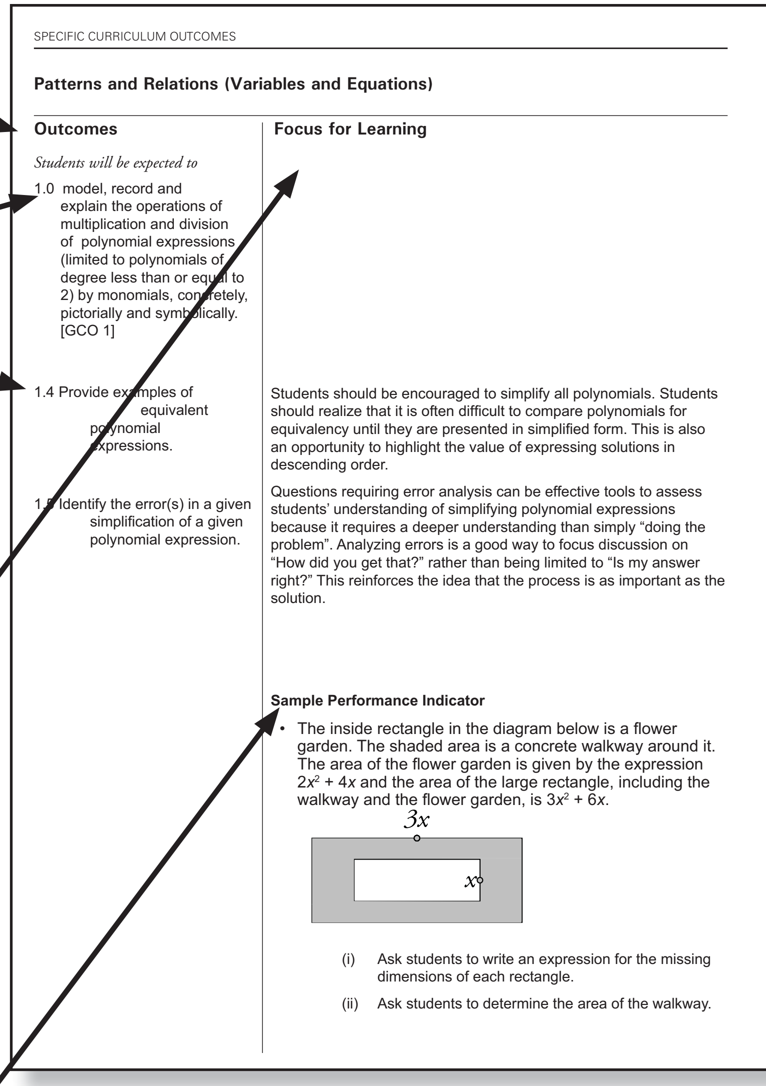
All outcomes are related to general curriculum outcomes.

Focus for Learning

Column two is intended to assist teachers with instructional planning. It also provides context and elaboration of the ideas identified in the first column.

This may include:

- cautionary notes
- clarity in terms of scope
- common misconceptions
- depth of treatment
- knowledge required to scaffold and challenge student's learning
- references to prior knowledge



SPECIFIC CURRICULUM OUTCOMES

Patterns and Relations (Variables and Equations)

Outcomes	Focus for Learning
Students will be expected to	
1.0 model, record and explain the operations of multiplication and division of polynomial expressions (limited to polynomials of degree less than or equal to 2) by monomials, concretely, pictorially and symbolically. [GCO 1]	
1.4 Provide examples of equivalent polynomial expressions.	Students should be encouraged to simplify all polynomials. Students should realize that it is often difficult to compare polynomials for equivalency until they are presented in simplified form. This is also an opportunity to highlight the value of expressing solutions in descending order.
1.5 Identify the error(s) in a given simplification of a given polynomial expression.	Questions requiring error analysis can be effective tools to assess students' understanding of simplifying polynomial expressions because it requires a deeper understanding than simply "doing the problem". Analyzing errors is a good way to focus discussion on "How did you get that?" rather than being limited to "Is my answer right?" This reinforces the idea that the process is as important as the solution.

Sample Performance Indicator

- The inside rectangle in the diagram below is a flower garden. The shaded area is a concrete walkway around it. The area of the flower garden is given by the expression $2x^2 + 4x$ and the area of the large rectangle, including the walkway and the flower garden, is $3x^2 + 6x$.

(i) Ask students to write an expression for the missing dimensions of each rectangle.

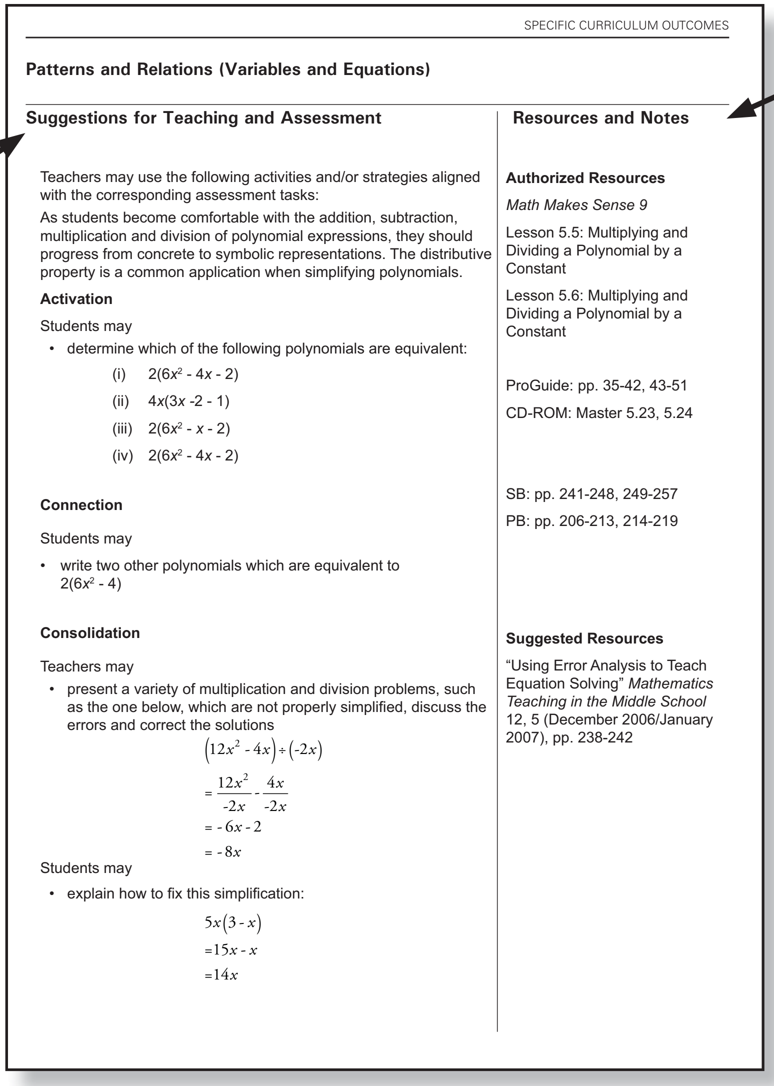
(ii) Ask students to determine the area of the walkway.

Sample Performance Indicator(s)

This provides a summative, higher order activity, where the response would serve as a data source to help teachers assess the degree to which the student has achieved the outcome.

Performance indicators are typically presented as a task, which may include an introduction to establish a context. They would be assigned at the end of the teaching period allocated for the outcome.

Performance indicators would be assigned when students have attained a level of competence, with suggestions for teaching and assessment identified in column three.



SPECIFIC CURRICULUM OUTCOMES

Patterns and Relations (Variables and Equations)

Suggestions for Teaching and Assessment

Teachers may use the following activities and/or strategies aligned with the corresponding assessment tasks:

As students become comfortable with the addition, subtraction, multiplication and division of polynomial expressions, they should progress from concrete to symbolic representations. The distributive property is a common application when simplifying polynomials.

Activation

Students may

- determine which of the following polynomials are equivalent:
  - (i) $2(6x^2 - 4x - 2)$
  - (ii) $4x(3x - 2 - 1)$
  - (iii) $2(6x^2 - x - 2)$
  - (iv) $2(6x^2 - 4x - 2)$

Connection

Students may

- write two other polynomials which are equivalent to $2(6x^2 - 4)$

Consolidation

Teachers may

- present a variety of multiplication and division problems, such as the one below, which are not properly simplified, discuss the errors and correct the solutions

$$\begin{aligned}&\left(12x^2 - 4x\right) \div \left(-2x\right)\\ &= \frac{12x^2}{-2x} - \frac{4x}{-2x}\\ &= -6x - 2\\ &= -8x\end{aligned}$$

Students may

- explain how to fix this simplification:

$$\begin{aligned}&5x\left(3 - x\right)\\ &= 15x - x\\ &= 14x\end{aligned}$$

Resources and Notes

Authorized Resources

Math Makes Sense 9

Lesson 5.5: Multiplying and Dividing a Polynomial by a Constant

Lesson 5.6: Multiplying and Dividing a Polynomial by a Constant

ProGuide: pp. 35-42, 43-51

CD-ROM: Master 5.23, 5.24

SB: pp. 241-248, 249-257

PB: pp. 206-213, 214-219

Suggested Resources

"Using Error Analysis to Teach Equation Solving" *Mathematics Teaching in the Middle School* 12, 5 (December 2006/January 2007), pp. 238-242

Resources and Notes

Column four references supplementary information and possible resources for use by teachers.

These references will provide details of resources suggested in column two and column three.

Suggestions for Teaching and Assessment

This column contains specific sample tasks, activities, and strategies that enable students to meet the goals of the SCOs and be successful with performance indicators. Instructional activities are recognized as possible sources of data for assessment purposes. Frequently, appropriate techniques and instruments for assessment purposes are recommended.

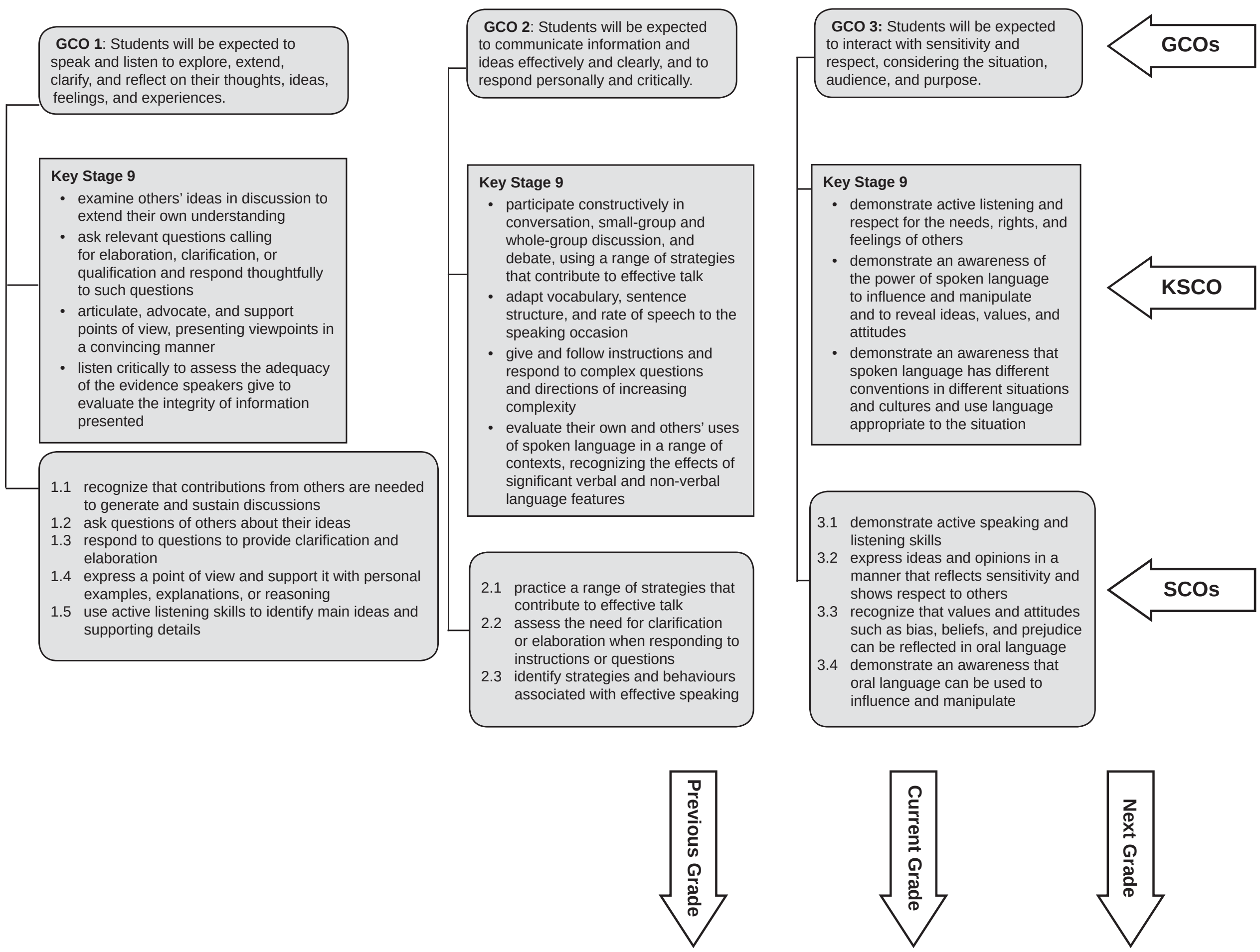
Suggestions for instruction and assessment are organized sequentially:

- Activation - suggestions that may be used to activate prior learning and establish a context for the instruction
- Connection - linking new information and experiences to existing knowledge inside or outside the curriculum area
- Consolidation - synthesizing and making new understandings
- Extension - suggestions that go beyond the scope of the outcome

These suggestions provide opportunities for differentiated learning and assessment.

How to Use a Unit Overview

At the beginning of each unit grouping there is explanation of the focus for the unit and a flow chart identifying the relevant GCOs, KSCOs and SCOs.



The SCOs Continuum follows the chart to provide context for teaching and assessment for the grade/ course in question. The current grade is highlighted in the chart.

GCO

SCOs

GCO 1: Students will be expected to speak and listen to explore, extend, clarify, and reflect on their thoughts, ideas, feelings, and experiences.

Grade 6	Grade 7	Grade 8
1.0 examine how sharing experiences, explanations or reasoning with others clarifies and extends thinking	1.1 recognize that contributions from others are needed to generate and sustain discussions	1.1 reflect upon the contribution of others' ideas during discussion
2.0 use active listening strategies for a variety of purposes	1.2 ask questions of others about their ideas	1.2 ask questions of others for clarification
3.0 assess how thinking may be affected as a result of listening to others	1.3 respond to questions to provide clarification and elaboration	1.3 respond to questions to provide accuracy, relevancy, and validity
	1.4 express a point of view and support it with personal examples, explanations, or reasoning	1.4 express a point of view and support it with personal examples and evidence from various sources
	1.5 use active listening skills to identify main ideas and supporting details	1.5 use active listening skills to interpret main ideas and the relevancy of supporting details

Section Three: Specific Curriculum Outcomes

Unit 1: Exploring Soils

Focus

Students discover that there is more to soil than just dirt. It is substrate for animals to live in and for plants to grow in, and provides a base for gardens, forests, fields, and farms. By examining soils, students discover that soils are made up of more than one thing, and that the particular combination of materials in soil has a lot to do with what lives in it and on it. By focusing on the ways we can change soils, especially changes that occur as a result of water, students learn that soil is affected by humans and the environment.

Scientific inquiry is the process focus of this unit. The unit emphasizes the development of skills related to posing questions, predicting, making and recording observations, constructing graphs, drawing conclusions, and communicating procedures and results of investigations, using scientific terminology.

Outcomes Framework

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

3.0 investigate a variety of soils and find similarities and differences among them
5.0 investigate and describe soil components
7.0 describe the effect of moisture on the characteristics of soil
9.0 compare the absorption of water by different soils
13.0 investigate and describe how living things affect and are affected by soils
15.0 investigate the effects of moving water on different soils
18.0 demonstrate and describe ways humans use soils to make useful objects

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

1.0 pose questions that lead to exploration and investigation
2.0 communicate using scientific terminology
4.0 communicate while exploring and investigating
6.0 use appropriate tools
8.0 sequence or group materials and objects
10.0 make and record observations and measurements
11.0 construct and label concrete-object graphs, pictographs, or bar graphs
12.0 use a variety of sources of science information and ideas
14.0 propose an answer to an initial question or problem and draw a simple conclusion
16.0 predict based on an observed pattern
17.0 communicate procedures and results

GCO 4 (Attitudes): Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

- recognize the role and contribution of science in their understanding of the world
- show interest in and curiosity about objects and events within their immediate environment
- willingly observe, question, and explore
- consider their own observations and ideas when drawing a conclusion
- appreciate the importance of accuracy
- be open-minded in their explorations and investigations
- work with others in exploring and investigating
- be sensitive to the needs of other people, other living things, and the local environment

SCO Continuum

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

<table>
<tr><th>Science 1</th><th>Science 3</th><th>Science 4</th></tr>
<tr><td>Needs and Characteristics of Living Things</td><td rowspan="2">Exploring Soils</td><td>Rocks, Minerals, and Erosion</td></tr>
<tr><td>• describe different ways plants and animals meet their needs</td><td>• describe how soil is formed from rocks
• demonstrate methods of weathering and erosion</td></tr>
<tr><td>Science 2</td><td rowspan="3">• investigate and compare a variety of soils
• investigate and describe soil components
• describe the effect of moisture on soil characteristics
• compare absorption of water by different soils
• investigate how living things affect and are affected by soils
• investigate the effects of moving water on different soils
• demonstrate and describe ways humans use soils to make useful objects</td><td>Science 7</td></tr>
<tr><td>Animal Growth and Changes</td><td>Earth’s Crust</td></tr>
<tr><td>• describe features of natural and human-made environments that support the health and growth of animals</td><td>• classify various types of soils according to their characteristics, and investigate ways to enrich soils
• relate various meteorological, geological, and biological processes to the formation of soils</td></tr>
</table>

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

Science 2	Science 3	Science 4-6
• pose questions that lead to exploration and investigation • predict based on an observed pattern • use appropriate tools • make and record observations and measurements • use a variety of sources of science information and ideas • sequence or group materials and objects • construct and label concrete-object graphs or pictographs • propose an answer to an initial question or problem and draw a simple conclusion • communicate while exploring and investigating • communicate using scientific terminology • communicate procedures and results	• pose questions that lead to exploration and investigation • predict based on an observed pattern • use appropriate tools • make and record observations and measurements • use a variety of sources of science information and ideas • sequence or group materials and objects • construct and label concrete-object graphs, pictographs, or bar graphs • propose an answer to an initial question or problem and draw a simple conclusion • communicate while exploring and investigating • communicate using scientific terminology • communicate procedures and results	• propose questions to investigate and practical problems to solve • state a predication and a hypothesis • select and use tools • make observations and collect information that is relevant to the question or problem • record observations • identify and use a variety of sources and technologies to gather relevant information • classify according to several attributes • compile and display data by hand or computer, in a variety of formats • draw a conclusion that answers an initial question • communicate questions, ideas, intentions, and listen to others while conducting investigations • communicate procedures and results

Suggested Unit Plan

Exploring Soils is an Earth science unit. It is positioned at the start of the school year to provide opportunities for outdoor learning and exploration of collected soils.

September	October	November	December	January	February	March	April	May	June

Exploring Soils

Exploring and Investigating Soils

Outcomes

Students will be expected to

1.0 pose questions that lead to exploration and investigation [GCO 2]

Focus for Learning

Science is often presented as a body of knowledge to be learned; however, it is much more than that. Science is a way of learning. Science is asking questions about the things we observe, and then exploring and investigating to find answers.

Questioning is a fundamental science skill that initiates the processes of scientific inquiry.

Primary students ask questions. Their questions flow from innate curiosity and observations of objects and events in their immediate environment. Questions lead naturally to exploration and investigation as students actively construct knowledge about the natural and constructed world around them.

To facilitate the posing of questions, establish a classroom culture where student questions are highly valued. Respond to questions positively, record and display them in the classroom, provide students with time to explore and investigate their questions and to communicate what they have learned.

Create a classroom curiosity centre, filled with interesting, soil-related objects and materials, for students to explore during structured and unstructured time.

Students are expected to pose soil-related questions throughout the unit. Their questions should lead to hands on exploration and investigation. Student questions may include:

- Where do you find soil?
- What does soil look, smell, sound, and feel like?
- How are soils the same or different? What are soils made of?
- How does soil change when it gets wet? Do some soils absorb more water than others?
- What lives in the soil? How do living things affect soil? What is compost?
- How does moving water affects soils?
- How do humans use soil? Do different soils have different uses? What do people make from soil?

Cross curricular connections may be made to English Language Arts 3 outcomes related to formulating questions that lead to inquiry.

Attitude

Encourage students to recognize the role and contribution of science in their understanding of the world. [GCO 4]

Exploring and Investigating Soils

Sample Teaching and Assessment Strategies

Provide daily opportunities for students to be scientists; to observe, pose questions, explore, investigate, share what is learned, and pose new questions that arise. This may be accomplished during morning routines through use of the curiosity centre, "I Wonder" wall, and mini inquiries.

Activation

Teachers may

- Ask "What is science?" and "What do Scientists do?" to highlight the role of asking questions in science inquiry.
- Read aloud *Underneath the Sidewalk* to pique student curiosity and generate initial soil-related questions.

Connection

Teachers may

- Create a curiosity centre for student exploration. Objects may include
    - children's literature, photographs, posters;
    - cobble, pebbles, sand, silt and clay, gravel, collected soils, potting soils, compost, peat;
    - earthworm farm, ant farm, potted plants, gardening tools;
    - magnifying glasses, tweezers, tooth picks, paintbrushes, spoons, zip top plastic bags, plastic containers and trays;
    - strainers, colanders, mesh screens, funnels, coffee filters;
    - objects made from soil (e.g., peat pots or pellets, bricks, modelling clay, jewelry, makeup, pottery, ceramics); and
    - water, spray bottle, eye dropper bottles, cookie cutters.

  Students may choose to add items to the centre for exploration.
- Model posing "I Wonder" questions from observations of soils.
- Record student questions on a digital or print anchor chart (e.g., "I Wonder" wall, RAN chart, KWLM chart) that is used as a focus for learning in subsequent classes. As the unit progresses, add new questions that arise to the anchor chart.
- Incorporate student inquiry questions into daily literacy activities (e.g., use "I wonder what lives in soil?" as a writing prompt).

Students may

- Participate in a nature walk to find soils and pose initial "I Wonder" questions from their observations (e.g., I wonder if there is soil under the grass? I wonder why this soil is a different colour?).
- Use question generators (i.e., who, what, when, where, why and how) or a question matrix to assist with posing inquiry questions.

Resources and Notes

Authorized

Let's Do Science (Teacher Resource [TR])

- *Exploring Soils*
    - pp.11-19
- Teachers Website
    - Anchor Video - *Exploring Soils*

Read Aloud

- *Underneath the Sidewalk*

Let's Do Science (Student Resource [SR])

- *Exploring Soils*
    - p. 1

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
    - Investigating Soils through Cross-Curricular Connections

Supplementary

Science Library

- *Up in the Garden and Down in the Dirt*

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Soil resources (websites and videos)
- Skill - Questioning (websites and videos)

Children's Literature

- *I Wonder* by A. Harris
- *Questions, Questions* by M. Pfister

Communicating about Soils

Outcomes

Students will be expected to

2.0 communicate using scientific terminology [GCO 2]

Focus for Learning

Whether engaged in science inquiry or problem solving, the ability to communicate so that others understand is an essential skill. Effective communication in science requires students to use appropriate scientific terminology.

Students are expected to use scientific terminology when communicating about soil-related objects, materials, and events.

Terminology should be introduced gradually as the need emerges. Throughout the unit, teachers should repeatedly assess student use of scientific terminology, model the use of appropriate terms, and encourage students to adopt them.

Memorizing definitions for terminology is not an expectation.

Unit terminology may include

- question, explore, investigate, observe, predict, measure, record, sequence, group, construct, label, conclude, communicate;
- soil, rock, particles, cobble, pebble, sand, silt, clay, humus, organic matter;
- gravel, loam, peat;
- moisture, absorption, erosion; and
- compost, composter, decompose, decay, nutrients.

Communicating using scientific terminology is a constant expectation throughout Science 3. Students should communicate their questions, ideas, intentions, as well as procedures and results, using written and oral language, and labelled drawings, charts, and graphs.

Communicating about Soils

Sample Teaching and Assessment Strategies

Throughout the unit, whenever students are exploring or investigating, their use of appropriate scientific terminology when communicating should be assessed.

Activation

Teachers may

- Create a visual display of unit terminology incorporating labelled pictures or add science terminology to existing word walls.
- Introduce soil-related terminology using relevant children's literature (e.g., Science Library titles). Once read aloud, these titles can be added to the curiosity centre.

Connection

Teachers may

- Incorporate scientific terminology into literacy activities (e.g., create a class digital book, including student-captioned soil-related images).

Students may

- Engage in a book walk through the student magazine, *Exploring Soils,* to identify soil-related terminology
- View the unit anchor video *Exploring Soils* and identify new terminology.
- Create a personal, visual glossary of science terms using labelled illustrations. Add new terms as they arise.
- Play word games (e.g., bingo) with unit terminology.

Consolidation

Teachers may

- Assess student use of terminology during collaborative discussions and when they are exploring and investigating. Digital recordings of student conversations may facilitate assessment.

Students may

- Collaboratively rewrite the story told in *Under Ground* to soil-related terminology.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Exploring Soils*
  - pp. 11-19
- Teachers Website
  - Anchor Video - *Exploring Soils*

Let's Do Science (SR)

- *Exploring Soils*
  - pp. 1-32

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Investigating Soils through Cross-Curricular Connections

Supplementary

Science Library

- *Dirt*
- *You Wouldn't Want to Live Without Dirt!*

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Skill - Using Appropriate Vocabulary (website)

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Dr. Bufflehead Explores Dirt* (Guided Reading)

Children's Literature

- *Under Ground* by D. Harris

How Are Soils Different?

Outcomes

Students will be expected to

3.0 investigate a variety of soils and find similarities and differences among them [GCO 1/3]

4.0 communicate while exploring and investigating [GCO 2]

Focus for Learning

Students should investigate soils personally collected from different locations to observe similarities and differences. Soils may be collected in zip top plastic bags and should be labelled, indicating the location where the sample was collected.

Soils obtained from different locations (e.g., flower box, vegetable garden, household plant pot, lawn, composter, sand box, roadside, forest, beach, bog, stream bed) may vary in colour, texture, odour, moisture content, and particle size.

Ensure that the collected soils investigated include a variety of different soil types and samples collected from various depths. Teachers may need to provide additional soil samples to ensure variety.

As part of their hands on investigations, students should

- make and record observations of multiple soil samples, using appropriate senses;
- describe the soil samples (e.g., grey, wet, sticky); and
- identify similarities and differences among samples.

The use of magnifying glasses may help students make more detailed observations.

Science is a social activity. While collaboratively investigating soils, students should be encouraged to communicate their thinking with those around them. They should communicate their questions, share their observations and ideas, and describe what they are doing or intending to do.

Students should communicate similarities and differences observed among collected soils (e.g., sample 1 is darker colour than sample 2, sample 3 is drier than sample 4).

Cross curricular connections may be made to English Language Arts 3 outcomes related to speaking and listening.

Attitude

Encourage students to work with others in exploring and investigating. [GCO 4]

Sample Performance Indicator

Observe and compare two or more soil samples and describe their similarities and differences using a Venn diagram.

How Are Soils Different?

Sample Teaching and Assessment Strategies

Collected soils should be retained at the completion of these investigations. They will continue to be used throughout the unit.

Activation

Teachers may
- Organize a "dig day" for students to collect soils from various locations around the school. Samples should be labelled with their location.

Students may
- Collect and bring in soils from home in zip top plastic bags. Samples should be labelled with their location. Digital images of the locations from which soils were collected may be captured.

Connection

Teachers may
- Present pp.4-5 from *Dirt* (Science Library) and ask students to
  - observe illustrated differences in the colour of soils found in different locations (e.g., tilled soil in the garden foreground, garden soil, soil on the path);
  - predict how the soil in different locations might feel and smell;
  - predict what the soil in the field might be like.

Students may
- Sketch soils to illustrate similarities and differences among them.

Consolidation

Teachers may
- Assess student communication while engaged in investigation of soils, using anecdotal notes, checklists, or audio recordings.

Students may
- In small collaborative groups, compare soils
  - collected from different locations, and
  - collected from different depths at the same location.
- Observe new, unlabelled soils and apply what was learned through investigation to predict the location (i.e., environment) each soil might have been collected.
- Use videoconferencing to communicate with students from other schools to compare the dominant soil types found in their area (e.g., comparing soils in the Codroy Valley with soils in Happy Valley-Goose Bay).

Resources and Notes

Authorized

Let's Do Science (TR)
- *Exploring Soils*
  - pp.11-19
- Teachers Website
  - Anchor Video - *Exploring Soils*
  - BLM - Venn Diagram
  - IWB Activity 1

Let's Do Science (SR)
- *Exploring Soils*
  - pp. 2-7

Teaching and Learning Strategies
- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Dig Day

Supplementary

Science Library
- *Dirt*

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html
- Science suppliers (websites)

What are Soils Made of?

Outcomes

Students will be expected to

5.0 investigate and describe soil components [GCO 1/3]

6.0 use appropriate tools [GCO 2]

Focus for Learning

Soils consist of organic matter, humus, air, water, and rock particles of varying sizes. Organic matter refers to the living things in the soil and the decomposing plant and animal matter (e.g., decaying leaves, grass, twigs, dead insects). Humus is the dark brown part of the soil that remains after organic matter has been decomposed. Rock particles contained in soils are classified according to their size:

- Pebbles are small rocks. They are larger than a grain of sand but smaller than cobble (fist sized rocks).
- Sand is smaller than a pebble and individual particles are visible without magnification. Sand has a granular texture.
- Silt and clay are very fine rock particles, much smaller than sand. Individual particles are only visible with strong magnification. Silts and clays feel like powder when dry and silky or sticky when wet.

Gravel generally refers to a mixture of pebbles, sand, silt, and clay.

Students should conduct guided inquiry investigations to separate the components of the collected soils; separating out the organic matter, humus, pebbles, sand, and silt and clay. Ensure a wide variety of soil types are investigated. Students should use appropriate senses to describe the appearance, odour, size, and texture of different soil components. They should continue to observe similarities and differences in components and their relative amounts among the soils investigated.

Provide a collection of tools to separate the soil components (e.g., magnifying glasses, spoons, tweezers, straws, toothpicks, paint brushes, various sizes of sieves, strainers, colanders, and mesh screens, coffee filters, cheesecloth, funnels, jars, measuring cups, spray bottles). Students should select those they wish to use.

Investigations provide opportunities for teachers to address and assess numerous skill outcomes (GCO 2). In addition to SCO 6.0, teachers may choose to address SCO 8.0, group materials and objects, and SCO 10.0, make and record observations and measurements, at this time (see pp. 40 and 42).

Attitude

Encourage students to show interest in and curiosity about objects and events within their immediate environment. [GCO 4]

Sample Performance Indicator

Create a multi-tab foldable to record observations from the soil components investigation. Illustrate the soil components on the front tabs of the foldable and describe them inside (the number of tabs should correspond to the number of different components observed).

What are Soils Made of?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Facilitate a brainstorming session to create a list of descriptive terms to use when describing soil components.
- Present the soil components illustrated on page 9 in *Dirt* (Science Library). Ask students to predict how the mole might have separated them (i.e., What tools might he have used?).

Connection

Teachers may

- Provide exemplars of pebbles, sand, and silt and clay for students to compare with components separated from their collected soils.

Students may

- Use tweezers, toothpicks, and/or paint brushes to separate components of soils. Observe the components using magnifying tools, and describe them using descriptive terminology.
- Use sieves, strainers, colanders, mesh screens, coffee filters, cheesecloth, and funnels to separate the components of collected soils. Drying the soil first may make it easier to separate components. Students should describe each component.
- In small collaborative groups, place a collected soil sample in a transparent container and add water until it is ¾ full. Cover and shake the container thoroughly. Then place it on a desk, allowing the components to settle (Components should settle in layers: pebbles followed by sand, then silt and clay. Humus and organic matter tend to float on the surface). Results should be illustrated and compared with those of other groups.
- View images of soil in *Seed Soil Sun* (Science Library) and describe the soil components observed.

Consolidation

Students may

- View digital images of various locations (e.g., forest, beach, farm) and predict what type of soil and relative amounts of soil components might be found there.
- Investigate the components of commercial potting soils. Potting soils are generally composed of peat, sand, composted pine bark, perlite (which provides air spaces). Some may contain fertilizer.

Extension

Students may

- Create a collection of images of soils under magnification.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Exploring Soils*
  - pp. 20-29
- Teachers Website
  - BLM - Sense Chart

Let's Do Science (SR)

- *Exploring Soils*
  - pp. 8-9

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Dig Day
  - Investigating Soils through Cross-Curricular Connections

Supplementary

Science Library

- *Dirt*
- *Seed Soil Sun*
- *Up in the Garden and Down in the Dirt*

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- What is soil made of? (websites and videos)
- Science suppliers (websites)

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Dr. Bufflehead Explores Dirt* (Guided Reading)

How Do Soils Change When They Get Wet?

Outcomes

Students will be expected to

7.0 describe the effect of moisture on the characteristics of soil [GCO 1/3]

8.0 sequence or group materials and objects [GCO 2]

Focus for Learning

Students are expected to carry out guided inquiry investigations to determine and describe how moisture affects the characteristics of soils (i.e., How do soils change when they get wet?).

Students should describe changes in appearance, texture, and the ability to clump of various soils (i.e., collected soils, commercial potting soil, sand, silt and clay).

When moisture is added, some soils may

- become darker in colour;
- feel sticky, silky, or spongy; and
- clump together, holding their shape when squeezed.

Sandy loam, for example, is easy to shape when moistened. Loam refers to soils containing varying amounts of sand, silt and clay. Sandy loam has a high sand content.

Students should have prior knowledge of moisture from Science 2, *Air and Water in the Environment*.

In Science K-3, students are expected to sequence (i.e., place in order) and group (i.e., sort) objects and materials according to one or more attributes. Sequencing and grouping require students to make detailed observations and identify changes, patterns, similarities, and differences.

Students have previously sorted (i.e., grouped) the components of soils. In the investigations above, students should sequence soils according to their ability to clump when squeezed.

Additional sequencing opportunities within the unit include sequencing soils from lightest to darkest colour, or according to particle size, and their ability to hold (i.e., absorb) water.

Attitude

Encourage students to be open-minded in their explorations and investigations. [GCO 4]

Sample Performance Indicator

Add moisture to potting soil and describe how it changes.

How Do Soils Change When They Get Wet?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Read aloud *The Sandcastle Contest.* Ask students to predict how Matthew was able to construct his house out of sand.

Students may

- In a sandbox, create sandcastles, using spray bottles and various tools and containers to shape their structures.

Connection

Teachers may

- Display an image of a sandy beach with a visible water line. Ask students to describe how the dry soil above the line might be different from the wet soil below the line.

Students may

- Individually, or in small collaborative groups, use sponges, eye dropper bottles, spray bottles, watering cans, or measuring cups to moisten collected soils and components. Students should describe how the appearance and texture of the soils change as moisture is added.
- Individually, or in small collaborative groups, add moisture to collected soils and components to investigate how moisture affects the clumping ability. Students may sequence soils according to their ability to clump.

Consolidation

Students may

- Construct a 3-D object using self-selected soils and investigate how much moisture needs to be added, or removed, to create the ideal clumping soil.
- Illustrate a “before and after” scene to show differences in soils after a rainfall. Scenes could include: a forest walking trail, the edge of a river bed, a vegetable garden, or a rocky beach.
- View images of soil in *Seed Soil Sun* (Science Library) and predict their sequence from wettest to driest. Describe what observations led to the predicted sequence.

Extension

Students may

- Discuss the effects of too much water and too little water on the growth of plants.

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Exploring Soils*
  - pp. 30-36
- Teachers Website
  - IWB Activity 2

Read Aloud

- *The Sandcastle Contest*

Let’s Do Science (SR)

- *Exploring Soils*
  - pp. 10-13

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Dig Day

Supplementary

Science Library

- *Seed Soil Sun*

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Soil moisture (websites)
- Skill - Classifying and Organizing (websites)

Do Soils Absorb Water?

Outcomes

Students will be expected to

9.0 compare the absorption of water by different soils [GCO 1/3]

10.0 make and record observations and measurements [GCO 2]

11.0 construct and label concrete-object graphs, pictographs, or bar graphs [GCO 2]

Focus for Learning

In prior investigations, students observed how soil characteristics change when moisture is added. The expectation of SCO 9.0 is for students to carry out investigations to compare how well different soils absorb (i.e., hold) water.

When added to soils, some water is held in the spaces between soil particles (i.e., is absorbed by the soil) and the rest drains through. How much water is absorbed depends on the soil type and particle size. Generally, soils with larger particles absorb less water than soils with finer particles. Sandy soils, for example, absorb less water than silty or clay-based soils, which have smaller particles.

Students should carry out a directed inquiry investigation to compare the absorption of water by different soils (e.g., collected soils, commercial potting soil, sand, silt and clay, peat). They should:

- Place a measured amount of a soil into a colander (or similar container) and add a measured amount of water to the top.
- After several minutes, observe the amount of water that has drained through the soil and has collected in a container placed below the colander.
- Measure (standard or non-standard units) and record the amount of collected water and compare to the initial added amount.
- Repeat the procedure for each soil.
- Construct a labelled bar graph comparing the amount of collected water for each soil tested.
- Draw conclusions about the absorption of water by different soils.

Alternatively, students could calculate the amount of water absorbed by finding the difference between the initial amount and what was collected and then construct a labelled bar graph of this data.

If investigating the absorption of peat, it is important to note that dry peat repels water, however, once moist it is highly absorbent.

Students are expected to display the results of investigations using graphs, when appropriate. Cross curricular connections may be made to Mathematics outcomes related to data management. Students have prior knowledge of concrete-object graphs and pictographs from Mathematics 2 and are introduced to bar graphs in Mathematics 3.

Attitude

Encourage students to appreciate the importance of accuracy. [GCO 4]

Do Soils Absorb Water?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Present images from *Up in the Garden and Down in the Dirt* (Science Library) that include water and ask students to discuss what they observe.
- Use a sponge to model how soils absorbs water; holding it in the spaces between the particles.

Connection

Teachers may

- Cover one end of several paper towel tubes with a coffee filter. Fill each tube with a different soil or soil component. Without telling students what they contain, pour an equal amount of water into each tube and record how long it takes for the water to flow out the bottom. Ask students to discuss why water might drain more quickly, or slowly, from one tube than another.
- Model investigating how well one collected soil absorbs water. Place a measured amount of soil into a perforated paper or Styrofoam cup. Suspend the cup above a container and pour a measured amount of coloured water on top of the soil. Allow the water to drain through. After several minutes, measure the amount of water collected in the container using cm, mL, or a non-standard unit.

Consolidation

Teachers may

- Invite a local farmer, gardener, or soil scientist into the classroom to talk about local soils and how well they absorb water.

Students may

- Construct a labelled bar graph to communicate the results of the investigation.
- Predict what type of soil farmers might prefer for growing vegetables.

Extension

Students may

- Collaboratively discuss the characteristics of an ideal soil for growing crops.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Exploring Soils*
  - pp. 37-45
- Teachers Website
  - BLM - Which Soil Absorbs Water the Best?

Let's Do Science (SR)

- *Exploring Soils*
  - pp. 14-17

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Dig Day

Supplementary

Science Library

- *Dirt*
- *Up in the Garden and Down in the Dirt*
- *You Wouldn't Want to Live Without Dirt!*

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Skill - Observing (websites)

Soils and Living Things

Outcomes

Students will be expected to

12.0 use a variety of sources of science information and ideas [GCO 2]

13.0 investigate and describe how living things affect and are affected by soils [GCO 1/3]

14.0 propose an answer to an initial question or problem and draw a simple conclusion [GCO 2]

Focus for Learning

Students are expected to investigate the relationship between soils and living things to answer these initial questions: "How do living things affect soils?" and "How are living things affected by soils?".

Students should use a variety of science information sources (e.g., research inquiry, experiments, field studies, models, surveys) when investigating these questions. Students should

- observe soils outdoors, turning over rocks and noting organisms living in and on the soil,
- create a worm jar to observe how earthworms affect the soil over time,
- section an apple, burying each piece in a different soil type, and recording how the apple decomposes over time,
- use informational texts to research the relationship between plants and soil, and
- view websites or videos related to burrowing animals and their affects on the soils in which they live.

Following their investigations, students should propose answers to the initial questions and describe examples of how living things affect and are affected by soils:

- Earthworms tunnel through the soil. This mixes the soil and creates space for air, water, and plant roots. Earthworms digest soil and organic matter. Their excrement (i.e., castings) adds nutrients to the soil.
- Decomposers (e.g., bacteria, fungi), which live in the soil, break down plant and animal waste (i.e., organic matter), returning nutrients to the soil.
- Burrowing animals live in the soil. The soil provides them shelter and protection. Their droppings put nutrients back into the soil.
- Plants grow in soil and their roots hold the soil in place. Plants obtain the water and nutrients they require for growth from the soil.

Attitude

Encourage students to consider their own observations and ideas when drawing a conclusion. [GCO 4]

Sample Performance Indicator

Write a diary entry, from the perspective of an earthworm, which describes how worms affect and are affected by the soil.

Soils and Living Things

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Brainstorm with students possible sources of science information (e.g., print or digital informational texts, field observations, surveys, models, experiments, knowledgeable individuals).
- Read aloud *Diary of a Worm* (Science Library) to pique curiosity about earthworms and how they affect and are affected by soils.

Connection

Teachers may

- Invite a knowledgeable community member to present to the class about topics related to composting and vermicomposting.
- Establish a classroom vermicomposter to observe how worms affect and are affected by soils.

Students may

- Go outside to explore soils and turn over rocks to find living things in the soil (e.g., earthworms, insects, slugs). Field observations may be recorded as digital images or sketches.
- Observe live earthworms in a tray of soil and describe how they move through the soil.
- Create a worm jar. Fill a mason jar, or similar transparent container, with repeating layers of potting soil and sand. Moisten the soil and add a small amount of organic matter as a food source. Wrap the jar in aluminum foil to prevent light from entering. Add an earthworm to the jar and set it aside. Remove the foil every couple of days to make and record observations. Ensure that the soil remains moist over time and add additional food as needed. There is no need to cover the jar.
- Place different soils (e.g., collected soils, commercial potting soils, humus, peat) in zip top plastic bags or transparent containers. Section an apple and bury a piece in each soil, ensuring it is positioned against the side of the container for easy viewing. Place one apple section in a container with no soil for comparison. Record observations of the apple sections over time, as fungi and microorganisms decompose the organic matter.
- Research, using informational texts, how ants, earthworms, and plants affect and are affected by soils.

Consolidation

Students may

- Draw an “above and below” soil picture. Annotate the illustration with labels and text to describe how the plants and animals affect and are affected by the soil.

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Exploring Soils*
  - pp. 46-55
- Teachers Website
  - IWB Activities 3-5

Read Aloud

- *Underneath The Sidewalk*

Let’s Do Science (SR)

- *Exploring Soils*
  - pp. 18-21

Supplementary

Science Library

- *Diary of a Worm*
- *Inside an Ant Colony*
- *It’s a Good Thing there are Earthworms*
- *Seed Soil Sun*
- *Wiggling Worms at Work*

What Is the Inquiry Process? (poster)

Suggested

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Explore! Magazine: Nature Up Close - The Forest Man of India*
- Science Library (Science 1)
  - *Wonderful Worms*
- Science Library (Science 2)
  - *An Earthworm’s Life*

How Does Moving Water Affect Soils?

Outcomes

Students will be expected to

15.0 investigate the effects of moving water on different soils
[GCO 1/3]

16.0 predict based on an observed pattern
[GCO 2]

17.0 communicate procedures and results
[GCO 2]

Focus for Learning

Water is always moving. It falls as rain, it sinks into or runs across the ground, flows in rivers and streams, and rolls in and out with the waves on a shoreline. As water moves it affects the soils over which it flows (e.g., erosion).

To investigate how moving water affects different soils, students should carry out an open inquiry investigation. Open inquiry provides opportunities for teachers to address and assess numerous skill outcomes. Students should

- select the soils they wish to test;
- decide how they wish to model moving water, how they will add the water to the soils;
- pose the question they want to investigate (e.g., I wonder how water sprinkled from a watering can affects gravel, sand, and potting soil?);
- select the materials needed to carry out their investigation and devise a procedure to follow;
- predict, based on prior observations, how the tested soils will be affected by moving water;
- carry out their procedure and make and record relevant observations;
- analyze their results and propose an answer to their investigated question (i.e., draw a conclusion);
- communicate to others what they were investigating (i.e., question), what they did (i.e., procedure), and what they found out (i.e., results); and
- pose new questions to investigate arising from what was learned.

Provide different soils (e.g., collected soils, commercial potting soils, gravel, sand, silt and clay, humus) and a wide variety of materials (e.g., cookie sheets, paint trays, foil pans, plastic containers, eye droppers, spray bottles, sports bottles, watering cans, sponges, measuring cups, graduated cylinders, perforated paper cups) for students to use in their investigations.

Through investigation, students should conclude that moving water washes away soil particles (i.e., erosion) and generally smaller soil particles erode more than larger soil particles.

Erosion is addressed at length in Science 4 *Rocks, Minerals, and Erosion* unit.

Attitude

Encourage students to willingly observe, question, and explore.
[GCO 4]

How Does Moving Water Affect Soils?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Ask students to think of a time when we experienced heavy rains. Where did they observe moving water? What did the water look like? Was anything washed away?
- Facilitate a community walk to observe evidence of moving water or its affects on soils (e.g., drip line around buildings, eaves trough down spout, drainage or roadside ditches, streams, beaches).

Connection

Students may

- In small collaborative groups,
  - place small piles of different soils on a plastic covered desk. With an eyedropper, drop water onto the piles and observe.
  - place large soil samples on the ground outside. Use a sprinkler head watering can to pour water onto the soil samples and observe the affect on soil components
  - place different soil samples, one at a time, on the sloped surface of a small paint tray or liner. Squeeze water onto the top of the soil using a sponge and observe the effect on the different soils.
  - pack different soil samples, one at a time, in one end of an aluminum foil tray. Fill the other end of the tray with water and direct waves toward the soil. Observe how the waves affect different soils.

  Students should record their predictions and observations.

Consolidation

Students may

- Present the findings of their investigation to their classmates, communicating the question they chose to investigate, describing what they did (i.e., procedure), and sharing what they found out (i.e., results). They should indicate whether their prediction was supported or rejected by their observations and identify new questions to investigate that arise from what was learned.
- Predict how ocean waves might affect a shoreline made of sand differently than a shoreline made of cobble.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Exploring Soils*
  - pp. 56-62

Let's Do Science (SR)

- *Exploring Soils*
  - pp. 22-25

Supplementary

Science Library

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Skill - Predicting (websites)

How Do Humans Use Soils?

Outcomes

Students will be expected to

18.0 demonstrate and describe ways humans use soils to make useful objects [GCO 1/3]

Focus for Learning

If asked, “How do humans use soils?”, students will likely respond that soils are used to grow plants for food and other purposes. Soils, however, are used by humans in many other ways to make useful products (e.g., construction materials, pottery, medicines, paints).

Students are expected to describe several ways humans use soils.

- Soils are used as a growth medium for plants. Humans eat some plants. Other plants are used as materials to construct useful products (e.g., cotton is used to make fabrics).
- Clay is used to make bricks, concrete, ceramics, jewelry, makeup, medicines, plaster, tiles, and various types pottery (e.g., earthenware, stoneware).
- Sand is used in the construction of concrete, glass, and mortar.
- Peat can be burned as a heat source, and is also used to make peat pots or pellets for germinating and growing plant seedlings.
- Soils are used to filter water.

Students should demonstrate ways soils can be used to make useful objects. Students could

- make mud bricks from collected soils, straw, and water;
- use clay to create art, jewelry, or pottery, or
- create art using soil paints made from different coloured soils mixed with water and white glue.

Cross curricular connections may be made to primary Art outcomes related to creating.

Humans benefit enormously from the products made from soils. Students could discuss ways to protect the health of soils.

Attitude

Encourage students be sensitive to the needs of other people, other living things, and the local environment. [GCO 4]

How Do Humans Use Soils?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Display various objects made from soils (e.g., dishes, jewelry, glass ornaments, makeup) at the curiosity centre.

Connection

Teachers may

- Invite knowledgeable community members (e.g., artisans, concrete contractors, farmers) to share with the class how they use soils to make products.

Students may

- Show and share products from home that are made from soils. With permission, items may be added to the curiosity centre for exploration until the end of the unit.

Consolidation

Students may

- Make mud bricks using collected soils, water, straw, and an ice cube tray as the form. Mud mixtures should be pressed into the tray and allowed to dry completely in a warm location before turning them out. Students could investigate which soils make the best bricks.
- Make different coloured paints by mixing collected soils with water and white glue. Use these soil paints to create art.
- Make beads using air-dried or oven-baked clay and create jewelry from these beads.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Exploring Soils*
  - pp. 63-74
- Teachers Website
  - IWB Activities 6-9

Let's Do Science (SR)

- *Exploring Soils*
  - pp. 26-31

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Investigating Soils through Cross-Curricular Connections

Supplementary

Science Library

- *Dirt*
- *Things People Make*
- *Where Does Chocolate Come From?*
- *Where Do T-Shirts Come From?*
- *Where Does Popcorn Come From?*

Section Three: Specific Curriculum Outcomes

Unit 2: Materials and Structures

Focus

Students learn about the nature of materials, not just by observing them but, more importantly, by using them; sometimes in their original form and sometimes as things that students themselves construct. The focus for students is on building things, and on selecting and using materials to fit the task at hand. Students learn that the strength and other characteristics of structures they build are linked to the properties of the materials they use, and to the particular way the materials are configured and joined.

The unit includes both science inquiry investigations and problem solving experiences. Students will follow an engineering design and problem solving process to build structures. Related skills addressed in the unit include: identifying problems to be solved, identifying materials and suggesting a plan for how they will be used, using appropriate tools, following simple procedures, following safety procedures and rules, estimating measurements, comparing and evaluating personally constructed objects, and collaboration.

Outcomes Framework

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

- 19.0 identify shapes and forms that are part of natural and human-built structures
- 20.0 investigate and describe ways different shapes and forms help provide strength and stability
- 23.0 describe the properties of some common materials and evaluate their suitability for use in building structures
- 25.0 investigate ways to join materials and identify the most appropriate methods for the materials to be joined
- 26.0 use appropriate tools in safely cutting, shaping, making holes through, and assembling materials
- 27.0 evaluate structures to determine if they are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment
- 33.0 test the strength and stability of personally built structures
- 36.0 identify ways of modifying a structure to increase its strength and stability

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

1.0 pose questions that lead to exploration and investigation
2.0 communicate using scientific terminology
6.0 use appropriate tools
17.0 communicate procedures and results
21.0 follow a simple procedure
22.0 identify and suggest explanations for patterns and discrepancies in objects and events
24.0 identify the most useful method of sorting
28.0 identify problems to be solved
29.0 identify materials and suggest a plan for how they will be used
30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions
31.0 estimate measurements
32.0 follow safety procedures and rules
34.0 pose new questions that arise from what was learned
35.0 compare and evaluate personally constructed objects

GCO 4 (Attitudes): Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

- recognize the role and contribution of science in their understanding of the world
- show interest in and curiosity about objects and events within the immediate environment
- appreciate the importance of accuracy
- be open-minded in their explorations and investigations
- work with others in exploring and investigating
- show concern for their safety and that of others in carrying out activities and using materials

SCO Continuum

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

<table>
<tr><th>Science 1</th><th>Science 3</th><th>Science 5</th></tr>
<tr><td>Properties of Objects and Materials</td><td>Materials and Structures</td><td>Properties and Changes of Materials</td></tr>
<tr>
<td rowspan="3">
identify objects, how they are used, and for what purpose they are used
observe objects and describe their similarities and differences
compare and describe properties of objects and materials
describe and demonstrate ways to use materials appropriately and effectively
explore ways to join materials
create a product by safely selecting, joining, and modifying materials
</td>
<td rowspan="3">
identify shapes and forms that are part of structures
investigate ways different shapes and forms help provide strength, stability, or balance
describe the properties of common materials and evaluate their suitability for use in building structures
investigate ways to join materials and identify the most appropriate methods for the materials to be joined
use appropriate tools in safely cutting, shaping, making holes through, and assembling materials
evaluate structures to determine if they are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment
test the strength and stability of personally built structures
identify ways of modifying structures to increase their strength and stability
</td>
<td>
group materials according to their properties
identify texture, hardness, flexibility, strength, buoyancy, and solubility as properties used to distinguish materials
identify the source of materials found in an object and describe the changes to the natural material required to make the object
</td>
</tr>
<tr><td>Forces and Simple Machines</td></tr>
<tr><td>
investigate forces used to move objects or hold them in place
describe how various forces can act directly or from a distance to cause objects to move
describe the effect of increasing and decreasing the amount of force applied to an object
</td></tr>
</table>

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

Science 2	Science 3	Science 4-6
• identify problems to be solved • follow a simple procedure • use appropriate tools • compare and evaluate personally constructed objects • pose new questions that arise from what was learned • communicate procedures and results • respond to the ideas and actions of others and acknowledge their ideas and contributions	• identify problems to be solved • identify materials and suggest a plan for how they will be used • follow a simple procedure • use appropriate tools • estimate measurements • follow safety procedures and rules • identify the most useful method of sorting • identify and suggest explanations for patterns and discrepancies in objects and events • compare and evaluate personally constructed objects • pose new questions that arise from what was learned • communicate procedures and results • respond to the ideas and actions of others and acknowledge their ideas and contributions	• propose questions to investigate and practical problems to solve • plan a set of steps to solve a practical problem and to carry out a fair test of a science-related idea • devise procedures to carry out a fair test and to solve a practical problem • follow procedures • select and use tools • estimate measurements • use tools and apparatus safely in a manner that ensures personal safety and the safety of others • classify according to several attributes • identify and suggest explanations for patterns and discrepancies in data • evaluate personally constructed devices • identify new questions or problems that arise from what was learned • communicate procedures and results • identify problems as they arise and collaborate with others to find solutions

Suggested Unit Plan

Materials and Structures is the first of two consecutive physical science units in the Science 3 curriculum.

September	October	November	December	January	February	March	April	May	June

Materials and Structures

Exploring and Investigating Materials and Structures

Outcomes

Students will be expected to

1.0 pose questions that lead to exploration and investigation
[GCO 2]

Focus for Learning

Skill outcome 1.0 was previously addressed in Unit 1. Refer to the elaboration provided on pp. 32-33.

Structures are natural or human-built objects which are constructed for a specific purpose (e.g. wasp nest, beaver dam, spider web, water bottle, chair, igloo, snowshoe, ladder, bridge, skyscraper). Structures vary in size, have more than one part, and are built using one or more materials.

Students are expected to pose questions that lead to exploration and investigation of structures and the materials they are made from. Questions could include

- What is a structure? How can we describe structures? How are natural and human-built structures different?
- Which shapes and forms are strongest?
- What what makes posts and beams strong? How might we make them stronger?
- What materials are used to build structures? Why are different materials used in different situations?
- What ways can different materials be joined together?
- What is the purpose of a structure? How can we evaluate and improve structures?
- Can we build our own structures? How will we evaluate them? How might we improve our structures?

Cross curricular connections may be made to English Language Arts 3 outcomes related to formulating questions that lead to inquiry.

Attitude

Encourage students to recognize the role and contribution of science in their understanding of the world. [GCO 4]

Exploring and Investigating Materials and Structures

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Read aloud *If I Built a House* (Science Library) to introduce the unit and encourage the generation of structure-related questions.

Connection

Teachers may

- Create a “curiosity centre” for student exploration. Objects may include
  - children’s literature, photographs, posters;
  - construction toys (e.g., wood blocks, Lego™, Jenga™, Crazy Forts™, K’Nex™);
  - construction materials (e.g., toothpicks, craft sticks, straws, coffee stir sticks, pipe cleaners, newspaper, paper, cardboard, corrugated plastic, balsa wood, wooden dowels, paper towel rolls, box board, modelling clay, fabrics, foam);
  - joining materials (e.g., tapes, glues, elastic bands, pipe cleaners, fasteners, staplers, binder clips, paper clips, screws, nails, nuts and bolts, clamps, hinges, modelling clay, marshmallows, string, Velcro™, cable ties, twist ties, wire, paper gussets);
  - measurement and construction tools; and
  - small natural and human-made structures (e.g., bird’s nest, wasp nest, pen, pencil sharpeners, pencil, ruler, tie clip, mobile phone case, swimming goggles, hair brush)

  Students may choose to add items to the centre for exploration.
- Present a series of high interest digital images depicting natural and human-built structures, including local examples. Ask students to pose and record “I wonder” questions that arise after viewing each image.

Students may

- Participate in a community walk to find local examples of natural and human-built structures. They could sketch or take digital images of the structures as a record of their observations. They may ask questions about the structures they find.

Resources and Notes

Authorized

Let’s Do Science (Teacher Resource [TR])

- *Materials and Structures*
  - pp. 11-15
- Teachers Website
  - Anchor Video - *Materials and Structures*
  - Image bank
  - IWB Activity 1

Let’s Do Science (Student Resource [SR])

- *Materials and Structures*
  - pp. 2-5

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Assessment

Supplementary

Science Library

- *Animal Architects*
- *Going Places*
- *If I Built a House*
- *Neo Leo*
- *Skyscrapers*

What Is the Inquiry Process?
What Is the Design Process?
(posters)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Structure resources (websites and videos)
- Skill - Questioning (websites)

How Can We Describe Structures?

Outcomes

Students will be expected to

2.0 communicate using scientific terminology [GCO 2]

Focus for Learning

Students should communicate about structures and the materials they are made from using appropriate scientific terminology.

Communicating using scientific terminology is an expectation throughout Science 3. Student use of appropriate terminology may be assessed whenever they are exploring, investigating, or problem solving.

Introduce and define new terminology gradually as the need emerges. Memorizing definitions is not a student expectation.

Unit terminology may include

- question, problem, explore, investigate, procedure, observe, estimate, measure, record, group, design, plan, construct, test, compare, evaluate, conclude, communicate;
- circle, square, triangle, rectangle, oval, line;
- sphere, cube, pyramid, rectangular prism, cylinder, cone, arch, dome;
- foundation, frame, beam, post, truss, joint, fastener; and
- construction materials (e.g., fabrics, glass, metal, paper, plastic, wood).

19.0 identify shapes and forms that are part of natural and human-built structures [GCO 1/3]

Students are expected to identify shapes and forms in natural and human-built structures. Shapes generally refer to two dimensional (2D) figures (e.g., circle, triangle, rectangle, line). Forms refer to three dimensional (3D) objects (e.g., rectangular prism, cylinder, sphere, arch, dome).

An igloo, for example, is a human-built structure that could be described as a dome. Students should determine which shapes and forms are commonly used in structures.

Cross curricular connections may be made to Mathematics 3 outcomes related to shape and space. Students describe a 3D object, for example, according to the shapes of its faces.

Cross curricular connections may also be made to Social Studies 3. Students could explore structures built and used by indigenous peoples of Newfoundland and Labrador.

Attitude

Encourage students to appreciate the importance of accuracy. [GCO 4]

Sample Performance Indicator

Create a personal, visual glossary of unit terminology. Include a labelled illustration for each term (e.g., sketch a table and label the posts).

How Can We Describe Structures?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Read Aloud *Build, Dogs, Build* (Science Library) and identify structure- and material-related terminology used to describe the structure.

Students may

- View the anchor video M*aterials and Structures* and identify structure-related terminology used.
- Sort unit terminology using personally selected sorting rules.

Connection

Teachers may

- Incorporate material- and structure-related terminology into daily writing activities.

Students may

- Take a walk around the school to identify shapes found in local natural and human-built structures. Ask students, “Which shape did you find most often?” and “Which shape did you find most often in human-built structures?”.
- View the illustrations in *If I Built a House* (Science Library) and identify the shapes and forms used.
- View a picture of a playground. Identify the shapes found in the picture and use a tally chart to record their frequency.
- Play a version of Balderdash™ where the scientific definition of a term is mixed with student-provided definitions. As the suggestions are read aloud, students should guess which is the scientific definition.

Consolidation

Teachers may

- Place labelled images of structure-related shapes, forms, parts, and materials on students’ backs. Students should ask yes/no questions to identify the term affixed to their back.

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Materials and Structures*
  - pp. 16-29
- Teachers Website
  - Image bank
  - IWB Activities 2-4

Let’s Do Science (SR)

- *Materials and Structures*
  - pp. 6-9

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Activities

Supplementary

Science Library

- *Build, Dogs, Build*
- *Cross a Bridge*
- *Engineers Build Models*
- *Engineers Solve Problems*
- *If I Built a House*
- *Neo Leo*

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Skill - Using Appropriate Vocabulary (websites)

Children’s Literature

- *How a House is Built* by G. Gibbons
- *The House that Max Built* by M. Newhouse

Which Shapes and Forms are the Strongest?

Outcomes

Students will be expected to

20.0 investigate and describe ways different shapes and forms help provide strength, and stability [GCO 1/3]

21.0 follow a simple procedure [GCO 2]

22.0 identify and suggest explanations for patterns and discrepancies in objects and events [GCO 2]

Focus for Learning

Students should investigate various shapes and forms to determine which are best suited for building strong and stable structures.

Strength refers to the ability of a structure to support weight (i.e., load). Stability refers to a structure's resistance to movement when a force is applied. A bookcase, for example, must be strong enough to support the weight of the books placed upon it. If the bookcase sways back and forth when a sideways force is applied or the shelves bow under the weight of the books, then the bookcase is unstable. Unstable structures are at risk of collapse.

Students should follow simple, teacher-provided procedures to investigate

- how wider foundations add stability to structures;
- the stability of rectangles, squares, triangles, and other shapes;
- the strength of a supported arch, square, and triangle; and
- the effect of post and beam length on strength and stability.

These investigations are described in column 3.

Upon completion, students should be provided with opportunities to modify and retest the structures to increase their strength and stability (SCO 36.0, pp. 72-73).

Analyzing the results of the above investigations, students should identify patterns in their findings. For example

- triangles are more stable than other shapes;
- triangles are a strong shape, arches are a strong form;
- shorter posts are stronger and more stable;
- shorter beams are stronger than longer beams; and
- wider foundations add stability to structures.

Students are expected to apply what is learned to suggest ways that the strength and stability of a structures could be improved.

Attitude

Encourage students to be open minded in their explorations. [GCO 4]

Sample Performance Indicator

Evaluate the strength and stability of a cube frame constructed from pipe cleaners. Suggest ways to improve the strength and stability of the cube.

Which Shapes and Forms are the Strongest?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- To demonstrate how forms provide strength, roll a single sheet of paper lengthwise to create a cylinder and use tape to help it maintain its form. Stand the cylinder upright on a flat surface and place textbooks upon it until it becomes unstable.

Connection

Teachers may

- Organize students into pairs and orally provide a procedure for students to test how widening their stance (i.e., the distance between their feet) affects their stability. When gently pushed on the shoulder by a partner, a wider stance increases their stability. Similarly, a wider foundation adds stability to structures.

Students may

- Place a large index card between two pieces of modelling clay to make a gently curved arch. Fold another index card to make a square post and beam shape and stand it between two pieces of modelling clay. Place the bottom of a small milk container or yogurt cup on top of each shape and add marbles to determine how many each can hold. Fold a third index card into a triangle shape and tape along the edge. Insert the triangle under the post and beam shape and retest to see how many marbles it can hold.
- Using pipe cleaners, make a rectangle, square, triangle, and other shapes. Evaluate the strength and stability of each shape by pushing or pulling on opposite corners. Add diagonal supports to the shapes (i.e., create triangles) and reevaluate them.
- Using string, suspend the bottom of a small milk container from the centre of a beam (e.g., plastic straw, wooden craft stick). Ask a classmate to hold both ends of the beam. Add marbles to the container until the beam collapses, and record the total number supported. Repeat the procedure with shorter beam lengths. If using craft sticks repeat the test with the stick on its edge.
- Use pieces of modelling clay to hold four straws upright like posts, close together in a square shape. Balance the bottom of a small milk container on top of the four posts. Carefully add marbles to the container until the posts fail. Repeat the test with shorter straws of equal length.

Consolidation

Students may

- Using toothpicks and marshmallows or gumdrops as a joining material, build a strong and stable structure.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Materials and Structures*
  - pp. 20-36
- Teachers Website
  - IWB Activity 3

Let's Do Science (SR)

- *Materials and Structures*
  - pp. 10-15

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Activities
  - Structures - Assessment

Supplementary

Science Library

- *Build, Dogs, Build*
- *Cross a Bridge*
- *Engineers Build Models*
- *Engineers Solve Problems*
- *Extreme Bridges*
- *If I Built a House*
- *Neo Leo*
- *Skyscrapers*
- *Things people Make*

Suggested

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Building a Skyscraper* (Guided Reading)

Selecting Suitable Materials

Outcomes

Students will be expected to

23.0 describe the properties of some common materials and evaluate their suitability for use in building structures [GCO 1/3]

24.0 identify the most useful method of sorting [GCO 2]

6.0 use appropriate tools [GCO 2]

Focus for Learning

Structures are made from a variety of materials. The suitability of a material for use in building a structure depends on the structure's purpose and the properties of the material (e.g., strength, flexibility, malleability, durability).

Students are expected to describe properties of common building materials such as: concrete, fabrics, glass, leather, metals, paper, plastic, rubber, stone, and wood. Wood, for example, may be described as strong, inflexible, durable, and flammable. It can be cut, drilled through, shaped, sanded, joined, and stained. Wood also absorbs water.

The properties of these common materials should be compiled on a class anchor chart and students should evaluate their suitability for use in building specific structures.

<u>Example</u>

What materials are suitable for making a construction worker's tool belt? What is the purpose of a belt? Which properties should be taken into consideration when selecting materials? Would concrete, fabric, leather, or rubber be a suitable material?

Students are expected to sort common materials according to their suitability for use in building a specific structure (i.e., whether they have, or do not have, the required properties).

Additionally, students should use appropriate tools (e.g., eyedropper, hand-held fan, hole punch, rubber mallet, sandpaper, stapler) to explore the properties of materials they may use later in the unit, to build their own structures (e.g., aluminum foil, cardboard, felt, modelling clay, paper, pipe cleaners, plastic straws, rubber, spaghetti, wooden craft sticks, or tooth picks). The use of some tools may require adult supervision.

Sample Performance Indicator

View pages 18-19 of the *Materials and Structures* student magazine and answer the following questions:

- What is the purpose of a dog house?
- What properties should the materials used to build it have?
- Sort the illustrated materials (i.e., wood, rubber, twigs, paper, cotton, straw, pipe cleaner, wire, modelling clay, felt, aluminum foil, plastic wrap, sandpaper) according to whether you would or would not use them in building a dog house.
- Select one material you would use and explain why it is suitable.
- Select one material you would not use and explain why.

Students may orally answer the questions during a teacher-student conference.

Selecting Suitable Materials

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Present examples of natural (e.g., wood, stone, straw) and human-made (e.g., concrete, plastic, steel) materials. Ask students to brainstorm how these materials might be used in different structures.
- Read aloud *The Little Knight who Battled a Dragon* and pause when the knight says "All I have is a wooden sword, a wooden shield and a wooden horse. I can't battle with those!*",* to discuss why. Ask students to predict what other materials he might use.

Students may

- Examine objects at the curiosity centre and identify the material(s) they are made from.
- View images of different structures (e.g., a house), identify the construction materials used, and discuss why they might have been chosen.

Connection

Teachers may

- Read aloud *Five Busy Beavers*. Ask students to identify the materials used to build the dam and why they were suitable.
- Read aloud *Things People Make* (Science Library). Ask students to create a list of properties for each material in the text and identify all the objects made from those materials.

Students may

- Complete a place mat activity using a wooden pencil at the centre. In each section around the pencil, record a different material used in its construction and list some properties of that material.
- Work in teams to determine the properties of different materials
  - expose to stress to determine durability (e.g., heat with a hair dryer, crumple and smooth out, rub with an eraser, strike with a rubber mallet);
  - add loads to determine strength;
  - attempt to tear or cut materials using various tools;
  - attempt to shape by hand or using appropriate tools; and
  - add water to determine if it is waterproof.

Consolidation

Students may

- Create a list of suitable materials to build a chair, umbrella, swing, or tree fort, and justify the choices made.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Materials and Structures*
  - pp. 37-44
- Teachers Website
  - BLM - Placemat
  - IWB Activity 5

Read Aloud

- *Five Busy Beavers*
- *The Little Knight who Battled a Dragon*

Let's Do Science (SR)

- *Materials and Structures*
  - pp. 16-19

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Activities

Supplementary

Science Library

- *Animal Architects*
- *Cleonardo*
- *The Boy Who Harnessed the Wind*
- *Things People Make*

Suggested

Children's Literature

- *A House is a House for Me* by M. Hoberman
- *Look at That Building: A First Book of Structures* by S. Ritchie
- *The Three Littles Wolves and the Big Bad Pig* by E. Trivizas

How Are Building Materials Joined Together?

Outcomes

Students will be expected to

25.0 investigate ways to join materials and identify the most appropriate methods for the materials to be joined
[GCO 1/3]

17.0 communicate procedures and results
[GCO 2]

26.0 use appropriate tools in safely cutting, shaping, making holes through, and assembling materials
[GCO 1/3]

Focus for Learning

Students should investigate different ways to join materials. They should be guided to try joining methods that involve the overlapping of components, the insertion of one component into another, and the use of various adhesives and other specialized fasteners.

Examples

- Wooden craft sticks can be woven together or notched to allow one piece to be inserted into another. They can be inserted into modelling clay, joined using various glues and tapes, or lashed together with twine. Card stock gussets can be used to join them at angles. Gluing sticks together lengthwise can form laminated (i.e., layered) beams; stagger joints for greater strength.
- Rolled newspaper can be joined lengthwise by inserting one roll inside the other. Rolls can be overlapped at an angle and lashed together with string. Masking tape can be used to join them.
- Cardboard can be joined perpendicularly by cutting slits into two pieces and inserting one into the other. Pieces of cardboard can be overlapped and hot glued or stapled together. Holes can be made through and brass paper fasteners inserted to join them. Cardboard could also be joined using packing tape.
- Felt strips can be woven together or the ends can be tied in knots to join them. Felt can be sewn together using a needle and thread, or joined using Velcro™ or buttons. White glue can also be used to join felt.
- Plastic straws can be joined lengthwise by cutting a slit into one straw and then inserting it into the end of another. Pipe cleaners or paper clips can be inserted into the ends of two straws to join them at angle. They can be woven together or lashed with dental floss. They can be joined with paper gussets or taped together.

Following investigation, students should communicate to others the joining methods tried and what they learned. They should apply this learning to identify the most appropriate joining method for the materials to be joined.

Some joining methods involve the use of tools to cut, make holes through, and assemble materials. Safe use of tools is an important science skill. Use of some tools may require adult supervision.

Attitude

Encourage students to work with others in exploring and investigating.
[GCO 4]

How Are Building Materials Joined Together?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Add a variety of fasteners, tools, and joining materials to the curiosity centre for students to explore.
- Read aloud *The Little Knight who Battled a Dragon* and pause when the knight's horse falls apart. Ask students to suggest ways the knight might join pieces of his horse back together.
- Demonstrate how to create a no-staple book as an example of joining materials by inserting one piece into another.

Students may

- View images of various structures and identify the ways the materials are joined.
- Brainstorm different ways that each material depicted in *Things People Make* (Science Library) might be joined.

Connection

Teachers may

- Provide a wide variety of adhesives, specialized fasteners, tools, and other joining materials. Ask students to select two pieces of the same material or two different materials to join. Students should investigate different joining methods, recording their observations after each test. Following their investigations, students should communicate to others which methods they tested and what they found out.

Students may

- Build two simple Lego™ walls at least three blocks wide. Stagger the blocks in building one wall. Align the blocks one on top of another in the second wall. Wiggle the walls to compare stability.
- View images of various structures and identify the ways the materials are joined.

Consolidation

Students may

- Construct a cube, or another 3D form, from selected materials. Join the materials using the most appropriate method identified.

Extension

Students may

- Create a commercial advertising the advantages of a specific adhesive or fastener. Highlight the materials with which their product works best.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Materials and Structures*
  - pp. 45-49
- Teachers Website
  - IWB Activity 6

Read Aloud

- *Five Busy Beavers*
- *The Little Knight who Battled a Dragon*

Let's Do Science (SR)

- *Materials and Structures*
  - pp. 20-21

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Activities
  - Structures - Assessment

Supplementary

Science Library

- *Audrey's Tree House*
- *Build Dog Build*
- *Things People Make*

What Is the Inquiry Process? (poster)

Evaluating Structures

Outcomes

Students will be expected to

27.0 evaluate structures to determine if they are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment [GCO 1/3]

28.0 identify problems to be solved [GCO 2]

Focus for Learning

A structure must safely and effectively achieve its purpose and make efficient use of materials. It must meet the criteria of its user and withstand the stresses of the environment in which it is used.

Students should evaluate a variety of structures, through use where possible. Students should consider

- its purpose, intended user, and how it is used;
- the effectiveness of the structure in achieving its purpose;
- the environmental conditions to which it is exposed;
- the suitability of the materials used and whether a different material might improve the structure;
- the design of the structure, it components, and joints, and whether a change to the design might improve the structure; and
- the safety of the structure.

Catastrophic failure of large structures (e.g., buildings, bridges, dams) may provide an interesting context to further explore this outcome. Given the reason for the failure, students could suggest structural modifications to increase strength and/or stability. Teachers may choose to introduce SCO 36.0, identify ways modify a structure to increase strength or stability, at this time (Refer to pp. 72-73).

Structural deficiencies identified through evaluation are problems that need to be solved. If evaluating a pair of scissors, for example, students might note that they are unable to use them to cut certain materials, the metal blade is rusted, the joint holding blades together is loose, the coloured plastic handle might be cracked or faded, and their hand might hurt after a few minutes of use.

Each deficiency is a problem to solve. Once identified, engineering design and problem solving processes are initiated to begin to find solutions.

Structures are never final. They are constantly modified and improved as new materials become available, and as the criteria used to determine their appropriateness to the user and environment changes.

Attitude

Encourage students to show interest in and curiosity about objects and events within the immediate environment. [GCO 4]

Evaluating Structures

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Present a personally constructed object (e.g., purse constructed from aluminum foil, pipe cleaners and tape) and ask students how they might evaluate it.
- Present images of homes from different parts of the world (e.g., apartment complex, brick house, igloo, mud hut, salt box house, stilt house, wig wam). Ask students to consider reasons for observed differences in design and the materials used.
- Present a collection of different student rulers. Ask students to identify differences among them and suggest reasons for those differences.

Connection

Teachers may

- Read a version of *The 3 Little Pigs*. Ask the students to evaluate the effectiveness of each house, and to identify the problems that existed in those that failed.
- Present a video clip showing the collapse of the Tacoma Bridge in 1940. Ask students to discuss what structural deficiency might have caused the bridge to collapse in gale force winds.

Students may

- Evaluate, in small collaborative groups, the effectiveness, safety, and efficient use of materials of a small structure (e.g., pen, pencil sharpener, ruler, scissors, small toy). Students should consider the purpose of the structure, intended user, and criteria to determine its appropriateness to the user and environment.

Consolidation

Students may

- Illustrate a home design that would be appropriate for a specific environment (e.g., arctic, desert, mountain side, tropical island). The design should incorporate materials and components to withstand the stresses of the specific environment (e.g., desert - intense heat and light, wide temperature range, sandstorms).
- View images of large failed structures and suggest modifications that might have prevented the failure.
- Create an “impossible structure” in Minecraft™ (since the laws of physics do not apply within the game, structures can be designed that would fail in the real world). Alternatively, they could draw an “impossible structure”. Students should identify problems that might exist if these structures were built in the real world.

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Materials and Structures*
  - pp. 50-53
- Teachers Website
  - IWB Activity 7

Read Aloud

- *The Little Knight who Battled a Dragon*

Let’s Do Science (SR)

- *Materials and Structures*
  - pp. 22-25

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Activities

Supplementary

Science Library

- Cleonardo
- Extreme Bridges
- Skyscrapers

Suggested

Children’s Literature

- *The 3 Little Pigs: An Architectural Tale* by S. Guarnaccia
- *The Magnificent Tree* by N. Bland

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Tunnel Vision: Building an Underwater Tunnel* (Guided Reading)

Designing Student-Built Structures

Outcomes

Students will be expected to

29.0 identify materials and suggest a plan for how they will be used [GCO 2]

30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions [GCO 2]

31.0 estimate measurements [GCO 2]

32.0 follow safety procedures and rules [GCO 2]

Focus for Learning

Address the remaining unit outcomes through a guided engineering design and problem solving experience. Students should have prior experience from Science 1 and Science 2 with "being engineers", and engaging in design and build activities.

Students should, in small collaborative groups, solve an identified problem by designing and building a structure (e.g., bridge, paper tower, skyscraper) that meets established design criteria. Criteria for a bridge, for example, could include

- span a distance of 30 cm between two desks,
- have a continuous flat deck that allows a toy car to roll across,
- incorporate found and recycled materials, and
- support as much weight as possible (e.g., marbles placed in a bucket suspended from the bridge deck with string).

Criteria should challenge students to apply what they have learned about materials and structures.

Students should follow an engineering design and problem solving process to design and build their structure. The initial stages of a typical process are described below. Students should

- clarify the problem and the design criteria;
- brainstorm possible solutions and consider the potential of each one;
- ensure the ideas of each group member are considered and collaboratively select one possible solution to try (SCO 30.0);
- devise a plan to build a prototype (i.e., model) that includes design sketches and a list of tools, fasteners, and materials that will be used (SCO 29.0); and
- build the prototype using appropriate tools (SCO 26.0).

In building their structure, students will estimate measurements and should be expected to follow all provided safety procedures and rules when constructing.

Testing and evaluation of the student-built prototypes are the next stages of the process.

Attitude

Encourage students to show concern for their safety and that of others in carrying out activities and using materials. [GCO 4]

Designing Student-Built Structures

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Read aloud *Engineers Solve Problems* (Science Library). Refer specifically to the stages of a design process described on pages 12-19.

Connection

Teachers may

- Develop, in collaboration with students, design criteria for the construction of a student-built structure (e.g., bridge, paper tower, skyscraper). Criteria may focus on strength, stability, and withstanding environmental conditions.
- Provide a large collection of varied materials, tools, and fasteners for students to choose from in constructing structures. The collection should include found and recycled materials.

Students may

- Brainstorm possible solutions to a problem and include detailed sketches labelled with design components, materials, and fasteners. They should communicate their design ideas to other members of their group. Sketches can be modelled after exemplars found in *Engineers Build Models, Engineers Solve Problems, and Neo Leo* from the science library.
- Collaboratively select a possible design solution to try and devise a construction plan. The plan should identify the tools and materials needed and estimates of material quantities required (refer to p. 20, *Engineers Build Models)*. Carry out the plan, making changes and modifications as problems are encountered.
- Participate in a "scouts out" activity, where one member of each group is sent out to silently observe other groups. When the scouts return they share what they observed and the group decides whether to incorporate the information gathered.

Consolidation

Students may

- Collaboratively, in small groups, construct a free standing skyscraper with a minimum height of 60 cm, and a maximum width of 30 cm, that can withstand the force of air moving against it.
- Collaboratively, in small groups, construct an "earth-quake proof" paper tower. The tower must be free standing and have a minimum height of 60 cm.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Materials and Structures*
  - pp. 54-58
- Teachers Website
  - IWB Activity 8

Let's Do Science (SR)

- *Materials and Structures*
  - pp. 26-27

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Assessment
  - Structures - Design Challenge

Supplementary

Science Library

- *Engineers Build Models*
- *Engineers Solve Problems*
- *Going Places*
- *Neo Leo*
- *The Boy Who Harnessed the Wind*

What Is the Design Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Design process (websites and videos)

Children's Literature

- *Rosie Revere, Engineer* by A. Beaty
- *The Most Magnificent Thing* by A. Spires
- *Those Darn Squirrels* by A. Rubin

Testing and Evaluating Student-Built Structures

Outcomes

Students will be expected to

33.0 test the strength and stability of personally built structures [GCO 1/3]

34.0 pose new questions that arise from what was learned [GCO 2]

35.0 compare and evaluate personally constructed objects [GCO 2]

Focus for Learning

The design process does not end with the construction of a prototype (i.e., model). Prototypes must be tested. Students should test the strength and/or stability of their prototype. Strength and stability are tested by applying forces to the structure (e.g., adding a load to a bridge, shaking a paper tower, using a hair dryer to blow air toward a skyscraper). Students should record the results of testing and identify structural deficiencies.

First attempts to solve problems are rarely successful. Students should apply their understanding of structures, shapes and forms, materials, and joints to make suggestions to improve their structure. These improvements should be carried out and the improved prototypes retested. Multiple iterations of prototype improvement and retesting should be expected to reach a final solution.

Occasionally, repeated failure in testing results in a prototype being abandoned. Should this occur, students should be encouraged to persevere and select another potential solution from those originally considered to try.

When testing prototypes, new questions will undoubtedly arise:

- Which design component failed during testing?
- Would a different material add strength?
- Is there another more appropriate fastener for these materials?
- How could we reinforce joints to increase strength and stability?
- Would adding additional supports improve stability?
- Would shortening posts or beams add strength?
- Does the structure need a wider foundation?

These questions lead to further exploration and investigation of materials, joints, and design. Students should be encouraged to think aloud; orally communicating their questions, ideas, and intentions.

Teachers may choose to address SCO 36.0 (pp. 72-73) in conjunction with the testing of student-built prototypes (Refer to pp. 72-73).

Once students are satisfied with their prototype, they should construct their final solution and submit it for final evaluation.

Students should compare the final solutions of different groups and evaluate those structures in relation to the design criteria. This final testing determines the degree to which each student-built solution solves the identified problem and meets the established design criteria.

SCO 27.0 (pp. 66-67) should be readdressed at this time. Students should evaluate whether the final structures are effective and safe, if they make efficient use of materials, and if they are appropriate to the user and the environment.

Testing and Evaluating Student-Built Structures

Sample Teaching and Assessment Strategies

Connection

Students may

- Test the strength and stability of their prototype to the point of breakage. Identify the structural deficiency and consider how changes to the materials, joints, or design might improve the strength or stability of the structure. Students should carry out the modifications and retest their improved prototype.
- Record observations from each test for future interpretation and analysis. Digital video is recommended for this purpose.
- Participate in a gallery walk to view prototypes in various stages of testing, modification, and retesting. One member of each group should remain with their prototype and explain to visiting classmates their prototype design, problems encountered, and progress to date. Classmates can provide constructive feedback and make suggestion for improvement.

Consolidation

Students may

- Test the strength of a bridge by suspending a plastic bucket from string tied around the deck of the bridge and adding measured amounts of water to the bucket until if fails.
- Test the strength of a skyscraper by placing a load (e.g., text books) on top of the structure until it collapses. The stability of the skyscraper could be tested using a hair dryer or electric fan to direct air at the structure.
- Test the stability of a paper tower, designed to withstand an earthquake, by affixing the bottom of the tower, with modelling clay, to a piece of cardboard and placing the cardboard on top of a bed of marbles contained in a box top. Shaking the box models the vibrations that occur during an earthquake.
- Present their final solution to their classmates, communicate problems encountered during testing, and explain how those problems were solved.
- Evaluate the final solutions of different groups. Does the structure solve the problem? Is it strong and stable? How might it be improved?

Extension

Students may

- Apply what is learned to create a strong and stable Lego™ structure. Describe the features of the structure that add to its strength and stability at a class fair.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Materials and Structures*
  - pp. 59-63

Let's Do Science (SR)

- *Materials and Structures*
  - pp. 28-29

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Assessing Skills
  - Structures - Assessment
  - Structures - Design Challenge

Supplementary

Science Library

- *Cleonardo*
- *Engineers Build Models*
- *Engineers Solve Problems*
- *Going Places*
- *Neo Leo*
- *The Boy Who Harnessed the Wind*

What Is the Design Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Structural failures (websites and videos)

Modifying Structures to Increase Strength and Stability

Outcomes

Students will be expected to

36.0 identify ways of modifying a structure to increase its strength and stability [GCO 1/3]

Focus for Learning

As a culminating experience, students should apply what they have learned regarding foundations, shapes and forms, posts and beams, materials, fasteners, and joints, to suggest ways to increase the strength and stability of various structures.

Depending on the structure, suggested modifications could include

- widening or reinforcing the foundation;
- adding supports to the frame to create triangle shapes;
- incorporating strong forms such as arches and domes;
- reinforcing the joints (e.g., gussets, overlap components);
- shortening posts and beams;
- selecting stronger materials; and
- selecting different fasteners or joining methods.

Sample Performance Indicator

View pages 14-15 of the *Materials and Structures* student magazine. Select three structures and identify ways that each structure could be modified to increase its strength and stability.

Modifying Structures to Increase Strength and Stability

Sample Teaching and Assessment Strategies

Connection

Teachers may

- Present pages 2-3 of the *Materials and Structures* student magazine. Ask students to view the images and collaboratively discuss how each of the structures could be modified to increase its strength and stability.
- Read mentor texts such as *The Three Little Pigs* to discuss modifications to structures to improve strength and stability.

Students may

- Explore small structures at the curiosity centre and discuss ways to increase their strength and stability.
- View images of large structures on the brink of structural failure (e.g., abandoned shed) and suggest how modifications might prevent it from collapsing.

Consolidation

Students may

- Suggest modifications to increase the strength and stability of final student-built structures.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Materials and Structures*
  - pp. 64-67
- Teachers Website
  - IWB Activity 9

Let's Do Science (SR)

- *Materials and Structures*
  - pp. 30-31

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Structures - Activities
  - Structures - Assessment
  - Structures - Design Challenge

Supplementary

Science Library

- *Cleonardo*
- *Engineers Build Models*
- *Engineers Solve Problems*
- *Going Places*
- *Neo Leo*
- *The Boy Who Harnessed the Wind*

What Is the Design Process? (poster)

Section Three: Specific Curriculum Outcomes

Unit 3: Invisible Forces

Focus

Some forces involve direct pushes and pulls, where a surface is directly contacted. Others involve interaction at a distance. The intent is to introduce students to two kinds of forces that can act between objects, where the objects need not be touching one another. Students learn that magnetic forces and static electric forces both involve attraction and repulsion, but have different origins and involve different kinds of materials. Students discover a variety of ways these forces can be applied or can affect their daily life.

The *Invisible Forces* unit has both a science inquiry and design and problem solving focus. Inquiry investigations provide opportunities for students to further develop skills related to posing questions, making predictions, making and recording observations, sequencing and grouping, and drawing conclusions. Design and problem solving experiences provide opportunities to further develop skills related to identifying problems, identifying materials and suggesting a plan for use, and comparing and evaluating personally constructed objects.

Outcomes Framework

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

37.0 describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact

38.0 describe examples of the effects of static electricity in their daily lives and identify ways in which static electricity can be used safely or avoided

39.0 identify conditions that affect the force of static electric materials

40.0 identify familiar uses of magnets

41.0 investigate and identify materials that are attracted by magnets and distinguish from those materials that are not affected by magnets

42.0 investigate how to magnetize magnetic materials

43.0 identify conditions that affect the force of magnets

44.0 investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

1.0 pose questions that lead to exploration and investigation
2.0 communicate using scientific terminology
8.0 sequence or group materials and objects
10.0 make and record observations and measurements
14.0 propose an answer to an initial question or problem and draw a simple conclusion
16.0 predict based on an observed pattern
17.0 communicate procedures and results
21.0 follow a simple procedure
28.0 identify problems to be solved
29.0 identify materials and suggest a plan for how they will be used
30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions
34.0 pose new questions that arise from what was learned
35.0 compare and evaluate personally constructed objects

GCO 4 (Attitudes): Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

- recognize the role and contribution of science in their understanding of the world
- show interest in and curiosity about objects and events within their immediate environment
- willingly observe, question, and explore
- appreciate the importance of accuracy
- be open-minded in their explorations
- work with others when exploring and investigating
- show concern for their safety and that of others in carrying out activities and using materials

SCO Continuum

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

Science K-2	Science 3	Science 5
	Invisible Forces	*Forces and Simple Machines*
	• demonstrate ways to produce static electric charges, and describe how charged materials interact • describe examples of the effects of static electricity and identify ways it can be used safely or avoided • identify conditions that affect the force of static electric materials • identify familiar uses of magnets • investigate materials that are attracted by magnets and distinguish from those that are not affected • investigate materials that can be magnetized • identify conditions that affect the force of magnets • investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel	• investigate forces used to move or hold objects in place • describe how forces can act directly or from a distance to cause objects to move • demonstrate the effect of increasing and decreasing the amount of force applied to an object **Science 6** *Electricity* • compare characteristics of static and current electricity • demonstrate how current electricity can produce magnetic effects • describe the relationship between electricity and magnetism when using an electromagnet

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

Science 2	Science 3	Science 4-6
• pose questions that lead to exploration and investigation • identify problems to be solved • predict based on an observed pattern • follow a simple procedure • make and record observations and measurements • sequence or group materials and objects • propose an answer to an initial question or problem and draw a simple conclusion • compare and evaluate personally constructed objects • pose new questions that arise from what was learned • communicate using scientific terminology • communicate procedures and results • respond to the ideas and actions of others and acknowledge their ideas and contributions	• pose questions that lead to exploration and investigation • identify problems to be solved • predict based on an observed pattern • identify materials and suggest a plan for how they will be used • follow a simple procedure • make and record observations and measurements • sequence or group materials and objects • propose an answer to an initial question or problem and draw a simple conclusion • compare and evaluate personally constructed objects • pose new questions that arise from what was learned • communicate using scientific terminology • communicate procedures and results • respond to the ideas and actions of others and acknowledge their ideas and contributions	• propose questions to investigate and practical problems to solve • state a prediction and a hypothesis • plan a set of steps to solve a practical problem and to carry out a fair test of a science-related idea • follow procedures • make observations and collect information that is relevant to the question or problem • classify according to several attributes • draw a conclusion that answers an initial question • evaluate personally constructed devices • identify new questions or problems that arise from what was learned • communicate procedures and results • identify problems as they arise and collaborate with others to find solutions

Suggested Unit Plan

Invisible Forces is the second physical science unit in the Science 3 curriculum. It is positioned during winter months when air is drier (i.e., less humid) and static electricity is more common.

September	October	November	December	January	February	March	April	May	June

Invisible Forces

Exploring and Investigating Invisible Forces

Outcomes

Students will be expected to

1.0 pose questions that lead to exploration and investigation
[GCO 2]

2.0 communicate using scientific terminology
[GCO 2]

Focus for Learning

Skill outcome 1.0 was previously addressed. Refer to the initial elaboration provided on pp. 32-33.

Students are expected to pose questions related to magnetism and static electricity that lead to exploration and investigation:

- What are forces? What effects do forces have on objects and materials? What is static electricity? What is a magnetic force?
- How is static electricity created? Which materials are most effective for producing static electricity? What conditions affect the strength of static electric materials? How can static electricity be used?
- How are magnets used? Where can you find them?
- Which materials are attracted by magnets? Which materials are not attracted? What happens when two magnets meet?
- Do magnets have different strengths? What affects the strength of a magnet? How can you make your own magnet?

Cross curricular connections may be made to English Language Arts 3 outcomes related to formulating questions that lead to inquiry.

Skill outcome 2.0 was previously addressed. Refer to the initial elaboration provided on pp. 34-35.

Introduce and define unit terminology gradually as the need emerges. Memorizing definitions is not a student expectation.

Unit terminology may include

- explore, investigate, question, problem, predict, procedure, plan, observe, measure, group, sequence, record, compare, evaluate, conclude, communicate;
- force, contact forces, invisible forces, static electricity (electrostatic force), magnetism;
- electrostatic charge, positive charge, negative charge, neutral charge, attract, repel;
- magnet, magnetic and non-magnetic material, magnetize; and
- north pole, south pole, compass.

Throughout the unit, whenever students are exploring, investigating, or problem solving, their use of scientific terminology when communicating should be assessed.

Attitude

Encourage students to willingly observe, question, and explore.
[GCO 4]

Exploring and Investigating Invisible Forces

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Perform "magic tricks" involving invisible forces
  - use static electricity to stick a balloon onto the wall or make a student's hair stand on end without touching it, and/or
  - use magnets to move an object without touching it.
- Read aloud *The Golden Goose* to introduce the concept of invisible forces and encourage the generation of related questions to explore and investigate.

Students may

- Play tug of war to explore the effects of pulling forces.
- Record prior knowledge of scientific terminology related to static electricity and magnets using pictures and words.

Connection

Teachers may

- Create a "curiosity centre" for invisible forces. Objects may include
  - children's literature;
  - various types and sizes of magnets, magnetic and non-magnetic materials, iron fillings;
  - compasses, magnetic toys; and
  - aluminum foil, balloons, Bounce™ sheets, combs, electrostatic dusters, felt, foam plates, fur, plastic wrap, rulers, silk, Swiffer™ cloth, window clings, wool.
- Record student questions in a class anchor chart.
- Create an ongoing visual word wall of unit terminology .

Students may

- View the anchor video *Invisible Forces* and identify examples of invisible forces that they have experienced.
- Play charades using unit terminology.

Consolidation

Students may

- Record inquiry questions and reflections in their science learning journal.
- Create a personal visual glossary or foldable of self-selected invisible force-related terminology.

Resources and Notes

Authorized

Let's Do Science (Teacher Resource [TR])

- *Invisible Forces*
  - pp. 10-15
- Teachers Website
  - Read Aloud - *The Golden Goose*
  - Anchor Video - *Invisible Forces*
  - IWB Activity 1
  - Image bank

Let's Do Science (Student Resource [SR])

- *Invisible Forces*
  - pp. 2-3

Supplementary

Science Library

- *Magnetism*
- *Magnets*
- *The Golden Goose*

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Invisible force resources (websites and videos)
- Skills - Questioning and Using Appropriate Vocabulary (websites)

Creating Static Electricity

Outcomes

Students will be expected to

37.0 describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact [GCO 1/3]

34.0 pose new questions that arise from what was learned [GCO 2]

Focus for Learning

Static electricity is produced when materials are rubbed together. Positive electrostatic charges build up on one material and negative electrostatic charges build up on the other. These charged materials can attract or repel other materials.

When a balloon is rubbed against your hair, for example, opposite static charges build up on the balloon and your hair. If subsequently brought together, the balloon and your hair will attract each other. The charged balloon will also attract (i.e., stick to) a neutral wall. If two balloons are rubbed against your hair, both balloons will gain like charges and, if subsequently brought together, will repel each other.

Describing static buildup as the transfer of negative charges is not an expectation. Teachers should avoid using the term electron.

Provide a collection of everyday materials (e.g., balloons, comb, cotton, felt, foam plates, fur, plastic rulers, silk, wool) for students to use to produce static electric charges and explore how charged materials interact. Students should, through directed investigations, observe how

- materials having opposite static electric charges attract,
- materials having like static electric charges repel, and
- electrostatic charged materials attract neutral materials.

Students should pose new questions to investigate, arising from what was learned (e.g., Does the number of times you rub a balloon affect how long it sticks to a wall?).

38.0 describe examples of the effects of static electricity in their daily lives and identify ways in which static electricity can be used safely or avoided [GCO 1/3]

Students should describe familiar examples of the effects of static electricity (e.g., static cling in clothing, static electricity in hair when combed, shocks from static discharge, lightning).

Static electricity can be helpful in our daily lives. Some technologies use static electricity (e.g., electrostatic dusters, plastic wrap, window clings). Other technologies were developed to avoid negative effects of static electricity (e.g., anti-static sprays, dryer sheets).

Walking across carpet in a pair of socks and touching a doorknob may cause a static electric shock. The shock felt is the discharge of built up static electric charges. If completely dark, the discharge would be visible as a spark. Similarly, lightning is the discharge of large amounts of static electricity in the atmosphere.

Most often, the discharge of static electricity is not harmful. Sometimes, however, it can be dangerous (e.g., lightning strikes). Static discharge when filling a plastic fuel container with gasoline can ignite the fuel. To be safe, static electricity should be discharged before filling the container with fuel.

Sample Performance Indicator

Create static electric forces using balloons and pieces of felt. Use these charged materials to demonstrate and describe possible interactions (i.e., attraction, repulsion).

Creating Static Electricity

Sample Teaching and Assessment Strategies

The use of balloons to demonstrate, explore, and investigate static electric forces is frequently suggested. Alternative materials (e.g., Styrofoam™ plates) should be used if latex allergies are present.

Activate

Teachers may

- Add technologies that use or reduce static electricity to the curiosity centre for exploration and investigation.
- Show a video of the effects produced by a Van de Graaff generator.
- Illuminate a fluorescent light bulb using static electricity by moving a charged balloon quickly back and forth near the bulb.

Connection

Students may

- Explore and compare static electric forces by rubbing balloons with different materials (e.g., cotton, felt, fur, hair, polyester, plastic wrap, wool).
- Tape a separate piece of string to the edge of two foam plates. Charge one plate by rubbing its bottom with wool. Then, holding both plates by their strings, bring them together and observe. Repeat the activity charging both plates with wool.
- Investigate how charged materials affect a thin stream of tap water when held close to the water.
- Predict the effect of static electricity on neutral substances such as paper confetti, pepper, salt, and sugar. Place a charged material above the substances to observe the effects and confirm predictions.
- Charge a plastic ruler by rubbing with an appropriate material and then use the ruler to move a table tennis ball without touching it.

Consolidation

Students may

- Participate in team competitions, using only static electricity, to keep a balloon stuck to the wall as long as possible or to move a table tennis ball the greatest distance.

Extension

Students may

- Research technologies that use static electricity (e.g., ink-jet printers, smoke-stacks, air purifiers, photocopiers, car painting).

Resources and Notes

Authorized

Let's Do Science (TR)

- *Invisible Forces*
  - pp. 16-22
- Teachers Website
  - BLM *How Long Did It Stick?*
  - IWB Activities 2-4
  - Image bank

Let's Do Science (SR)

- *Invisible Forces*
  - pp. 4-7

Supplementary

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Static electricity resources (websites and videos)

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Felicity Discovers Electricity* (Guided Reading)
  - *Make Electrostatic Slime* (Guided Reading)

What Conditions Affect Static Electricity?

Outcomes

Students will be expected to

39.0 identify conditions that affect the force of static electric materials [GCO 1/3]

10.0 make and record observations and measurements [GCO 2]

Focus for Learning

Working in collaborative groups, students should devise and carry out investigations to identify conditions (e.g., distance, material type, repetition, humidity, temperature) that affect the strength of electrostatic forces.

Possible inquiry questions to investigate include

- How does changing the distance a charged object or material is held from paper confetti affect the amount of confetti it can pick up?
- How does the material (e.g., cotton, fur, silk, wool) used to charge a plastic comb affect how far a thin stream of water bends?
- How does the material (e.g., felt, nylon, plastic wrap, polyester) used to charge a balloon affect the length of time it can remain attached to a wall?
- How does the number of times a balloon is rubbed with a material affect the length of time it remains attached to a wall?
- How does adding mist to the air near a wall (e.g., humidity) affect how long a charged balloon will remain attached?

As part of these guided inquiry investigations, students should make and record observations and measurements. Observations and measurements may be qualitative (e.g., the water bends more) or quantitative in nature (e.g., 5 pieces of confetti, 42 seconds) and should be recorded, using written language, drawings, charts, tables, digital images, or video, for future interpretation and analysis.

In addition to SCO 10.0, these guided investigations provide opportunities for teachers to address and assess additional inquiry-related skill outcomes: posing questions to investigate, making predictions, identifying and suggesting explanations for patterns and discrepancies, drawing conclusions, constructing and labeling bar graphs, communicating procedures and results, and communicating using scientific terminology (SCOs 1.0, 16.0, 22.0, 14.0, 11.0, 17.0, and 2.0 respectively).

Attitude

Encourage students to work with others when exploring and investigating. [GCO 4]

Sample Performance Indicator

Demonstrate and describe how to charge a balloon to maximize the amount of paper confetti it can pick up.

What Conditions Affect Static Electricity?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Read aloud *Ada Twist, Scientist* to reinforce that asking questions about observations is the initial step of an inquiry process.
- Ask students to recall prior experiences with the effects of static electricity. What did they see, feel, hear? What were they doing? Was the weather warm or cold? Was it humid or dry?

Connection

Students may

- Investigate how charging a balloon with different materials affects the length of time it stays attached to a bare wall. To investigate this question, students should
  - inflate four identical balloons ensuring they are the same size;
  - select four different materials (e.g., cotton, nylon, plastic wrap, wool) with which to charge the balloons;
  - predict which of the selected materials will produce the greatest electrostatic force and which will produce the least;
  - rub each balloon with a different selected material for the same length of time;
  - attach the balloons to a bare wall and measure how long it takes each one to fall;
  - record data in a table and create a bar graph of the results; and
  - draw a simple conclusion based on their results.

  While not a Science 3 expectation, teachers may choose to introduce the concept of fair testing.
- Communicate the question investigated by their group, the procedure followed, and the results obtained. Identify new questions to investigate that arise from what was learned.

Consolidation

Students may

- Create a comic strip featuring “Static Kid” whose superpowers are creating and discharging strong electrostatic forces to help solve problems.

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Invisible Forces*
  - pp. 23-27

Read Aloud

- *Ada Twist, Scientist*

Let’s Do Science (SR)

- *Invisible Forces*
  - pp. 8-11

Supplementary

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Skill - Observing (websites)

What Materials Are Attracted to Magnets?

Outcomes

Students will be expected to

40.0 identify familiar uses of magnets [GCO 1/3]

41.0 investigate and identify materials that are attracted by magnets and distinguish from those materials that are not affected by magnets [GCO 1/3]

16.0 predict based on an observed pattern [GCO 2]

8.0 sequence or group materials and objects [GCO 2]

Focus for Learning

There are many important uses of magnets. Students should identify ways magnets are used in their home, school, and community (e.g., can openers, compass, cranes, electrical motors, fridge magnets, keeping a refrigerator door closed, attaching locker mirrors, magnetic car signs, magnetic lid lifter for bottling, magnetic screw driver bits, purse fasteners, shower curtains, speakers, toys).

Magnets only attract certain materials. These materials are called magnetic. Materials that are not attracted to magnets are called non-magnetic. Magnetic materials contain iron, nickel, or cobalt. Confusing magnets with magnetic materials is a common error. Magnets produce a magnetic field and are able to attract or repel. Magnetic materials are affected by magnetism but they do not repel like magnets.

Students should collect classroom objects and predict whether the materials they are made from are magnetic or non-magnetic. Each object should be tested with a magnet to confirm or reject the prediction. Following testing, students should group magnetic and non-magnetic materials and identify and suggest explanations for patterns and discrepancies (e.g., identifying that the magnetic materials are all metals, identifying that some metals are non-magnetic, explaining that non-magnetic metal objects must not contain iron, nickel, or cobalt). The notion that all metals are magnetic is a common misconception. Note that some objects have both magnetic and non-magnetic parts (e.g., scissor have magnetic blades but may have non-magnetic handles). If objects containing both magnetic and non-magnetic parts are included in the collection, a Venn diagram may be used for grouping.

In addition to skill outcomes 16.0 and 8.0, teachers may assess additional skill outcomes: making and recording observations, suggesting explanations for patterns and discrepancies, drawing simple conclusions, and communicating using scientific terminology (SCOs 10.0, 22.0, 14.0, and 2.0 respectively).

Attitude

Encourage students to show interest in and curiosity about objects and events within their immediate environment. [GCO 4]

Sample Performance Indicator

Identify three ways magnets are used at home.

Use a magnet to determine whether the objects below are magnetic, non-magnetic, or contain both magnetic and non-magnetic parts. Record your observations in a Venn diagram.

- aluminum foil, barrette, bobby pin, coloured pencil, coin, cork, crayon, eraser, hair elastic, key, nail, paper clip, rock, rubber band, ruler, safety pin, scissors, staples, string, toothpick.

What Materials Are Attracted to Magnets?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Set up a “fish pond” containing magnetic and non-magnetic objects. Without looking, students should fish out objects from the pond with a magnet suspended from a metre stick with string. Once all possible objects have been “caught”, students should compare the caught objects with those that could not be caught and identify similarities and differences among them.

Connection

Teachers may

- Add a variety of objects and materials (e.g., various coins, wood blocks, scissors, pencils, erasers, thumb tacks, chair legs, cork, keys, nails, safety pins, magnetite, markers, white board, sticky tack, modelling clay, textbooks) to the curiosity centre for students to explore whether they are attracted to magnets or not. Be sure to include objects made from metals that are non-magnetic (e.g., aluminum, brass, copper). Students can make and record predictions and confirm them after testing.

Students may

- Participate in a school-based scavenger hunt to find magnetic and non-magnetic objects and materials. Students may take digital images of examples found and create a digital poster or story book to communicate their observations.

Consolidation

Students may

- Create a collage of images depicting uses of magnets in everyday life.
- Participate in a Jeopardy-style game where objects and materials are the clues. One team predicts whether the clue is magnetic or non-magnetic. Points are awarded if the prediction is confirmed by testing.

Extension

Students may

- Research less familiar uses of magnets (e.g., cow magnets, Mag-Lev trains, microwave ovens).

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Invisible Forces*
  - pp. 28-33
- Teachers Website
  - BLM *My Predictions*
  - IWB Activities 5-6

Let’s Do Science (SR)

- *Invisible Forces*
  - pp. 12-15

Supplementary

Science Library

- *Magnetism*
- *Magnets*
- *What Makes a Magnet?*

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Magnetism resources (websites and videos)
- Magnet suppliers (websites)
- Skill - Predicting (websites)

How Can You Make Your Own Magnet?

Outcomes

Students will be expected to

21.0 follow a simple procedure
[GCO 2]

42.0 investigate how to magnetize magnetic materials
[GCO 1/3]

Focus for Learning

Magnetic materials can acquire the properties of magnets for short periods of times (i.e., they become magnetized).

Students should follow a simple procedure to magnetize a paper clip:

- Drag a bar magnet from one end of a paper clip to the other, in the same direction, 20 times (i.e., 20 strokes).
- Test to confirm that the paper clip has been magnetized by using it to try and pick up a number of loose staples.
- Record the number of staples picked up by the paper clip.

As students learn to magnetize materials, new questions to investigate should arise:

- Does the type (e.g., bar, horseshoe, ring, ball) or strength of magnet used affect the strength of the magnetized material?
- Does increasing or decreasing the number of strokes affect the strength of the magnetized material?
- Is there a maximum magnetic strength that can be reached regardless of the number of strokes?
- Do all magnetic materials (e.g., paper clip, nail, screw) magnetize equally?

In small collaborative groups, students should investigate these questions by altering aspects of the initial procedure above. To determine how changing the number of strokes affects the strength of the magnetized material, for example, students may repeat the initial procedure several times, using a different number of strokes each time. Results should be recorded in a table for future interpretation and analysis and subsequently communicated using a bar graph. Note that a new, unmagnetized magnetic material should be used with each test to ensure fairness.

Teachers may choose to address and assess additional skill outcomes including: posing questions that lead to investigation, predicting based on an observed pattern, making and recording observations, drawing simple conclusions, and communicating using scientific terminology (SCOs 1.0, 16.0, 10.0, 14.0, and 2.0 respectively).

Attitude

Encourage students to appreciate the importance of accuracy.
[GCO 4]

Sample Performance Indicator

Demonstrate a procedure to magnetize an iron nail and suggest how the procedure could be modified to increase the strength of the temporary magnet.

How Can You Make Your Own Magnet?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Ask students to predict whether a pair of scissors can act as a magnet. Students could test their prediction by trying to pick up magnetic materials using their own scissors (Given that their scissors have not been magnetized, they will not act like a magnet). Using a previously magnetized pair of scissors, pick up several paper clips and ask students to suggest explanations for the discrepant observation.
- Revisit *The Golden Goose and a*sk students whether it's possible that the people in the story were temporarily magnetized. Then, brainstorm materials that might be able to be magnetized.
- Place materials that can be magnetized at the curiosity centre for exploration.

Connection

Students may

- Follow a simple procedure to magnetize various magnetic objects (e.g., scissors, paper clip, iron nail). Stroke each item 20 times in one direction. Test the strength of each magnetized item by determining how many loose staples it can pick up.
- Make their own magnet following the simple procedure found within *Magnets* or *What Makes a Magnet?* from the Science Library.

Consolidation

Students may

- Pose inquiry questions related to magnetizing magnetic materials and devise procedures to investigate them. Students could investigate how the temporary magnet's strength is affected by:
  - the type of magnet used to magnetize it (e.g., bar, disc);
  - the magnetic material used (e.g., paper clip, iron nail),
  - the size of the magnetic material;
  - different stroke methods used when magnetizing; and
  - changing the number of strokes when magnetizing.

  Observations should be recorded and displayed in tables and graphs.
- Create a "how to" video to communicate how to create a temporary magnet from a magnetic material.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Invisible Forces*
  - pp. 34-37
- Teachers Website
  - Read Aloud - *The Golden Goose*

Let's Do Science (SR)

- *Invisible Forces*
  - pp. 16-17

Supplementary

Science Library

- *Magnets*
- *The Golden Goose*
- *What Makes a Magnet?*

What is the Inquiry Process? (poster)

What Conditions Affect the Strength of Magnets?

Outcomes

Students will be expected to

43.0 identify conditions that affect the force of magnets [GCO 1/3]

Focus for Learning

Working in collaborative groups, students should devise and carry out investigations to determine conditions affecting the force of magnets (e.g., barriers, distance, magnet size and shape, temperature).

Possible inquiry questions to investigate include

- Does the type, size, or shape of a magnet affect its strength?
- Does the distance a magnet is held from a magnetic material affect whether it will attract?
- Can magnetic forces act through different barriers (e.g., aluminum foil, cardboard, cotton, metal paper, plastic wrap, wood)?
- Is the strength of a magnet affected by temperature (i.e., Can it attract as many objects inside a refrigerator, freezer, or warm oven as it does at room temperature?)?
- Do magnets work in different mediums (e.g., water)?
- Does humidity affect magnetic strength?

14.0 propose an answer to an initial question or problem and draw a simple conclusion [GCO 2]

Scientists investigate questions to find answers. To investigate their inquiry questions, students should devise and fairly carry out procedures and make and record relevant observations and measurements. Interpretation and analysis of their results should enable them to draw a conclusion that answers their initial question. Students should communicate their results, noting any discrepancies between groups investigating the same question.

If investigating whether the force of a magnet will work through various barriers, for example, students could secure different barriers, one at a time, between two tables using several textbooks as anchors. They could place a paper clip on top of each barrier and attempt to move the paper clip using a magnet held underneath the barrier. Students could use a chart to record which barriers were tested, and whether or not they allowed the magnetic force to pass through. They should analyze their results to draw a simple conclusion and propose an answer to their initial question (i.e., indicating which barriers the magnetic force passes through).

Additional skill outcomes may be addressed and assessed including: posing questions that lead to investigation, sequencing or grouping materials and objects, communicating procedures and results, identifying and suggesting explanations for patterns and discrepancies in events, and posing new questions to investigate (SCOs 1.0, 8.0, 17.0, 22.0, and 34.0 respectively).

Attitude

Encourage students to be open-minded in their explorations. [GCO 4]

What Conditions Affect the Strength of Magnets?

Sample Teaching and Assessment Strategies

Magnets need to be stored properly to maintain their strength. If they become demagnetized, their strength can be restored using a device called a remagnetizer (available from science supply companies).

Activate

Teachers may

- Add materials (e.g., aluminum foil, cardboard, cotton, paper, plastic wrap, wood) to the curiosity centre to create barriers.

Students may

- Determine the strength of various magnets by testing the number of paper clips they can attract or hold in a chain.
- Explore whether magnets work through water.

Connection

Students may

- Investigate how the distance between a magnet and a magnetic material affects the force of the magnet. They should
  - select a magnet and a magnetic material (e.g., paper clip),
  - regularly increase the distance between the magnet and the material, using standard or non-standard measures, and test whether the material is attracted;
  - continue until the magnet is unable to attract the magnetic material; and
  - repeat the procedure for different magnets and sequence them from strongest to weakest.
- Test the number of paper clips a magnet can attract in different temperature environments (e.g., room temperature, outdoors, inside a refrigerator, inside a freezer, in a warm oven).

Consolidation

Teachers may

- Read aloud *The Magnetic Racetrack* and ask students to design and create their own magnetic racetrack applying what has been learned form their investigations.

Students may

- Create a piece of art using magnetic forces. Attach a piece of paper to some cardboard, anchored between two desks. Add drops of paint and a paper clip onto the paper. Use a magnet underneath the cardboard to move the paper clip through the drops of paint to create art.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Invisible Forces*
  - pp. 38-43
- Teachers Website
  - BLM *Measuring the Strength of Magnets*

Let's Do Science (SR)

- *Invisible Forces*
  - pp. 18-19

Supplementary

Science Library

- *Magnets*

What is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Proper storage of magnets (videos)
- Remagnitizer suppliers (websites)

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *The Magnetic Racetrack* (Shared Reading)

What Happens When Two Magnets Meet?

Outcomes

Students will be expected to

44.0 investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel
[GCO 1/3]

Focus for Learning

Scientists refer to the space around a magnet where magnetic forces act as the magnetic field. Magnets typically have two ends called poles (i.e., north-seeking or north pole and south-seeking or south pole). Here the magnetic force is the strongest. Note that fridge magnets are composed of thin strips of magnets that alternate between north and south.

Students should

- sprinkle iron filings around various magnets to visualize their magnetic field and identify the poles (i.e., locations with a high concentration of force lines emanating from them);
- investigate how bar magnets, with labelled north and south poles, interact when placed together in various orientations;
- demonstrate how opposite poles attract and like poles repel; and
- use a labelled magnet to determine the pole orientation of an unlabelled magnet.

Similarities and differences in attraction and repulsion among magnets and electrostatic charged materials should be considered.

The polarity of Earth should be introduced. A bar magnet suspended horizontally with a string should spin to orient itself with Earth's north or south pole. The north-seeking or north pole of the magnet should point toward Earth's magnetic north pole. This technique could be used to determine the polarity of an unlabelled magnet.

Students should explore how to use a compass and recognize that the north-seeking end of the magnetized needle orients itself toward Earth's magnetic north pole.

Cross curricular connections may be made to Social Studies 3. Students could participate in orienteering activities using both maps and compasses.

Attitude

Encourage students to recognize the role and contribution of science in their understanding of the world. [GCO 4]

Sample Performance Indicator

View diagrams of labelled bar magnets placed near each other in various arrangements and draw arrows to show how they will interact.

Demonstrate how to determine the orientation of poles for an unlabelled magnet.

What Happens When Two Magnets Meet?

Sample Teaching and Assessment Strategies

Activate

Teachers may

- Use a magnet to attract a bar magnet suspended horizontally with string. Then, say a “magic word” and repel the suspended with the same magnet. Ask students to suggest reasons why the same magnet was able to both attract and repel the suspended magnet.

Connection

Teachers may

- Read *Magnets* (Science Library) to identify uses of magnets in our everyday lives.

Students may

- Use iron filings to make a magnet’s magnetic field visible. Sprinkle the iron filings on and around a magnet, observing the pattern made. Sketch the magnetic field as shown by the iron filings.
- Investigate how various magnets interact when placed near each other in different orientations. Draw diagrams to record how the magnets were placed and arrows to show how they moved.
- Make a paper turtle compass. Colour a small paper turtle with a thick layer of wax crayons to make the paper water resistant. Magnetize an unbent paper clip and attach it to the coloured turtle to make a tail. Place the turtle on the surface of a water-filled container. The turtle will rotate in the water so that the tail (i.e., the magnetized paper clip) points north.

Consolidation

Teachers may

- Set up an orienteering course for the students.

Students may

- Suspend an unlabelled bar magnet horizontally with sting. Once the suspended bar magnet comes to a rest, compare with a compass needle and identify the north- and south-seeking poles of the magnet.
- Place magnets near each other in various orientations and visualize the magnetic field surrounding them with iron filings.

Extension

Students may

- Research an animal that uses the Earth’s magnetic field to navigate (e.g., brown bats, butterflies, migrating birds, salmon, turtles, lobsters).

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Invisible Forces*
  - pp. 44-48
- Teachers Website
  - IWB Activities 7-8

Let’s Do Science (SR)

- *Invisible Forces*
  - pp. 20-25

Supplementary

Science Library

- *Magnetism*
- *Magnets*
- *What Makes a Magnet?*
- *You Can Use a Compass*

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Polarity resources (websites and videos)
- Iron filing suppliers (websites)

What Can You Make That Uses Invisible Forces?

Outcomes

Students will be expected to

28.0 identify problems to be solved
[GCO 2]

29.0 identify materials and suggest a plan for how they will be used
[GCO 2]

30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions
[GCO 2]

35.0 compare and evaluate personally constructed objects
[GCO 2]

17.0 communicate procedures and results
[GCO 2]

Focus for Learning

Students should, in small collaborative groups, follow an engineering design and problem solving process to create a game or toy that incorporates an invisible force (i.e., magnetism or static electricity). The context could be the creation of a game or toy for younger students. These students could be involved in the development of criteria and the testing and evaluation of constructed games and toys.

Project criteria should ensure that students are challenged to apply their learning about invisible forces.

As part of the design and problem solving process, students should

- clarify the problem to be solved and the design criteria that will be used to evaluate their solution;
- brainstorm possible solutions and consider the potential of each one before collaboratively selecting one to try;
- devise a plan to build a prototype of their game or toy that includes design sketches and a list of required tools and materials;
- determine how they will test their prototype;
- construct and test the prototype;
- make and carry out suggestions for improvement, if testing results are promising,
- consider abandoning the idea, if testing results are not promising, and collaboratively select another potential solution to try;
- continue to modify and test their prototype until an optimal solution is reached;
- present their final game or toy solution, describing problems encountered and how they were solved; and
- submit their game or toy for peer evaluation.

This design and problem solving experience provides an opportunity to address and assess additional skill outcomes including: communicating using scientific terminology, using appropriate tools, making and recording observations, using a variety of sources of information and ideas, and follow safety procedures and rules (SCOs 2.0, 6.0, 10.0, 12.0, and 32.0 respectively).

Attitude

Encourage students to show concern for their safety and that of others in carrying out activities and using materials. [GCO 4]

What Can You Make That Uses Invisible Forces?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Add games and toys that incorporate invisible forces to the curiosity centre for exploration.

Students may

- Show and share personal games or toys that use invisible forces.

Connection

Teachers may

- Invite a focus group of younger students to class to discuss what makes a game or toy fun to play and/or to assist with the development of project criteria.
- Provide a collection of magnets, magnetic materials, electrostatic materials, and tools for use in constructing games or toys.

Students may

- Research games and toys that use invisible forces.
- Brainstorm and draw sketches of their ideas for games and toys and communicate their ideas to group members.

Consolidation

Teachers may

- Organize a toy convention for students to unveil and present their toys.

Students may

- Use an assessment tool to assess how well the group collaborated to solve the problem.
- Construct a
    - toy that uses an object charged with static electricity to keep a plastic ring, cut from a grocery bag, floating in the air;
    - static electric hockey game using charged sticks and a ball;
    - magnetic version of Mr. Potato Head™;
    - magnetic toy boat that can move in a tub of water; or
    - sled that can move up and down a ramp.
- Evaluate their toy and those of classmates against design criteria.

Extension

Students may

- Create an advertisement for their toy that highlights its use of invisible forces.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Invisible Forces*
    - pp. 49-57
- Teachers Website
    - BLM *Two Stars and a Wish*
    - IWB Activity 9

Let's Do Science (SR)

- *Invisible Forces*
    - pp. 26-29

Supplementary

What is the Design Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Magnetic toys and games resources (websites and videos)
- Skill - Working Collaboratively (websites)

Section Three: Specific Curriculum Outcomes

Unit 4: Plant Growth and Changes

Focus

Careful observation of the natural world reveals patterns of growth; how plants grow and respond to their natural environment. Students' awareness of plants begins with a variety of informal encounters within the local environment, but their deeper understanding grows best from experience in planting, nurturing, and observing individual plants over an extended period of time. Through these experiences, students come to recognize the link between themselves and other living things, and appreciate the benefits and responsibilities they have for the care of these organisms.

Science inquiry is the focus of this life science unit. Investigating the life needs of plants provides a final opportunity to address and assess inquiry-related skill outcomes such as: posing questions to investigate, making predictions, observing and recording, constructing and labelling graphs, and identifying and suggesting explanations for patterns and discrepancies in data.

Outcomes Framework

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

45.0 identify and describe parts of plants and their general function
46.0 identify and investigate life needs of plants and describe how plants are affected by the conditions in which they grow
48.0 observe and describe changes that occur through the life cycle of a flowering plant
49.0 describe ways in which plants are important to living things and the environment
50.0 identify parts of different plants that provide humans with useful products, and describe the preparation that is required to obtain these products and how our supply of useful plants is replenished

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

1.0 pose questions that lead to exploration and investigation
2.0 communicate using scientific terminology
10.0 make and record observations and measurements
11.0 construct and label concrete-object graphs, pictographs, or bar graphs
16.0 predict based on an observed pattern
22.0 identify and suggest explanations for patterns and discrepancies in objects and events
30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions
32.0 follow safety procedures and rules
47.0 distinguish between useful and not useful information when answering a science question

GCO 4 (Attitude): Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment.

- recognize the role and contribution of science in their understanding of the world
- show interest in and curiosity about objects and events within the immediate environment
- consider their observations and their own ideas when drawing a conclusion
- appreciate the importance of accuracy
- be open-minded in their explorations and investigations
- be sensitive to the needs of other people, other living things, and the local environment

SCO Continuum

GCO 1 (STSE): 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.

GCO 3 (Knowledge): Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge.

<table>
<tr><th>Science 1</th><th>Science 3</th><th>Science 4</th></tr>
<tr><td>Needs and Characteristics of Living Things</td><td rowspan="2">Plant Growth and Changes</td><td rowspan="2">Habitats and Communities</td></tr>
<tr><td>observe and identify similarities and differences in the needs of living things
describe ways plants and animals meet their needs
describe ways humans use their knowledge of living things in meeting their own needs and the needs of plants and animals
recognize that living things depend on their environment</td></tr>
<tr><td>Science 2</td><td rowspan="3">identify and describe parts of plants and their general function
investigate life needs of plants and describe how they are affected by their growing conditions
observe and describe changes that occur through the life cycle of a flowering plant
describe ways plants are important to other living things and the environment
identify parts of different plants that provide humans with useful products, and describe the preparation that is required to obtain these products and how our supply of useful plants is replenished</td><td rowspan="3">compare the structural features of plants that enable them to thrive in different kinds of places
predict how the removal of a plant or animal population affects the rest of the community
relate habitat loss to the endangerment or extinction of plants and animals
identify local and regional habitats and their associated plant and animal populations
classify organisms according to their role in the food chain</td></tr>
<tr><td>Animal Growth and Changes</td></tr>
<tr><td>compare life cycles of familiar animals
observe and describe changes in appearance and activity of animals as they grow and develop
describe features of natural environments that support the health and growth of animals</td></tr>
</table>

GCO 2 (Skills): Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions.

Science 2	Science 3	Science 4-6
• pose questions that lead to exploration and investigation • predict based on an observed pattern • make and record observations and measurements • construct and label concrete-object graphs or pictographs • communicate using scientific terminology • respond to the ideas and actions of others and acknowledge their ideas and contributions	• pose questions that lead to exploration and investigation • predict based on an observed pattern • make and record observations and measurements • follow safety procedures and rules • construct and label concrete-object graphs, pictographs, or bar graphs • identify and suggest explanations for patterns and discrepancies in objects and events • distinguish between useful and not useful information when answering a science question • communicate using scientific terminology • respond to the ideas and actions of others and acknowledge their ideas and contributions	• propose questions to investigate and practical problems to solve • state a predication and a hypothesis • make observations and collect information that is relevant to the question or problem • compile and display data by hand or computer, in a variety of formats • identify and suggest explanations for patterns and discrepancies in data • evaluate the usefulness of different information sources in answering a given question • identify problems as they arise and collaborate with others to find solutions

Suggested Unit Plan

Plant Growth and Changes is the life science unit of the Science 3 curriculum. It is positioned at the end of the school year to capitalize on the spring planting season and to allow for observations of plants in their natural environments.

September	October	November	December	January	February	March	April	May	June
								Plant Growth and Changes	

What Are Plants?

Outcomes

Students will be expected to

1.0 pose questions that lead to exploration and investigation [GCO 2]

Focus for Learning

Skill outcome 1.0 was addressed in each of the preceding units. Refer to the initial elaboration provided on pp. 32-33.

Students are expected to pose questions that lead to exploration and investigation of plant growth and changes:

- What are plants? Where are plants found? What plants grow in our province?
- What are the parts of plants? Does the same plant part look the same on different plants? What does each part of a plant do?
- Why do some plants grow better than others? Do some plants grow better in certain environments than others?
- What do plants need to grow? How does a plant develop? What do seeds need in order to germinate? How do we take care of plants?
- What is the life cycle of a plant? How do plants change during their life cycle? Do all plants change in the same way?
- How do humans and other animals use plants? What are some useful products that are made from plants?
- How do plants help the environment? How can we help plants?

Cross curricular connections may be made to English Language Arts 3 outcomes related to formulating questions that lead to inquiry.

When exploring and investigating how plants grow and change, it is essential to provide hands on experiences with a variety of different plants (i.e., indoor plants and plants within their local environment). Students should have opportunities to plant, nurture, and observe plants within their classroom environment over an extended period of time.

Attitude

Encourage students to recognize the role and contribution of science in their understanding of the world. [GCO 4]

What Are Plants?

Sample Teaching and Assessment Strategies

Later in the unit, students will investigate conditions affecting the growth of plants. They will need established seedlings to carry out their investigations. Ensure that seeds are planted well in advance of when the seedlings will be needed.

Activation

Teachers may

- Read aloud *Picture a Tree.* Ask students to note how the trees change with the seasons and encourage “I wonder” questions.

Connection

Teachers may

- Create a “curiosity centre” for student exploration. Objects may include
  - children’s literature, photographs, posters, artificial plants;
  - various plants at differing life cycle stages, including flowering and non-flowering plants;
  - various types and sizes of seeds, seed packages, bark, bulbs, flowers, leaves, tree cones, tree cross sections, twigs;
  - planting materials (e.g., soils, peat pellets or pots, plastic planting trays or pots), gardening tools, watering cans;
  - measuring tools (e.g., graduated cylinders, measuring cups and spoons, measuring tapes, rulers);
  - dried fruit, fruit, nuts, seeds, vegetables; and
  - items made from plants (e.g., carnauba wax, chewing gum, chocolate, cork, cotton fabric, flour, henna dye, herbs and spices, jam, lumber, paper, rubber, sisal, sugar, vanilla extract, vegetable oils).

  Note: Be aware of student food allergies.
- Display images of interesting plants (e.g., baseball plant, bat plant, baobab tree, bottle tree, dragon blood tree, monkey face orchid, pitcher plant, venus flytrap). In groups, ask students to discuss their observations and record any questions they have.

Students may

- Participate in a nature walk to observe local plants and collect items for the curiosity centre.

Consolidation

Teachers may

- Facilitate a game of “Is it a plant?” using images of living things.
- Invite a relevant guest speaker (e.g., amateur gardener, botanist, farmer, florist) to present to the class..

Resources and Notes

Authorized

Let’s Do Science (Teacher Resource [TR])

- *Plant Growth and Changes*
  - pp. 10-17
- Teachers Website
  - Anchor Video - *Plant Growth and Changes*
  - IWB Activity 1
  - Image bank

Read Aloud

- *Picture a Tree*

Let’s Do Science (Student Resource [SR])

- *Plant Growth and Changes*
  - pp. 2-5

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Experiences with Plants
  - Learning About Plants Through Children’s Literature

Supplementary

Science Library

- *Amazing Plant Powers*
- *Killer Plants*
- *Tell Me, Tree*

What Is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Plant resources (websites and videos)
- Skill - Questioning (websites)

Communicating about Plants

Outcomes

Students will be expected to

45.0 identify and describe parts of plants and their general function
[GCO 1/3]

Focus for Learning

Plants come in many shapes, sizes, and colours, however, most have the same basic parts which serve different functions:

- Roots help anchor plants and draw in water and nutrients from the soil.
- Stems transport water and nutrients from the roots to the rest of the plant. Tree stems, called trunks, provide support to the branches and leaves above. Trunks are covered in bark.
- Leaves contain chlorophyll. Chlorophyll helps leaves make food for the plant using a process called photosynthesis. Needles are the leaves of some coniferous trees.
- Flowers are the reproductive parts of flowering plants. During pollination, pollen from the male stamen is transferred to the female pistil resulting in seed formation. In some plants, fruit forms around the seed. Some non-flowering plants also produce seeds. Conifers, for example, have male and female cones. Pollen from the male cones pollinates the female cones forming seeds. Other plants (e.g., moss, ferns) reproduce using spores.

2.0 communicate using scientific terminology
[GCO 2]

Students should use scientific terminology throughout the unit when communicating about plants. Refer to the initial elaboration provided on pp. 34-35.

Unit terminology may include

- explore, question, problem, investigate, predict, procedure, plan, observe, measure, group, sequence, record, compare, evaluate, conclude, communicate;
- plant, root, stem, trunk, bark, branch, leaf, needle, flower, stamen, pollen, pistil, fruit, seed, spore, cone, bulb;
- photosynthesis, chlorophyll, oxygen, carbon dioxide; and
- life cycle, germinate, seedling, growth, pollination, dormancy.

Attitude

Encourage students to show interest in and curiosity about objects and events within their immediate environment. [GCO 4]

Sample Performance Indicator

Create a sketch of a flowering plant. Label the parts of the plant and describe their function.

Communicating about Plants

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Provide images of familiar objects and ask students to identify the different parts of these objects and explain their purpose.
- Add images of different vegetables to the curiosity centre and ask students to identify which part of the plant they represent.
- Read aloud *Hungry Plants* (ELA 3) to introduce plants with some unusual parts.

Connection

Teachers may

- Read aloud *What Do Roots Do?* (Science Library) and ask students to identify how roots help plants grow.

Students may

- Predict and observe what happens when a stalk of leafy celery is placed in red and blue coloured water (i.e., food colouring in water). Then predict and observe what happens when the bottom of a stalk is split in half and each piece is placed in water of a different colour. As the water is gradually transported up the stem to the leaves a change in colour should be identified.
- Draw a sketch of a carrot plant, illustrating what would be visible both above and below the ground. Label the parts of the plant.
- Observe plants in and around the school and record observations as digital images or sketches. Then label the parts of the plants.

Consolidation

Students may

- Create a vertical, multi-tab foldable to identify and describe the parts of a plant and their function.
- Create a class mural illustrating various plants and their parts (both above and below the soil). The mural could include labels and text features that describe the function of the different plant parts.
- Visit a grocery store and find examples of different plant parts (i.e., fruit, leaf, root, seed, stem) in the produce section.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Plant Growth and Changes*
  - pp. 18-26
- Teachers Website
  - BLM *Plant Parts at the Grocery Store*
  - IWB Activities 2-5

Let's Do Science (SR)

- *Plant Growth and Changes*
  - pp. 6-11

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.htm
  - Outdoor Science Experiences

Supplementary

Science Library

- *Amazing Plant Powers*
- *Flip, Float, Fly: Seeds on the Move*
- *From Bulb to Daffodil*
- *Seed to Plant*
- *Seed, Soil, Sun*
- *Tell Me, Tree*
- *What Do Roots Do?*
- *You Wouldn't Want to Live Without Trees*

Suggested

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Hungry Plants* (Guided reading)

Children's Literature

- *Tops and Bottoms* by J. Stevens

What Do Plants Need?

Outcomes

Students will be expected to

46.0 identify and investigate needs of plants and describe how plants are affected by the conditions in which they grow
[GCO 1/3]

47.0 distinguish between useful and not useful information when answering a science question
[GCO 2]

16.0 predict based on an observed pattern
[GCO 2]

30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions
[GCO 2]

Focus for Learning

Students are expected to identify the life needs of plants. Plants need water, energy from the Sun, and carbon dioxide from the air to make their own food. This process is called photosynthesis. Plants also need nutrients, which they obtain from the soil, sufficient space to grow and develop, and the appropriate environmental conditions.

Many plants begin life as seeds. Seeds may remain dormant for many years, however, when conditions are right they begin to germinate.

Students should be provided with opportunities to observe the germination of seeds. They could, for example, place bean seeds and moistened paper towel in a zip top bag, and then place the bag in a warm location. Daily observations should be made until most of the seeds have germinated. Digital images may be used as a record of observations. Note that the time required for germination varies depending on seed type.

The essential condition needed to initiate the process of germination is moisture. Soil and light are not typically necessary for germination. Once seeds germinate, however, their life needs change.

Students are also expected to devise guided inquiry investigations related to the life needs of plants. Students could, for example, investigate how plant growth is affected by soil type or the amount of fertilizer, soil, space, sunlight, or water. Students should

- select a condition to test (e.g., the amount of sunlight or water) and pose a question to investigate;
- collaboratively discuss the evidence needed to answer their question;
- collaboratively devise a procedure which includes a list of materials needed to carry out their plan;
- include a prediction about what they expect to observe; and
- seek approval for their plan.

Teachers should ensure that student plans include appropriate safety procedures and rules.

Teachers may choose to introduce the concept of fair testing. In science, a fair test is one where only one condition is changed and all other conditions are kept the same. If investigating how the amount of water affects plant growth, for example, individual plants would be given different amounts of water. All other conditions would be kept the same (e.g., the same type of plant, same type and amount of soil, same amount of fertilizer, same amount of sunlight).

The carrying out of these guided inquiry investigations is described on subsequent pages of the curriculum guide.

What Do Plants Need?

Sample Teaching and Assessment Strategies

Purple peacock pole beans are a recommended fast growing plant which may grow several centimetres per day.

Activation

Teachers may

- Display a variety of non-toxic, untreated seeds (e.g., bean, carrot, lettuce, popcorn, pumpkin, radish, sunflower) and ask students to predict what type of plant each seed will become.
- Read aloud Seeds! Seeds! Seeds! (Science 1 Library) and ask students to create their own seed collection. Students' seeds could be added to the class curiosity centre.

Students may

- Brainstorm conditions that might affect the growth of plants.

Connection

Teachers may

- Read aloud pages pp. 6-17 of *Amazing Plant Powers* (Science Library) to highlight how some plants are adapted to survive in varying conditions.
- Facilitate a directed investigation to determine the affect of temperature on seed germination. Fast germinating seeds (e.g., radish) could be placed, in groups of 10, into zip top bags with moistened paper towel. The bags could then be placed in locations with different temperatures (e.g., freezer, refrigerator, classroom drawer, incubator). After sufficient time, the number of seeds that germinate in each environment could be recorded and the results communicated in a bar graph. Students should conclude that warm temperatures are favourable for germination.
- Provide established seedlings, and healthy plants for student groups to use in their investigations.

Student may

- Collaboratively design and carry out investigations related to plant needs and growth:
  - How does the depth seeds are planted affect plant growth?
  - How does the number of seeds grown in a small container affect plant growth?
  - How does the amount of sunlight affect plant growth?
  - How does artificial light affect plant growth?
  - How does the amount of water affect plant growth?
  - How does soil type affect plant growth?
  - How does the amount of fertilizer affect plant growth?

Resources and Notes

Authorized

Let's Do Science (TR)

- *Plant Growth and Changes*
  - pp. 27-35
- Teachers Website
  - BLM *Plant Needs Investigation: Our Plan*
  - IWB Activity 6

Let's Do Science (SR)

- *Plant Growth and Changes*
  - pp. 12-17

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.htm
  - Experiences with Plants

Supplementary

Science Library

- *Amazing Plant Powers*
- *Killer Plants*

What is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Seed suppliers (websites)
- Support organizations (websites)

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Plantzilla* (Read aloud - Synthesizing Unit)

Observing and Recording How Plants Are Affected by Growing Conditions

Outcomes

Students will be expected to

46.0 identify and investigate needs of plants and describe how plants are affected by the conditions in which they grow [GCO 1/3]

47.0 distinguish between useful and not useful information when answering a science question [GCO 2]

32.0 follow safety procedures and rules [GCO 2]

10.0 make and record observations and measurements [GCO 2]

11.0 construct and label concrete-object graphs, pictographs, or bar graphs [GCO 2]

22.0 identify and suggest explanations for patterns and discrepancies in objects and events [GCO 2]

30.0 respond to the ideas and actions of others and acknowledge their ideas and contributions [GCO 2]

Focus for Learning

Students are expected to collaboratively carry out the investigation previously devised. They should

- carry out their approved procedure, following appropriate safety procedures and rules;
- make and record their observations of plant growth (e.g., qualitative descriptions, quantitative measurements using standard units, sketches, digital photographs) in a science journal;
- construct a labelled bar graph to display their quantitative data (e.g., plant height, number of leaves);
- analyze their results to identify pattens or discrepancies; and
- draw a simple conclusion that answers their initial question.

When investigating, students should collect very detailed observations. Later, during analysis of their results, they should determine the usefulness of information to help answer the initial inquiry question. Students may observe, for example, that bean plants germinated and grown in the dark are not green. This information may be deemed irrelevant if investigating the affect of light on plant height but relevant if investigating the affect on plant health.

Additionally, students should analyze their results to identify patterns or discrepancies. If investigating how the amount of water affects plant health, for example, students may observe that seedlings receiving no water died, as did those watered twice daily, while those watered daily or every second day remained healthy. From these observations, they should conclude that plants need the right amount of water to survive and may be able to quantify this amount from their results.

When collaboratively devising and carrying out investigations and analyzing results, students should communicate aloud their thoughts, ideas, questions, and intentions. This practice may expose students to ideas that differ from their own. Teachers should encourage students to acknowledge the ideas of others, ask clarifying questions when something is not understood, and be open to incorporating different ideas.

Cross curricular connections may be made to Mathematics 3 outcomes related to measurement and data analysis.

Attitude

Encourage students to

- be open-minded in their explorations,
- appreciate the importance of accuracy, and
- consider their observations and their own ideas when drawing a conclusion. [GCO 4]

Observing and Recording How Plants Are Affected by Growing Conditions

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Show images of healthy and unhealthy plants and ask students How can you tell which plants are healthy? Which ones are unhealthy? Why might the plants look as they do?
- Collect some quantitative data (e.g., ask students to vote for their favourite tree) and construct a bar graph to display the data. Discuss with students how graphs make it easier to understand and compare data.

Connection

Students may

- Investigate, in small collaborative groups, how soil type affects the growth of beans (e.g., purple peacock pole beans). Students should
  - select three different types of soil to test,
  - predict which soil will yield the best results,
  - fill and label three identical containers with the same amount of a different soil,
  - plant the same number of seeds in each container at the same planting depth,
  - add the same measured amount of water to each container to ensure that the soil is moist,
  - provide equivalent care to the developing seedlings in each containers,
  - make and record observations and growth related measurements over time, and
  - draw a simple conclusion that answers the initial question about the affect of soil type on bean growth.
- Grow flowering plants from bulbs and measure and record their height daily.

Consolidation

Students may

- Create labelled bar graphs to communicate and compare the growth of plants grown in different conditions.
- Create a “W*hat to Expect When You’re Gardening*” guide, that highlights how to care for plants and what might happen if their needs for air, nutrients, space, sunlight, and water are not met.

Resources and Notes

Authorized

Let’s Do Science (TR)

- *Plant Growth and Changes*
  - pp. 36-41
- Teachers Website
  - BLM *Plant Needs Investigation: Our Plan*

Let’s Do Science (SR)

- *Plant Growth and Changes*
  - pp. 18-19

Teaching and Learning Strategies

- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.htm
  - Experiences with Plants

Supplementary

Science Library

- *Amazing Plant Powers*
- *Killer Plants*

What is the Inquiry Process? (poster)

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html

- Plant investigations (websites and videos)

Life Cycle of a Flowering Plant

Outcomes

Students will be expected to

48.0 observe and describe changes that occur through the life cycle of a flowering plant
[GCO 1/3]

Focus for Learning

In Science 2, students investigated changes in the appearance and activity of various animals as they go through their life cycle. In Science 3, students should investigate changes that occur through the life cycle of a flowering plant.

The typical life cycle of a flowering plant is as follows:

- Flowering plants begin life as a seed. Under favourable conditions, the seed absorbs water and begins to germinate.
- During germination the roots, stem, and seed leaves (i.e., cotyledons) form. The seed leaves contain the stored food reserves of the seed.
- After germination, a period of active growth occurs. The first true leaves form and the seedling is now able to make its own food (i.e., photosynthesis).
- If favourable conditions continue to exist, the developing plant will flower. Depending on the type of plant, flowers can be male, female, or contain both male and female parts (i.e., stamen, pistil).
- During pollination, pollen from the male stamen is transferred to the female pistil by the wind, insects, or other animals.
- Pollination results in the formation of seeds. Some plants surround these developing seeds with fruit.
- Eventually, mature seeds are dispersed to new locations where they remain dormant until favourable conditions exist again and a new life cycle begins.

Students should grow various flowering plants within their classroom and observe and describe the changes the plant undergoes through its life cycle. This could also be achieved with a school garden or through participation in educational programs such as *Little Green Thumbs* or *Tomatosphere)*.

Sample Performance Indicator

View pages 26 and 27 of *Seed to Plant* (Science Library) with the text covered. Create your own text to accompany the images; explaining what is happening at each stage of the sunflower's life cycle.

Life Cycle of a Flowering Plant

Sample Teaching and Assessment Strategies

Activation

Teachers may
- Display science cards 2, 6, and 7 from the Science 2 *Animal Growth and Changes* unit, to activate students' prior knowledge of life cycles. Then ask students if plants have a life cycle and how they might compare to the life cycles of animals.
- Read aloud *Tell Me, Tree and/*or *Up in the Garden, Down in the Dirt.* Discuss with students how the plants change through the seasons.

Connection

Teachers may
- Provide images of the stages of different plant life cycles. Ask students to sequence the photos and justify their choices.
- Provide cut flowers (e.g., daffodil, lily, tulip) with large stamens and pistils for students to observe.

Students may
- Read *Flip, Float, Fly: Seeds on the Move* and compile a list of the different ways seeds get around.
- Read *Life Cycle of a Plant* (ELA 3) and discuss how the life cycle of this plant is similar to and different from the life cycle of a flowering plant such as a sunflower.

Consolidation

Students may
- Observe and/or collect dandelions at various stages of its life cycle. Sketch the life cycle of this flowering plant. Discuss what happens to the dandelions during the winter months.
- Create a digital presentation of the life cycle of a flowering plant using observations of flowering plants grown in the classroom.
- Create a labelled life cycle wheel for a selected flowering plant. Explain the changes that occur at each stage.
- Use claymation art to represent the life cycle of a flowering plant.

Extension

Students may
- Use research inquiry to find out about the purpose of the *Svalbard Global Seed Vault.*
- Research the type of information provided on seed packets. Then, create a seed packet, using a blank envelope, for a flowering plant that has been investigated.

Resources and Notes

Authorized

Let's Do Science (TR)
- *Plant Growth and Change*
  - pp. 42-50
- Teachers Website
  - BLM *Life Cycle Wheel*
  - IWB Activity 7
  - Image bank

Let's Do Science (SR)
- *Plant Growth and Change*
  - pp. 20-23

Teaching and Learning Strategies
- www.k12pl.nl.ca/curr/k-6/sci/science-3/teaching-and-learning-strategies.html
  - Experiences with Plants
  - Outdoor Science Experiences

Supplementary

Science Library
- *Flip, Float, Fly: Seeds on the Move*
- *From Bulb to Daffodil*
- *Seed to Plant*
- *Tell Me, Tree*
- *Up in the Garden, Down in the Dirt*

Suggested

Resource Links: www.k12pl.nl.ca/curr/k-6/sci/science-3/resource-links.html
- Life cycle resources (websites and videos)

Other curriculum resources
- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Life Cycle of a Plant* (Guided reading)

Why are Plants Important?

Outcomes

Students will be expected to

49.0 describe ways in which plants are important to living things and the environment [GCO 1/3]

50.0 identify parts of different plants that provide humans with useful products, and describe the preparation that is required to obtain these products and how our supply of useful plants is replenished [GCO 1/3]

Focus for Learning

Plants are essential to all life on Earth:

- Plants release oxygen, a byproduct of photosynthesis, which is used by both animals and plants.
- Many animals, including humans, rely on plants for food.
- Plants provide habitats for animals.
- Plants help clean both the air and water.
- Plant roots help prevent soil erosion and when plants decompose their nutrients are added to the soil.

Students are expected to describe the importance of plants.

Humans use plants in a variety of ways to meet their needs. Plants provide us with many useful products, including

- foods and flavourings (fruit, herbs, nuts, seeds, spices, vegetables);
- building materials (e.g., bamboo, rattan for furniture, softwood and hardwood lumber, straw or palm fronds for thatched roofs);
- fibres (e.g., cotton or hemp for cloth making, sisal for burlap or rope, wood pulp for paper)
- fuel (e.g., biodiesel, firewood);
- dyes;
- gums and resins (e.g., adhesives, rubber bands);
- perfumes (e.g., essential oils); and
- medicines (e.g., aspirin).

These plant-derived products come from different plant parts. Perfume, for example, is extracted from flowers. Lumber is cut from tree stems (i.e., trunks). Herbs are dried leaves and stems. Coffee is ground seeds (i.e., beans). Students should identify the parts of different plants that provide us with useful products, and describe the preparation required to produce them. Students could, for example, use research inquiry to determine how chocolate, coffee, cotton fabric, paper, or lumber is produced.

Given the importance of plants to humans, other living things, and the environment, students should consider how we can conserve and replenish useful plants.

Attitude

Encourage students to be sensitive to the needs of other people, other living things, and the local environment. [GCO 4]

Sample Performance Indicator

Create a collage of products made from a specific plant part (e.g., bark, flowers, fruit, leaves, roots, seeds, stems).

Why are Plants Important?

Sample Teaching and Assessment Strategies

Activation

Teachers may

- Add objects derived from plants to the curiosity centre. Ask students to identify what the objects are made from.
- Read aloud *Find the Products from Nature* from *Explore! Magazine: Nature Up Close* (ELA 3). Challenge students to identify the products made from plants.

Connection

Teachers may

- Place freshly cut green leaves in a clear bowl of water and leave them in sunlight. Have students predict what might happen. After an hour, ask students to observe the leaves closely and record their observations. Bubbles should be visible along the edges of the leaves as oxygen is released.
- Read aloud *Where Do T-Shirts Come From?*, *Where Does Chocolate Come From?*, *Where Does Popcorn Come From?* (Science Library). Ask students to record the steps required to produce each product in a flow chart.

Students may

- Participate in a scavenger hunt at home to find examples of products made from plants.
- Explore making coloured dyes from different plant materials (e.g., avocado skins, beets, blueberries, carrots, onion skins, orange rinds, tea, turmeric powder).
- Explore making paper from different plant fibres (e.g., corn husks, grass, leaves).

Consolidation

Teachers may

- Present images of plant products or physical objects (e.g., apple, burlap, carrot, cinnamon stick, coffee beans, flour, jam, lavender scented perfume, oregano, paper, pepper corns, vanilla extract, sisal rug wicker basket, wood block, parts) and ask students to identify the part of the plant each product is derived from.

Students may

- Participate in a collaborative place mat activity to record ways plants are important to the environment.
- Grow fruit and vegetables for consumption in their classroom or a school garden.

Resources and Notes

Authorized

Let's Do Science (TR)

- *Plant Growth and Changes*
  - pp. 51-61
- Teachers Website
  - BLM *Plant Scavenger Hunt*
  - Image bank

Let's Do Science (SR)

- *Plant Growth and Changes*
  - pp. 24-31

Supplementary

Science Library

- *Amazing Plant Powers*
- *Living Sunlight*
- *Seed to Plant*
- *Seed, Soil, Sun*
- *Tell Me, Tree*
- *Up in the Garden, Down in the Dirt*
- *What Do Roots Do?*
- *Where Does Chocolate Come From?*
- *Where Does Popcorn Come From?*
- *Where Do T-Shirts Come From?*
- *You Wouldn't Want to Live Without Trees*

Suggested

Other curriculum resources

- *Literacy Place for the Early Years Grade 3* (ELA 3)
  - *Find the Products from Nature (Explore! Magazine: Nature Up Close)*
  - *Solomon's Tree* (Read aloud - Making Connections unit)

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