Prince Edward Island

Education, Early Learning and Culture
English Programs

CANADA

Prince Edward Island Science Curriculum

CURRICULUM

Science

Grade 7 (Draft)

Revised 2016
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Acknowledgments

The P.E.I. Department of Education and Early Childhood Development expresses its gratitude to members of the provincial curriculum committee for their professional expertise and insights in developing this Grade 7 Science curriculum guide. In addition, the curriculum committee and pilot teachers who contributed comments and suggestions are to be commended for their commitment to developing exemplary science programs.

Prince Edward Island Grade 7 Science Curriculum Committee

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Introduction

Foreword

The pan-Canadian *Common Framework of Science Learning Outcomes K to 12* (1997) will assist in standardizing science education across the country. The Prince Edward Island Department of Education and Early Childhood Development commits to align, where possible and appropriate, the scope and sequence of science education in Prince Edward Island with the scope and sequence outlined in the *Common Framework of Science Learning Outcomes K to 12*. New provincial science curriculum is also supported by the *Foundation for the Atlantic Canada Science Curriculum* (1998).

Purpose

The purpose of this curriculum is to outline the provincial requirements for Grade 7 Science. This guide provides the specific curriculum outcomes that Grade 7 students are expected to achieve in science by the end of the year. Achievement indicators and elaborations are included to provide the breadth and depth of what students should know and be able to do in order to achieve the outcomes. This renewed curriculum reflects current science education research, updated technology, and recently developed resources, and is responsive to changing demographics within the province.

Focus and Context

The focus of Grade 7 Science is to introduce students to a balance of life science, physical science, and Earth and space science. The concepts and terminology associated with Grade 7 Science will be delivered through the contexts of Interactions within Ecosystems, Mixtures and Solutions, Heat, and Earth's Crust. Inquiry investigations and problem-solving situations create powerful learning opportunities for students. They increase students' understanding of scientific and technological concepts and help students connect ideas about their world. The Grade 7 Science program supports an interactive learning environment that encourages students to make sense of experiences through a combination of "hands-on" and "minds-on" activities.

Aim

The aim of science education in the Prince Edward Island is to develop scientific literacy. Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problemsolving, 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 that provide opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment.

Scientific Literacy

Vision

The Prince Edward Island science curriculum is guided by the vision that all students, regardless of gender or cultural background, will have an opportunity to develop scientific literacy. Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge that 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.

Goals

Consistent with views expressed in a variety of national and international science education documents, the following goals for Canadian science education have been established:

- encourage students at all grade levels to develop a critical sense of wonder and curiosity about scientific and technological endeavours
- enable students to use science and technology to acquire new knowledge and solve problems, so that they may improve the quality of their own lives and the lives of others
- prepare students to address critically science-related societal, economic, ethical, and environmental issues
- provide students with a foundation in science that creates opportunities for them to pursue progressively higher levels of study, prepares them for science-related occupations, and engages them in science-related hobbies appropriate to their interests and abilities
- develop in students, of varying aptitudes and interests, a knowledge of the wide variety of careers related to science and technology

While teachers play the most significant role in helping students achieve scientific literacy, they need support from the rest of the educational system if the challenge is to be met. Science must be an important component of the curriculum at all grade levels and must be explored in an enjoyable environment that students find interesting and intrinsically rewarding. The designation of science into various categories should be discouraged at the primary and elementary levels. At the high school level students will be introduced to the traditional sciences. These divisions are arbitrary and do not reflect current scientific practice. At all stages of science education the connections within and across the sciences, as well as the connections of science to technology, society and the environment should be stressed.

To achieve scientific literacy for all students (K–12), the science curriculum is expected to:

- address the three basic scientific fields of study—life, physical, and Earth and space science. From K–10, students will be exposed to all fields. At the high school level students may opt to take specific sciences. However, in all cases attempts should be made to develop the connections among the basic sciences
- demonstrate that science is open to inquiry and controversy; promote student understanding of how we came to know what we know and how we test and revise our thinking
- utilize a wide variety of print and non-print resources developed in an interesting and interactive style.
- involve instructional strategies and materials which allow all learners to experience both challenge and success
- incorporate assessment approaches that are aligned and correlated with the instructional program
- engage students in inquiry, problem solving, and decision-making situations and contexts that give meaning and relevance to the science curriculum. These include the processes of science such as predicting and formulating hypotheses, higher level skills such as critical thinking and evaluating, and manipulative skills such as the use of laboratory equipment
- give students the opportunities to construct important ideas of science, which are then developed in depth, through inquiry and investigation
- be presented in connection with students' own experiences and interests by frequently using hands-on experiences that are integral to the instructional sequence
- demonstrate connections across the curriculum

Student achievement in science and in other school subjects such as social studies, English language arts, technology, etc. is enhanced by coordination between and among the science program and other programs. Furthermore, such coordination can maximize use of time in a crowded school schedule.

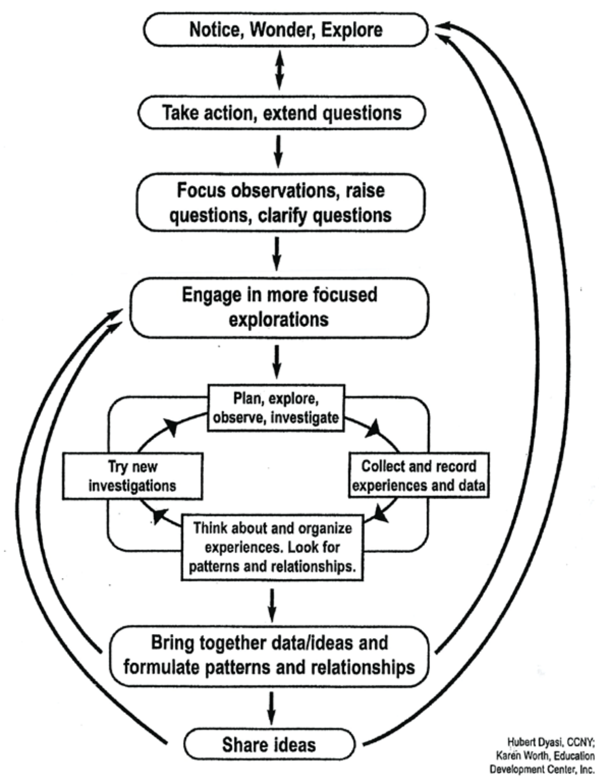
The Three Processes of Scientific Literacy

A science education which strives for scientific literacy must engage students in asking and answering meaningful questions. Some of these questions will be posed by the teacher, while others will be generated by the students. These questions are of three basic types: "Why…?" "How…?" and "Should…?". There are three processes used to answer these questions. Scientific inquiry addresses "why" questions. "How" questions are answered by engaging in the problem solving process, and "should" questions are answered by engaging in decision making.

Scientific Inquiry

The first of the three processes, scientific inquiry, is a way of learning about the universe. It involves the posing of questions and the search for explanations of phenomena. Although there is no such thing as a "scientific method," students require certain skills to participate in the activity of science. There is general agreement that skills such as questioning, observing, inferring, predicting, measuring, hypothesising, classifying, designing experiments, collecting data, analysing 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 phenomena under investigation. Teachers should engage students in scientific inquiry activities to develop these skills.

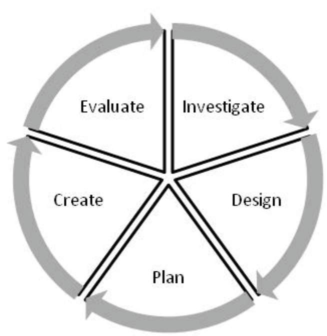
YOUNG CHILDREN'S INQUIRY



Problem Solving

The second process, problem solving, seeks solutions to human problems. It is also often represented as a cycle. In this case the cycle represents the proposing, creating, and testing of prototypes, products, and techniques in an attempt to reach an optimum solution to a given problem. The skills involved in this cycle facilitate a process which has different aims and different procedures from the inquiry process. Students should be given ample opportunity in the curriculum to propose, perform, and evaluate solutions to problem solving or technological tasks or questions.

Problem Solving Process



Decision Making

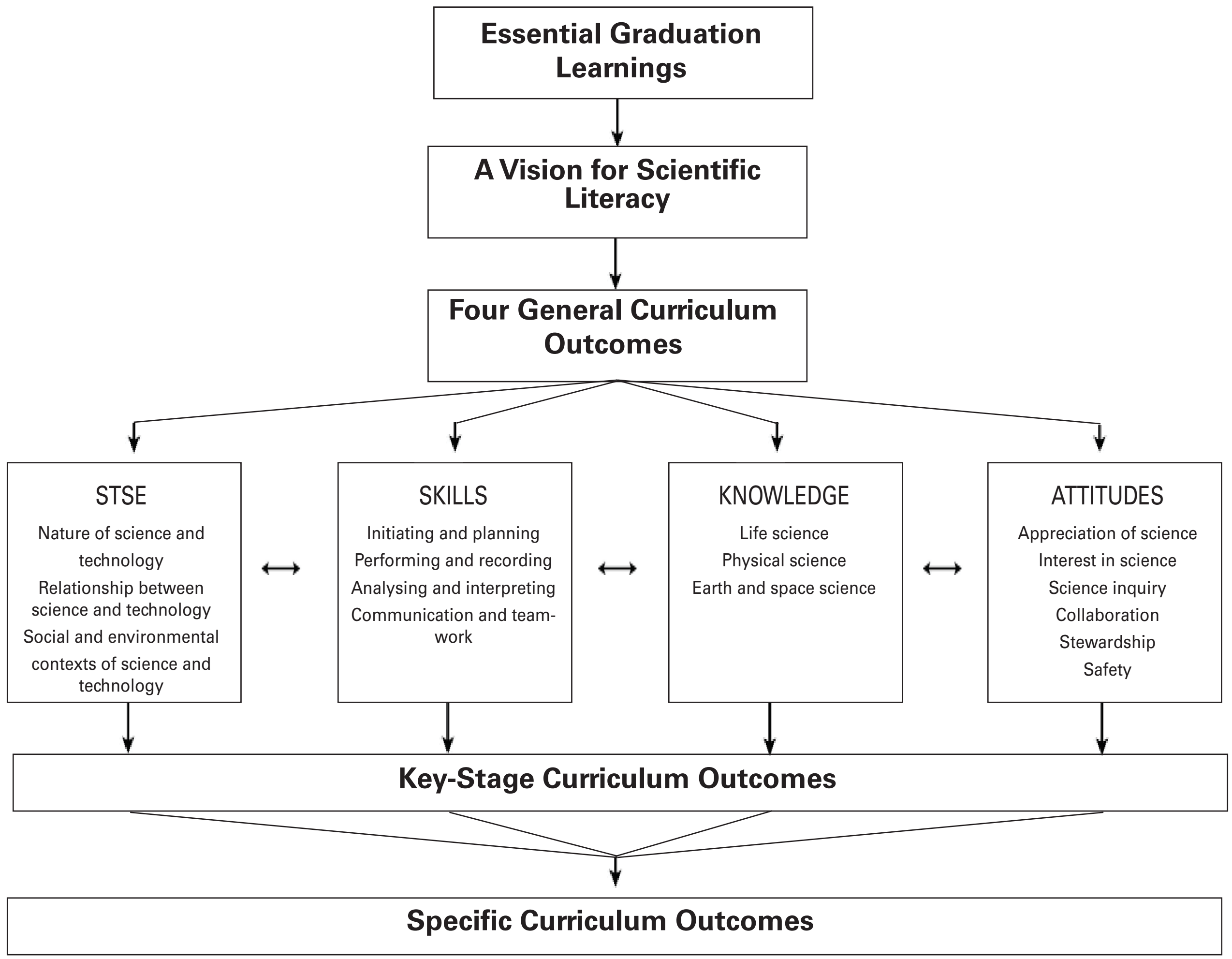
The third process is decision making. It is the determination of what we, as global citizens, should do in a particular context or in response to a given situation. Increasingly, the types of problems that we deal with, both individually and collectively, require an understanding of the processes and products of science and technology. The actual process of decision making involves the 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 as they progress through the science curriculum. Decision making situations not only are important in their own right, they also often provide a relevant context for engaging in scientific inquiry and/or problem solving.

Process Involved in Answering the Question:	**Scientific inquiry**	**Technological problem solving**	**Decision making**
Question:	Why does my coffee cool so quickly? (Science question)	How can I make a container to keep my coffee hot? (Technology question)	Should we use styrofoam cups or ceramic mugs for our meeting? (STSE question)
Response:	Heat energy is transferred by conduction, convection, and radiation.	A styrofoam cup will keep liquids warm for a long time.	Personal health, the environment, cost, and availability must be considered along with science and technology information
Problems Arise from:	Curiosity about events and phenomena in the natural world	Coping with everyday life, practices, and human needs	Different views or perspectives based on different or the same information
Types of Questions:	What do we know? How do we know?	How can we do it? Will it work?	What alternatives or consequences are there? Which choice is best at this time?
Solutions Result in:	Knowledge about the events and phenomena in the natural world	An effective and efficient way to accomplish a task	A defensible decision in the particular circumstances

Curriculum Outcomes Framework

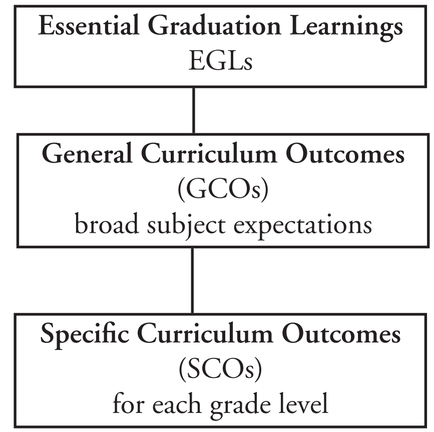
Conceptual Map

The conceptual map below provides the blueprint of the Prince Edward Island science outcomes framework and is the basis from which general and key-stage outcomes have been developed. At all times when making use of this framework, educators must keep in mind that the outcomes are intended to develop scientific literacy in students. The outcomes in the following section are taken from the Pan-Canadian framework document Common Framework of Science Learning Outcomes K–12.



Essential Graduated Learning

The CTE curricular program design and components are supportive of the framework incorporated in the *Atlantic Canada Technology Education Foundation Document*.



Essential Graduation Learnings (EGLs) serve as a framework for the curriculum development process and are statements describing 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. These learnings describe expectations not in terms of individual school subjects but in terms of knowledge, skills, and attitudes developed throughout the curriculum. They confirm that students need to make connections and develop abilities across subject boundaries if they are to be ready to meet the shifting and ongoing demands of life, work, and learning today and in the future. EGLs are cross-curricular, and curriculum in all subject areas is focused on enabling students to achieve these learnings.

Graduates from the public schools of Prince Edward Island will demonstrate knowledge, skills, and attitudes expressed as EGLs, and will be expected to:
respond with critical awareness to various forms of the arts and be able to express themselves through the arts; assess social, cultural, economic, and environmental interdependence in a local and global context; 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; continue to learn and to pursue active, healthy lifestyles; use the strategies and processes needed to solve a wide variety of problems, including those requiring language, and mathematical and scientific concepts; use a variety of technologies, demonstrate an understanding of technological applications, and apply appropriate technologies for solving problems.

Essential Graduation Learnings
- Aesthetic Expression
- Citizenship
- Communication
- Personal Development
- Problem Solving
- Technology Competency

General Curriculum Outcomes

The general curriculum outcomes (GCO) form the basis of the outcomes framework. They constitute a starting point for the development of all subsequent work. The also identify the key components of scientific literacy. Four general curriculum outcomes have been identified to delineate the four critical aspects of students' scientific literacy. They reflect the wholeness and interconnectedness of learning and should be considered as interrelated and mutually supportive.

General Curriculum Outcome 1:
Science, technology, society, and the environment (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.

General Curriculum Outcome 2:
Skills and processes—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.

General Curriculum Outcome 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.

General Curriculum Outcome 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.

Description of the General Curriculum Outcomes

GCO 1: Science, technology, society, and the environment (STSE)

This general curriculum outcome is the driving force of the curriculum outcomes framework. Many keystage curriculum outcomes presented in this document flow directly or indirectly from the STSE domain. The outcome statement focusses on three major dimensions:

- the nature of science and technology
- the relationships between science and technology
- the social and environmental contexts of science and technology

Nature of science and technology

Science provides a base used for predicting, interpreting, and explaining natural and technological phenomena. It is one way of knowing nature, based on curiosity, imagination, intuition, exploration, observation, replication, interpretation of evidence, and consensus making over this evidence. Science-based ideas are continually being tested, modified, and improved as new ideas supersede existing ideas. There is no set procedure for conducting a scientific investigation. Rather, science is driven by a combination of theories, knowledge, experimentation, and processes anchored in the physical world.

Technology, like science, is a creative human activity, but is concerned with solving practical problems that arise from human/social needs, particularly the need to adapt to the environment and to fuel a nation's economy. New products and processes are produced by research and development through the processes of inquiry and design.

Relationships between science and technology

While there are important relationships between science and technology, there are also important differences. Science and technology differ in purpose and in process. Where the focus of science is on the development and verification of knowledge; in technology, the focus is on the development of solutions. The test of science knowledge is that it helps us explain, interpret, and predict; the test of technology is that it works – it enables us to achieve a given purpose.

By understanding the relationships between science and technology, students learn to appreciate how science and technology interact, how they develop in a social context, how they are used to improve people's lives, and how they have implications for the students themselves, for others, for the economy, and for the environment.

Social and environmental contexts of science and technology

The history of science highlights the ways in which culture has influenced the questions of science, and how science in turn has influenced culture. Growth in STSE understandings may involve the following elements:

- increasing complexity of scientific understanding - from simple to abstract ideas
- applications in local and global contexts
- consideration of variables and perspectives - from simple to complex
- critical judgement - from simple right and wrong assessments to complex evaluations
- decision making - from guided decisions based on limited knowledge, to independent decisions based on extensive research and personal judgement.

GCO 2: Skills and processes

This GCO identifies the skills and processes students develop in answering questions, solving problems, and making decisions. While these skills and processes are not unique to science, they play an important role in the development of scientific and technological understanding and in the application of acquired knowledge to new situations. Four broad skill areas are outlined in this GCO. The listing of these skills is not intended to imply a linear sequence or to identify a single set of skills required in each science investigation. Every investigation and application of science has unique features that determine the particular mix and sequence of skills involved.

As students advance from grade to grade, the skills they have developed are applied in increasingly demanding contexts. Growth in skills may involve each of the following skill elements:

- range of application—from a limited range to a broad range of applications
- complexity of application—from simple, direct applications to applications that involve abstract ideas and complex interpretations and judgements
- precision of measures and manipulations—from coarse measures and manipulations to those that are precise
- use of current and appropriate technologies and tools—from working with a few simple tools to working with a broad array of specialized and precise tools
- degree of independence and structure—from working under teacher guidance or in a structured situation to working independently and without guidance
- awareness and control—from following a predetermined plan to an approach involving awareness, understanding, and control, such as selecting skills and strategies that are most appropriate to the task at hand and making use of metacognition and strategic thinking
- ability to work collaboratively— from working as an individual to working as part of a team

Initiating and planning

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

Performing and recording

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

Analysing and interpreting

These are the skills of examining information and evidence, of processing and presenting data so that it can be interpreted, and of interpreting, evaluating, and applying the results.

Communication and teamwork

In science and technology, as in other areas, communication skills are essential whenever ideas are being developed, tested, interpreted, debated, and accepted or rejected.

Teamwork skills are also important because the development and application of ideas rely on collaborative processes both in society and in learning.

GCO 3: Knowledge

This general curriculum outcome focuses on the subject matter of science including the theories, models, concepts, and principles that are essential to an understanding of the natural and constructed world. For organizational purposes, this GCO is framed using the widely accepted science disciplines - life science, physical science, Earth and space science.

Life science

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

Physical science

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

Earth and space science

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

GCO 4: Attitudes

This general curriculum outcome focuses on encouraging students to develop attitudes, values, and ethics that inform a responsible use of science and technology for the mutual benefit of self, society, and the environment. Attitudes are not acquired in the same way as skills and knowledge. They cannot be observed at any particular moment, but are evidenced by regular, unpromoted displays over time. Attitude development is a lifelong process that involves the home, the school, the community, and society at large. This GCO identifies six categories in which science education can contribute to the development of scientific literacy.

Appreciation of science

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

Interest in science

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

Scientific inquiry

Students will be encouraged to develop critical beliefs concerning the need for

- open-mindedness and flexibility,
- critical-mindedness and respect for evidence,
- initiative and perseverance,
- creativity and inventiveness

in the development of scientific knowledge.

Colloboration

Students will be encouraged to develop attitudes that support collaborative activity. This will develop their sense of interpersonal responsibilities, an openness to diversity, respect for multiple perspectives, and an appreciation of the efforts and contributions of others.

Safety

Students engaged in science and technology activities will be expected to demonstrate a positive attitude toward safety and doing no harm to themselves or others.

Stewardship

Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment. They should be involved in activities that encourage responsible action toward living things and the environment, and to consider issues related to sustainability from a variety of perspectives.

Specific Curriculum Outcomes

The learning expected of students in Prince Edward Island is defined by specific curriculum outcomes (SCOs) for each area of study within each grade. As Prince Edward Island students achieve the grade and subject-specific outcomes identified in curricula, they will deepen their understanding of each area of study as a living field of knowledge. All specific curriculum outcomes within a grade and subject-area of study are compulsory.

Specific Curriculum Outcomes state the intended outcomes of instruction, and identify what students are expected to know and be able to do within a particular grade and subject-area of study. SCOs provide the goals or targets of instruction in terms of measurable or observable student performance. SCOs provide a focus for instruction and provide a basis for the assessment of student achievement. SCOs are observable, assessable, and supported by achievement indicators that help to define the breadth and depth of the outcome. The outcome of learning described in each SCO provides the basis for selecting learning and teaching activities and assessment procedures. SCOs contribute to the achievement of the key-stage curriculum outcomes. Together, the SCOs provide a continuum of learning from entry through grade 12. In short, SCOs describe the intended outcomes of instruction in performance terms without restricting the means of achieving them.

Science K-10: At a Glance

The following chart outlines the K-10 science topics organized by processes and skills, life science, physical science, and Earth and space science. Note that these four organizers are for the purposes of identifying prescribed learning outcomes; they are not intended to suggest a linear delivery of course material.

	Processes and Skills of Science	Life Science	Physical Science	Earth and Space Science
Kindergarten	• Observing • Communicating (Sharing)	• Exploring the World Using our Senses		
Grade 1	• Communicating (Recording) • Classifying	• Needs and Characteristics of Living Things	• Exploring Objects and Materials With Our Senses	• Daily and Seasonal Changes
Grade 2	• Interpreting Observations • Making Inferences	• Animal Growth and Changes	• Properties of Liquids and Solids • Relative Position and Motion	• Air and Water in the Environment
Grade 3	• Questioning • Measuring and Reporting	• Plant Growth and Changes	• Invisible Forces • Materials and Structures	• Exploring Soils
Grade 4	• Interpreting Data • Predicting	• Habitats and Communities	• Sound • Light	• Rocks, Minerals and Erosion
Grade 5	• Designing Experiments • Fair Testing	• Meeting Basic Needs and Maintaining a Healthy Body	• Properties and Changes of Materials • Forces and Simple Machines	• Weather
Grade 6	• Controlling Variables • Scientific Problem Solving	• Diversity of Life	• Electricity	• Space • Flight

	Processes and Skills of Science	Life Science	Physical Science	Earth and Space Science
Grade 7	• Hypothesizing • Developing Models	• Interactions within Ecosystems	• Mixtures and Solutions • Heat	• Earth's Crust
Grade 8	• Safety • Scientific method • Representing and interpreting scientific information • Scientific literacy • Ethical behaviour and cooperative skills • Application of scientific principles • Science-related technology	• Cells, Tissues, Organs and Systems	• Optics • Fluids	• Water Systems on Earth
Grade 9		• Reproduction	• Atoms and Elements • Electricity	• Space Exploration
Grade 10		• Sustainability of Ecosystems	• Chemical Reactions • Motion	• Weather

Key-Stage Curriculum Outcomes

Science, Technology, Society, and the Environment (STSE)
Students will develop an understanding of the nature of science and technology, ofthe relationships between science and technology, and of the social and environmental contexts of science and technology.

By the end of grade 3 (STSE/knowledge), students will be expected to

- investigate objects and events in their immediate environment, and use appropriate language to develop understanding 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

By the end of grade 6, students will have achieved the outcomes for entry–grade 3 and will also be expected to

- demonstrate that science and technology use specific processes to investigate the natural and constructed world or to seek solutions to practical problems
- demonstrate that science and technology develop over time
- describe ways that science and technology work together in investigating questions and problems and in meeting specific needs
- describe applications of science and technologythat have developed in response to human and environmental needs
- describe positive and negative effects that result from applications of science and technology in their own lives, the lives of others, and the environment

By the end of grade 9, students will have achieved the outcomes for entry–grade 6 and will also be expected to

- describe various processes used in science and technology that enable people to understand natural phenomena and develop technological solutions
- describe the development of science and technology over time
- explain how science and technology interact with and advance one another
- illustrate how the needs of individuals, society, and the environment influence and are influenced by scientific and technological endeavours
- analyse social issues related to the applications and limitations of science and technology, and explain decisions in terms of advantages and disadvantages for sustainability, considering a few perspectives

By the end of grade 12, students will have achieved the outcomes for entry–grade 9 and will also be expected to

- describe and explain disciplinary and interdisciplinary processes used to enable us to understand natural phenomena and develop technological solutions
- distinguish between science and technology in terms of their respective goals, products, and values and describe the development of scientific theories and technologies over time
- analyse and explain how science and technology interact with and advance one another
- analyse how individuals, society, and the environment are interdependent with scientific and technological endeavours
- evaluate social issues related to the applications and limitations of science and technology, and explain decisions in terms of advantages and disadvantages for sustainability, considering a variety of perspectives

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.

By the end of grade 3 (STSE/knowledge), 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

By the end of grade 6, students will have achieved the outcomes for entry–grade 3 and will also be expected to

- ask questions about objects and events in the local environment and develop plans to investigate those questions
- observe and investigate their local environment and record the results
- interpret findings from investigations using appropriate methods
- work collaboratively to carry out science-related activities and communicate ideas, procedures, and results

By the end of grade 9, students will have achieved the outcomes for entry–grade 6 and will also be expected to

- ask questions about relationships between and among observable variables and plan investigations to address those questions
- conduct investigations into relationships between and among observations, and gather and record qualitative and quantitative data
- analyse qualitative and quantitative data and develop and assess possible explanations
- work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures, and results

By the end of grade 12, students will have achieved the outcomes for entry–grade 9 and will also be expected to

- ask questions about observed relationships and plan investigations of questions, ideas, problems, and issues
- conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information
- analyse data and apply mathematical and conceptual models to develop and assess possible explanations
- work as a member of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

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.

By the end of grade 3 (STSE/knowledge), students will be expected to

- For grade 3, STSE and knowledge outcomes are combined in the STSE section.

By the end of grade 6, students will have achieved the outcomes for entry–grade 3 and will also be expected to

- describe and compare characteristics and properties of living things, objects, and materials
- describe and predict causes, effects, and patterns related to change in living and non-living things
- describe interactions within natural systems and the elements required to maintain these systems
- describe forces, motion, and energy and relate them to phenomena in their observable environment

By the end of grade 9, students will have achieved the outcomes for entry–grade 6 and will also be expected to

Life Science

- explain and compare processes that are responsible for the maintenance of an organism's life
- explain processes responsible for the continuity and diversity of life
- describe interactions and explain dynamic equilibrium within ecological systems

Physical Science

- describe the properties and components of matter and explain interactions between those components
- describe sources and properties of energy, and explain energy transfers and transformations
- recognize that many phenomena are caused by forces and explore various situations involving forces

Earth and Space Science

- explain how Earth provides both a habitat for life and resource for society
- explain patterns of change and their effects on Earth
- describe the nature and components of the solar system

By the end of grade 12, students will have achieved the outcomes for entry–grade 9 and will also be expected to

Life Science

- compare and contrast the reproduction and development of representative organisms
- determine how cells use matter and energy to maintain organization necessary for life
- demonstrate an understanding of the structure and function of genetic material
- analyse the patterns and products of evolution
- compare and contrast mechanisms used by organisms to maintain homeostasis
- evaluate relationships that affect the biodiversity and sustainability of life within the biosphere

Chemistry

- identify and explain the diversity of organic compounds and their implications in the environment
- demonstrate an understanding of the characteristics and interactions of acids and bases
- illustrate and explain the various forces that hold structures together at the molecular level, and relate the properties of matter to its structure
- use the redox theory in a variety of contexts related to electrochemistry
- demonstrate an understanding of solutions and stoichiometry in a variety of contexts
- predict and explain energy transfers in chemical reactions

Physics

- analyse and describe relationships between force and motion
- analyse interactions within systems, using the laws of conservation of energy and momentum
- predict and explain interactions between waves and with matter, using the characteristics of waves
- explain the fundamental forces of nature, using the characteristics of gravitational, electric, and magnetic fields
- analyse and describe different means of energy transmission and transformation

Earth and Space Science

- demonstrate an understanding of the nature and diversity of energy sources and matter in the universe
- describe and predict the nature and effects of changes to terrestrial systems
- demonstrate an understanding of the relationships among systems responsible for changes to the Earth's surface
- describe the nature of space and its components and the history of the observation of space

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.

By the end of grade 3 (STSE/knowledge), students will be expected to

- recognise 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
- willingly observe, question, and explore
- consider their observations and their own ideas when drawing a conclusion
- appreciate the importance of accuracy
- be open-minded in their explorations
- 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 own safety and that of others in carrying out activities and using materials

By the end of grade 6, students will have achieved the outcomes for entry–grade 3 and will also be expected to

- appreciate the role and contribution of science and technology in their understanding of the world
- realize that the applications of science and technology can have both intended and unintended effects
- recognize that women and men of any cultural background can contribute equally to science
- show interest and curiosity about objects and events within different environments
- willingly observe, question, explore, and investigate
- show interest in the activities of individuals working in scientific and technological fields
- consider their own observations and ideas as well as those of others during investigations and before drawing conclusions
- appreciate the importance of accuracy and honesty
- demonstrate perseverance and a desire to understand
- work collaboratively while exploring and investigating
- be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment
- show concern for their own safety and that of others in planning and carrying out activities and in choosing and using materials
- become aware of potential dangers

By the end of grade 9, students will have achieved the outcomes for entry–grade 6 and will also be expected to

- value accuracy, precision, and honesty
- persist in seeking answers to difficult questions and solutions to difficult problems
- work collaboratively in carrying out investigations as well as in generating and evaluating ideas
- be sensitive and responsible in maintaining abalance between the needs of humans and a sustainable environment
- project, beyond the personal, consequences of proposed actions
- show concern for safety in planning, carrying out, and reviewing activities
- become aware of the consequences of their actionsappreciate the role and contribution of science and technology in our understanding of the world
- appreciate that the applications of science and technology can have advantages and disadvantages
- appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds
- show accontinuing curiosity and interest in a broad scope of science-related fields and issues
- confidently pursue further investigations and readings
- consider many career possibilities in science- and technology-related fields
- consider observations and ideas from a variety of sources during investigations and before drawing conclusions

By the end of grade 12, students will have achieved the outcomes for entry–grade 9 and will also be expected to

- value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not
- appreciate that the applications of science and technology can raise ethical dilemmas
- value the contributions to scientific and technological development made by women and men from many societies and cultural backgrounds
- show a continuing and more informed curiosity and interest in science and science-related issues
- acquire, with interest and confidence, additional science knowledge and skills, using a variety of resources and methods, including formal research
- consider further studies and careers in science and technology-related fields
- confidently evaluate evidence and consider alternative perspectives, ideas, and explanations
- use factual information and rational explanations when analysing and evaluating
- value the processes for drawing conclusions
- work collaboratively in planning and carrying out investigations, as well as generating and evaluating ideas
- have a sense of personal and shared responsibility for maintaining a sustainable environment
- project the personal, social, and environmental consequences of a proposed action
- want to take action for maintaining a sustainable environment
- show concern for safety and accept the need for rules and regulations
- be aware of the direct and indirect consequences of their actions

Achievement Indicators

Achievement indicators help to define the breadth and depth of the SCO and are representative of what teachers may observe in the classroom. Achievement indicators, taken together as a set, define the specific level of attitudes demonstrated, skills applied, or knowledge acquired by the student in relation to the corresponding learning outcome. Indicators are examples of ways that students might be asked to demonstrate achievement of an outcome. The set of indicators is not a mandatory checklist, prioritized list of instructional activities, or prescribed assessment items. When teachers are planning for instruction, they must be aware of the set of indicators to understand the breadth and depth of the outcome. Based on their resulting understanding of the outcome, teachers may add to the existing indicators to support the intent of the outcome and to be responsive to their students' interests, lives, and prior learning. It is important to note that, if additional indicators are developed or if given indicators are substituted with alternate indicators, they must be reflective of and consistent with the breadth and depth that is defined by the given indicators. Teachers determine which indicators are most relevant at a particular time (e.g., developmental stage, time of the year, relevant circumstance) by analysing the needs and interests of the student – what s/he already knows, understands, and is able to do. Indicators help to identify the level and types of knowledge intended by the outcome. Lists of achievement indicators will begin with the phrase, "Students who have achieved this outcome should be able to…"

The complete set of indicators is an example of how students might be asked to demonstrate achievement of an outcome. The set of indicators provided for an outcome:

- provides the intent (depth and breadth) of the outcome
- tells the story, or creates a picture, of the outcome
- defines the level and types of knowledge intended by the outcome
- is not a checklist or prioritized list of instructional activities or prescribed assessment item

Blooms Taxonomy

Prince Edward Island specific curriculum outcomes require that students develop a combination of factual, conceptual, procedural, and metacognitive knowledge. Bloom's influential learning taxonomy of knowledge and cognitive process dimensions has been revised and expanded since it was first developed in 1956. The most recent revision process involved some of Bloom's former colleagues and representatives of three groups including "cognitive psychologists, curriculum theorists and instructional researchers, and testing and assessment specialists" (Anderson & Krathwohl, 2001, p. xxviii). The revised taxonomy recognizes the different types of knowledge (the knowledge dimension) and the processes that students use as they learn (the cognitive process dimension).

The Cognitive Dimension	The Knowledge Dimension			
	Factual Knowledge	Conceptual	Procedural	Metacognitive
Remembering				
Understanding				
Applying				
Analysing				
Evaluating				
Creating				

As Wiggins and McTighe (2005) observe in Understanding by Design,"… in the best designs, form follows function. In other words, all the methods and materials we use are shaped by a clear conception of the vision of desired results" (p. 14). The vision or visualization of the desired results (e.g., outcomes) is a key to developing a deep understanding of the intent of each outcome. For example, when writing an outcome, it is important to determine the type of knowledge required by the outcome (e.g., factual, conceptual, procedural, metacognitive, or a combination).

As teachers reflect deeply and collaborate with each other to identify the types of knowledge required by the outcomes, they will be better able to visualize what the achievement of each outcome will look, sound, and feel like in the classroom. Clear visualization of the desired results (e.g., evidence of achievement of outcomes) assists teachers in planning learning experiences that engage students in higher level thinking and learning.

When determining the intent of curriculum outcomes and indicators, teachers need to look at the nouns to determine what is being learned, and the verbs to determine the cognitive process dimension. Note that some verbs fit into more than on dimension of the cognitive process. Several educational researches provide examples of verbs related to each cognitive process dimension.

Table of Specifications

Units	Level 1	Level 2	Level 3	% of Curriculum
Interactions within Ecosystems	LS1	LS2	LS3	30%
Mixtures and Solutions	PS1, PS2		PS3	25%
Heat	PS5	PS4	PS6	25%
Earth's Crust	ESS1, ESS2		ESS3	20%
	50%	17%	33%	100%

Principles of Teaching and Learning Science

The central goal of science education is scientific literacy. All activities that fall under the umbrella of instruction (teaching and learning) should therefore be aimed at that central goal. An effective approach to science education places the instruction in the context of a contemporary societal or environmental situation, question, or problem. The desire to investigate the situation, answer the question, or solve the problem creates in the students a meaningful context in which to address the skills, concepts, and understandings of the course.

Explanations, Evidence, and Models in Science

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

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

- Law – A law is a generalized description, usually expressed in mathematical terms, that describes some aspect of the natural world under certain conditions.

- Theory – A theory is an explanation for a set of related observations or events that may consist of statements, equations, models, or a combination of these. Theories also predict the results of future observations. A theory becomes a theory once the explanation is verified multiple times by different groups of researchers. The procedures and processes for testing a theory are well-defined within each scientific discipline, but they vary between disciplines. No amount of evidence proves that a theory is correct. Rather, scientists accept theories until the emergence of new evidence that the theory is unable to adequately explain. At this point, the theory is discarded or modified to explain the new evidence. Note that theories never become laws; theories explain laws.

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

Scientific models are constructed to represent and explain certain aspects of physical phenomenon. Models are never exact replicas of real phenomena; rather, models are simplified versions of reality, generally constructed in order to facilitate study of complex systems such as the atom, climate change, and biogeochemical cycles. Scientists spend considerable time and effort building and testing models to further understanding of the natural world.

Students should be able to identify the features of the physical phenomena their models represent or explain. Just as importantly, students should identify which features are not represented or explained by their models. Students should determine the usefulness of their model by judging whether the model helps in understanding the underlying concepts or processes. Ultimately, students realize that different models of the same phenomena may be needed in order to investigate or understand different aspects of the phenomena.

Investigative Activities

The National Research Council (2006, p. 3) defines a school laboratory investigation as an experience in the laboratory, the classroom, or the field that provides students with opportunities to interact directly with natural phenomena or with data collected by others using tools, materials, data collection techniques, and models.

While investigative activities are not unique to science, they are more commonly associated with science programs than with any other area of the curriculum. Investigative activities include a variety of activities ranging from the traditional experiment done in a science laboratory to a quick field trip to the school yard. All such activities are characterized by active student involvement in attempting to find answers to questions about the natural or constructed world. Many activities involve the use of scientific and technological tools and equipment; others simply involve observation using the senses.

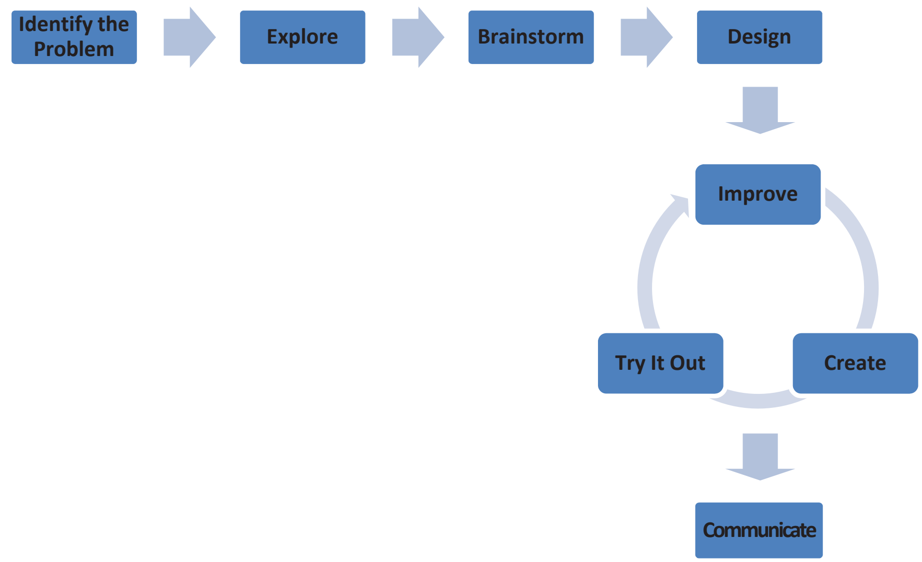
A strong science program includes a variety of individual, small, and large group classroom and field experiences for students. Most importantly, these experience needs to go beyond conducting confirmatory “cook-book” experiments. Similarly, computer simulations and teacher demonstrations are valuable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

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

The investigation is a special instructional format that provides students with the opportunity to do science, not just learn science. Without activities of this sort it is extremely difficult, if not impossible, for students to develop an understanding of the nature of science, to develop the cognitive, scientific, and technical skills associated with doing science, or to construct the important ideas of science.

Design Process

The design process is a problem solving strategy used to develop possible solutions to solve a problem. The goal for students is to define problems, specifying criteria and constraints for solutions, as well as anticipating potential impacts on society and the environment. Upon careful exploration and research, students brainstorm possible solutions to the problem. Students will next design and create their model/prototypes. After, they will test out their designs, analyse the results, modify their designs accordingly, and then re-test and modify their designs again. Students may go through this cycle numerous times before reaching the optimal result. Students should communicate their results, regardless of the form, such as a poster, drawing, prototype, presentation, or report.



1) Identify the Problem: Describe the challenge to be solved, including limits and constraints.
2) Explore: Do background research to collect information. What have others done? Visit the library. Use computer databases. Ask questions.
3) Brainstorm: What are some solutions?
4) Design: Use your knowledge and creativity to come up with many solutions. Choose one idea and draw or make a model of it.
5) Create: Make your solution. Construct your prototype.
6) Try It Out: Test your solution.
7) Improve: Evaluate how the solution worked and think of how to modify or improve your design to make it better.
8) Communicate: Share your results. This may be presented in many forms, such as a poster, drawing, prototype, presentation, or report.

Reference:

Next Generation Science Standards, June, 2013. http://www.nextgenscience.org/sites/ngss/files/MS%20ETS%20topics%20combined%20 6.12.13.pdf

Project Based Learning

Project Based Learning (PBL) is a teaching and learning methodology in which students engage in a rigorous, extended process of inquiry focused on complex, authentic questions and problems as they achieve the knowledge, skills, and attitudes defined by the curriculum outcomes. A set of learning experiences and tasks guide students in inquiry toward answering a central question, solving a problem or meeting a challenge, as opposed to several activities tied together under a theme, concept, time period, culture, or geographic area (e.g. the Renaissance, the ocean, WWII, Canada). Throughout the project, students work as independently from the teacher as possible, and have some degree of "voice and choice".

PBL is unlike traditional projects in the sense that it is informed by the curriculum and *drives* the instruction and learning, as opposed to involving students in a "fun activity" or "making something". It is often focused on creating physical artifacts but must involve other intellectually challenging tasks and products focused on research, reading, writing, discussion, investigation, and oral presentation. Through PBL, students can develop and demonstrate in-depth understanding of academic knowledge and skills while enhancing habits of mind, along with collaboration, critical thinking, and communication skills. PBLs can be interdisciplinary in nature and allow for curriculum integration from different subject areas within one project. This learning experience ends with a high-quality product or performance created by the student(s) and presented to a public audience.

Two important components of PBL are the creation of a driving question and the collaboration with a Subject Matter Expert (SME).

The Driving Question

A well-crafted *driving question* is essential to all effective PBLs. It is this question that will form the basis of explicit links with the curriculum, create the focus of the project for the students, and encourage their process of inquiry and investigation. All driving questions should be provocative, challenging, open-ended, and complex and must be linked to the core of what students are to learn as determined by the provincially authorized curriculum. Sample driving questions might include:

- Who are the heroes of our community?
- When is war justified?
- What effect does population growth have on our society?
- Is watching TV beneficial or harmful to teenagers?
- How can we create a piece of media to demonstrate diversity in our school?

Students may work in collaborative teams or individually to investigate, research, and refine knowledge and skills to adequately answer the driving question. Because the driving question is open-ended, students are able to reach a variety of potential conclusions in countless ways, while still building in-depth knowledge and skills. This creates the independent nature of the project and also the feeling of "voice and choice" for the students. The teacher then assumes more of a facilitator/coach role, assisting and guiding during an investigation and providing direct instruction when necessary.

Subject Matter Expert (SME)
A well crafted PBL also includes the role of a *Subject Matter Expert*, or *SME*. These individuals/groups play a key role in PBL as they bring first-hand authentic knowledge and experience from the specific content field to the classroom. They may be sought out by the student(s) during their investigation or prearranged by the teacher depending on the project. These experts provide additional support and information to the students related to the topics and help demonstrate to the students that the work they are completing is authentic and "real-world". The involvement of these experts allows educators to expand the classroom walls and make strong connections and links with surrounding communities.

At the conclusion of the PBL, students are required to present their findings to a public audience. Their peers in the classroom may act as the dress rehearsal for this presentation and provide valuable feedback to refine the presentation. However, in order to "raise the stakes" for the students' final presentation, students should present their findings to members of the community, experts in the field (including the involved SME), parents, or school administration in addition to presenting to their classroom peers.

Adapted from *PBL Starter Kit*, (2009) The Buck Institute for Education. (www.bie.org)

Resources

One of the characteristics of the science curriculum that will help all students become scientifically literate is that it should utilize a wide variety of print and non-print resources that have been developed in an interesting and interactive style. Teachers should consider the following in the selection of resources:
- the use of hands-on activities is an essential learning strategy in all science programs
- even with the advent of new media, print materials remain a dominant type of resource for science teaching and learning
- computer software and online resources can offer simulations and models of real-life situations that permit the investigation of phenomena that are not available because of cost, safety, or accessibility
- resources used in all activities should be appropriate to the grade level

Education for Sustainable Development

Education for sustainable development (ESD) involves incorporating the key themes of sustainable development–such as poverty alleviation, human rights, health, environmental protection, and climate change–into the education system. ESD is a complex and evolving concept and requires learning about these key themes from a social, cultural, environmental, and economic perspective, and exploring how those factors are interrelated and interdependent.

With this in mind, it is important that all teachers, including CTE teachers, attempt to incorporate these key themes in their subject areas. One tool that can be used is the searchable on-line database *Resources for Rethinking*, found at [**http://r4r.ca/en**]. It provides teachers with access to materials that integrate ecological, social, and economic spheres through active, relevant, interdisciplinary learning.

Technology

Technology-based resources are essential for instruction in the science classroom. Technology is intended to extend our capabilities and, therefore, is one part of the teaching toolkit. Class reflection and discussions are required to connect the work with technology to the conceptual development, understandings, and activities of the students. Choices to use technology, and choices of which technologies to use, should be based on sound pedagogical practices, especially those which support student inquiry. Technology should enhance, but not replace, essential hands-on science activities.

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

Data Collection and Analysis
- Data loggers (e.g., temperature probes, motion detectors) permit students to collect and analyze data in real-time.
- Databases and spreadsheets can facilitate the analysis and display of student-collected data or data obtained from scientists.

Visualization and Imaging
- Simulation and modeling software provide opportunities to explore concepts and models which are not readily accessible in the classroom.
- Students may collect their own digital images and video recordings as part of their data collection and analysis or they may access digital images and video online to help enhance understanding of scientific concepts.

Communication and Collaboration
- Students can use word-processing and presentation tools to share the results of their investigations with others.
- The Internet can be a means of networking with scientists, teachers, and other students by gathering information and data, posting data and findings, and comparing results with students in different locations.

Safety

Safety in the classroom is of paramount importance. To create a safe classroom requires that a teacher be informed, aware, and proactive and that the students listen, think, and respond appropriately. Safety cannot be mandated solely by teacher's rules or school regulations. Safety and safe practice are an attitude.

Safe practice in the laboratory is the joint responsibility of the teacher and students. The teacher's responsibility is to provide a safe environment and to ensure the students are aware of safe practice. Teachers must also follow the guidelines outlined in the Prince Edward Island *Science Safety Resource Manual*. The students' responsibility is to act intelligently based on the advice which is given and which is available in various resources.

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

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

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

Prevent
- Assess and mitigate hazards
- Review procedures for accident provention with students
- Teach and review safety procedures with students, including the need for appropriate clothing
- Do not use defective or unsafe equipment or procedures
- Do not allow students to eat or drink in science areas

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

Science and Literacy

Aside from developing students' scientific literacy, the outcomes undertaken by students in the science curriculum build on, reinforce, and enhance certain aspects of the language arts and mathematics curricula. Fostering students' communication skills is an important part of the teachers' role in the science classroom. Students need to be able to use oral communication, reading, writing, and media literacy skills to gain new learning in science and to communicate their understanding of what they have learned.

Students' understanding is revealed through both oral and written communication. Writing in science employs special forms and therefore requires specific and direct learning opportunities, but it is not necessary for all science learning to involve a written communication component. To develop their oral communication skills, students need numerous opportunities to listen to information and talk about a range of subjects in science and technology. When reading science texts, students use a different set of skills than they do when reading fiction. They need to understand vocabulary and terminology that are unique to science, and must be able to interpret symbols, charts, and diagrams. To help students construct meaning, it is essential that science teachers model and teach the strategies that support learning to read, write, and communicate in this subject area.

The Department of Education and Early Childhood Development has materials to support literacy instruction across the curriculum. Helpful advice for integrating literacy instruction in science and technology may be found in the document *Cross-Curriculuar Reading Tools.*

Assessment

Introduction

This section contains information about student assessment, measurement of student achievement, and evaluation.

Assessment techniques are used to gather information for evaluation.
Information gathered through assessment helps teachers determine students' strengths and needs in their achievement of the curriculum outcomes, and guides future instructional approaches. Practices should accept the needs of diverse learners in classrooms and should accept and appreciate learners' linguistic and cultural diversity.

Teachers are encouraged to be flexible in assessing the learning success of all students, and to seek diverse ways in which students might demonstrate what they know and are able to do. Assessment criteria and the methods of demonstrating learning successes may vary from student to student depending on their strengths, interests, and learning styles.

Evaluation involves the weighing of the assessment information against a standard in order to make an evaluation or judgment about student achievement. Assessment informs the evaluation process.

Assessment

Assessment should provide students with a variety of ways to demonstrate what they know and are able to do with many different types of text over time. It is the journey of their learning. Teachers collect, interpret, and synthesize information from a variety of student learning activities to gather information about student progress in relation to the achievement of learning outcomes.

Students must recognize each learning activity as worthwhile and relevant, and understand the expectations for each. Information provided through assessment activities allows teachers to give descriptive feedback to students to support and monitor future learning, and allows for necessary adjustments to instruction. Assessment feedback can also be incorporated through peer-and self-assessment activities.

Purposes of Assessment

According to research, assessment has three interrelated purposes:

- assessment *for* learning to guide and inform instruction
- assessment *as* learning to involve students in self-assessment and setting of goals for their own learning
- assessment *of* learning to make judgments about student performance in relation to curriculum outcomes

Other research indicates that assessment *as* learning should be viewed as part of assessment *for* learning, because both processes enhance future student learning. In all circumstances, teachers must clarify the purpose of assessment and then select the method that best serves the purpose in the particular context.

The interpretation and use of information gathered for its intended purpose is the most important part of assessment. Even though each of the three purposes of assessment (*for, as, of*) requires a different role for teachers, and different planning, the information gathered through any one purpose is beneficial and contributes to an overall picture of an individual student's achievement.

Assessment *for* Learning

Assessment *for* learning involves frequent interactive assessments designed to make student understanding visible so as to enable teachers to identify learning needs and adjust teaching accordingly. It is teacher-driven, and involves an ongoing process of learning and teaching.

- integrates strategies with instructional planning;
- requires the collection of data from a range of assessments to find out as much as possible about what students know and can do, and in order to plan for future instruction, to learn what student needs still must be addressed;
- uses curriculum outcomes as reference points, along with exemplars and achievement standards that differentiate quality;
- provides descriptive, specific, and instructive feedback to students and parents regarding the next stage of learning;
- actively engages students in their own learning as they assess themselves and understand how to improve performance;
- allows for judgments about students' progress for reporting purposes;
- provides information on student performance that can be shared with parents/guardians, school and district staff, and
- other educational professionals for the purposes of curriculum development.

This type of assessment provides ways to engage and encourage students to acquire the skills of thoughtful self-assessment and to promote their own achievement. Student achievement is compared to established criteria rather than to the performance of other students.

Assessment *as* Learning

Assessment *as* learning actively involves students' reflection on their learning, and monitoring of their own progress. Student-driven, and supported with teacher guidance, it focuses on the role of the student as the critical connector between assessment and learning— thereby developing and supporting metacognition in students.

Assessment *as* learning is ongoing and varied in the classroom. This assessment

- integrates strategies with instructional planning;
- focuses on students as they monitor what they are learning and use what they discover to make adjustments, adaptations, or changes in their thinking so as to achieve deeper understanding;
- supports students in critically analysing their learning as it relates to learning outcomes;
- prompts students to consider how they can continue to improve their learning;
- enables students to use collected information to make adaptations to their learning processes and to develop new understandings.

The goal in assessment *as* learning is for students, with teacher support and guidance, to acquire the skills needed to be metacognitively aware of their increasing independence as they take responsibility for learning and constructing meaning. Through self-assessment, students think about what they have learned and what they have not yet learned, and decide how to best improve their achievement.

Assessment *of* Learning

Assessment *of* learning involves strategies designed to confirm what students know, demonstrate whether or not they have met curriculum outcomes or the goals of their individual learning plans, or certify proficiency and make decisions about students' future learning needs. Assessment *of* learning occurs at the end of a learning experience that contributes directly to reported results.

Traditionally, teachers relied on this type of assessment to make judgments about student performance by measuring learning after the fact and then reporting it to others. However, used in conjunction with assessment *for* and assessment *as* learning (previously outlined), assessment *of* learning is strengthened.

Assessment *of* learning

- confirms what students know and can do;
- occurs at the end of a learning experience, using a variety of tools;
- provides opportunities to report to parents/guardians, school and district staff, and other educational professionals evidence to date of student achievement relative to learning outcomes, for the purpose of curriculum development;

- may be either criterion-referenced (based on specific curriculum outcomes) or norm-referenced (comparing student achievement to that of others);
- provides a foundation for discussions on student placement or promotion.

Because the consequences of assessment *of* learning are often far-reaching and affect students seriously, teachers have the responsibility to report student learning accurately and fairly, based on evidence obtained from a variety of contexts and applications.

Designing Effective Assessment

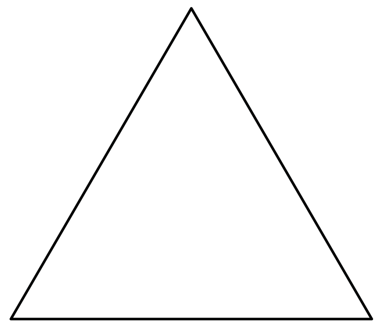
Effective assessment improves the quality of learning and teaching. It can help teachers to monitor and focus their instruction, and help students to become self-reflective and to feel in control of their own learning. When students are given opportunities to demonstrate what they know and what they can do with what they already know, optimal performance can be realized.

Teachers must collect evidence of student learning through a variety of methods. Valuable information about students can be gained through conversations, observations, and products. A balance among these three sources ensures reliable and valid assessment of student learning.

- Conversations may either be informal or structured in the form of a conference, and can provide insight into student learning that might not be apparent through observation or from products. Student journals and reflections provide a written form of conversation with the teacher.
- Observing a student while he/she is engaged in a learning activity allows a teacher insight into this process at various points throughout the activity. Observation is effective in assessing achievement of many of the speaking and listening outcomes.
- Products are work samples completed by a student. Samples can be in the form of written texts, or visual or oral products.

Effective assessment strategies

- are explicit and are communicated to students and parents at the beginning of the school term (and at other appropriate points throughout the school year) so that students know expectations and criteria to be used to determine the level of achievement;
- must be valid in that they measure what they intend to measure;
- must be reliable in that they consistently achieve the same results when used again, or similar results with a similar group of students;
- involve students in the co-construction, interpretation, and reporting of assessment by incorporating their interests (students can select texts or investigate issues of personal interest);
- reflect where the students are in terms of learning a process or strategy, and help to determine what kind of support or instruction will follow;



- allow for relevant, descriptive, and supportive feedback that gives students clear directions for improvement;
- engage students in metacognitive self-assessment and goal setting that can increase their success as learners;
- are fair in terms of the students' background or circumstances and provide all students with the opportunity to demonstrate the extent and depth of their learning;
- accommodate the diverse needs of students with exceptionalities, including students with individual learning plans;
- assist teachers in selecting appropriate instruction and intervention strategies to promote the gradual release of responsibility;
- are transparent, pre-planned, and integrated with instruction as a component of the curriculum;
- are appropriate for the learning activities used, the purposes of instruction, and the needs and experiences of the students;
- are comprehensive and enable all students to have diverse and multiple opportunities to demonstrate their learning consistently, independently, and in a range of contexts in everyday instruction;
- include samples of students' work that provide evidence of their achievement;
- are varied in nature, administered over a period of time, and designed to provide opportunities for students to demonstrate the full range of their learning.

Grade 7 Science Specific Curriculum Outcomes

Life Science - Interactions within Ecosystems (September - Mid November)	30%
LS1 Explain how different parts of an ecosystem interact and affect each other.	
LS2 Illustrate and analyse how food chains and food webs can be used to visualize the transfer of energy in an ecosystem.	
LS3 Propose actions to reduce the impact of human activities on a specific ecosystem.	

Physical Science - Mixtures and Solutions (Mid November - January)	25%
PS1 Distinguish between pure substances and mixtures using the particle theory of matter.	
PS2 Describe the characteristics and applications of solutions.	
PS3 Design and conduct out experiments to explore methods of separating mixtures and solutions and extend the impact of those methods on society and the environment.	

Physical Science - Heat (February - Mid April)	25%
PS4 Conduct experiments to describe the effect of heat on different forms of matter.	
PS5 Explain how heat is transferred by conduction, convection and radiation in solids, liquids, and gasses.	
PS6 Create a prototype of a device that will provide a solution to a practical heating or cooling problem.	

Earth and Space Science - Earth's Crust (Mid April - June)	20%
ESS1 Identify the characteristics and relationships among rocks and minerals.	
ESS2 Explain how the Earth's crust undergoes gradual and sudden changes over time.	
ESS3 Investigate the characteristics of soil and conditions that affect its formation and degradation.	

Interactions within Ecosystems

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **LS1 Explain how different parts of an ecosystem interact and affect each other.**

6SCIA	7SCIA	SCI421A
Diversity of Life Students explore local habitats to observe and record the variety of species.	**LS1 Explain how different parts of an ecosystem interact and affect each other.**	Sustainability of Ecosystems Students explain how biodiversity of an ecosystem contributes to its sustainability.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Identify and describe examples of local ecosystems.
- Identify and explain the roles of producers, consumers, and decomposers in an ecosystem and how they interact with one another.
- Use instruments (thermometer, pH meter) safely, effectively, and accurately to observe and measure biotic and abiotic factors in a local ecosystem.
- Explain how abiotic factors can affect biotic factors in an ecosystem.

Elaboration

Focus question: What are some ways that living and non-living elements of an ecosystem interact and depend on each other?

Ecosystems large and small are comprised of both living and non-living things. Teachers may begin this unit with a brainstorming session in which students express their current conceptions of what an ecosystem is and what it looks like. Students should also develop questions to investigate, such as, "What types of organisms live in a particular ecosystem?" These strategies can be used to assess prior knowledge and common interests.

Students should have working definitions of the roles and relationships of producers, consumers, and decomposers. Knowledge of the roles of biotic and abiotic components will reinforce the systematic and cyclic nature of ecosystems. Through the use of pictures and video, teachers should expose students to various types of ecosystems and ask them to identify the biotic and abiotic factors present. Students should also have the opportunity to visit a local ecosystem and observe and measure its living and non-living components.

Literacy connection (Scientific Terminology): Students should be given a variety of learning activity opportunities order to introduce the use of scientifically appropriate language. For example, students could write a paragraph, using scientific terms, to describe the abiotic and biotic components of a local ecosystem. A Frayer Model is a visual organizer that helps students understand key words or concepts. The Frayer Model is a chart divided into four quadrants. In these quadrants, students write the definition, characteristics/facts, examples, and non-examples of the word or concept.

Science

7SCIA

Interactions within Ecosystems

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **LS2 Illustrate and analyse how food chains and food webs can be used to visualize the transfer of energy in an ecosystem.**

6SCIA	7SCIA	SCI421A
Diversity of Life Students will create classification schemes for various species and display them in charts and diagrams.	**LS2 Illustrate and analyse how food chains and food webs can be used to visualize the transfer of energy in an ecosystem.**	Sustainability of Ecosystems Students will analyse and interpret energy transfer information in a variety of formats.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Distinguish between a food chain and a food web.
- Illustrate how energy is supplied to, and how it flows through, food chains and food webs.
- Examine food chains and food webs to explain the interdependence and interactions among producers, consumers, and decomposers in a particular ecosystem.
- Predict what would happen if one or more organisms were removed from a food web.
- Discuss the strengths and limitations of models in science, and then apply these criteria to analyse a diagram showing the flow of energy in an ecosystem.

Elaboration

Focus question: How are all of the parts within an ecosystem connected?

The non-living (abiotic) conditions will dictate the types of living things in the ecosystem. Students can construct simple food chains and food webs, using the organisms identified in a local ecosystem. Visual representations (e.g., food pyramids, energy pyramids) should qualitatively outline that many producers are required to provide the food/energy required for a small number of consumers. Students should also predict how the removal or introduction of a consumer can affect other components of a food chain or food web.

Students could use terrariums, jars, or pop bottles to construct their own ecosystem. In constructing these systems, students will need to make various questions, such as: What organisms will be included? How will I make it sustainable? What biotic and abiotic factors must be taken into account in the design? Will I include animals or just plants? Can I construct an aquatic ecosystem?

Literacy connection (Models and Diagrams): Teachers should lead students in a discussion of the strengths and limitations of using models or diagrams in science. These graphic organizers attempt to simplify complex relationships simply. Students should understand that in an effort to simplify, some diagrams can lead to incomplete representation or oversimplification of natural processes. Before relying on standard diagrams of energy flow through food chains and food webs, have students make their own diagrams that depict their interpretation of this concept. As instruction proceeds, the diagram should become more complete and more consistent with standard representations.

Science

7SCIA

Interactions within Ecosystems

Learning Contexts	
	Scientific Inquiry
	Technological Problem Solving
✓	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **LS3 Propose actions to reduce the impact of human activities on a specific ecosystem.**

6SCIA	7SCIA	SCI421A
Electricity Students describe the potential impact of the use by humans of regional natural resources.	**LS3 Propose actions to reduce the impact of human activities on a specific ecosystem.**	Sustainability of Ecosystems Students explain how biodiversity of an ecosystem contributes to its sustainability.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Identify factors that are critical for healthy ecosystems.
- Describe the process of succession in ecosystems.
- Analyse how natural events (e.g., storms, floods) and human activities (e.g., urbanization, agriculture, forestry, pollution, open-pit mining) impact ecosystems.
- Research individuals or groups at local, national, and global levels that focus on protecting the environment.

Elaboration

Focus question: What can humans do to keep the environment healthy?

Students should understand that ecosystems are often impacted and changed by succession and other natural disturbances, such as storms, floods, and forest fires. Humans have a major impact on ecosystems because of our demand for resources and large populations. Students should be able to assess ways in which humans affect habitats, both positively and negatively (e.g., urbanization, adding greenbelts, habitat fragmentation, riparian zones, protection of species at risk) by looking for a cause and effect link.

Students could choose a large habitat and create a pro/con chart reflecting the human impacts on it. They may list experimental questions for further study (e.g., Does new road building cause water erosion?) and propose actions to mitigate or reverse human impacts.

Researching local, national, and global groups that are dedicated to protecting the environment may raise students' awareness of sustainability and stewardship issues.

Literacy connection (Conducting Scientific Research): Teachers should provide students with some suggestions on conducting scientific research such as:

- Ask questions about the world around them.
- Identify a research topic or develop a research question.
- Identify sources of information.
- Evaluate the sources of information.
- Record and organize the information.
- Make a conclusion.
- Evaluate their research.
- Communicate their conclusions.

Science 7SCIA

Mixtures and Solutions

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **PS1 Distinguish between pure substances and mixtures using the particle theory of matter.**

5SCIA	7SCIA	9SCIA
Properties and Changes of Materials Students explore the differences between physical and chemical changes.	**PS1 Distinguish between pure substances and mixtures using the particle theory of matter.**	Atoms and Elements Students investigate materials and describe them in terms of their physical properties.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Identify physical properties of a variety of objects and materials.
- Record qualitative (e.g., colour, texture, and state of matter) and quantitative (e.g., density, melting point, and freezing point) physical properties in a chart or data table.
- Use a graphic organizer to distinguish between pure substances, heterogeneous mixtures, and homogeneous mixtures (solutions).
- Classify common substances found in the home as pure substances, heterogeneous mixtures, or homogeneous mixtures (solutions).

Elaboration

Focus question: What kinds of matter are around us?

Students should realize that matter can be categorized into two main groups: pure substances (one kind of material such as sugar), and mixtures (a combination of two or more pure substances). Ask students to identify different mixtures in their school or home and identify the mixtures as homogeneous (solutions) or heterogeneous. The particle theory of matter should be used to explain the difference among pure substances, heterogeneous mixtures, and solutions. The concept of simple dissociation is as far as one needs to go at this level.

Literacy connection (Comparisons): As students read this section, ask them to compare pure substances and mixtures, as well as comparing homogeneous and heterogeneous mixtures.

S 7SCIA
cience

Mixtures and Solutions

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **PS2 Describe the characteristics and application of solutions.**

2SCIA	**7SCIA**	**CHM521A**
Properties of Liquids and Solids Students investigate questions about the properties of various liquids and solids.	**PS2 Describe the characteristics and applications of solutions.**	Solution Properties and Solubility Students explain solubility, using the concept of equilibrium.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Distinguish among solutes, solvents, and solubility.
- Describe the concentration and solubility of substances qualitatively and quantitatively.
- Design and carry out procedures to study the effect of temperature, surface area, and stirring on solubility/solubility rates and explain the results.

Elaboration

Focus question: What are the parts of a solution, and how do the particles of a solution behave?

When one substance dissolves in another, the substance that dissolves is the solute and the substance in which it dissolves is the solvent. A word wall may help students distinguish among the terms solute, solvent, and solubility. The particle theory of matter should be used to explain why soluble substances dissolve in a solvent.

Teachers should facilitate opportunities for students to explore concentrations of solutions both qualitatively and quantitatively. Students should be encouraged to develop testable questions and also to recognize and control the major variables in any of the tests carried out. Students can create different solutions (e.g., food coloring and water, sugar and water, salt and water, baking soda and water) and explore different methods to increase or decrease their solubility or dissolving rates (e.g., changes in temperature, stirring, surface area). By collecting, recording, and organizing the data in the forms of graphs, for example, students should be able to make predictions regarding the amount of solute that can be dissolved in a particular solvent.

At the end of the investigations, students should be able to answer questions, such as "How does changing the amount of solute or solvent affect the solution? What factors affect the amount or speed of solute that can dissolve in a solvent? Why are some substances insoluble?"

Literacy connection (Interactive Word Wall): An interactive word wall is an organized collection of words displayed in a classroom, arranged to illustrate relationships and organize learning. Word walls provide reference support for students during reading and writing activities. Word walls should include terms and concepts aligned with the curriculum, visual supports, and student generated material. Students should be provided with opportunities to interact with the word wall, such as creating a concept map, summary sentence, short story, or poem.

Science 7SCIA

Mixtures and Solutions

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
✓	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **PS3 Design and conduct experiments to explore methods of separating mixtures and solutions, and extend the impact of those methods on society and the environment.**

6SCIA	7SCIA	9SCIA
Diversity of Life Students provide examples of how science and technology have been used to solve problems around the world.	**PS3 Design and conduct experiments to explore methods of separating mixtures and solutions, and extend the impact of those methods on society and the environment.**	Atoms and Elements Students explain how society's needs can lead to developments in science and technology.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Use laboratory equipment safely to demonstrate different methods (e.g., sorting, filtration, evaporation, distillation) to separate a variety of mixtures and solutions.
- Describe the scientific principles underlying a technology designed to separate mixtures (e.g., petroleum refining, sewage treatment plant, recycling station, combine harvester).
- Identify and explain examples of mixtures and solutions that have an impact on science, technology, and the environment (e.g., salt on roads in winter, agricultural sprays, bleach, battery acids).
- Identify new questions and problems that arise from what was learned about mixtures and solutions (e.g., Can some mixtures not be separated? Does the concentration of a pollutant affect its impact on the environment? How is oil removed from ocean water? What is the best way to sort garbage?).

Elaboration

Focus question: How can we separate the components of a mixture or solution?

Students should be asked to describe different procedures or technologies that they use everyday to separate mixtures (e.g., colanders, furnace filters, separating white clothes from dark clothes before washing, separating garbage into waste, compost, and recyclables). This exercise could then lead to classroom activities to further explore separating mixtures (e.g., using filtration and magnetism to separate a mixture of paperclips, sand, and water; using filtration to separate different size marbles; using evaporation to separate salt from water). Encourage students to identify, on the basis of their introductory investigations and discussions, new questions and problems that arise from what was learned, such as, "Are there mixtures that cannot be separated?"

A discussion and/or investigation on the use of separating technologies (e.g., sewage treatment plant, fractional distillation) will help students see the connection between science and technology in their everyday environment. It is important that students identify some positive and negative effects, and intended and unintended consequences of a particular scientific or technological development related to mixtures and solutions.

Literacy connection (Making Connections): To gain deeper meaning from their reading, students should practise making connections between what they are reading and what they have read before, from what they know about similar topics, and from their own life experiences. Use a double-entry journal, a two-column graphic organizer where the left-handed column is used to record important, factual information, and the right-hand column is used to make connections to the text by recording personal responses.

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **PS4 Conduct experiments to describe the effect of heat on different forms of matter.**

6SCIA	7SCIA	8SCIA
Flight Students make observations and collect information that is relevant to a given question or problem.	**PS4 Conduct experiments to describe the effect of heat on different forms of matter.**	Fluids Students predict how temperature will affect the density of a substance.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Explain how each state of matter reacts to changes in temperature using terms such as melting, boiling, freezing, and evaporation.
- Graph a heating curve for water, using student-collected data, and identify the states of matter and changes of state.
- Use appropriate equipment safely, effectively, and accurately for collecting temperature data when performing experiments on changes of states of matter.
- Distinguish between heat and temperature.
- Explain temperature using the concept of kinetic energy as it relates to the particle theory of matter.
- State a conclusion, based on experimental data and evidence, on how the addition of heat affects the volume of objects.

Elaboration

Focus question: How does heat affect matter?

This unit can begin by providing an opportunity to think about heat and temperature and discuss how we use these terms in everyday language. Temperature could be defined initially as how hot or cold something is and then later tied to kinetic energy and the particle theory of matter. The terms "heat" and "temperature" are often confused or misused by students; therefore, teachers should take time to differentiate between them. Students should have the opportunity to explore and examine a variety of instruments used to measure temperature and how these technologies have developed over time.

The effect of temperature change on objects (expansion and contraction) should also be explored using the particle theory and connected to everyday experiences (e.g., balloons deflate when taken outside on a cold day, expansion joints on bridges, bimetallic strips in thermostats). Students should be provided with the opportunity to investigate how the addition of heat affects the volume of different gases, liquids, and solids.

Literacy connection (Asking Questions): Questions asked early give the reader a purpose fo reading. Asking questions and searching for answers ensure that we are monitoring comprehension and interacting with the text to construct meaning. Good questions spring from background knowledge. When students generate their own questions, not only do they remember the information better, they are more interested in what they are reading. The "Say Something" strategy helps students attend to their reading. This strategy interrupts a student's reading, giving him or her a chance to think about what is being read. Students get into small groups and take turns reading aloud. As they read, they occassionally pause to "say something" about what was read. They make a prediction, ask a question, clarify confusion, comment on a what is happening next, or connect what is in the text to something they know. The reading partners offer a response to what was said, then a different student continues the reading until the next time they pause to say something.

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **PS5 Explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases.**

	7SCIA	SCI421A
	PS5 Explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases.	Weather Dynamics Students describe and explain the effects of heat transfer on weather dynamics.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Compare the three forms of heat transfer (conduction, convection, radiation) using the particle theory of matter and/or the movement of energy.
- Observe demonstrations and models to describe real-world examples of how heat is transferred by conduction, convection, and radiation (e.g., ocean currents, warmth from the Sun, frying bacon on a stove, tea kettle).
- Use experimentation to compare heat transmission in different materials (e.g., conduction of heat through different solids, convection currents in liquids or gasses, absorption of radiant heat by light/dark or shiny/dull surfaces).

Elaboration

Focus question: What are three forms of heat transfer?

Activities in which students are engaged with heat transfer should be part of this unit. Students should experience how thermal energy is transferred from one object to another.

Conduction experiments could involve heating different solid rods (e.g., copper, wood, plastic, aluminum) of similar lengths to see which transfers heat the fastest. Students can investigate convection by observing coloured chalk dust placed into a beaker of boiling water. Radiant energy experiments could involve comparing surfaces to see which ones absorb radiant energy most efficiently (e.g., light vs. dark, shiny vs. dull, smooth vs. rough). Students should also understand that radiant energy from the Sun is the source of energy for much of the conduction and convection of heat energy on Earth. Students should be able to transfer the knowledge that they have learned from their experiments to describe real-world examples of how heat is transferred by conduction, convection, and radiation. This could be accomplished through a brainstorm and categorize activity.

Students can be encouraged to investigate various technologies that reduce heat transfer, such as Thermos® bottles, Styrofoam®, and different types of home insulation (insulation batts, blow insulation, spray foam).

Literacy connection (Brainstorming): is a free flow of ideas through individual or group reflection/discussion to generate a list related to the topic. Students then sort the words/ideas in the list into categories (e.g., conduction, convection, radiation). A word sort is a categorizing and classifying activity. This strategy helps activate prior knowledge and link it to the reading as they sort words. Another brainstorming activity is the Placemat Activity whereby students work in groups and record in individual sections of a large piece of paper their ideas around a concept being introduced or question posed to them. Students share their individual responses with the group and then decide as a group similarities or a common response which they record in the middle of the placement.

Science 7SCIA

Heat

Learning Contexts	
	Scientific Inquiry
✓	Technological Problem Solving
✓	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **PS6 Create a protoype of a device that will provide a solution to a practical heating or cooling problem.**

6SCIA	7SCIA	SCI421A
Flight Students provide examples of how science and technology have been used to solve problems around the world.	**PS6 Create a prototype of a device that will provide a solution to a practical heating or cooling problem.**	Weather Dynamics Students identify instances in which science and technology are limited in finding the answer to questions or the solution to problems.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Provide examples of heating and insulating technologies from the past to present.
- Identify and discuss the scientific principles of technologies designed to address practical problems regarding heating and cooling.
- Design, construct, evaluate, and present a prototype of a device that will provide a solution to a practical problem related to heating or cooling (e.g., cooking food, keeping food warm or cool for an extended period, keeping a shelter warm or cool, keeping a person warm or cool).
- Describe how a home heating system and wall thermostat keep a house at a constant temperature.
- Evaluate similar materials and systems that maximize or minimize heat transfer (e.g., Thermos®, central heating, hair dryer, home insulation, microwave ovens).
- Compare the advantages and disadvantages of different home heating systems (e.g., forced air furnace, electric baseboard).

Elaboration

Focus question: How does the transfer of energy affect human-built environments?

The concept of heat transfer should be approached by having students research historic and modern methods of heating homes on Prince Edward Island. This discussion could include fire places, wood/coal stoves, and more recent innovations such as central heating systems, electric baseboards, air conditioning, solar heating, and geothermal heating. The broad range of heating technologies studied will expose students to examples of conduction, radiation, and convection. They can then discuss the advantages and disadvantages of different home heating systems. Students should understand, in general terms, how heat flows through a house and how thermostats keep a home at a desired temperature.

A culminating activity for this unit could be to have students work collaboratively and use the design process to develop a prototype of a device that manipulates the principles of conduction, convection, and radiation to maximize or minimize heat transfer (e.g., keep an ice cube from melting for as long as possible, cook an egg as fast as possible, build a better winter glove, build a model of a super-insulated doghouse).

Literacy connection (Summarizing): Summarizing involves reducing a text to its main points. After reading, good readers summarize by thinking about the most important details. Students could ask themselves, “What are the key ideas about heat transfer? How can this information help us build our prototype?”

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **ESS1 Identify the characteristics and relationships between rocks and minerals.**

4SCIA	7SCIA	
Rocks, Minerals and Erosion Students describe, compare, and classify rocks and minerals according to their physical properties.	**ESS1 Identify the characteristics and relationships between rocks and minerals.**	

Achievement Indicators

Students who have achieved this outcome should be able to...

- Classify minerals based on their physical properties.
- List the similarities and differences between rocks and minerals.
- Identify the three main types of rocks (igneous, metamorphic, and sedimentary) and their relationships in the rock cycle.

Elaboration

Focus question: How are old rocks recycled into new rocks?

Students should be given the opportunity to use a classification key to identify sample minerals based on their physical properties (e.g., lustre, colour, streak, hardness, cleavage, and fracture). Students should be made aware that in order to correctly identify minerals, more than one property must be observed.

Students should learn that Earth's crust is composed of a variety of rocks and minerals in a multitude of combinations and forms. Students can be asked to bring in one or more samples of local rocks and examine them in order to identify any similarities and differences among them. Students should be encouraged to propose questions that could lead to investigations about how the main rock types form. Questions, such as, "How do the crystals or minerals form in a rock?" or "Why do some rocks have layers?" can be investigated in a variety of activities.

Students can simulate the formation of the three basic rock types (igneous, sedimentary, and metamorphic) through a series of hands-on activities. They should also see that the relationship of the formation of rocks can be depicted in a rock cycle diagram. Students can investigate commercial or other human uses of rocks and how that usage relates to the properties of rock. When discussing examples of the three rock types, teachers should use actual examples.

Literacy connection (Writing): Students need opportunities to write about science. A biopoem follows a pattern that enables writers to synthesize and reflect on what they have learned about a person, place, thing, concept, or event under study. For example, students could write a biopoem as a rock, or about the rock, or the rock cycle.

Science

7SCIA

Earth's Crust

Learning Contexts	
✓	Scientific Inquiry
	Technological Problem Solving
	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **ESS2 Explain how the Earth's crust undergoes gradual and sudden changes over time.**

	7SCIA	8SCIA
	ESS2 Explain how the Earth's crust undergoes gradual and sudden changes over time.	Water Systems on Earth Students examine how water movement shapes our landscape.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Describe the composition of the Earth's crust and some of the technologies which have allowed scientists to study geological features in and on the Earth's crust.
- Explain, using models or simulations, why earthquakes and volcanoes occur and how mountains are formed.
- Describe how plate tectonic theory has evolved in the light of new evidence.
- Research catastrophic geological events (e.g., volcanoes, earthquakes, tsunamis) and predict the impact of future events on the environment, economy, and society.

Elaboration

Focus question: How do we know that the Earth's crust is constantly changing?

Students could construct a global map of catastrophic geological events such as volcanoes and earthquakes, and then examine the relationship between the location of these events and the major geological plates. Once students understand *what* happens at plate boundaries they can begin to investigate *why* this happens. Students may develop a conceptual model of Earth's crust and core which explains the role of convection currents in plate movement. Students should appreciate that mounting evidence from a variety of sources led to our present theory of plate tectonics.

Mountain formation, folding, and faulting can be dealt with as local or regional aspects of global plate tectonic movement. Students can observe maps of continents and ocean basins that contain ocean ridges and major structural features. Investigation into how volcanic activity contributes to mountain building should be a part of this study of these processes. Various models and visualizations can be used so that students can explore and understand these processes. Students should begin to appreciate the magnitude of time involved in most geological processes and events.

Literacy connection (Cause-and-Effect Text Pattern): Science text is often written in a cause-effect order. It explains events that have occurred (cause) and what happens as a result of these events (effect). As they read this section, students should consider the effects of changes to the Earth's crust.

Science
7SCIA

Earth's Crust

Learning Contexts	
✓	Scientific Inquiry
✓	Technological Problem Solving
✓	STSE Decision Making

Specific Curriculum Outcome
Students will be expected to... **ESS3 Investigate the characteristics of soil and conditions that affect its formation and degradation.**

3SCIA	7SCIA	8SCIA
Exploring Soils Students gather a variety of soil samples from different locations and examine their composition.	**ESS3 Investigate the characteristics of soil and conditions that affect its formation and degradation.**	Water Systems on Earth Students examine how water movement shapes our landscape.

Achievement Indicators

Students who have achieved this outcome should be able to...

- Discuss how soil is a component of the Earth's crust.
- Differentiate between weathering, erosion, and deposition, and explain their effects on PEI's environment.
- Use tools safely and accurately to collect and examine samples of local soils to determine their physical properties (e.g., colour, texture, presence of organic matter, pore size, and air and water holding capacity).
- Assess the environmental, societal, and economic impacts of past and current land use practices in PEI (e.g., agriculture, urban development, recreation, road construction).
- Use the design process to create a prototype of a device or system to prevent soild erosion.

Elaboration

Focus question: How is soil made, moved, and lost?

Weathering (mechanical and chemical) and erosion are important components of the rock cycle. It is important that students differentiate between the terms weathering (process of wearing structures down) and erosion (moving weathered material). Students should realize that weathered and eroded rocks form the parent material of soils.

Soil use and loss is of key importance to Prince Edward Island and all of its citizens. Farmers and others who have a stake in sustaining good, fertile soils must be aware of what our activities and technologies can do to enhance and harm soils. Students should investigate and classify soils as to their basic types (clay, silt, sand) and relate the soil type to other factors such as the location in which it is found and the types of vegetation growing in it. A farmer or soil-management technician can be invited to class to discuss ways in which soils are enriched.

Students can be asked to identify examples of soil erosion in their community. Students should be encouraged to investigate, debate, and discuss the use and misuse of soil in their region or in the context of agricultural use, urban development, road construction and forestry practices. They should then create a prototype of a device or system that is designed to prevent soil erosion in one of these contexts.

Literacy connection (Critical Literacy): As they read about past and current land use practices, ask students if the information is objective or identifies a bias. What factors need to be considered? Students should use critical literacy skills when researching a major issue regarding land use practices in PEI. Students could write a position paper or formal letter.