Atlantic Canada Science Curriculum

New Brunswick
Department of Education
Educational Programs & Services Branch

New Nouveau Brunswick

Science 7

CURRICULUM

2002

Additional copies of this document (*Science Grade 7*) may be obtained from the Instructional Resources Branch.
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Foreword

The pan-Canadian *Common Framework of Science Learning Outcomes K to 12*, released in October 1997, assists provinces in developing a common science curriculum framework.

New science curriculum for the Atlantic Provinces is described in *Foundation for the Atlantic Canada Science Curriculum (1998)*.

This curriculum guide is intended to provide teachers with the overview of the outcomes framework for science education. It also includes suggestions to assist teachers in designing learning experiences and assessment tasks.

Acknowledgements

The departments of Education of New Brunswick, Newfoundland and Labrador, Nova Scotia and Prince Edward Island gratefully acknowledge the collaborative effort of all teachers and other educators and stakeholders across Atlantic Canada who contributed to the development of the Grade 7 Science curriculum.

Contents

The placement of the units in this curriculum guide is not meant to suggest coverage sequence. Units can be covered in any order.

Introduction

Background

The curriculum described in *Foundation for the Atlantic Canada Science Curriculum* was planned and developed collaboratively by regional committees. The process for developing the common science curriculum for Atlantic Canada involved regional consultation with the stakeholders in the education system in each Atlantic province. The Atlantic Canada science curriculum is consistent with the framework described in the pan-Canadian *Common Framework of Science Learning Outcomes K to 12*.

Aim

The aim of science education in the Atlantic provinces is to develop scientific literacy.

Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become life-long 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.

Program Design and Components

Learning and Teaching Science

What students learn is fundamentally connected to how they learn it. The aim of scientific literacy for all has created a need for new forms of classroom organization, communication, and instructional strategies. The teacher is a facilitator of learning whose major tasks include

- creating a classroom environment to support the learning and teaching of science
- designing effective learning experiences that help students achieve designated outcomes
- stimulating and managing classroom discourse in support of student learning
- learning about and then using students' motivations, interests, abilities, and learning styles to improve learning and teaching
- assessing student learning, the scientific tasks and activities involved, and the learning environment to make ongoing instructional decisions
- selecting teaching strategies from a wide repertoire

Effective science learning and teaching take place in a variety of situations. Instructional settings and strategies should create an environment that reflects a constructive, active view of the learning process. Learning occurs through actively constructing one's own meaning and assimilating new information to develop a new understanding.

The development of scientific literacy in students is a function of the kinds of tasks they engage in, the discourse in which they participate, and the settings in which these activities occur. Students' disposition towards science is also shaped by these factors. Consequently, the aim of developing scientific literacy requires careful attention to all of these facets of curriculum.

Learning experiences in science education should vary and should include opportunities for group and individual work, discussion among students as well as between teacher and students, and hands-on/minds-on activities that allow students to construct and evaluate explanations for the phenomena under investigation. Such investigations and the evaluation of the evidence accumulated provide opportunities for students to develop their understanding of the nature of science and the nature and status of scientific knowledge.

Writing in Science

Learning experiences should provide opportunities for students to use writing and other forms of representation as ways to learning. Students, at all grade levels, should be encouraged to use writing to speculate, theorize, summarize, discover connections, describe processes, express understandings, raise questions, and make sense of new information using their own language as a step to the language of science. Science logs are useful for such expressive and reflective writing. Purposeful note making is also an instrinsic part of learning in science that can help students better record, organize, and understand information from a variety of sources. The process of creating webs, maps, charts, tables, graphs, drawing, and diagrams to represent data and results help students learn and also provides them with useful study tools.

Learning experiences in science should also provide abundant opportunities for students to communicate their findings and understandings to others, both formally and informally, using a variety of forms for a range of purposes and audiences. Such experiences should encourage students to use effective ways of recording and conveying information and ideas and to use the vocabulary of science in expressing their understandings. It is through opportunities to talk and write about the concepts they need to learn that students come to better understand both the concepts and related vocabulary.

Learners will need explicit instruction in and demonstration of the strategies they need to develop and apply in reading, viewing, interpreting, and using a range of science texts for various purposes. It will be equally important for students to have demonstrations of the strategies they need to develop and apply in selecting, constructing, and using various forms for communicating in science.

The Three Processes of Scientific Literacy

An individual can be considered scientifically literate when he/she is familiar with, and able to engage in, three processes: inquiry, problem-solving, and decision making.

Inquiry

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

Problem Solving

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

Decision Making

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

Meeting the Needs of All Learners

Foundation for the Atlantic Canada Science Curriculum stresses the need to design and implement a science curriculum that provides equitable opportunities for all students according to their abilities, needs, and interests. Teachers must be aware of and make adaptations to accommodate the diverse range of learners in their class. To adapt instructional strategies, assessment practices, and learning resources to the needs of all learners, teachers must create opportunities that will permit them to address their various learning styles.

As well, teachers must not only remain aware of and avoid gender and cultural biases in their teaching, they must also actively address cultural and gender stereotyping (e.g., about who is interested in and who can succeed in science and mathematics. Research supports the position that when science curriculum is made personally meaningful and socially and culturally relevant, it is more engaging for groups traditionally under-represented in science, and indeed, for all students.

While this curriculum guide presents specific outcomes for each unit, it must be acknowledged that students will progress at different rates.

Teachers should provide materials and strategies that accommodate student diversity, and should validate students when they achieve the outcomes to the best of their abilities.

It is important that teachers articulate high expectations for all students and ensure that all students have equitable opportunities to experience success as they work toward achieving designated outcomes. Teachers should adapt classroom organization, teaching strategies, assessment practices, time, and learning resources to address students' needs and build on their strengths. The variety of learning experiences described in this guide provide access for a wide range of learners. Similarly, the suggestions for a variety of assessment practices provide multiple ways for learners to demonstrate their achievements.

Assessment and Evaluation

The terms “assessment” and “evaluation” are often used interchangeably, but they refer to quite different processes. Science curriculum documents developed in the Atlantic region use these terms for the processes described below.

Assessment is the systematic process of gathering information on student learning.

Evaluation is the process of analysing, reflecting upon, and summarizing assessment information, and making judgments or decisions based upon the information gathered.

The assessment process provides the data, and the evaluation process brings meaning to the data. Together, these processes improve teaching and learning. If we are to encourage enjoyment in learning for students now and throughout their lives, we must develop strategies to involve students in assessment and evaluation at all levels. When students are aware of the outcomes for which they are responsible and of the criteria by which their work will be assessed or evaluated, they can make informed decisions about the most effective ways to demonstrate their learning.

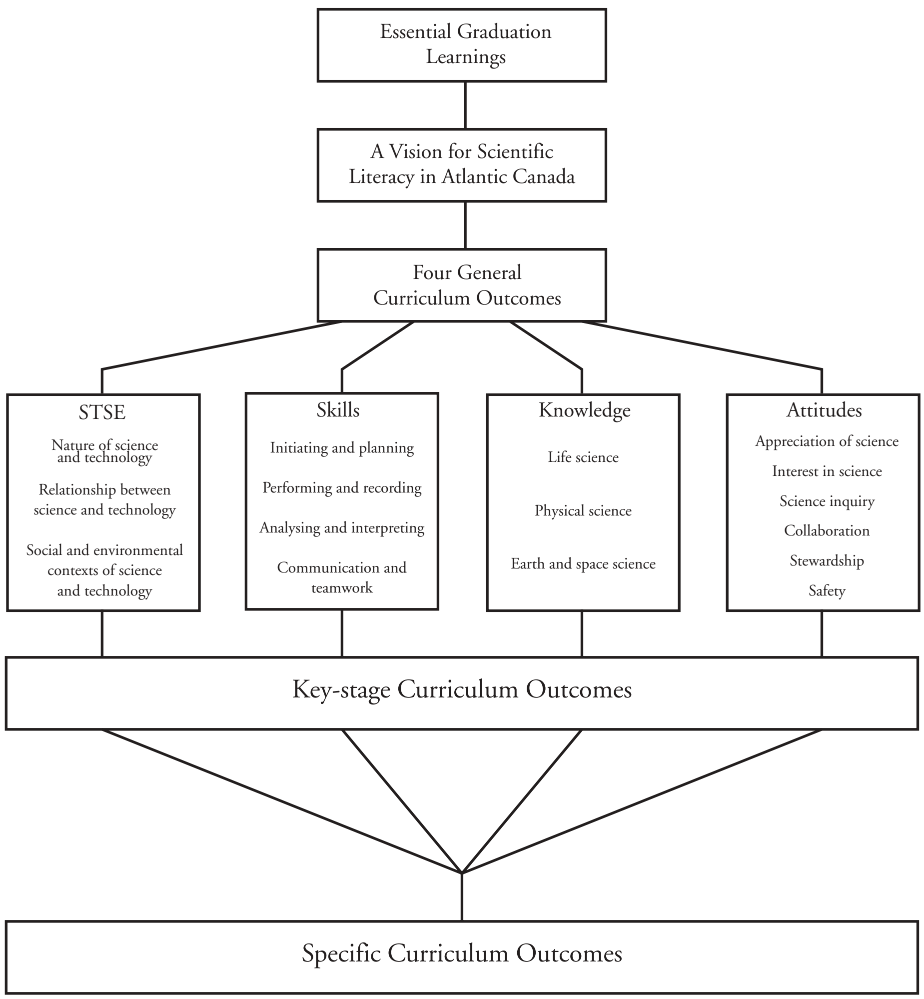
The Atlantic Canada science curriculum reflects the three major processes of science learning: inquiry, problem solving, and decision making. When assessing student progress, it is helpful to know some activities/skills/actions that are associated with each process of science learning. Student learning may be described in terms of ability to perform these tasks.

Curriculum Outcomes Framework

Overview

The science curriculum is based on an outcomes framework that includes statements of essential graduation learnings, general curriculum outcomes, key-stage curriculum outcomes, and specific curriculum outcomes. The general, key-stage, and specific curriculum outcomes reflect the pan-Canadian *Common Framework of Science Learning Outcomes K to 12*. Figure 1 provides the blueprint of the outcomes framework.

Outcomes Framework



General Curriculum Outcomes

The general curriculum outcomes form the basis of the outcomes framework. They 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 interrelated and mutually supportive.

Science, Technology, Society, and the Environment

Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology.

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.

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.

Attitudes

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

Key-Stage Curriculum Outcomes

Key-stage curriculum outcomes are statements that identify what students are expected to know, be able to do, and value by the end of grades 3, 6, 9, and 12 as a result of their cumulative learning experiences in science. The key-stage curriculum outcomes are from the *Common Framework for Science Learning Outcomes K-12*.

Specific Curriculum Outcomes

Specific curriculum outcome statements describe what students are expected to know and be able to do at each grade level. They are intended to help teachers design learning experiences and assessment tasks. Specific curriculum outcomes represent a framework for assisting students to achieve the key-stage curriculum outcomes, the general curriculum outcomes, and ultimately, the essential graduation learnings.

Specific curriculum outcomes are organized in units for each grade level.

Attitude Outcomes

It is expected that the Atlantic Canada science program will foster certain attitudes in students throughout their school years. The STSE, skills, and knowledge outcomes contribute to the development of attitudes, and opportunities for fostering these attitudes are highlighted in the Elaborations—Strategies for Learning and Teaching sections of each unit.

Attitudes refer to generalized aspects of behaviour that teachers model for students by example and by selective approval. Attitudes are not acquired in the same way as skills and knowledge. The development of positive attitudes plays an important role in students' growth by interacting with their intellectual development and by creating a readiness for responsible application of what students learn.

Since attitudes are not acquired in the same way as skills and knowledge, outcome statements for attitudes are written as key-stage curriculum outcomes for the end of grades 3, 6, 9, and 12. These outcome statements are meant to guide teachers in creating a learning environment that fosters positive attitudes.

The attitude outcomes from grade 7 through grade 9 are listed in pages 12-13.

From grade 7 through grade 9

It is expected that students will be encouraged to...

Appreciation of science

422 appreciate the role and contribution of science and technology in our understanding of the world
423 appreciate that the applications of science and technology can have advantages and disadvantages
424 appreciate and respect that science has evolved from different views held by women and men from a variety of societies and cultural backgrounds

Evident when students, for example,

– recognize the potential conflicts of differing points of view on specific science-related issues
– consider more than one factor or perspective when formulating conclusions, solving problems, or making decisions on STSE issues
– recognize the usefulness of mathematical and problem-solving skills in the development of a new technology
– recognize the importance of drawing a parallel between social progress and the contributions of science and technology
– establish the relevance of the development of information technologies and science to human needs
– recognize that science cannot answer all questions
– consider scientific and technological perspectives on an issue
– identify advantages and disadvantages of technology
– seek information from a variety of disciplines in their study
– avoid stereotyping scientists
– show and interest in the contributions women and men from many cultural backgrounds have made to the development of science and technology

Interest in Science

425 show a continuing curiosity and interest in a broad scope of science-related fields and issues
426 confidently pursue further investigations and readings
427 consider many career possibilities in science- and technology-related fields

Evident when students, for example,

– attempt at home to repeat or extend a science activity done at school
– actively participate in co-curricular and extra-curricular activities such as science fairs, science clubs, or science and technology challenges
– choose to study topics that draw on research from different science and technology fields
– pursue a science-related hobby
– discuss with others the information presented in a science show or on the Internet
– attempt to obtain information from a variety of sources
– express a degree of satisfaction at understanding science concepts or resources that are challenging
– express interest in conducting science investigations of their own design
– choose to investigate situations or topics that they find challenging
– express interest in science- and technology-related careers
– discuss the benefits of science and technology studies

Scientific inquiry

428 consider observation and ideas from a variety of sources during investigations and before drawing conclusions
429 value accuracy, precision, and honesty
430 persist in seeking answers to difficult questions and solutions to difficult problems

Evident when students, for example,

– ask questions to clarify meaning or confirm their understanding
– strive to assess a problem or situation accurately by careful analysis of evidence gathered
– propose options and compare them before making decisions or taking action
– honestly evaluate a complete set of data based on direct observation
– critically evaluate inferences and conclusions, basing their arguments on fact rather than opinion
– critically consider ideas and perceptions, recognizing that the obvious is not always right
– honestly report and record all observations, even when the evidence is unexpected and will affect the interpretation of results
– take the time to gather evidence accurately and use instruments carefully
– willingly repeat measurements or observations to increase the precision of evidence
– choose to consider a situation from different perspectives
– identify biased or inaccurate interpretations
– report the limitations of their designs
– respond skeptically to a proposal until evidence is offered to support it
– seek a second opinion before making a decision
– continue working on a problem or research project until the best possible solutions or answers are identified

From grade 7 through grade 9

It is expected that students will be encouraged to...

Collaboration

431 work collaboratively in carrying out investigations as well as in generating and evaluating ideas

Evident when students, for example,

- assume responsibility for their share of the work to be done
- willingly work with new individuals regardless of their age, their gender, or their physical or cultural characteristics
- accept various roles within a group, including that of leadership
- help motivate others
- consider alternative ideas and interpretations suggested by members of the group
- listen to the point of view of others
- recognize that others have a right to their points of view
- choose a variety of strategies, such as active listening, paraphrasing, and questioning, in order to understand others' points of view
- seek consensus before making decisions
- advocate the peaceful resolution of disagreements
- can disagree with others and still work in a collaborative manner
- are interested and involved in decision making that requires full-group participation
- share the responsibility for carrying out decisions
- share the responsibility for difficulties encountered during an activity

Stewardship

432 be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment

433 project, beyond the personal, consequence of proposed actions

Evident when students, for example,

- show respect for all forms of life
- consider both the immediate and long-term effects of their actions
- assume personal responsibility for their impact on the environment
- modify their behaviour in light of an issue related to conservation and protection of the environment
- consider the cause-and-effect relationships of personal actions and decisions
- objectively identify potential conflicts between responding to human wants and needs and protecting the environment
- consider the points of view of others on a science-related environmental issue
- consider the needs of other peoples and the precariousness of the environment when making decisions and taking action
- insist that issues be discussed using a bias-balanced approach
- participate in school or community projects that address STSE issues

Safety

434 show concern for safety in planning, carrying out, and reviewing activities

435 become aware of the consequences of their actions

Evident when students, for example,

- read the labels on materials before using them, and ask for help if safety symbols are not clear or understood
- readily alter a procedure to ensure the safety of members of the group
- select safe methods and tools for collecting evidence and solving problems
- listen attentively to and follow safety procedures explained by the teacher or other leader
- carefully manipulate materials, using skills learned in class or elsewhere
- ensure the proper disposal of materials
- immediately respond to reminders about the use of safety precautions
- willingly wear proper safety attire without having to be reminded
- assume responsibility for their involvement in a breach of safety or waste disposal procedures
- stay within their own work area during an activity, respecting others' space, materials and work
- take the time to organize their work area so that accidents can be prevented
- immediately advise the teacher of spills, breaks, and unusual occurrences, and use appropriate techniques, procedures, and materials to clean up
- clean their work area during and after an activity
- seek assistance immediately for any first aid concerns like burns, cuts, or unusual reactions
- keep the work area uncluttered, with only appropriate materials present

Curriculum Guide Organization

Specific curriculum outcomes are organized in units for each grade level. Each unit is organized by topic. Suggestions for learning, teaching, assessment, and resources are provided to support student achievement of the outcomes.

The order in which the units of a grade appear in the guide is meant to suggest a sequence. In some cases, the rationale for the recommended sequence is related to the conceptual flow across the year. That is, one unit may introduce a concept that is then extended in a subsequent unit. Likewise, one unit may focus on a skill or context that will be built upon later in the year.

Some units or certain aspects of units may also be combined or integrated. This is one way of assisting students as they attempt to make connections across topics in science or between science and the real world. In some cases, a unit may require an extended time frame to collect data on weather patterns, plant growth, etc. These cases may warrant starting the activity early and overlapping it with the existing unit. In all cases, the intent is to provide opportunities for students to deal with science concepts and scientific issues in personally meaningful and socially and culturally relevant contexts.

Unit Organization

Each unit begins with a two-page synopsis. On the first page, introductory paragraphs provide an unit overview. These are followed by a section that specifies the focus (inquiry, problem solving, and/or decision making) and possible contexts for the unit. Finally, a curriculum links paragraph specifies how this unit relates to science concepts and skills addressed in other grades so teachers will understand how the unit fits with the students' progress through the complete science program.

The second page of the two-page overview provides a table of the outcomes from the *Common Framework of Science Learning Outcomes K to 12* that the unit will address. The numbering system used is the one in the pan-Canadian document as follows:

100s—Science-Technology-Society-Environment (STSE) outcomes
200s—Skills outcomes
300s—Knowledge outcomes
400s—Attitude outcomes

These code numbers appear in brackets after each specific curriculum outcome (SCO).

The Four-Column Spread

All units have a two-page layout of four columns as illustrated below. In some cases, the four-column spread continues to the next two-page layout. Outcomes are grouped by a topic indicated at the top of the left page.

Two Page, Four Column Spread

Page One		Page Two	
Topic			
Outcomes	Elaborations—Strategies for Learning and Teaching	Tasks for Instruction and/or Assessment	Resources/Notes
Students will be expected to		*Informal/Formal Observation*	Provincial responsibility
Specific curriculum outcome based on the pan-Canadian outcomes (outcome number)	elaboration of outcome and strategies for learning and teaching	*Performance* *Journal* *Interview*	
Specific curriculum outcome based on the pan-Canadian outcomes (outcome number)	elaboration of outcome and strategies for learning and teaching	*Paper and Pencil* *Presentation* *Portfolio*	

Column One: Outcomes

The first column provides the specific curriculum outcomes. These are based on the pan-Canadian *Common Framework of Science Learning Outcomes K to 12*. The statements involve the Science-Technology-Society-Environment (STSE), skills, and knowledge outcomes indicated by the outcome number(s) that appears in parenthesis after the outcome. Some STSE and skills outcomes have been written in a context that shows how these outcomes should be addressed.

Specific curriculum outcomes have been grouped by topic. Other groupings of outcomes are possible and in some cases may be necessary to take advantage of local situations. The grouping of outcomes provides a suggested teaching sequence. Teachers may prefer to plan their own teaching sequence to meet the learning needs of their students.

Column One and Column Two define what students are expected to learn, and be able to do.

Column Two: Elaborations—Atlantic Science Curriculum

The second column may include elaborations of outcomes listed in column one, and describes learning environments and experiences that will support students' learning.

The strategies in this column are intended to provide a holistic approach to instruction. In some cases, they address a single outcome; in other cases, they address a group of outcomes.

Column Three: Tasks for Instruction and/or Assessment

The third column provides suggestions for ways that students' achievement of the outcomes could be assessed. These suggestions reflect a variety of assessment techniques and materials that include, but are not limited to, informal/formal observation, performance, journal, interview, paper and pencil, presentation, and portfolio. Some assessment tasks may be used to assess student learning in relation to a single outcome, others to assess student learning in relation to several outcomes. The assessment item identifies the outcome(s) addressed by the outcome number in brackets after the item.

Column Four: Resources/Notes

Although Science Power™ 7 (McGraw Hill Ryerson) is the text that is primarily referred in this column, teachers are encouraged to seek out other resources to help address a particular outcome. All Audio Visual movies stated can be obtained through Instructional Resources, New Brunswick Department of Education.

INTERACTIONS WITHIN ECOSYSTEMS

Unit 1:
Interactions within Ecosystems

Unit Overview

Introduction

Most students have been interacting with a variety of living organisms from a very young age, but they are not necessarily aware of the essential role many organisms play in large systems like ecosystems. This unit enables students to study the diversity of organisms by introducing them to the characteristics of various organisms and by presenting different ways in which organisms interact. The dependence of living organisms on their physical world reinforces the interrelationships among all components of healthy ecosystems.

Ecosystems such as forests, croplands, rivers, lakes, estuaries, and oceans are inhabited by different organisms that are well adapted to their environment. Each ecosystem is biologically and physically unique, yet all ecosystems function as a systems model. Energy from the sun is fixed by plants and then transferred to a variety of consumers and decomposers. The ecosystems themselves are not independent of one another as energy, biotic and abiotic factors can move from one ecosystem to another to involve even larger relationships.

Focus and Context

This unit's focusses are decision making and inquiry and are concentrated on students' collections and analyses of data and information from field trips, investigations, and other sources. Students can explore and investigate a range of relationships within a familiar environment while determining the factors that enhance or threaten the existence of a particular local habitat of an organism. Students should be given the opportunity to examine and discuss real-world situations in which wildlife habitat are threatened, in order to make informed decisions on various courses of action. The context of the unit will depend on local or regional issues involving wildlife or habitat loss.

Science Curriculum Links

In previous grades, students will have been exposed to various elementary aspects of this unit. By the end of grade 3, students address the needs and characteristics of living things. In grades 4 and 6, students are introduced to habitats and communities and the diversity of life. In high school, students will be involved with a unit of study entitled "Sustainability of Ecosystems."

In this unit, students will use the concepts they have learned about biotic and abiotic factors as well as food webs to help them understand such things as the mechanics of bioaccumulation and the impact of external factors on ecosystems.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

109-1 describe the role of collecting evidence, finding relationships, and proposing explanations in the development of scientific knowledge

109-12 distinguish between terms that are scientific or technological and those that are not

109-13 explain the importance of choosing words that are scientifically and technologically appropriate

Relationships Between Science and Technology

111-1 provide examples of scientific knowledge that have resulted in the development of technologies

111-6 apply the concept of systems as a tool for interpreting the structure and interactions of natural and technological systems

Social and Environmental Contexts of Science and Technology

112-4 provide examples of Canadian institutions that support scientific and technological endeavours

112-8 provide examples to illustrate that scientific and technological activities take place in a variety of individual or group settings

113-10 provide examples of problems that arise at home, in an industrial setting, or in the environment that cannot be solved using scientific and technological knowledge

113-11 propose a course of action on social issues related to science and technology, taking into account personal need

Skills

Students will be expected to

Initiating and Planning

208-2 identify questions to investigate arising from practical problems and issues

208-3 define and delimit questions and problems to facilitate investigation

208-5 state a prediction and a hypothesis based on background information or an observed pattern of events

Performing and Recording

209-3 use instruments effectively and accurately for collecting data

209-4 organize data, using a format that is appropriate to the task or experiment

209-5 select and integrate information from various print and electronic sources or from several parts of the same source

Analysing and Interpreting

210-1 use or construct a classification key

210-2 compile and display data, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, bar graphs, line graphs, and scatter plots

210-3 identify strengths and weaknesses of different methods of collecting and displaying data

210-12 identify and evaluate potential applications of findings

Communication and Teamwork

211-5 defend a given position on an issue or problem on the basis of their findings

Knowledge

Students will be expected to

306-3 describe interactions between biotic and abiotic factors in an ecosystem

304-2 identify the roles of producers, consumers, and decomposers in a local ecosystem, and describe both their diversity and their interactions

304-1 explain how biological classification takes into account the diversity of life on Earth

306-1 describe how energy is supplied to, and how it flows through, a food web

306-2 describe how matter is recycled in an ecosystem through interactions among plants, animals, fungi, and microorganisms

304-3 describe conditions essential to the growth and reproduction of plants and microorganisms in an ecosystem, and relate these conditions to various aspects of the human food supply

306-4 identify signs of ecological succession in a local ecosystem

Components of an Ecosystem

Outcomes

Students will be expected to

- identify, delimit, and investigate questions related to a local ecosystem such as "What types of species live in a particular ecosystem?" (208-2, 208-3)
- use instruments effectively and accurately to investigate components of an ecosystem (209-3)
- organize and record data collected in an investigation of an ecosystem (209-4)
- describe interactions between biotic and abiotic factors in an ecosystem (306-3)
- identify the roles of producers, consumers, and decomposers in a local ecosystem and describe both their diversity and their interactions (304-2)
- classify organisms as producers, consumers, and decomposers (210-1)

Elaboration–Strategies for Learning and Teaching

Questions directed to the students concerning local habitats and the changes or proposed changes to them can elicit interest and discussion at the beginning of the unit of study—questions such as "What do you think will happen to the wildlife in an area if a baseball field is built?" or "What kinds of animals would a community attract if a proposed landfill site were built?"

Students have investigated and studied components and elementary relationships of and in ecosystems in grades 4 and 6. A K-W-L (What I Know–Want to Learn–Learned) chart can be started. With this approach, previous knowledge and understanding can be assessed and areas of common interests can be identified.

Students will need to visit a local habitat in order to make observations. They may visit an area that is or is going to be modified in order to gain an appreciation of how changes might affect the ecosystem.

At this level, activities exploring the interactions and the environment should be limited to the following physical or abiotic factors in the environment: temperature, moisture, light, aeration, and salinity. A class discussion of the area and a visit to the area will permit the students to observe and note what is there. Students can use instruments such as magnifying glasses, field binoculars, and hand-held microscopes to closely observe organisms in the ecosystem. Students can use thermometers to compare temperatures at different locations in the area being investigated. Light meters can also be used by some students to investigate any differences in light intensities. Upon return to class, students can attempt to classify the features and components of the ecosystem they observed which may lead to an emergent understanding of the biotic and abiotic factors in the area studied.

By discussing the roles and the needs of the living things identified in the ecosystem, students can extend their understanding of the roles and relationships among the producers, consumers, and decomposers. Students should come to realize and understand that one of the most important roles green plants have in any ecosystem is that of being a food (energy) source for consumers and decomposers. The process of photosynthesis can be explored by placing seedlings in light and darkness for several days to see the effect light has on plants. Glass containers can be placed on small plants to view the transpired water condensed on the inside of the glass. Small squares of cardboard or aluminium foil can be carefully attached to both sides of a leaf on a plant and removed several days later to observe its effects.

. . . continued

Components of an Ecosystem

Tasks for Instruction and/or Assessment

Observation

- Does the student use the instrument for collecting data (e.g., magnifying glass) appropriately and safely? (209-3)

Journal

- The thing that surprised me the most when I visited our ecosystem was ... (304-2), (306-3)
- Two questions I would like to investigate related to my local ecosystem are ... (208-2, 208-3)

Paper and Pencil

- Explain what might happen to plants if the atmosphere were to be polluted by dust from a major volcano eruption or air pollution. (306-3)
- Choose a biotic factor and an abiotic factor and describe their interaction. (306-3)
- How do you interact with biotic and abiotic factors in your environment? Think of how you affect biotic and abiotic factors in your environment. (306-3)
- Draw/sketch a particular ecosystem and note some of the interactions that take place. (306-3)
- Personify an abiotic factor and describe its possible interactions with other abiotic and biotic factors (creative writing). (306-3)
- Create a classified list of organisms from your field study and describe how the organisms interact in the ecosystem. (209-4), (210-1), (304-2)

Interview

- Is soil necessary for plant growth? Explain your answer. (306-3)

Presentation

- Work in small groups to create a bulletin-board display to show how abiotic factors affect living things. (306-3)

Resources

Science Power™ 7

Pages 6-7	Sec 1.1 (208-2, 208-3)
Pages 11-13	Sec 1.2 INV 1-B (209-3, 209-4, 306-3)
Pages 15-18	Sec 1.3 INV 1-C (208-2, 208-3, 209-3, 209-4)
Pages 38-43	Sec 2.1 (304-2, 210-1)
Pages 468-469	Appendix A (304-2, 210-1)
Page 47	CYU #6 (304-2, 210-1)

AV

"Ecosystems" - 1992 MCI #704340, VH (208-2, 208-3)

"Science Power™ 7" - MGH Available Sept. 2002 (208-2, 208-3, 306-3, 304-2, 210-1)

Components of an Ecosystem (continued)

Outcomes

Students will be expected to

- distinguish between the following scientific terms:
  - consumer
  - decomposer
  - producer
  - ecosystem
  - habitat
  - photosynthesis (109-12)
- explain how biological classification takes into account the diversity of life on Earth, using the terms *producer*, *consumer,* and *decomposer* (304-1)
- explain that observations and identification of similar characteristics enables classification in an ecosystem (109-1)

Elaboration–Strategies for Learning and Teaching

Students can use carbon dioxide sensors in a sealed vessel to measure CO_2 depletion when light is present. Students should come to realize that plants make their own foods from sunlight, carbon dioxide from the air and water. This is the first introduction to photosynthesis and should not be a major component of the unit.

Students can construct simple food chains (introduced in grade 4), using the organisms identified in the local ecosystem. The following questions may lead to further discussion regarding the quantity of producers, consumers, and decomposers in the ecosystem.
Which organisms are the most numerous? What reasons do you have to support your answer?

Students have been introduced to the terms *consumer* and *producer* in the elementary grades. It is important that the students begin to extend their understanding of the relationships incumbent in an ecosystem by including the role of decomposers and looking at the systematic and cyclic nature of an ecosystem. Students can try to classify the organisms observed in their outing to a local habitat, using the terms *producer, consumer,* and *decomposer*. Students will need to have exposure to activities in which decomposers can be more broadly and carefully studied, as most of the decomposers are microscopic. For example, students may observe mould growing on a piece of bread or fruit. Observation and discussions about such things as rotting logs or stumps and compost in compost bins can help students understand and recognize the essential role decomposers play in an ecosystem.

An investigation into the wide variety of organisms that can be classified as either producers, consumers, or decomposers will help students understand that a wide range of organisms can be associated under these categories. For example, students can come to understand that organisms as diverse as spiders, cats, and deer can all be classified as consumers because of their reliance on producers or other consumers.

Components of an Ecosystem (continued)

Tasks for Instruction and/or Assessment

Paper and Pencil

- Classify some of the organisms as producers, consumers, or decomposers, after viewing a video on a particular ecosystem. (109-1), (210-1)
- Why would robins and crows both be classified as consumer? (109-1)

Presentation

- Using a camera (digital, video, or 35 mm), take pictures of decomposers in an ecosystem and display them on a poster, or show them with notes explaining their role in a food chain. (304-1)
- Prepare a model of an ecosystem from Plasticine or paper-mâché and identify and distinguish between producers and consumers in their habitats. (109-12)

Portfolio

- Classify the organisms found in pictures from a wildlife magazine or other similar source as producers, consumers, and decomposers. Explain how we can use this classification system to group most living things. (210-1)

Resources

Science Power™ 7

Pages 6-7	Sec 1.1 (109-12)
Pages 38-43	Sec 2.1 (109-12)
Pages 67-68	(109-12)
Pages 15-18	INV 1-C (304-1, 109-1)

AV
"Biology Essentials - Web of Life"
#705400, VH (109-12, 304-1)

Food Webs

Outcomes

Students will be expected to

- demonstrate the importance of choosing words that are scientifically appropriate by using these words in context:
  - niche
  - habitat
  - population
  - community
  - ecosystem (109-13)
- prepare a chart that describes how energy is supplied to, and how it flows through, a food web (210-2, 306-1)
- identify the strengths and weaknesses of a diagram showing the flow of energy in an ecosystem (210-3)
- apply the concept of a food web as a tool for interpreting the structure and interactions of a natural system (111-6)
- describe how matter is recycled in an ecosystem through interactions among plants, animals, fungi, and microorganisms (306-2)
- identify and evaluate potential applications of the recycling of matter in an ecosystem (210-12)

Elaboration–Strategies for Learning and Teaching

Students should be able to demonstrate their understanding of the vocabulary and related concepts associated with the interactions within ecosystems. Students should not be expected to simply give definitions for these terms. Instead, the following terms and concepts should be introduced in context and assessed in sense-making assessment activities. *The niche of an organism is the role it plays within a community. The place where an organism lives is called its habitat. A population is a group of organisms of the same species that live in the same area at the same time. A community is composed of all of the populations that live and interact with each other in a particular area. An ecosystem is a community of organisms interacting with each other and with abiotic factors in their environment.* Students should be given a variety of opportunities in learning activities to demonstrate their understanding of these terms.

From their observations, discussions, and the use of simple diagrams, students can identify a number of the food chains constructed after visiting the local ecosystem, and begin to link the food chains together to form other food chains and food webs.

The flow of energy in the various relationships can be discussed to illustrate the quantity of biotic material that is required in various parts of a food chain. This should be extended to food webs. Students can prepare a chart or some other similar visual representation of the quantity of energy requirements. Students should come to understand that many producers are required to provide the energy/food required for a small number of consumers. This should be a qualitative appreciation using food or energy pyramids, for example. It is important that students be asked to identify and reflect upon the strengths and weaknesses in the types of representation used to illustrate energy transformations. Food or energy pyramids illustrate the direction and relative amounts of food or energy that flows through a foodchain. These representations do not always indicate the exact amounts of food or energy required and tend to restrict themselves to simple foodchain examples. Students should also recognize the fact that energy is transformed into other types of energy and is not always used just for growth.

Students should use their knowledge and understanding of food-chains to construct possible food webs. It is important that students appreciate the potential complexity of a food web and that an organism in one food web may be part of a number of other food webs.

Students should investigate and explore what happens to consumers that have no predators and other biotic material that is not consumed. This will help the students to gain an appreciation of the role of the decomposers. It will also help to further their understanding of the systematic and cyclic nature of matter and energy in ecosystems, as well as overpopulation of some species.

Food Webs

Tasks for Instruction and/or Assessment

Performance

- Draw a food web of organisms researched, using various print and electronic sources. Illustrate the flow of energy throughout the food web in the form of a poster. (111-6, 210-2, 306-1)

Journal

- Tell me how you could explain the following terms so that a grade 3 or 4 student would understand their meanings and relationships:
  - niche - ecosystem - community (109-13)
  - population - habitat

- Describe the niche of a fungus. (109-13)

- What are some of the ideas that you can communicate well, using a food web? What are some ideas that cannot be communicated well? (111-6)

Paper and Pencil

- Give examples of populations of plants in your backyard. (109-13)

- In an essay, describe how matter (hay for cattle, for example) is recycled in the ecosystem. Describe the roles of plants, animals and decomposers. (111-6, 210-2, 306-1, 306-2)

- Write a short story that illustrates the flow of energy through a food chain or a sample food web. (111-6, 306-1)

Presentation

- Construct a three-dimensional model of a food web. (111-6)

- Interview a hog farmer to learn how pig manure is recycled and used as a fertilizer. Report to the class. (306-2)

Portfolio

- Research and report on the composting of organic/biotic material in a local Waste Watch program. (210-12)

Resources

Science Power™ 7

Pages 6-7	Sec 1.1 (109-13)
Pages 46	(109-13)
Pages 38-40	Sec 2.1 (210-2, 210-3, 306-1, 111-6)
Pages 51-53	Sec 2.3 (210-2, 210-3, 306-4)
Page 46	(210-2, 306-1)
Page 16-18	INV 1-C (111-6)
Page 42-45	INV 2-B (306-2, 210-12)

Decomposers

Outcomes

Students will be expected to

- describe conditions essential to the growth and reproduction of plants and microorganisms in an ecosystem, and relate these conditions to various aspects of the human food supply:
  - air
  - temperature
  - light
  - moisture (304-3)

- provide examples of how knowledge of microorganisms has resulted in the development of food production and preservation techniques:
  - describe techniques used in the past (pickling, salting, drying, smoking) to preserve food
  - describe more recent food preservation techniques that have been developed to preserve food (refrigeration, freeze-drying, radiation, canning) (111-1)

Elaboration–Strategies for Learning and Teaching

One approach to develop students' appreciation and understanding of the basic conditions necessary for growth and reproduction in plants and microorganisms is to investigate the environmental requirements of both plants and decomposers which are familiar to the students. Key concepts that should be addressed are that microorganisms

- are found in a variety of habitats
- play important roles in relation to human food supplies
- have been used by people who continue to use a variety of technologies and approaches to food preservation.

Many students have had experience with food decomposing in a variety of contexts. Bread in the bread container or long-forgotten lunches in lockers are examples. Students can identify the conditions that are required for decomposition and thus growth of microorganisms. Particular attention should be given to working with or handling materials that are decomposing. A fair test can be designed and carried out in order to determine the best conditions for decomposition.

Teachers can also use this opportunity to help students learn more about the use and care of the light microscope and/or dissecting microscope while observing common decomposers such as fungi.

Inviting representatives from the food-growing and/or food-processing industries, such as farmers and food technologists, provides an opportunity to learn about the links among the foods we eat and the microorganisms that also depend on and at times spoil the food grown and processed. A Health Inspector for food establishments may also be a possible guest speaker.

Students can proceed to investigate past and present food preservation methods which protect food supplies from being adversely affected by microbial action. Students can interview parents, grandparents, or older neighbours about how food was preserved in the past. A collage of food preservation techniques or actual samples can be prepared for class study.

Students should come to realize that the components of decomposed organic matter not utilized by decomposers is often reused as nutrients by green plants. Composting and *Waste Watch* programs can be highlighted and discussed at this point. A field trip to a farm that uses compost or a local business that manufacturers compost will highlight the economic benefits of composting.

Decomposers

Tasks for Instruction and/or Assessment

Journal

- Imagine you are a fungus or bacterium on an apple core put into a compost pile. Describe your life over a two-week period of time in the compost heap. (304-3)

Paper and Pencil

- Write a lab/activity summary describing the results of a fair test to determine conditions essential to the growth of plants and/or microorganisms. (304-3)

- Analyse your results in a fair-test activity to explain why cold rooms were important storage areas in many farmhouses in the past. (304-3)

- Interview a person who composts in order to learn about conditions required for decomposition of wastes. (304-3)

- Plants are producers and fungi are decomposers. Which conditions essential for growth and development might be common for both? (304-3)

Presentation

- Prepare a collage of food preservation techniques used in the present and in the past. (111-1)

- Describe how twenty food items in your house are preserved. Give the name of the food and the preservation technique used to keep it safe to eat. (111-1)

- Interview a senior in your community to learn about what types of foods were pickled, salted, dried, and smoked in the past to preserve them. Report to the class. (111-1)

- Research and report on the history of canning as a food preservation technique. (111-1)

Resources

Science Power™ 7

Pages 12-13 INV 1-B (304-3)

Internet
- Howthingswork.com
- AskJeeves.com
  For research to answer.... (111-1)

Ecological Succession

Outcomes

Students will be expected to

- identify signs of ecological succession in a local ecosystem:
  - pioneer species
  - climax community
  - primary succession
  - secondary succession (306-4)
- predict what an ecosystem will look like in the future on the basis of the characteristics of the area and the long-term changes (succession) observed in the site (208-5)

Elaboration–Strategies for Learning and Teaching

View pictures, film strips, videos, or other media to study the various stages of succession in a particular area. Preferably, students can participate in a field trip to areas that are in various stages of ecological succession, such as old farm fields and "scrubby" (pin cherry, alders, aspen) areas. If the opportunity for students to visit an area in a particular stage of ecological succession is at hand, students can observe and describe the ecosystem in detail. They can record and report the biotic and abiotic factors observable in the ecosystem.

Students can be asked to prepare before and after pictures of the above-mentioned scenarios. The teacher can also ask students to predict what will happen further into the future with regard to the environments previously mentioned. It may be advantageous to ask older relatives and/or community members for historical information in order to gain a better appreciation of the magnitude of change over time within a particular ecosystem.

Students should come to understand that ecosystems are very dynamic. The change may be slow and difficult to perceive over short periods of time, such as in the establishment of pioneer species such as mosses and lichens in a mined-over area, or it may be rapid as in the case of a forest fire. Ultimately, most ecosystems reach a fairly stable stage compared to those that preceded it. This is called a climax community. Two types of ecological succession are generally recognized and should be addressed. First, there is primary succession which takes place in areas lacking soil (bare rocks, sand dunes, surface mining areas, and cooled volcanic lava). More common and recognizable to most students is secondary succession. This occurs in areas that were previously inhabited (abandoned farm land, burned forests, and polluted areas).

Students should be challenged to think of positive or negative ways in which forest fires impact upon biotic and/or abiotic factors. Activities and discussion will lead the students to appreciate the fact that a particular change that may impact negatively on one aspect of an ecosystem may in fact benefit another aspect of that ecosystem.

After a series of activities and opportunities to examine and reflect upon ecological succession in a number of contexts, students should be able to predict the various stages of ecological succession in a given situation.

Ecological Succession

Tasks for Instruction and/or Assessment

Performance

- Create a model that illustrates various stages of succession from pioneer species to a climax community. (306-4)

Journal

- Compare and contrast historical and recent photographs of areas in which primary and/or secondary succession has taken place. (306-4)

Paper and Pencil

- Interview farmers in the community to prepare a report on ecological succession on local farmland. (306-4)
- Write a report about the various major succession changes after a major forest fire. (208-5)
- Draw a ditch/pond/flower bed/woodlot, and so forth, 20 years ago, at present, and 20 years in the future. (208-5)

Presentation

- Describe or illustrate what a sidewalk, an abandoned farm, or a clearcut forest might look like ten years in the future. (208-5)
- Research and write a report on the impact a forest fire might have on the types of sun-tolerant trees that might establish themselves on the site. (208-5)
- Prepare a video presentation of several local areas in which a number of stages of ecological succession are taking place at once. (208-5), (306-4)

Portfolio

- Prepare a series of drawings/sketches that show the succession in an unkept vegetable garden/pond/powerline corridor. (306-4)
- Develop a concept web, using the following concepts: succession, herbivore, carnivore, communalism, predation, decomposer, ecosystem, habitat, and niche. (208-5, 306-4)

Resources

Science Power™ 7

Pages 54-58	Sec 2.4 INV 2-C (306-4)
Page 79	(208-5)

Action

Outcomes

Students will be expected to

- propose and defend a course of action to protect the local habitat of a particular organism (113-11, 211-5)
- provide examples of problems that arise in the environment that cannot be solved using scientific or technological knowledge (113-10)
- use various print and electronic sources to research individuals or groups in Canada interested in protecting the environment (112-4, 112-8, 209-5)

Elaboration–Strategies for Learning and Teaching

During the study of this unit, students have gathered and organized data and information about the local habitat being investigated as well as at least one organism that lives in the habitat. Students have acquired enough information to produce and defend a recommendation to protect the local habitat of the organism they have investigated. Students should be encouraged to reflect upon a variety of possible courses of action to protect the habitat and choose and act upon one of them.

Students should be given the chance to identify problems and situations that cannot be wholly solved by using scientific or technological knowledge. Students may come to the conclusion, for example, that the particular habitat that they have investigated may indeed succumb to development without crucially harming a particular species in an area, but the decision may be based on a variety of other factors such as financial, aesthetic, or future considerations. Students should realize that there are problems that arise in the environment that are dealt with from a societal or political standpoint. There may be compelling scientific evidence, for example, to make a particular decision, but it might not be a popular or desirable one in a particular community or region because of other factors. A number of examples can be highlighted and discussed, such as the following scenarios. An area of high unemployment has the chance to have a blueberry-processing/ packaging plant in the region if enough forest land can be transformed into blueberry fields. A group of citizens refuses to permit an aquaculture endeavour from developing a certain shoreline. A particular community refuses to have a modern landfill site in its area. A national park decides to reduce the number of visitors owing to environmental damage, but the local community believes that such a measure would have a negative impact on the local economy.

An extrapolation to regional, national, and perhaps even global exemplars related to the local habitat scenario will permit students to identify and associate environmental conservation groups, federal and/ or provincial government departments, and even Canadians who are well known for being responsible for or interested in the environment. Students can investigate environmental organisms such as the Canadian Nature Federation, Friends of the Earth, Project Green, the Sierra Club of Canada, the World Wildlife Fund of Canada, and Ducks Unlimited. Students can participate in a webquest in which a particular group is researched to learn of its mandate.

Action

Tasks for Instruction and/or Assessment

Observation

- Participate in a role-play/debate in which various points of view are put forth regarding the preservation or utilization of a local habitat. Develop a scoring rubric for your preparation on work and your participation in the debate. (211-5)

Journal

- Describe one problem in the environment that cannot be solved using scientific or technological knowledge and explain why it is seen as a problem for people. (113-10)

Paper and Pencil

- Research and prepare a report based on protecting the local habitat of a particular organism. (113-11)
- Write to a group such as the Canadian Wildlife Federation to determine its position on a particular topic or to get information regarding the organization. (112-4, 112-8, 209-5)
- Interview a politician or community leader about a decision made to alter an ecosystem, and find out how/if science was used to make the decision. Prepare a short report. (113-10)

Presentation

- Prepare and deliver an oral presentation based on the preservation and protection of a particular habitat. (113-11)
- Give an oral presentation based on the research of a Canadian environmental organization. (112-4, 112-8, 209-5)

Resources

Internet

- http://www.cwf-fcf.org/
  Canadian Wildlife Federation
- http://www.cnf.ca/contact_main.html
  Canadian Nature Federation
- http://www.foecanada.org/index.html
  Friends of the Earth
- http://www.projectgreen.ca/
  index.html
  Project Green
- http://www.sierraclub.ca/national/
  index.html
  Sierra Club Canada
- http://www.wwfcanada.org/
  World Wildlife Fund of Canada
- http://vm.ducks.ca/index.html
  Ducks Unlimited
- http://www.clean.ns.ca/
  Clean Nova Scotia
- http://www.ec.gc.ca/ecoaction/
  index_e.htm
  ECOAction2000
- http://www.evergreen.ca/
  Evergreen Foundation
- http://www.fef.ca/
  Friends of the Environment
- http://www.greenpeacecanada.org/
  Greenpeace Canada
- http://www.peisland.com/nature/
  trust.htm
  Island Nature Trust
  (112-4, 112-8, 204-5)

Science Power™ 7

Pages 71-86 Sec 3.2 to Sec 3.5
(113-10)
choose carefully
Pages 94-95 Unit Project
(113-11)
Also...
“In the Know...” A directory of environmental organizations etc. Produced by the New Brunswick Environmental Network.

EARTH'S
CRUST

Unit 2:
Earth's Crust

Unit Overview

Introduction

Knowledge of the Earth is rapidly growing as new methods and technologies are developed to study the components and dynamics of the Earth's crust. As students develop an understanding of the dynamics of geological systems and events, they are better able to explain and make connections between the theories of Earth science and their own experiences with local geology.

Focus and Context

An inquiry-based approach to this unit will permit the students to investigate many of the properties of the Earth to which they have had some exposure. The most recent and widely accepted theory that is used to explain many crustal features and phenomena, continental drift, is formally introduced and should be approached using crustal phenomena that are both relevant and motivating to the student. The context for this unit can be the rocks, minerals, and evidence of geological processes in the local environment of the student.

Science Curriculum Links

In grade 3, students investigate the basic components of the soil (organic and inorganic components) and how soils and plants are intricately linked. In grade 4, students begin describing rocks and minerals according to physical properties such as colour, texture, and hardness. They also investigate how processes such as wind, water, and ice reshape the landscape and the processes of erosion, transport, and deposition that are linked to the creation of soils. In high school, some students may choose to further investigate Earth systems, Earth resources, Earth processes, and historical geology.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

109-7 identify different approaches taken to answer questions, solve problems, and make decisions

110-1 provide examples of ideas and theories used in the past to explain natural phenomena

110-4 describe examples of how scientific knowledge has evolved in light of new evidence

Relationships between Science and Technology

111-2 provide examples of technologies used in scientific research

Social and Environmental Contexts of Science and Technology

112-3 explain how society's needs can lead to developments in science and technology

112-7 provide examples of how science and technology affect their lives and their community

112-12 provide examples of Canadian contributions to science and technology

113-1 identify some positive and negative effects and intended and unintended consequences of a particular science or technological development

113-7 suggest solutions to problems that arise from applications of science and technology, taking into account potential advantages and disadvantages

Skills

Students will be expected to

Initiating and Planning

208-2 identify questions to investigate arising from practical problems and issues

Performing and Recording

209-1 carry out procedures controlling the major variables

209-4 organize data, using a format that is appropriate to the task or experiment

209-6 use tools and apparatus safely

Analysing and Interpreting

210-1 use or construct a classification key

210-6 interpret patterns and trends in data, and infer and explain relationships among the variables

210-12 identify and evaluate potential applications of findings

Communication and Teamwork

211-3 work co-operatively with team members to develop and carry out a plan, and troubleshoot problems as they arise

211-4 evaluate individual and group processes used in planning, problem solving, decision making, and completing a task

Knowledge

Students will be expected to

311-4 examine some of the catastrophic events, such as earthquakes or volcanic eruptions, that occur on or near Earth's surface

311-5 analyse data on the geographical and chronological distribution of catastrophic events to determine patterns and trends

311-1 explain the processes of mountain formation and the folding and faulting of Earth's surface

311-6 develop a chronological model or time scale of major events in Earth's history

310-2a classify minerals based on their physical characteristics by using a dichotomous key

310-1 describe the composition of Earth's crust

310-2b classify and describe rocks on the basis of their method of transformation in the rock cycle

311-2 explain various ways rocks can be weathered

310-3 classify various types of soil according to their characteristics, and investigate ways to enrich soils

311-3 relate various meteorological, geological, and biological processes to the formation of soils

Geological Plate Tectonics and Time Scale

Outcomes

Students will be expected to

- compare some of the catastrophic events, such as earthquakes and volcanic eruptions, that occur on or near Earth's surface (311-4)

- organize and analyse data on the geographical and chronological distribution of earth quakes and volcanoes to determine patterns and trends (209-4, 210-6, 311-5)

- describe how plate tectonic theory has evolved in light of new geological evidence (110-4)

- provide examples of ideas and theories used in the past to explain volcanic activity, earthquakes, and mountain building (110-1)

Elaboration–Strategies for Learning and Teaching

Many students are intrigued and fascinated by earthquakes and volcanoes. Unlike most geological processes, earthquakes and volcanoes generally occur over a short period of time and are readily observable. This unit can begin with a general discussion about these phenomena. Opening questions such as "Do we experience volcanoes and earthquakes in our region?" and "Is there evidence for these types of geological process in our region?" allow for an assessment of students' prior knowledge, as well as motivate the students to begin considering these topics in light of their immediate environment. Students can view videos or use computer software to see actual scenes of volcanoes and earthquakes in the process of occurring, and discuss the effects that they have on local environments.

Information-processing skills can be addressed in an activity in which students research the location and dates of major earthquakes and volcanoes in recorded history. This information can then be recorded on a world map. In this way, students can 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. Students can explore the fit of the continents, using a *jigsaw puzzle* approach, with continents serving as pieces.

The concept that continents have moved relative to one another (called continental drift) and the early evidence that led to the development of the plate tectonic theory came to light at the beginning of the 1900s. Students should come to appreciate that mounting evidence from a variety of sources led to our present theory of plate tectonics. Paleogeographic evidence, structure and rock-type evidence, evidence from glaciation, and evidence from paleoclimates (that is, the formation of coal deposits in Antarctica), as well as other types of evidence are used in arguments for continental drift. A study of mid-ocean ridges also provides evidence for this theory.

Once students understand <u>what</u> happens at plate boundaries they can begin to investigate <u>why</u> this happens. Students may develop a conceptual model of Earth's crust and core which explains the role of convection currents in plate movement.

Different cultures throughout history have had ideas and theories about the origins and causes of volcanic and earthquake activity and mountain formation. Students can be challenged to investigate a particular group or culture in order to learn about peoples' ideas about these events in the past.

. . . continued

Geological Plate Tectonics and Time Scale

Tasks for Instruction and/or Assessment

Observation

- Complete a self- and group- assessment based on the task of modelling the action of plate tectonics. (110-4, 211-4, 311-4)

Paper and Pencil

- Pretend that you are the science reporter for a newspaper. Write a newspaper report/article that compares volcanoes and earthquakes for your readers. (311-4)
- In pairs, research the location and type of famous volcanoes and earthquakes and, as a class, locate these events on a world map. Is there a pattern regarding the location of the earthquakes and/or volcanoes? (209-4, 210-6, 311-5)
- Prepare a time line that illustrates the evolution of our understanding of plate tectonic theory. (110-4)
- Investigate how people in the past explained catastrophic events such as volcanoes and earthquakes. (110-1)

Presentation

- Prepare a poem or a song in which volcanoes and earthquakes are compared and contrasted. (311-4)
- Create a multimedia presentation on volcanic activity in your province or a neighbouring province. (311-4)
- Prepare a mural of ancient stories that are associated with volcano and mountain building. (110-1)
- Prepare a recording or short dramatization that illustrates how a certain culture explained volcanic or earthquake activity. (110-1)

Resources

Science Power™ 7

Pages 314-316	Sec 11-1 (311-4)
Pages 326-329	Sec 11-2 (311-4)
Pages 330-331	INV 11-C (209-4, 210-6, 311-5)
Pages 352-357	Sec. 12-3 (110-4)
Pages 344-346	Sec 12-1 (110-1)
Pages 347-351	Sec 12-2 (110-1)

AV

"Plate Tectonics" - Film ID #704628, VH
(311-4, 311-5, 110-4)

Geological Plate Tectonics and Time Scale (continued)

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to	Some possible research ideas might include: - Pele (Hawaiian goddess who makes the mountains shake and lava flow at Kilauea, Hawaii) - Glooscap (Mi'kmaq legend about the Sugarloaf Mountains) - Ovid (Roman poet who claimed that earthquakes occurred when the earth became too close to the sun and trembled from the great heat) - Anaxagoras (Greek who believed that volanic eruptions were caused by great winds within the earth) - René Descartes (French philosopher who believed incandescent earth core was the source of volcanic heat)
• provide examples of Canadians and Canadian institutions that have contributed to our understanding of local, regional, and global geology (112-12)	Students should have the opportunity to learn about Canadian geologists such as Tuzo Wilson and Joseph Tyrrell, as well as Canadian institutions involved with geological research such as the Geological Survey of Canada. It is the work and research of these people and institutions, as well as many others, that is the basis of our current understanding of the earth and its geological history.
• explain the processes of mountain formation and the folding and faulting of the Earth's surface (311-1)	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, as well as observe and interpret that the puzzle pieces have natural boundaries formed by these features. Investigation into how volcanic activity contributes to mountain building should be a part of this study of these processes. Various models and videos can be used so that students can explore and understand these processes. Plasticine pieces of various colours can be used to replicate layers of the Earth's crust. Students can use straws to simulate the taking of core samples which illustrate the composition and thickness of the layers. Also, students can see what happens when pressure builds, by pushing together the ends of the Plasticine, for example. Models of faults can also be made in this way. It is important that students use local examples of folding and faulting if at all possible.
• develop a chronological model or geological time scale of major events in Earth's history (209-4, 311-6)	Students should begin to appreciate the magnitude of time involved in most geological processes and events. Students can prepare and construct their own life time scale and compare it to a geological time scale. Students should come to realize that geological time has been subdivided into eras, periods, and further into epochs. Features that may be included in a geological time scale are such things as fossils and periods of mountain building. It is not intended that students memorize the names of these subdivisions or their order.

Geological Plate Tectonics & Time Scale (continued)

Tasks for Instruction and/or Assessment

Performance

- Complete a webquest on the topics of volcanoes, earthquakes, and mountain building, using Canadian Earth Science Internet sites. (112-12, 311-1, 311-4)

- Create a layered cross-section of the Earth's crust out of soft styrofoam sheets and demonstrate faulting and folding. (311-1)

Journal

- Write a newspaper article that announces the development and explanation of plate tectonic theory. (311-1)

Paper and Pencil

- Research and prepare a report that compares and contrasts the dominant animals and plants in each era of geologic time. (311-6)

- Produce a chronological time scale of some major events in human history and compare it to Earth's history. (209-4, 311-6)

- In a written report, describe the relationships among plate boundaries, mountain building, and trenches. (311-1)

- Research Tuzo Wilson and report on his contribution to the theory of plate tectonics. (112-12)

Presentation

- Create a three-dimensional model of a volcano to illustrate how it can become a mountain. (311-1, 311-4)

Portfolio

- Create a timeline that illustrates the development of the theory of plate tectonics. (110-1)

Resources

Science Power™ 7

Pages 355 (112-12)

choose carefully from Pages 288, 301, 305, 363 and 368-369
(112-12)

Pages 334-336	Sec 11-3 (311-1)
Pages 358-363	Sec 12-4 (209-4, 311-6)
Pages 372-373	Unit Project (209-4, 311-6)

AV
"Faulting and Folding" - Film ID #704619, VH
(311-1)

"Earth Essentials - History of Earth" Kinectic
#705415, VH
(209-4, 311-6)

Rocks and Minerals

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to • classify minerals on the basis of their physical characteristics by using a dichotomous key (210-1, 310-2a)	Students should be involved in using a dichotomous key, using such physical characteristics as streak, colour, lustre, and hardness. Students can for example test a variety of minerals to determine whether they provide a streak or not. Some more unique traits may include magnetic quality and double diffraction.
• work co-operatively with team members to plan how to determine a geological profile of a land mass by using simulated core sampling techniques (211-3)	Research teams can use print and non-print sources to research topics related to rocks and minerals such as specific types of rocks and minerals native to the local area, mining activity in the province, technology used in geological surveys, and /or uses of minerals. Students can construct or be given fictitious two-dimensional or three-dimensional geological profiles. Using layers of various coloured modelling clay, for example, students can construct a model of the earth's crust. Students can also use books, binders, and notebooks to simulate various layers of rock and other materials in the earth's crust. Paper straws and strips of paper may be used to simulate core sampling. By placing the straws or strips of paper beside the modules and recording the various thicknesses of the layers on the straws or strips of paper, students will see how core samples can be used to help determine a geological profile of the earth's crust.
• evaluate the individual and group processes in planning how to determine a geological profile of a land mass using simulated core sampling in geological models (210-12, 211-4)	Students can be challenged to graph the profile of their model or another group's model. Students can also attempt to build a two-dimensional or three-dimensional model, using the simulated core samples (straws and/or strips of paper) from another group. Students should evaluate individual and group/team processes during and after this activity.
• describe the composition of Earth's crust and some of the technologies which have allowed scientists to study geological features in and on the earth's crust (109-7, 111-2, 310-1)	Actual core samples from a mining company or university geology department can be examined and discussed. A well-drilling contractor can be invited to class to talk about drilling through different soil and rock layers when looking for water. Students should learn that Earth's crust is composed of a variety of rocks and minerals in a multitude of combinations and forms. They should have exposure to the ways in which geologists investigate and explore Earth's crust by looking at some of the technologies used in gathering the data about Earth's crust. Students can investigate technologies such as satellite imaging, seismographs, remote sensing, magnometers, and core sampling.

Rocks and Minerals

Tasks for Instruction and/or Assessment

Observation

- Complete a self- and group evaluation of the group processes used in planning how to determine a geological profile of a land mass. (210-12), (211-3), (211-4)

Performance

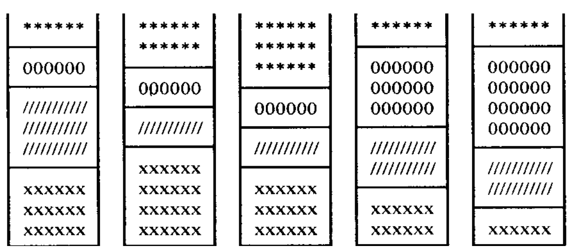
- Use streak plates to determine the streaks left by mica, quartz, calcite, and so on, and produce a table that communicates your findings. (210-1, 310-2a)

- Using a number of minerals with which to do scratch tests, determine the relative hardness of the minerals, using the Mohs' scale. (210-1, 310-2a)

- Create a dichotomous key that classifies minerals by their physical characteristics. (210-1, 310-2a)

- Produce a graph to show the composition and thickness of layers in a model core sample. (210-12, 211-4)

- You are given these pictorial representations of five core samples that were taken at equal intervals over a 100-metre distance (straight line). Draw the geological profile of the earth's crust for that 100-metre distance. (310-1)



Paper and Pencil

- Given several pairs of minerals that look similar, write a note to another student describing several tests that may help differentiate them. (210-1, 310-2a)

Presentation

- Research and write a report on a technology used to study geological features and resources. (109-7, 111-2, 310-1)

Resources

Science Power™ 7

Pages 280-285 Sec 10-1
INV 10-A
(210-1, 310-2A, 210-12, 211-3, 211-4)

Pages 315, 337-338 and 352-353
(109-7, 111-2, 310-1)

<u>AV</u>
"Bill Nye: Science Guy Earth's Crust/Rock and Soil" - Magic #704835, VH
(109-7, 208-2, 209-6)

The Rock Cycle

Outcomes

Students will be expected to

- identify questions to investigate arising from the study of the rock cycle (208-2)
- use tools and apparatus safely when modelling or simulating the formation of rock types (209-6)
- classify rocks on the basis of their characteristics and method of formation:
  - sedimentary
  - igneous
  - metamorphic (310-2b)
- explain how society's needs led to developments in technologies designed to use rocks (112-3)

Elaboration–Strategies for Learning and Teaching

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 in them. Students should examine common rock types such as sandstone, shale, basalt, granite, gneiss, and slate. Students can be asked to compare the sample rocks and attempt a personal classification based on their differences and similarities. 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 may also investigate factors which affect the type of rock produced.

Students can, for example, simulate and examine the effect of cooling rate on crystal size, using stearic acid or epsom salts, and associate this with the formation of crystals and igneous rocks. Students may also simulate and examine the effects of heat and temperature on the formation of metamorphic rocks. The baking of "rock" cookies, consisting of chocolate chips and other foods that melt and deform when heated, can help students understand what happens to mineral crystals in rocks under great heat and pressure. Students should see that minerals are the constituents of rocks and that rocks are the parent material of soil. Students may simulate the creation of several rock types in the rock cycle, using shavings from coloured wax crayons. Students can put different coloured shavings in aluminium-foil sandwiches and apply various amounts of pressure to simulate the creation of sedimentary rocks (pressed between the hands) and metamorphic rocks (lots of pressure, placing a board on the sandwich and standing on it). Shavings are placed in a cup shaped with aluminium foil and heated (carefully) on a hot plate as a demonstration to simulate rocks under great heat. They should also see that the relationship of the formation of rocks can be depicted in a rock cycle. Students can be challenged to associate the characteristics of a particular rock with its method of formation.

Much of the exploration of Earth's crust is done for economic reasons. Some types of minerals, ores, and rocks are sought and exploited. Students can investigate commercial or other human uses of rocks and how that usage relates to the properties of rock. Granites, because they are very hard and stable, are used in the construction industry. Pumice, a relatively soft rock, is used as a skin cleanser.

The Rock Cycle

Tasks for Instruction and/or Assessment

Performance

- Create an observation checklist to assess how students use materials, including stearic acid, to simulate crystal growth under various conditions. (209-6)
- Keep a scrapbook of pictures or sketches showing how we use rocks in or as various technologies. (112-3)

Journal

- Questions I could ask in order to investigate differences in rocks are ... (208-2)
- The three rock types are ... I learned that they formed ... (310-2b)

Paper and Pencil

- Explain how crystal size and/or shape in rocks may help to describe their origin. (310-2b)
- Using a concept-mapping technique, illustrate what occurs during the rock cycle. (208-2, 310-2b)
- Create an illustration that depicts the formation of an igneous rock, a metamorphic rock, and a sedimentary rock. (310-2b)
- Create sketches or drawings of the crayon shavings before and after pressure and heat were applied. (209-6)

Presentation

- Write a tourist guide brochure or booklet describing how the rocks in your region were formed. (310-2b)
- Research the uses of rocks and minerals in your region. Report on their uses to the class. (112-3)
- Draw a series of sketches that demonstrate what happens to the mineral crystals in sedimentary and igneous rocks when they are subjected to great heat and pressure. (310-2b)

Resources

Science Power™ 7

Pages 289-294 Sec 10-2
INV 10-B
(208-2, 209-6, 310-26)

AV
"The Rock Cycle" - Film ID #704630, VH
(209-6, 310-2b, 311-2)

Weathering

Outcomes

Students will be expected to

- explain various ways in which rocks can be weathered:
  - mechanical
  - chemical (311-2)

Elaboration–Strategies for Learning and Teaching

Students should be encouraged to consider and propose questions related to the break-up or weathering of rocks on or near the earth's surface. Weathering and erosion (concepts introduced in the elementary grades) are important components of the rock cycle. Questions such as "Are there different ways in which rocks can be weathered?" and "How long does it take to weather some types of rocks?" could be used to further investigate the phenomena of weathering.

Teacher Information: Weathering is the mechanical and chemical breakdown of rock. Erosion is the process that loosens and moves sediments and weathered rocks over the earth's surface. Rocks that are created by magma or lava, sedimentation, or metamorphic processes are all exposed to the forces of weathering when at or near the surface of the earth.

In mechanical weathering, rocks are simply broken into smaller fragments. The most important type of mechanical weathering is frost action or ice wedging. Students should be encouraged to think of examples where they have seen the action of ice and frost produce broken rocks. Local cliff or seashore embankments are good locations to find this type of mechanical weathering.

When the surface layers of rock bodies are removed by erosion, pressure is released, and rocks tend to expand. Large horizontal fractures may occur this way within these rocks. The movement of plants (roots) and animals (worms, rodents, ants) move rock and soil particles about.

In chemical weathering, chemical reactions that create new substances occur within rocks. Students can investigate the effect acids (acid rain) have on some rocks such as chalk. In the first stage of chemical weathering, solutions made with water are created. Salt, gypsum and limestone are all soluble, to some extent, in water. The acidic action of some organisms such as lichens that live on rocks can cause chemical weathering. Students may be able to describe rocks or headstones in their community that are being weathered in this way. Students may investigate how rocks have been or are removed and used from local quarries. Gypsum and salt deposits in local areas can provide the context for investigating how and why these rocks are mined. Students can explore how local construction materials and styles have been determined by the availability of construction materials such as quarried rock or stone.

It is important that students differentiate between the terms weathering (process of wearing structures down) and erosion (moving weathered material). Local examples of water as both a weathering and erosion agent allow students to better understand water as the most powerful of geological forces. Gravity, glaciers, vegetation, and wind can be looked at as agents of weathering and erosion.

Weathering

Tasks for Instruction and/or Assessment

Paper and Pencil

- Identify examples of weathering and erosion in your community. (311-2)

Interview

- What is the difference between weathering and erosion? (311-2)

Presentation

- Research and report on how some structures made of rocks (pyramids, statues, gravestones) are changed by weathering and erosion. (311-2)

Portfolio

- Imagine you are writer for a scientific magazine. Write a short article describing how a mountain can be weathered and eroded and how the sediments can create new sedimentary rocks. (311-2)

Resources

Science Power™ 7

Pages 295-299 Sec 10-2
INV 10-C
(311-2)

AV
"Weathering" - Film ID #704633, VH
(311-2)

Soil

Outcomes

Students will be expected to

- design and conduct a fair test of soil properties (209-1)
- classify various types of soil according to their characteristics, and investigate ways to enrich soils:
  - coarse-textured (sandy/ gravel) soil
  - medium-textured (loamy) soil
  - fine-textured (clay) soil (310-3)

Elaboration–Strategies for Learning and Teaching

Rocks and minerals become components of soil through weathering and erosion. These processes can be destructive to soils in certain situations. 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. This section can focus on the context of agricultural practices as they relate to the use and/or abuse of our soils.

While much of this unit has focussed on global or regional aspects, this topic can have more of a local context. Students may construct local, regional and/or provincial maps which identify soil type. They should also 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 was found. Students will design and conduct fair tests of soil porosity and permeability. Porosity, which is the proportion of empty space in a soil or rock, is directly proportional to the permeability of the soil or rock. Permeability is defined as a measure of the ease with which liquids and gases pass through a soil or a rock. Students can determine, for example, how much water is required to saturate the soil and drip through a given amount of time. Using local types of soils permits students to associate the types of vegetation growing in it.

The students can be asked to identify examples of soil erosion in the community. It can be as simple as the wearing away of the shoulders of roads or as costly and complex as the erosion of topsoil from agricultural land. Students should be encouraged to identify the positive and negative aspects of erosion in various contexts.

Soils differ in organic matter, parent soil material, and the amount of air and water they contain. Students should recognize that the classification of soils is generally based on the textured qualities or how they "feel." It is also important to realize that there is a wide variety of soils owing to the great possibility of percentage compositions of the soils. Students should be able to classify and describe sandy/gravel soils, loamy soils, and clay soils. Coarse-textured soils feel gritty, and students might be able to identify the small grains, using the naked eye. Clay soils feel "greasy" with very little texture, especially when wet. A loamy soil is a soil composed of sand, silt, and clay in nearly equal proportions, and it has various textures depending on the percentages of its composite parts. A farmer or soil-management technician can be invited to class to discuss ways in which soils are enriched.

. . . continued

Soil

Tasks for Instruction and/or Assessment

Observation

- Teacher observation of laboratory procedures in the fair test of soil properties. (209-1)

Observation/Performance

- Create a rubric, with the help of students, to assess the procedures and efforts to conduct a fair test of porosity and permeability of various soil samples. (209-1)

Performance

- Given a variety of soil types, classify them as closely as possible, in the three main types. (310-3)

Presentation

- Create a poster illustrating how soils have been created in your area. (310-3)

- Research and write a report on how soils are maintained and fertilized in your region. (310-3)

Portfolio

- Interview a farmer or agricultural technician to find out about the soil types in your region and what grows best in them. (310-3)

Resources

Science Power™ 7

Pages 302-304	INV 10-D (209-1)
Pages 305-306	(310-3)

Soil (continued)

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to • relate various meteorological, geological, chemical, and biological processes to the formation of soils: - rain and wind - glaciers and gravity - plants and acidic action (311-3)	Weathering and erosion are important processes in the formation and development of soils. Students should come to understand that weathered and eroded rocks form the parent material of soils. Organic material provides the nutrient base for a variety of soil ecosystems. Students should also investigate local soil profiles in order to appreciate the fact that soil is not of one type and a transition from parent material to nearly pure humus exists. Students should be able to locate the position of the soil component and the parent material component.
• identify some positive and negative effects and intended and unintended consequences of enriching soils (113-1)	Composts, manure, and chemical fertilizers may be addressed when looking at ways to enrich soils. Students who have composters at home can describe what they do with the composted material. It is not necessary to delve into the chemical nutrients of soils and the various soil deficiencies. It is sufficient to note that some of the organic material is either leached out or utilized by other living things such as plants and soil-living organisms. Students should investigate and discuss various positive and negative effects and intended and unintended consequences of enriching soils. For example, fertilizer usage on lawns and gardens can encourage growth of certain plant species, but it can also discourage the growth of other plants that some organisms rely on. Enriching soils with commercial chemical fertilizers may help produce larger crop fields in the short term, but may also harm the soil if used at the expense of regular crop rotation which naturally enriches the soils and provides humus to keep it more stable. A person using fertilizer to help crops to grow does not intend to have fish killed if the fertilizer is washed out of the soil and into a stream after a heavy rain.
• provide examples of how science and technology associated with soil enrichment affects their lives (112-7)	Our ability to enrich soils with a variety of fertilizers to grow more food than ever can be addressed. The energy expenditures required to enrich soils can be explored. Farmers using organic and chemical methods to enrich soils can be invited to class to talk about their methods and procedures.
• suggest solutions to problems or issues related to soil use and misuse (113-7)	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 and forestry practices. Students should learn to appreciate the delicate nature of soils when they are not used wisely or safeguarded from abusive practices. Students should come to realize that the loss of soil has an impact on humans in any given ecosystem.

Soil (continued)

Tasks for Instruction and/or Assessment

Presentation

- Create a mural illustrating the various intended and unintended consequences of enriching soils. (113-1)
- Identify examples of misuse of soil in your community. Present a sketch of the situations to your class. (113-7)
- Research and role-play various stakeholders in an environmental/ economic impact meeting concerning forest or agricultural land as it relates to soil. (113-7)

Paper and Pencil

- Research which foods are able to be grown in your region because of our ability to enrich soils. (112-7)
- Write to an organization that is involved with the care and use of soils to find out what we can do to preserve soils in our region. (113-7)
- Match and be able to explain the processes below:

- rain and wind	a. chemical	
- glaciers and gravity	b. meteorological	
- plants and acidic action	c. geological	(311-3)

Portfolio

- Imagine you are a farmer. What measures would you employ to help reduce soil erosion? (113-7)

Resources

Science Power™ 7

Pages 300-306 (311-13)

Pages 305-308 (113-1, 112-7, 113-7)

<u>AV</u>
"Our Soil" - NRCAN
#705845, VH
(113-1, 112-7)

"Soil Erosion" - NBDA
#701412, VH
(113-7)

HEAT

Unit 3:
Heat

Unit Overview

Introduction

Heat is a form of energy that is part of students' lives and that of their communities. Students should have an opportunity to explore the properties of heat and how they are related to the measurement of temperature. The particle theory and the kinetic molecular theory help students explain their observations and understand both the relationship between heat and temperature and the concept of heat capacity on a qualitative level.

Matter is composed of tiny particles in constant motion. This constant motion of particles demonstrates that they possess energy (kinetic). The average kinetic energy of these particles is directly related to how we perceive how hot something is, that is, its temperature. One can cause the motion of these particles to increase by adding more energy by hitting a nail with a hammer, rubbing our hands together, or plugging in a kettle of water, for example. The temperature of an object is the measure of the average kinetic energy per particle of a substance. Teachers should help students to develop a conceptual understanding of what the particles would be like in each state of matter. Students should have the opportunity to make drawings or use other representations to demonstrate the motion of the particles in solids, liquids, and gases.

Focus and Context

The focus of this unit is on problem solving and design technology. Students, for example, will plan and design air thermometers as well as qualitatively evaluate the heat capacities of some common materials. The context of this unit is on exploring heat and temperature in the immediate environment and life of the student.

Science Curriculum Links

In grade 2, students study a unit entitled "Liquids and Solids" in which they describe the characteristics of the three states of water and predict changes from one state to another. They also investigate the reversibility of these states of matter.

In grade 5, students study a unit called "Properties and Changes of Materials" during which they have the opportunity to group materials as solids, liquids, or gases, according to their properties.

Later, in grade 10, students illustrate how factors such as heat can affect chemical reactions in a unit called "Chemical Reactions."

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

109-4 provide examples of how technologies used in the past were developed through trial and error

110-7 provide examples of technologies used in the past to meet human needs

Relationships Between Science and Technology

111-5 describe the science underlying particular technologies designed to explore natural phenomena, extend human capabilities, or solve practical problems

Social and Environmental Contexts of Science and Technology

112-1 describe how an individual's needs can lead to developments in science and technology

112-9 identify science- and technology-based careers in their community

113-4 analyse the design of a technology and the way it functions on the basis of its impact on their daily lives

Skills

Students will be expected to

Initiating and Planning

208-8 select appropriate methods and tools for collecting data and for solving problems

Performing and Recording

209-1 carry out procedures controlling the major variables

209-3 use instruments effectively and accurately for collecting data

Analysing and Interpreting

210-2 compile and display data, by hand or computer, in a variety of formats, including diagrams, flow diagrams, flow charts, tables, bar graphs, line graphs, and scatter plots

210-10 identify potential sources and determine the amount of error in measurement

210-11 state a conclusion, based on experimental data, and explain how evidence gathered supports or refutes an initial idea

210-12 identify and evaluate potential applications of findings

210-13 test the design of a constructed device or system

Communication and Teamwork

211-2 communicate questions, ideas, intentions, plans, and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language, and other means

Knowledge

Students will be expected to

308-1 compare various instruments used to measure temperature

308-3 explain how each state of matter reacts to changes in temperature

308-4 explain changes of state, using the particle model of matter

308-2 explain temperature, using the concept of kinetic energy and the particle model of matter

308-5 compare transmission of heat by conduction, convection, and radiation

308-7 explain, using the particle model of matter, differences among heat capacities of some common materials

308-6 describe how various surfaces absorb radiant heat

Temperature

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to	This unit can begin by providing an opportunity for students to think about temperature and discuss how we use the term in everyday language. This discussion can then be related to the scientific meaning developed in this unit. The need for standardizing a way to measure temperature can be introduced. Students can discuss topics such as what they consider to be "comfortable temperatures" and why some people are cold when others feel warm. Students can try to measure with their hands the temperatures of pans of warm and cold water to demonstrate that some ways of measuring temperature are very subjective. The need in science to have a standardized method to measure temperature led to the development of a variety of thermometers.
• select appropriate methods and tools in order to construct and test an air thermometer (208-8, 210-13) • compile and display data collected in the test of the design of an air thermometer (210-2) • compare various instruments used to measure temperature: - liquid-in-glass thermometers - digital thermometers - thermocouples - computer probes (308-1)	Students can be asked if they have had any experience with inflatable objects (balls, bicycle tires, for example) at warm and cold temperatures. Two balloons can be inflated to the same size at room temperature and then stored in warm and cold locations until next class, at which time they can be examined and compared. Students should be presented with the problem of how to measure temperature in the classroom using air as a temperature indicator. Supply the basic components needed to construct an air thermometer, such as a clear flask, water pan, and water, or a balloon, flask, and water, or have students brainstorm to develop a plan to build an air thermometer. Students can also follow the steps to design and test an air thermometer constructed from a closed pipette with a small amount of coloured water. Students can construct, calibrate, and test their own air thermometers. This type of activity may lead into an examination of the historical development of the thermometer to show its evolution over time.
• use and read a thermometer safely and properly (209-3)	Students should have the opportunity to explore and examine a variety of instruments used to measure temperature. Centres that highlight the various types of thermometers can be set up in the classroom, and groups of students can rotate through centres, using the thermometers in a variety of activities. They may also do research on the various types of thermometers. Most students have had some experience with liquid in glass thermometers and/or digital thermometers used to take the body's temperature. The alcohol thermometer should be introduced, and students should learn to use the thermometer to measure temperature. Computer temperature probes, if available, may be utilized to take temperature readings. Students should be able to relate the various types of thermometers to their particular uses.
• provide examples of temperature-measuring technologies used in the past (110-7)	Students should learn how to use thermometers safely. Particular attention should be placed on the careful use of glass thermometers. Non-mercury glass thermometers should be used. A survey of the early thermometers such as the Galileo thermoscope, Boyle's thermometer, and early liquid-filled thermometers, will illustrate that a variety of temperature-measuring technologies have developed over time.

Temperature

Tasks for Instruction and/or Assessment

Performance

- Construct a scoring rubric for the air thermometer activity.

FOUR	Activity is complete and planning is evident. Data are complete and neatly presented. There is evidence of careful planning and organization.
THREE	Activity fulfils the requirements of outcomes.
TWO	Activity is completed in basic form.
ONE	Insufficient work is completed; evaluation is not possible. (208-8)

- Read the temperature of thermometers in order to calibrate an air thermometer and report them in an appropriate format. (209-3)

Paper and Pencil

- Compare a modern digital thermometer with a liquid thermometer in terms of safe use when taking the temperature of young children. (308-1)

- What materials were used in the early types of thermometers? (110-7)

Presentation

- Prepare a poster illustrating the steps in designing, testing, and calibrating an air thermometer. (208-4, 208-8, 210-13)

Portfolio

- Compare various temperature-measuring technologies found in your house. Make a pictorial essay. (308-1)

Resources

Science Power™ 7

Pages 190-191	INV 7A *Alternate to Air Thermometer*
Pages 187-189	Sec 7-1 (209-3)
Pages 192-193	INV 7-B (209-3)
Pages 187, 189, 195, 196 and 197	(308-1)
Pages 187-189	(110-7)

Temperature and Matter

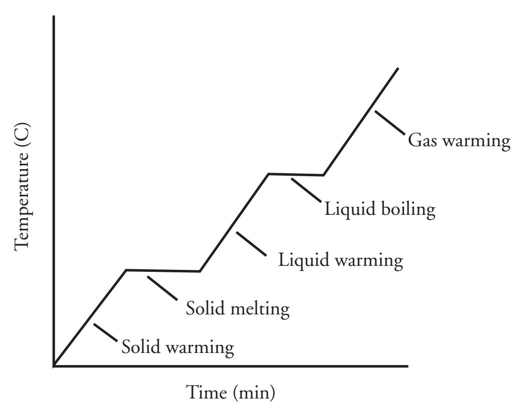
Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to • explain how each state of matter reacts to changes in temperature (308-3)	Computer or video simulations showing the effect of temperature on kinetic motion are excellent visual aids which can assist students in better understanding this concept. Situations which involve the application of the particle model of matter provide a good opportunity for students to begin to develop their understanding before they move on to distinguish between temperature and heat. Useful questions or scenarios include explaining why air pressure in tires increases during a car trip, and why footballs or soccer balls deflate when they are taken outside on a cold day and reinflate when they are taken back inside a warm environment. Students can experience the effect of temperature change on metals, such as a ball and ring apparatus or a bimetallic strip. Reflection on the effect that temperature has on air, as demonstrated in the construction of an air thermometer, will help students conceptualize what is happening at the particle level in gases. At this point students can determine the general relationship between temperature changes and volumes of solids, liquids, and gases.
• explain changes of state, using the particle model of matter (308-4)	Students have had many everyday experiences, especially with water, where temperature has had an impact on the state of matter. Having ice cubes melt in their soft drinks, watching water boil in a pot on the stove, and seeing the formation of ice-covered ponds are all common experiences. Demonstrations, activities, and discussion of common experiences will reinforce the concept that a temperature change has an effect on matter. Holding three tennis balls in your hand can represent, for example, particles in a solid state. Rolling the three balls in your hand can demonstrate particle movement in a liquid. Tossing the tennis balls to others can represent particle motion in a gas. These activities will permit students to move towards a more abstract understanding and explanation of these experiences, using the particle model of matter.
• explain temperature, using the concept of kinetic energy and the particle model of matter (308-2)	Through activities or demonstrations, students should experience that it takes more energy to raise the temperature of a larger mass of a substance than it does to raise the temperature to the same level using a smaller mass of the same substance. Students should realize, for example, that a large bucket of water with a temperature of 28 °C has more energy (thermal energy or heat) in it than a small cup of water at the same temperature. *Teacher Information: Temperature is the average kinetic energy of the particles of a substance and not a measure of the total kinetic energy of the particles within a substance*. At this level, students should come to understand that temperature is a relative measure of energy that is transferred from one object to another. It is important that students have many varied opportunities to witness the effects that temperature changes have on different materials and states of matter. These experiences will help the students to better relate what they see and experience to the concept of kinetic energy and the particle model of matter. Students can be challenged to develop scenarios, using themselves as particles, to represent solids, liquids, and gases at different temperatures.

Temperature and Matter

Tasks for Instruction and/or Assessment

Paper and Pencil

- In essay form, using illustrations if desired, explain how each state of matter reacts to changes in temperature, using the particle model of matter. (308-2)
- In a series of drawings, explain what is happening to a substance when it is warmed, using the particle model of matter. (308-2)
- Write an article for grade 4 or 5 students that would help them to understand the difference between temperature and heat. (308-3)
- On the following heat-curve graph, indicate:
  - the melting/freezing point of water
  - the boiling point of water
  - 50 °C (308-3)



Presentation

- Simulate changes in matter at the particle level when the temperature changes by using yourselves to represent particles of a substance. (308-2)
- Demonstrate, through a musical composition or performance, how particles might be acting in the various states of matter. (308-4)

Portfolio

- Create a graphical presentation that illustrates how each state of matter reacts to changes in temperature. (308-3)

Resources

Science Power™ 7

Pages 214-220	Sec 8-1 INV 8-A (308-3)
Pages 228-231	Sec 8.3 INV 8-D (308-3)
Pages 199-201	Sec 7.2 (308-2)
Pages 205-206	Sec 7.3 (308-2)
Pages 250-253	Sec 9.2 (308-2)
Pages 234-236	(308-4)

<u>AV</u>
"Changes of State" - Kinetic #705418, VH
(308-3, 308-4)

Heat Transfer

Outcomes

Students will be expected to

- compare transmission of heat by conduction, convection, and radiation (308-5)

Elaboration–Strategies for Learning and Teaching

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.

Students can explore conduction by placing a number of different objects of similar lengths that have butter on one end (for example, a stainless steel spoon, a wooden spoon, a plastic spoon, a copper rod) in a container and adding hot water to the container to see which material conducts the heat the fastest. Students should come to realize that metals are some of the best conductors of heat. A common misconception with regard to metals is that they are "colder" or have a lower temperature than the surrounding environment (for example, a metal tap in a washroom). It feels colder because heat from our hands is quickly conducted to the metal, thereby lowering the temperature of our fingers at point of contact. Insulators, such as a rug or carpet, conduct heat very poorly away from the body and do not feel cold. Students can be encouraged to investigate various technologies that reduce heat transfer, such as Thermos bottles, Styrofoam, and insulation bats in homes, in order to learn about their insulating properties. Students should come to understand that conduction can occur in all three states of matter but decreases in efficiency from solids to liquids to gases. Students simulating the various phases of matter, using themselves as particles, can investigate and propose reasons why conduction of heat energy would be more efficient in solids.

Students can investigate convection of heat by observing coloured chalk dust placed into a beaker of boiling water. Convection currents in the water carry the particles up and down. Some students may refer to similar convection currents in a pot of soup on the stove. Placing a light object next to a radiator or heating source in the classroom will provide proof of convection currents in air. Students may be able to relate experiences of "drafts" at home that are caused by convection currents in the air. Convection can occur in liquids and gases.

Radiant energy is heat energy that is transmitted by electromagnetic waves that do not need matter in order to travel. Unlike conduction and convection, radiant energy can travel through a vacuum (no particles). Students have had experiences with radiant energy when they felt the warmth of the sun on their bodies or sat close to a fireplace or stove. Radiant energy from the sun is the source of energy for much of the conduction and convection of heat energy on earth.

. . . continued

Heat Transfer

Tasks for Instruction and/or Assessment

Performance

- Design a working model that would illustrate convection currents. (308-5)

Paper and Pencil

- How could one use a wood stove to explain the transmission of heat by radiation, conduction, and convection? (308-5)
- Predict how convection currents form in your classroom when the thermostat is turned up. Sketch your prediction. (308-5)

Interview

- Describe a food container that would keep a meal hot for a long trip. (210-12, 308-5, 308-6)

Presentation

- Investigate how air currents, produced by heated air, help large birds of prey to stay aloft for long periods of time. (308-5)

Resources

Science Power™ 7

Pages 242-249 Sec 9-1 (308-5)

Heat Transfer (continued)

Outcomes

Students will be expected to

- describe the science underlying heat transfer in solar heating systems and central heating systems in houses (111-5)
- describe how a technology associated with heat has affected lives (113-4)
- compare, in qualitative terms, the heat capacities of some common materials (308-7)
- carry out a procedure to investigate how various surfaces absorb radiant heat and control major variables (209-1)
- identify potential sources of error in data while investigating how various surfaces absorb radiant heat (210-10)
- identify, evaluate, and draw a conclusion about the relationship between colour and heat absorption in materials (210-11, 210-12)
- communicate results of experiments and/or investigations related to colour and heat absorption by using language and a variety of tables, charts, and/or graphs (211-2)
- describe how various surfaces absorb radiant heat:
  - colour
  - texture (308-6)

Elaboration–Strategies for Learning and Teaching

The concept of heat transfer may be approached by having students investigate methods of heating homes. This investigation may cover the historical development of heating devices such as stoves and/or more recent innovations such as solar heating and central heating systems. The broad range of heating technologies studied will expose students to examples of conduction, radiation, and convection. Student questions about how each of these technologies works can provide direction for a series of activities which have students investigate the three types of heat transfer and develop a working definition for each. Students can investigate technologies such as central heating systems or air conditioners.

Different substances have different capacities for storing internal energy. Students will probably be able to relate, to personal experiences of biting into a hot apple pie that has been out of the oven for a period of time and being able to touch a piece of aluminium foil almost immediately after it comes out of an oven. Groups of students can investigate the rates at which common liquids, such as water and vegetable oil, increase in temperature as heat is added to them. Students can conduct an experiment in which the same mass of water and vegetable oil heat up over a given period of time. Please note that vegetable oil and other oils should be heated in hot water baths and not directly on a stove or a hotplate. The longer a substance takes to heat up or cool down, the higher its heat capacity is. *Teacher Information: The rate of heat loss or heat gain also depends on the shape and surface area of the substance*. Students should come to understand that different substances often heat up and cool down at different rates.

Have students conduct a fair test to determine the relationship between the colour of a material, such as construction paper, and the temperature increase caused by radiation. Ice cubes, for example, may be placed under paper or fabrics of different colours or on materials that are reflective (mirrors, aluminium foil) and non-reflective materials in direct light to see if colour will affect the rate of melting. Following this, students can be challenged to create a model solar house which applies the results of their findings. This may be done as a form of problem-solving activity involving “Science Olympics.” Students should come to realize that radiant heat, when absorbed by materials, is transferred by conduction or convection.

Heat Transfer (continued)

Tasks for Instruction and/or Assessment

Performance

- Identify the controlled variables in a fair test to evaluate the relationships between colour and heat absorption. (209-1)

- Construct an appropriate graph to communicate the results of colour versus heat absorption investigations. (211-2)

- Observation checklist for the experiment to test the heat absorption of various surfaces: (209-1)

	Rarely			Always
- Follows steps carefully.	1	2	3	4
- Identifies major variables.	1	2	3	4
- Works safely with materials.	1	2	3	4
- Works collaboratively with a partner.	1	2	3	4
- Records data effectively.	1	2	3	4

Paper and Pencil

- What are several potential sources for error in data in the experiment to determine how various surfaces absorb heat? (210-10)

- Write a lab report describing how you use a “fair test” to evaluate the relationship between colour and heat absorption in materials. (210-11), (210-12)

- Place the following items in order of their ability to absorb radiant heat. Explain your choices. (308-6)
  - white paper
  - aluminium foil
  - black plastic
  - brown cloth
  - red vinyl

- Make a list of things that you can eat that have a high heat capacity. (308-7)

Presentation

- Create a chart that communicates the results of an experiment which investigates how various surfaces absorb radiant heat. (211-2, 308-6)

- Research and present orally the heating technology used in your school. Include references to conduction and convection. (111-5, 113-4)

Resources

Science Power™ 7

Pages 242-247	Sec 9-2 (111-5)
Pages 251-253	(111-5)
Page 254	INV 9-B (111-5)
Page 259	(111-5)
Pages 222-226	Sec 8.2 INV 8-B INV 8-C (308-7)
Pages 242-244	Sec 9-1 INV 9A (209-1, 210-10, 210-11, 210-12, 211-2, 308-6)
Pages 263-265	INV 9-D (209-1, 308-6)
Pages 260-261	(113-4)

Technology, Temperature, and Heat

Outcomes

Students will be expected to

- describe how our needs related to heat can lead to developments in science and technology (112-1)
- identify examples of science- and technology-based careers that are associated with heat and temperature (112-9)
- provide examples of insulating technologies used in the past that were developed through trial and error (109-4)

Elaboration–Strategies for Learning and Teaching

The context here and throughout the unit can be heat loss and personal survival in a Canadian winter. Students have had numerous everyday experiences with a variety of winter clothing, for example. Investigation into why various materials are better insulators than others can be a discussion starting point for this section.

Students may wish to research or investigate the development of certain types of clothes and the types of materials used in them. Students can compare, for example, wool sweaters and Gortex jackets. Some types of clothing have been developed to absorb the perspiration that is produced by the body to keep it cool. Other types of clothing have been developed to help reduce the amount of heat reaching the body (light-coloured clothes) or to permit heat to escape easily to prevent over- heating. Some students may wish to investigate the development of central heating by comparing and contrasting wood stoves and hot air/water central heating systems.

Students should have the opportunity to make links to everyday technologies that they use or come into contact with that are associated with temperature and heat. Students can create a “Temperature, Heat, and Technology” wall display or mural, and, over the course of the unit, additions can be made to the display/mural. Included can be a section designated to science- and technology- based careers associated with the technologies identified and discussed in class. Examples may include health care workers, furnace service technicians, lightbulb manufacturers, and blacksmiths.

The evolution of insulating materials used in and around some dwellings can be investigated. These may include straw, sawdust, seaweed, fibreglass, and foam insulation. The foundations of many homes in the Atlantic provinces were and still are insulated with straw or seaweed. Students can interview seniors in their community to find out if other materials were ever used and how some materials came to be preferred insulators.

Technology, Temperature, and Heat

Tasks for Instruction and/or Assessment

Paper and Pencil

- In a short research project, describe the various technologies that people in your community have used to heat their homes over the past one hundred years. (112-1)

Presentation

- Create a display or mural illustrating the development of materials and clothes used for insulation. (112-1)
- Interview a person who has a science- and/or technology-based job associated with heat production and/or control (furnace repair person, home insulation representative, styrofoam package manufacturer, for example). Report to the class. (112-9)
- Compare various home designs and their heating/cooling systems. Indicate why they are useful designs in their given environments. (112-1, 109-4)

Resources

Science Power™ 7

Pages 202-203 INV 7-D (112-1, 109-4)

Pages 258-262 (109-4, 112-1)

Pages 204, 215, 221, 247 (112-9)

AV
"Old House, New House" - EH #700329, VH
(109-4)

"Science Power™ 7" - MGH
available Sept. 2002
(112-1, 112-9)

Unit 4:
Mixtures and Solutions

Unit Overview

Introduction

Working with and discussing mixtures and solutions allows students to make use of their emerging understanding of the particulate nature of matter. Students will increasingly see that many mixtures and solutions are extremely useful and directly related to their lives.

Students have explored and investigated physical properties and changes in previous grades. They have also had an introduction to distinguishing between physical and chemical changes in their everyday environment. In this unit students will explore and investigate the similarities and differences between general mixtures and solutions, as well as a variety of ways to separate the component parts of these materials. Students will not be expected to distinguish and differentiate suspensions, emulsions, and colloids at this level.

Focus and Context

The focus in this unit is on inquiry, with an emphasis on making observations. Students should have opportunities to make and examine various types of solution (solid in a liquid, liquid in a solid, liquid in a liquid, for example) and devise activities for separating them according to their physical properties. The concept development of the particle model of matter with regard to pure substances and mixtures is one of the key components of this unit. Exploring common and easily made mixtures in the students' environment should be the focus of this unit. Students can use various common materials and technologies to help them separate the component parts of mixtures and solutions.

Science Curriculum Links

Students have experiences exploring the world around them in grade 1 in a unit entitled "Materials, Objects, and Our Senses." In grade 2, students investigate "Air and Water in the Environment" as well as "Liquids and Solids." In grade 5, students explore and investigate the "Properties and Changes in Materials." This unit provides the opportunity for students to gain an elementary understanding and appreciation of solutions. This is addressed again in greater detail in the grade 10 unit called "Chemical Reactions" in which the understanding of concentration and how heat and surface area affects chemical reactions is developed.

Curriculum Outcomes

STSE	Skills	Knowledge
Students will be expected to Nature of Science and Technology 109-4 provide examples of how technologies used in the past were developed through trial and error 109-7 identify different approaches taken to answer questions, solve problems, and make decisions 109-10 relate personal activities in formal and informal settings to specific science disciplines 109-14 explain the importance of using precise language in science and technology Relationships Between Science and Technology 111-5 describe the science underlying particular technologies designed to explore natural phenomena, extend human capabilities, or solve practical problems Social and Environmental Contexts of Science and Technology 112-7 provide examples of how science and technology affect their lives and their community 113-1 identify some positive and negative effects and intended and unintended consequences of a particular scientific or technological development	Students will be expected to Initiating and Planning 208-1 rephrase questions in a testable form and clearly define practical problems 208-6 design an experiment and identify major variables Performing and Recording 209-1 carry out procedures controlling the major variables 209-3 use instruments effectively and accurately for collecting data 209-6 use tools and apparatus safely 209-7 demonstrate a knowledge of WHMIS standards by using proper techniques for handling and disposing of lab materials Analysing and Interpreting 210-4 predict the value of a variable by interpolating or extrapolating from graphical data 210-7 identify, and suggest explanations for, discrepancies in data 210-9 calculate theoretical values of a variable 210-16 identify new questions and problems that arise from what was learned	Students will be expected to 307-1 distinguish between pure substances and mixtures, using the particle model of matter 307-2 identify and separate the components of mixtures 307-3 describe the characteristics of solutions, using the particle model of matter 307-4 describe qualitatively and quantitatively the concentration of solutions 307-5 describe qualitatively the factors that affect solubility

Mixtures

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to	This unit can begin with a discussion about how we make sure we have clean drinking water. Students can be asked if they have ever opened a tap and noticed unclean water. Questions and discussion about the ways in which water is made fit for human consumption can provide an opportunity to access students' understanding of some techniques used in the separation of mixtures and solutions.
• relate the formation and separation of everyday mixtures and solutions to disciplines such as chemistry and engineering (109-10)	Have students try to identify various mixtures that are separated in or around their homes. For example, flour sifters, colanders, and cheese-cloth are sometimes found in kitchens. These technologies and the mixtures associated with them can be associated with food science. Water softeners can be associated with chemistry. Oil, gas, and air filters in various engines help to keep impurities out of the mixtures required to run the engines may be related to the physical sciences and engineering. A student-generated bulletin-board display of mixtures and how they can be separated using such techniques as settling, sifting, filtering, and distillation can be developed during the unit.
• safely using tools and apparatus, identify and separate the components of a variety of mixtures, using (209-6, 307-2) - mechanical sorting - filtration - evaporation - distillation - paper chromatography	This unit can open with an activity or series of activities which engage students in separating mixtures. The intent of the following activities is to expose students to different mechanisms of separation and to have them conclude that some mechanisms which may be successful in some cases may not be successful in others. This activity will result in the identification of new questions and will lay the groundwork for future concept development relating particle size to the type of mixture. Students should be exposed to a variety of materials (both pure substances and mixtures) as well as a variety of types of mixture (solid with a solid, solid with a liquid, liquid with a liquid, for example). Some separation activities may include using filter-lined funnels for sand and water, boiling salt water, evaporating salt water, using magnets to separate iron filings and sand, removing bits of copper from salt by hand, and using the property of attraction of water in paper chromatography.
• identify new questions and problems about mixtures that arise from what is learned (210-16)	Students should come to realize that matter is generally categorized into two main groups: substances (one kind of material such as sugar), and mixtures (a combination of two or more substances). Gold (substance) can be separated from gravel (mixture) by a type of mechanical sorting with the help of gravity, for example, when one pans for gold. A salad spinner could also be examined as another way to separate mixtures. Encourage students to identify, on the basis of their introductory investigations and discussions, new questions and problems that arise from what is learned, such as "Are there mixtures that cannot be separated?"

Mixtures

Tasks for Instruction and/or Assessment

Observation

- Observation checklist for assessment of separation of mixtures:

	Rarely			Always
1. Follows safety rules.	1	2	3	4
2. Stays on task.	1	2	3	4
3. Carefully observes and records observation.	1	2	3	4
4. Distinguishes between observations and inferences.	1	2	3	4

(209-6, 307-2)

Performance

- Give students a choice of mixtures (for example, sand and water, salt water, oil and water). Separate the component substances. (209-6, 307-2)

Journal

- Identify any questions or thoughts concerning the activity in which a variety of mixtures was separated. (210-16)

- Some mixtures that we sometimes separate are ... (109-10)

Paper/Pencil

- Research how different industries separate mixtures, and present your findings to the class, using diagrams, pictures, or demonstrations to illustrate; for example, extraction of salt from water, separation of aluminium cans, cardboards, and so forth at a recycling depot. (307-2, 112-7)

- Create an illustrated children's book that describes how salt is obtained in different places and cultures. (307-2)

Interview

- What types of mixture cannot be separated by separation techniques such as settling, sifting, filtering, and distillation? Explain why. (307-2)

Presentation

- Make a poster of various mixtures and the industries/services that might be associated with them. (109-10)

- Students research how salt is obtained in various places or cultures and prepare a drama, for younger children, that illustrates these methods of separation. (307-2, 112-7)

Resources

Science Power™ 7

Pages 163-168	Sec 6.3 INV 6-C (109-10)
Pages 128-129	INV 5A (209-6, 307-2)
Pages 180-181	Unit Project (209-6, 210-16, 307-2)

AV

"Separating Mixtures" - C-Video #705265, VH
(109-10, 209-6, 307-2)

Solutions

Outcomes

Students will be expected to

- distinguish between pure substances and mixtures, using the particle theory of matter:
  - pure substances versus mixtures
  - heterogeneous mixtures
  - homogeneous mixtures (solutions) (307-1)
- describe the characteristics of solutions, using the particle model of matter and the terms:
  - solute
  - solvent
  - dissolving
  - soluble (109-14, 307-3)

Elaboration–Strategies for Learning and Teaching

Students can be given a known set of solutions and non-solutions in order to compare and contrast them. A list of characteristics can be developed to describe the solutions in the set. To help develop the concept of the particle model of matter, students can dissolve a number of solids (coloured sugar crystals into a drop of water, for example or watch a piece of soft candy dissolve in warm water) and observe what happens to the sugar, using light scopes or dissecting scopes. Students may then be encouraged to explain what they believe is happening to the sugar at the particle level. The concept of simple dissociation is as far as one needs to go at this level. The use of Styrofoam balls, marbles, and sand in clear containers may help students gain an emergent understanding of the characteristics of solutions, using the particle model of matter. Teachers or students may want to investigate the different types of non-solutions such as dispersions, emulsions, and colloids if students' discussion leads to this differentiation and if time permits; however, these concepts are not core to this unit.

The students themselves can be used in an activity to illustrate the difference between homogeneous and heterogeneous mixtures. Using pinnies or different jerseys from the gym, have one colour represent the solvent and the other colour to represent the solute. In a heterogeneous mixture, have different-sized groups (4–5) of solute particles (students) link arms together and mix unevenly around the solvent particles. This activity can also be used to illustrate the characteristics of solutions. A demonstration illustrating the reduction in volume of a solution of water and alcohol when equal amounts of each are mixed together helps to solidify the understanding of homogeneous mixtures. Equal amounts (volumes) of marbles and sand help students to visualize and conceptualize this phenomenon. Students can, themselves, represent a homogeneous mixture if the same number of males and females occupy the same area and move randomly from one place to another.

It is important that the students properly use the terms associated with solutions in their discussions and writings. In most cases the solute is the smaller quantity in the solution. This may not always be true, however, as in the case of concentrated solutions of sugar and water.

The Tyndall Effect is a phenomenon that one can use to help distinguish between a solution and what appears to be a solution. If you shine a narrow beam of light directly through a mixture and you do not see the beam in the mixture, it is probably a solution. If you observe a light beam or light scattering, this is the Tyndall Effect, which indicates that there are particles that are not dissolved and the light is being scattered by them. The Tyndall Effect cannot be used to distinguish a solution from a pure liquid. Both will allow light to pass through unobstructed. The Tyndall Effect is used to distinguish a suspension from a solution.

. . . continued

Solutions

Tasks for Instruction and/or Assessment

Performance

- Using a "Draw" application or illustrations by hand, highlight the differences between
  - pure substances and mixtures
  - heterogeneous mixtures and homogeneous mixtures (307-1)

- Using Styrofoam balls, marbles, and sand, demonstrate an understanding of the characteristics of substances and mixtures, using the particle theory of matter. (307-3)

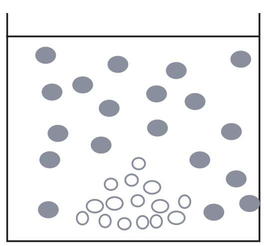
Journal

- "It is important to use the terms solute and solvent properly when creating or separating solutions because ..."

Paper and Pencil

- Explain/illustrate what happens to both the solute and the solvent in a solution. (307-3)

- Using the diagram below as the first step, sketch what the solution might look like when thoroughly mixed. Indicate the particles resenting the solute and the solvent.



Portfolio

- In an advice column about science projects in a school newspaper, explain the importance of knowing what the following words mean when doing a related science activity:
  - solute
  - solvent
  - dissolving
  - soluble (109-14)

Resources

Science Power™ 7

Pages 98-106	Sec 4.1 INV 4-A (307-1)
Pages 107-110	Sec 4.2 INV 4-B (307-1)
Pages 112-115	Sec 4.3 (307-1)
Pages 122-125	Sec 5.1 (109-14, 307-1)
Pages 128-130	INV 5-A (307-1)
Pages 148-150	(307-1, 307-3)
Pages 152-157	Sec 6.2 INV 6-A (307-1, 307-3)

Solutions (continued)

Outcomes

Students will be expected to

- describe the science underlying a distillation apparatus (111-5)

- demonstrate a knowledge of WHMIS standards by recogizing and following warning labels symbols (209-7)

Elaboration–Strategies for Learning and Teaching

By doing a teacher-led demonstration, students can observe and describe simple distillation apparatus such as the boiling of water in a pot and allowing the water vapours to rise to a suspended plate with ice in it. The condensing water vapour drips off the edges of the plate. A commercial distillation apparatus can also be used if available. It is important that students do not do activities that involve the use of boiling or boiled water owing to safety considerations. Students should come to understand that the solvent and the solute are separated and both can be reclaimed by the evaporation and the subsequent condensation of the solvent.

A class demonstration to show a distillation apparatus can involve a tub with 3 cm of dirty water in it. Put a heavy pot in the middle of the tub. Cover the tub with plastic wrap, and put a stone on the wrap so it is positioned in the middle. This will make an indentation on the plastic wrap. Water will condense on the plastic wrap and drip down into the pot. A challenge for students can be to extract as much salt as they can from a variety of salt solutions and determine the amount of solute.

Students should understand the importance of recognizing and safely using products labelled with WHMIS caution, warning, and danger symbols. Students can be asked to identify and report on household products that have these symbols on mixtures and substances in order to make a classroom display.

Solutions (continued)

Tasks for Instruction and/or Assessment

Paper and Pencil

- Given the following materials, write the directions for a survival manual to put together a distillation apparatus:
  - cup
  - plastic sheet
  - large bowl (111-5)

- Draw a distillation apparatus and describe the function of each part from the point of view of the distillation process. (111-5)

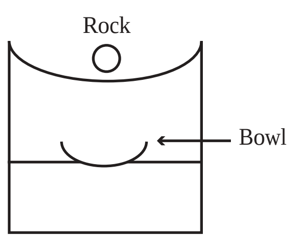
- Apply the following terms to the water cycle, using a labelled diagram, cartoons of water drops, or in a paragraph:
  - evaporation
  - cooling
  - condensation (111-5)
  - precipitation
  - filtration

- Using the following diagram, explain how water could be purified. (111-5)

- Make a list of 15-20 solutions and mixtures that you encounter in a day and identify those that may pose safety risks. (209-7)

Portfolio

- Create a booklet of labels from household products which are mixtures. Identify all WHMIS references. (209-7)



Resources

Science Power™ 7

Pages 126-137 Sec 5.2
INV 5-A
INV 5-B
(111-5)

Pages 160 and 492
(209-7)

Concentration of Solutions

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to • describe the concentrations of solutions qualitatively, using the terms *dilute*, *concentrated*, *saturated*, and *unsaturated* (307-4)	A continued exploration and investigation into the particle model of matter as it relates to mixtures and particularly solutions can be accomplished with opportunities for students to explore the concentrations of solutions both qualitatively and quantitatively. Students can create solutions of varying concentrations of food colouring and water and quantitatively and qualitatively describe the solutions they create. Discussion of common everyday experiences related to the terms *dilute* and *concentrated* such as "orange concentrate" and "weak coffee" can allow for a better appreciation of the students' understanding of the terms before formal investigations and learning activities. Coloured pinnies on students may be used to illustrate the terms dilute and concentrated. In dilute solutions, there will be very few "solute" students moving about the "solvent" students. This is a good opportunity to dispel a popular misconception that concentrated means more solute by keeping the same number of "solute" students and removing (evaporating) some "solvent" students. The terms saturated and unsaturated can be used and discussed after these experiences.
• identify different ways that concentrations can be demonstrated for various substances (109-7)	Students can investigate more quantitative descriptions of concentrations by noting or bringing to class various commercial product labels and/or newspaper articles in which the concentrations are indicated. Examples of concentrations described in ppm (parts per million) and percentage by mass will permit students to see that concentrations can be described in various ways.
• calculate concentrations of solutions in g/L (210-9)	Using data collected from various procedures, students can problem-solve in order to determine a method to calculate the concentrations determined in the procedures in g/L. This is an opportunity to provide a math link to science. Students can add different amounts of solute to varying volumes of solvent and then determine a way to compare the results. In this way, students should come to realize that a common volume of solute would be required to make comparisons. If students find that a particular substance has a solubility of 60 g/100mL, they should be able to devise and use a method to express the solubility in g/L.
• rephrase questions related to solubility in a testable form and clearly define practical problems (208-1)	Students should be encouraged to develop testable questions and also to recognize and control the major variables in any of the tests carried out. By collecting and recording data observed during the procedures, 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. . . . continued

Concentration of Solutions

Tasks for Instruction and/or Assessment

Observation

- Prepare and describe a solution of a certain concentration. (Observe their technique.) (307-4)

Paper and Pencil

- How might a person make maple syrup from maple sap without boiling? (307-4)

- Given a concentration of 4 g/50 mL, calculate the concentration of the solution in g/L. (109-7, 210-9)

Resources

Science Power™ 7

Pages 138-141 Sec 5.3
INV 5-C
(307-4)

Pages 148-150 (109-7, 208-1, 210-9)

Concentration of Solutions (continued)

Outcomes

Students will be expected to

- design and carry out procedures to study the effect of temperature on solubility (208-6, 209-1)
- identify and suggest explanations for discrepancies in data after carrying out procedures designed to study the effect of temperature on solubility (210-7)
- predict the solubility of a solute by interpolating or extrapolating from graphical data (210-4)
- describe qualitatively the factors that affect solubility:
  - temperature
  - pressure

  (307-5)
- use a commercial or student-made hydrometer effectively and accurately for collecting data (209-3)

Elaboration–Strategies for Learning and Teaching

The temperature versus the amount of solute being dissolved should be highlighted here. It should be noted that the relationship between temperature and solubility is not simple. The solubility of some solutes goes down as temperature rises (calcium acetate), whereas the solubility of some others is relatively unaffected by increased temperatures of the solute (sodium chloride and calcium carbonate). Other solutes (potassium chloride, sugar) have increased solubility with an increasing temperature. Working with computer spreadsheets will enable students to organize data and to possibly create graphs from which to predict the value of a variable such as the amount of solute in a solvent.

Many students have had experiences with soft drinks and the effects pressure has on the solubility of carbon dioxide in the water. When students open a bottle or can of pop, the gas solute comes out of solution due to a decrease in pressure. Students can be challenged to investigate the impact increased temperature has on the solubility of gases in pop. Many students have experienced tasting flat pop after a bottle of pop is left open for a period of time or is warm. The solubility of sugar in water as temperature changes can be investigated. Through exploration and investigation, students should be able to qualitatively describe the relationships between temperature and solubility and pressure and solubility. In most cases, as the temperature or pressure rises, so does solubility.

Students should use solubility graphs to interpolate and extrapolate solubility rates at various temperatures. Math outcomes from Data Management can be addressed in this type of activity.

The preparation of simulated maple sap using water, sugar, and vanilla, or a visit to a sugar bush camp also permits students to observe and collect data on the effect heat has on the various concentrations of sap. Students will see that various concentrations of sap create maple butter, maple cream, and hard maple sugar. Students must be given the opportunity to observe and use hydrometers (commercial and/or student-made) in their explorations, in order to experience how this simple technology permits one to determine the concentrations of various solutions. The construction, using a lump of clay and a straw, and calibration of a hydrometer also permits the students to carry out and control major variables in their tests. Students can interview the Foods Technology teacher to find out how and why hydrometers are used in the preparation of some foods.

Concentration of Solutions (continued)

Tasks for Instruction and/or Assessment

Performance

- Design an experiment to determine the mass of a given amount of solute (salt, sugar) it takes to dissolve at different temperatures. (208-1, 208-6, 209-1)

- Determine the concentration of a solution, using a hydrometer. (209-3)

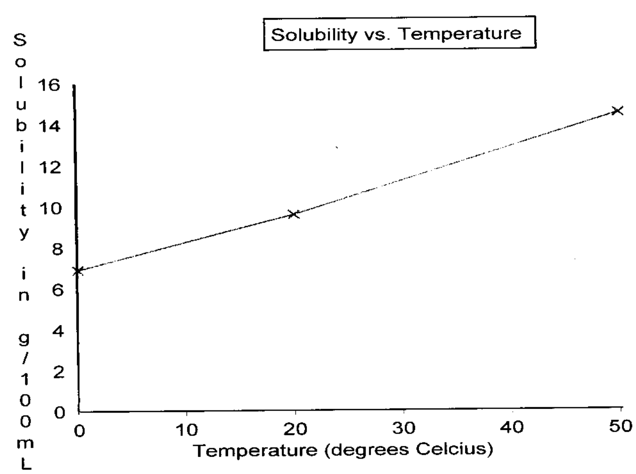
- Create a graph from the data collected in the activity and give several possible values by interpolating information on the graph. (210-4)

Journal

- Identify reasons why data collected during investigations into temperature and solubility may differ from group to group. (210-7)

- How does an increase in temperature usually affect the solubility of
  - a gas in a liquid? - a solid in a liquid? (307-5)

- a) How many grams of solute can be dissolved at 15 °C?
  b) How many grams of solute do you predict would dissolve at 60 °C? (210-4)



Interview

- What would a solubility curve look like for a substance that has decreased solubility as temperature increases? (210-4)

Resources

Science Power™ 7

Pages 154-156 INV 6-A (208-6, 209-1, 307-5)

Page 160 (208-6, 209-1, 307-5)

Pages 158-159 INV 6-B (210-7, 307-5)

Outcomes 210-4 and 209-3 can be accomplished using other sources.

Mixtures, Solutions and the Environment

Outcomes

Students will be expected to

- provide examples of how science and technology, related to mixtures and solutions, affect our lives (112-7)
- identify some positive and negative effects and intended and unintended consequences of a particular scientific or technological development related to mixtures and solutions (113-1)
- provide examples showing the evolution of refining and separation techniques (109-4)

Elaboration–Strategies for Learning and Teaching

Students should be encouraged to bring forth and discuss various examples of how the knowledge and use of mixtures and solutions affect our lives. Examples such as the use of road salt on our highways and salt to make ice cream enable students to see the utility and application of the science involved with mixtures and solutions. In addition, students can investigate the positive and negative and intended and unintended consequences of applying road salt to highways, for example. Discussing the positive safety aspects of improved driving conditions and the negative effects that salt water solutions have on roadside vegetation and the metal in cars give students the occasion to bring out the positive and negative effects of using science and technology to solve problems.

A study of how solutions and other types of mixtures are separated in sewage filtration and treatment plants and/or home septic systems can be undertaken. Town engineers and environmental waste specialists may be invited to class to talk about the methods used to safely recycle and dispose of various solutions and other mixtures.

Some students may have water softeners in their homes. A discussion/ investigation on the use of these technologies will help students see the connection between science and technology in their everyday environment.

A field trip to a local water treatment plant can be undertaken. An official from the local water utility or a representative for water softener technology companies can be invited to speak to the students.

Students can investigate mixtures such as agricultural sprays and identify their benefits to society and the potential harm they can have if not used carefully and safely. Other common mixtures and solutions that may be discussed or investigated are bleaches, battery acids, and drain cleaners.

Many of the technologies and techniques associated with the creation and separation of mixtures and solutions have been developed through trial and error. Some students may want to investigate the following examples of evolving technologies:
- seepage beds to septic tank systems

Mixtures, Solutions and the Environment

Tasks for Instruction and/or Assessment

Journal

- A farmer once said that the earth is one of nature's filtration systems. Explain what he might have meant by this? (109-4, 113-1)

Paper and Pencil

- Interview a construction worker or house builder about the differences between seepage beds as used by many rural people in the past, and modern septic tank systems. (109-4)

- Research a specific mixture/solution and report on its importance to people/society. (112-7)

Presentation

- Create a mural that illustrates the mixtures and solutions you encounter in everyday life. (112-7)

- Research and report on the positive and negative effect of applying salt to highways in the winter. (113-1)

- In a series of illustrations, drawings, or pictures, show how a particular separation technique has changed and developed over time. (113-1)

- Prepare a photo essay on the development of distillation apparatus. (109-4)

Portfolio

- Create a "Day in the Life of ..." in which the main character encounters and describes mixtures and solutions in a typical day. (112-7)

Resources

Science Power™ 7

Pages 163-171 Sec 6.3
INV 6-D
(112-7, 109-4)

Sample Pathways

This section contains Sample Pathways of resource material to be used by teachers as they work through the curriculum guide. These are provided as a suggested way to help cover as many outcomes as possible in an allotted time frame that spans approximately 20 lessons per unit. For example, if a teacher has a class of science 3 times a week they can follow the 20 suggested lessons (7-8 weeks) and is assured of covering a vast majority of the prescribed outcomes listed in this curriculum guide. A lesson can vary from half a class period to several periods. Some teachers may have an opportunity to cover some of the alternative text sections if they have science more frequently or if they feel those sections cover outcomes better.

Though the sample pathways provided are specific to a resource, teachers are always encouraged to use additional/alternative resources to help address a specific outcome. The blank Pathway sheets are provided so that teachers can photocopy and design their own "pathways" and lesson time-lines. A 7-9 week period is suggested to cover a particular unit of science content.

Teachers are encouraged to use the Pathways in order to allow time for Science Fairs, Science Olympics, and other science related activities that are an important component in helping students develop scientific literacy.

Sample Unit 1
Critical Pathway (Life Sciences: Interactions within Ecosystems – Grade 7)

Lesson	Text Section(s)	OR *Alternative* Text Section(s)	Outcome(s)
1	Intro. Sec 1.1, pages 6/8	Inv 1A, page 9	208-2, 208-3, 109-12, 109-13
2	Sec 1.2, pages 11/12		306-3
3	Sec 1.3, Inv 1C, pages 16-18	Inv 1B, page 13	208-2, 208-3, 209-3, 209-4, 304-1, 109-1, 111-6, 304-3
4	Sec 2.1, pages 38-40		210-1, 109-12, 210-2, 210-3, 306-1, 111-6
5	Inv 2-A, page 41		304-2, 210-1
6	Sec 2.1, pages 42-43		210-1, 109-12, 210-2, 210-3, 306-1, 111-6
7	Inv 2-B, pages 44/45		306-2, 210-12
8	Sec 2.1, pages 46/47		109-12, 109-13. 304-2. 210-1
9	Sec 2.3, pages 51-53		210-2, 210-3, 306-4
10	Sec 2.4, pages 53-54		306-4
11	Inv 2C, pages 56-57		306-4
12	Page 68 for Photosynthesis		109-12
13	Sec 3.3, pages 77-79		208-5
14	A project on protecting Habitat or Species can address		113-11, 211-5, 113-10, 112-1, 112-8, 209-5

Sample Unit 2

Critical Pathway (Earth and Space Science Earth's Crust – Science 7)

Lesson	Text Section(s)	OR *Alternative* Text Section(s)	Outcome(s)
1	Intro. Activity, page 279	Inv 10-A, pages 284-285	210-1, 310-2A
2	Sec 10.2, page 289		208-2, 310-2B
3	Inv 10-B, pages 290-291		208-2, 209-6, 310-2B
4	Sec 10.2, pages 292-294		208-2, 310-2B
5	Sec 10.2, pages 295-297/299		311-2
6	Inv 10-C, page 298		311-2, 211-3, 210-12, 211-14
7	Sec 10.3, pages 300-301		311-3
8	Inv 10-D, pages 302-304		209-1, 310-3
9	Sec 10.3, pages 305-307		113-1, 112-7, 113-7
10	Intro. Pages 312-313	Sec 11.1, pages 314-316 or Sec 11.2, pages 326-329	311-4
11	Inv 11-C, pages 330-331		209-4, 210-6, 311-5
12	Sec 11.3, pages 334-336		311-1
13	Sec 12.1, pages 344-345		110-1
14	Sec 12.2, pages 347-351		110-4
15	Sec 12.3, pages 352-357		110-4, 112-12
16	Sec 12.4, pages 358-362		209-4, 311-6
17	Activity page 363		209-4, 311-6

Sample Unit 3
Critical Pathway (Physical Science: Heat – Grade 7)

Lesson	Text Section(s)	OR *Alternative* Text Section(s)	Outcome(s)
1	Sec 7.1, pages 186-189		209-3, 308-1, 110-7
2	Inv 7A – pages 190-191	Make air thermometer	208-8, 210-13, 210-2
3	Inv 7B, pages 192-193		209-3
4	Sec 7.2, pages 199-201		308-2
5	Inv 7D, pages 202-203		112-1, 109-4
6	Sec 7.3, pages 205-206		308-2
7	Sec 8.1, pages 214-215 & 218		308-3
8	Inv 8A, part A only, page 216		308-3
9	Activity, page 220		308-3
10	Sec 8.2, page 222		308-7
11	Inv 8B, page 223	Inv 8C, page 224	308-7
12	Inv 8D, pages 228-229	Inv 8E, page 230	308-3
13	Sec 8.4, pages 234-236		308-4
14	Sec 9.1, pages 242-243, 245-247		308-5, 209-1, 210-10, 210-11, 210-12, 211-2, 308-6
15	Inv 9A, page 244		308-5
16	Sec 9.2, page 251-253	Inv 9B, page 254-255	111-5, 308-2
17	Inv 9D, page 263-265	Pages 260-262	113-4, 209-1, 308-6

Sample Unit 4

Critical Pathway (Physical Science: Mixtures and Solutions – Grade 7)

Lesson	Text Section(s)	OR *Alternative* Text Section(s)	Outcome(s)
1	Intro. Activity page 99		307-1
2	Sec 4.1, pages 100-103		307-1
3	Inv. 4A, pages 104-105		307-1
4	Inv 4B, pages 108-109		307-1
5	Sec 4.3, pages 112-115		307-1
6	Sec 5.1, pages 122-125		109-14, 307-1
7	Inv 5A, pages 128-130		111-5, 209-6, 307-2
8	Pages 180-181		210-16, 209-6, 307-2
9	Sec 5.3, pages 138-139	Sec 6.3, pages 163-165	307-4, 109-10
10	Inv 5C, pages 140-141	Inv 6C, page 166	307-4, 109-10
11	Sec 6.1, pages 148-151		109-7, 208-1, 210-9, 307-1, 307-3
12	Sec 6.2, pages 152-153		307-1, 307-3
13	Inv 6A, pages 154-156		208-6, 209-1, 307-1, 307-3, 307-5
14	Pages 160-161		208-6, 209-1, 307-5

Sample Unit ____
Critical Pathway (____)

Lesson	Text Section(s)	OR *Alternative* Text Section(s)	Outcome(s)
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