



Department of Education
English Programs

Atlantic Canada Science Curriculum

Science

Grade 4

CURRICULUM

Acknowledgements

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- The Provincial Curriculum Working Group, comprising teachers and other educators in Prince Edward Island, which served as lead province in drafting and revising the document.
- The teachers and other educators and stakeholders across Atlantic Canada who contributed to the development of the grade 4 science curriculum guide.

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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.

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.

Suggested Teaching Sequence for grade 4 Science

The grade 4 science curriculum consists of four units: one Life Science (*Habitats and Communities*), one Earth Science (*Rocks, Minerals and Erosion*), and two Physical Science units (*Light* and *Sound*). The following teaching sequence is suggested; however, teachers are encouraged to identify opportunities to integrate science with other curricula throughout the year.

Rocks, Minerals and Erosion

Having investigated the composition of soils at the grade 3 level, students will now explore the physical properties of rocks and minerals and the effects of erosion on the landscape. In general, most children have few prior ideas about how rocks are formed and many will assume that rocks have always existed just as they are today.

Light

Children at this level often equate light with its source and do not understand it as a distinct entity. They may think that light exists in only two categories - electric light and sunlight, or that light travels further at night than in the day. In this unit children will become familiar with the fact that light usually travels in straight lines, and that it can also be reflected, bent, and scattered by interacting with various objects in the environment.

Sound

Students may have significant misconceptions as to how sound is perceived and few understand the role of air as the medium for sound waves. Learning how sound is caused by vibrations, as well as the varying abilities of humans and other animals to detect sounds are the fundamental concepts that this unit explores.

Habitats and Communities

Spring is a good time to explore the amazing diversity of the natural world. This unit allows children the opportunity to further develop concepts related to plants, animals and habitat. Students can begin to look for ways in which organisms in one habitat differ from those in another, and consider how some of those differences are helpful for survival.

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 intrinsic 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.

Inquiry

- *define questions related to a topic*
- *select an appropriate way to find information*
- *make direct observations*

Problem Solving

- *gather information from a variety of sources*
- *appreciate that several solutions should be considered*
- *plan and design a product or device intended to solve a problem*

Decision Making

- *evaluate the validity of the information source*
- *identify the different perspectives that influence a decision*
- *present information in a balanced manner*

Student learning may be described in terms of ability to perform these tasks.

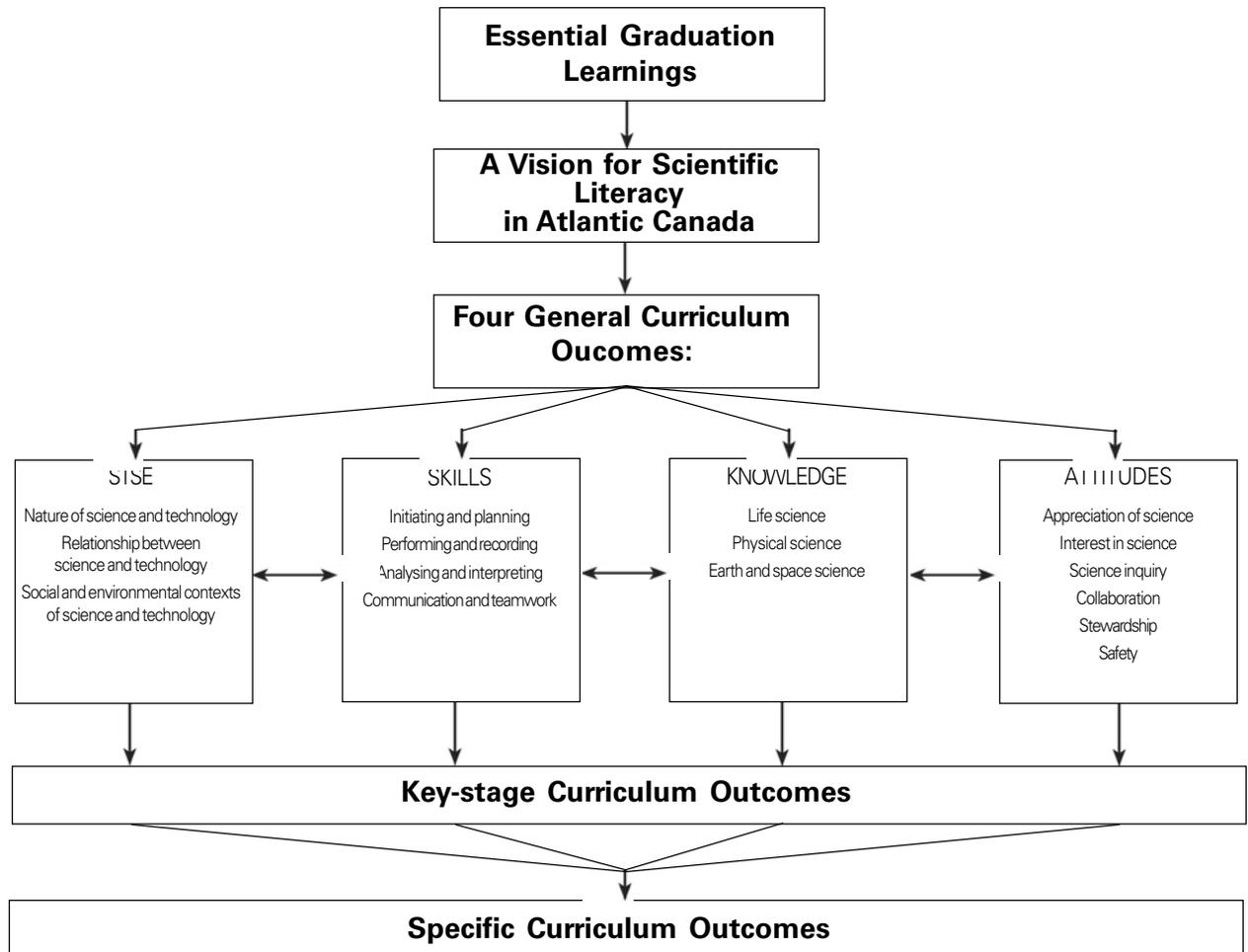
Curriculum Outcomes Framework

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

FIGURE 1



Essential Graduation Learnings

Essential graduation learnings are statements describing the knowledge, skills, and attitudes expected of all students who graduate from high school. Achievement of the essential graduation learnings will prepare students to continue to learn throughout their lives. These learnings describe expectations not in terms of individual school subjects but in terms of knowledge, skills, and attitudes developed throughout the curriculum. They confirm that students need to make connections and develop abilities across subject boundaries and to be ready to meet the shifting and ongoing opportunities, responsibilities, and demands of life after graduation. Provinces may add additional essential graduation learnings as appropriate. The essential graduation learnings are:

Aesthetic Expression

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

Citizenship

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

Communication

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

Personal Development

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

Problem Solving

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

Technological Competence

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

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.

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 three-page synopsis. On the first page, a general introduction to the topic is provided. This is followed by sections that specify 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 synopsis 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:

- 100s—Science-Technology-Society-Environment (STSE) outcomes
- 200s—Skills outcomes
- 300s—Knowledge outcomes
- 400s—Attitude outcomes (see pages 17–19)

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

The third page contains the PEI/APEF Specific Curriculum Outcomes that teachers will use for daily planning, instructional, and assessment purposes.

The Four-Column Spread

All units have a two-page layout of fo below. In some cases, the four-colum two-page layout. Outcomes are group top of the left page.

Habitats and Populations

Outcomes

- Students will be expected to
- use the terms habitat, population, and community in appropriate contexts (104-6)
 - identify questions to investigate about the types of plants and/or animals at a local habitat, and the conditions under which they live (204-1)

Elaborations—Instructional Strategies/Suggestions

Field studies are essential to the achievement of the outcomes in this unit. Ideally, multiple visits to one site in various types of weather would permit observations of different aspects of the habitat.

Students should develop questions surrounding what they would like to discover in their local habitat. This should include the types of plants and/or animals that live in their local habitat.

Examples of questions which might be developed are

- How do plants and animals interact within the habitat and community?
- What types of plants and animals will I find?
- What factors affect the survival of plants and/or animals in their local community as they relate to shelter or landscape?
- Do different habitats have different types of flowers and trees? Are their seeds different? Students can collect seeds from plants or trees in the fall, count them, and compare their shapes.
- Does habitat affect blooming times? Teachers could contact local horticultural societies, government agencies, universities, or people in their community who collect data on various plants and how they are impacted by the environment.
- What is the soil and ground terrain like where blueberries grow? Where do partridge berries, raspberries, and cranberries grow?
- What birds come to the selected habitat? What do they feed on?

Habitats and Populations

Tasks for Instruction and/or Assessment

Journal

- Finish the sentences in your journal.
 - The things that I think I will see on my field trip are ...
 - The questions that I would like answered are ... (204-1)
 - My understanding of habitat, population, and community is ... (104-6)

Paper and Pencil

- Compare two communities. What types of populations are found in each? (104-6)

Interview

- What different populations of organisms do you think you will find in a seashore habitat? A field habitat? (104-6)

Resources/Notes

Science and Technology 4

Teachers Guide: Habitats

- Launch: A Place to Live, p.8
 1. What is Habitat? p.10
 2. Field Trip, p.14
 7. Building Food Chains, p.31
 Design Project: Habitat Help, p.56

Special Places: Eco-lessons from the National Parks in Atlantic Canada (CD-ROM). These creative activities are designed to be teacher friendly and student centered and combine research, discussion and group work. Each lesson plan includes learning outcomes, materials, background information and detailed procedures. You will also find a map locating the national parks within Atlantic Canada, illustrated black line masters on the national parks and their species, as well as an extensive teacher's glossary. Activities that address science curriculum outcomes at the grade 4 level are referenced in this curriculum guide. Also available on the internet at www.parksatlcanada.gc.ca (Click on *Educational Resources*, then *Teachers Guide* and finally *eco-lessons*)

- Lesson 1.1: Creature Features
 Lesson 2.1: More Than a Campground
 Lesson 3.1: Conservation Advice for National Parks

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.

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.

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.

This column provides correlations of outcomes to authorized resources.

Life Science: Habitats and Communities

Introduction

By grade 4, students should be familiar with the basic needs of living things and can explore how various organisms satisfy their needs in the habitat in which they are typically found. Students can begin to look for ways in which organisms in one habitat differ from those in others, and consider how some of those differences are helpful for survival. The concept of interrelatedness can be expanded upon further by looking at the variety of populations that exist in a habitat and the impact of the loss of one population on a community.

Focus and Context

The focuses in this unit are inquiry and decision-making. Students, while exploring and investigating the plants and animals that live in local habitats, should realize the impact that they can have on the environment. How do they treat the organisms that they encounter? Are they going to ensure that they don't leave behind any garbage? What small steps can they take in their local area to ensure that habitats are preserved and protected? Their investigation of a habitat and their impact on it can be used to create a meaningful context which drives this unit.

Science Curriculum Links

The needs and characteristics of living things were investigated in grade 1. This leads to investigating the growth, changes, and life cycles of animals in grade 2, and the growth, life cycles, and parts of plants in grade 3.

The concepts of habitats, populations, food chains, predator/prey relationships, and the roles of producers, consumers, and decomposers will be developed in this unit. This will lead to a more formal classification systems in the grade 6 unit, *Diversity of Life*.

In grade 7, relationships between organisms are further explored by developing the concept of ecosystems and food webs in *Interactions within Ecosystems*.

pan-Canadian Science Learning Outcomes

N.B. The following pan-Canadian Science Learning Outcomes were used as the framework in the development of the Atlantic Canada Science Curriculum at this grade level. For planning, instructional, and assessment purposes, teachers should refer to the PEI/APEF Specific Curriculum Outcomes found on the next page.

STSE	Skills	Knowledge
<p><i>Students will be expected to</i></p> <p>Nature of Science and Technology</p> <p>104-4 compare the results of their investigations to those of others and recognize that results may vary</p> <p>104-6 demonstrate that specific terminology is used in science and technology contexts</p> <p>105-1 identify examples of scientific questions and technological problems that are currently being studied</p> <p>Relationships Between Science and Technology</p> <p>106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications</p> <p>Social and Environmental Contexts of Science and Technology</p> <p>108-1 identify positive and negative effects of familiar technologies</p> <p>108-3 describe how personal actions help conserve natural resources and care for living things and their habitats</p> <p>108-6 identify their own and their family's impact on natural resources</p>	<p><i>Students will be expected to</i></p> <p>Initiating and Planning</p> <p>204-1 propose questions to investigate and practical problems to solve</p> <p>204-3 state a prediction and a hypothesis based on an observed pattern of events</p> <p>204-6 identify various methods for finding answers to given questions and solutions to given problems, and select one that is appropriate</p> <p>Performing and Recording</p> <p>205-1 carry out procedures to explore a given problem and to ensure a fair test of a proposed idea, controlling major variables</p> <p>205-5 make observations and collect information that is relevant to a given question or problem</p> <p>205-10 construct and use devices for a specific purpose</p> <p>Analysing and Interpreting</p> <p>206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying</p> <p>206-2 compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs</p> <p>206-3 identify and suggest explanations for patterns and discrepancies in data</p> <p>206-6 suggest improvements to a design or constructed object</p> <p>Communication and Teamwork</p> <p>207-2 communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawings, and oral language</p>	<p><i>Students will be expected to</i></p> <p>302-1 identify a variety of local and regional habitats and their associated populations of plants and animals</p> <p>302-2 describe how a variety of animals are able to meet their basic needs in their habitat</p> <p>300-1 compare the external features and behavioural patterns of animals that help them thrive in different kinds of places</p> <p>300-2 compare the structural features of plants that enable them to thrive in different kinds of places</p> <p>302-3 classify organisms according to their role in a food chain</p> <p>301-1 predict how the removal of a plant or animal population affects the rest of the community</p> <p>301-2 relate habitat loss to the endangerment or extinction of plants and animals</p>

PEI/APEF Specific Curriculum Outcomes

Habitats and Populations

Students will be expected to

- use the terms habitat, population, and community in appropriate contexts (104-6)
- identify questions to investigate about the types of plants and/or animals at a local habitat, and the conditions under which they live (204-1)
- identify various methods for finding answers to questions related to their local habitat, and select one that is appropriate (204-6)
- make observations and collect information related to local habitats and their associated populations of plants and animals (205-5, 302-1)
- identify their own and their families' impact on habitats, and describe how personal actions help conserve habitats (108-6, 108-3)
- compile and display the data collected in the habitat study using tallies, tables, and/or bar graphs (206-2)
- present the procedures and results of their habitat studies, compare their results with those of other class members, recognizing that results may vary, and suggest explanations for these discrepancies (104-4, 206-3, 207-2)

Collecting Scientific Information using Models of Natural Habitats

Students will be expected to

- construct and/or maintain a model of a natural habitat, and use it to make observations and collect information about organisms in this habitat (205-10, 205-5)
- suggest improvements to the model of the natural habitat to make it more realistic and habitable for organisms (206-6)

Behavioural and Structural Features of Animals That Enable Them to Survive in Their Habitat

Students will be expected to

- compare the external features and behavioural patterns of various animals and relate these features to their ability to meet their basic needs in their natural habitats (302-1, 300-1)
- carry out procedures and ensure a fair test to explore how appearance affects visibility (205-1)
- predict the structural and/or behavioural adaptations needed for an animal to live in a particular habitat, real or imagined (204-3)

Structural Features of Plants that Enable Them to Survive in Their Habitat

Students will be expected to

- using appropriate terminology compare the structural features of plants that enable them to thrive in different kinds of places (300-2, 104-6)
- describe how scientists' knowledge of plant growth has led to agricultural innovations and techniques (106-4)
- describe current investigations into local or regional habitat issues (105-1)

Food Chains

Students will be expected to

- classify organisms according to their role in a food chain and draw a diagram to illustrate the food chain (302-3, 104-6, 206-1)
- predict how the removal of a plant or animal population affects the rest of the community (301-1)
- relate habitat loss to the endangerment or extinction of plants and animals (301-2)

The Impact of Technology on Natural Habitats

Students will be expected to

- identify examples of positive and negative effects of technological developments on natural habitats (108-1)

Habitats and Populations

Outcomes

Students will be expected to

- use the terms habitat, population, and community in appropriate contexts (104-6)
- identify questions to investigate about the types of plants and/or animals at a local habitat, and the conditions under which they live (204-1)

Elaborations—Instructional Strategies/Suggestions

Field studies are essential to the achievement of the outcomes in this unit. Ideally, multiple visits to one site in various types of weather would permit observations of different aspects of the habitat.

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Examples of questions which might be developed are

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- What types of plants and animals will I find?
- What factors affect the survival of plants and/or animals in their local community as they relate to shelter or landscape?
- Do different habitats have different types of flowers and trees? Are their seeds different? Students can collect seeds from plants or trees in the fall, count them, and compare their shapes.
- Does habitat affect blooming times? Teachers could contact local horticultural societies, government agencies, universities, or people in their community who collect data on various plants and how they are impacted by the environment.
- What is the soil and ground terrain like where blueberries grow? Where do partridge berries, raspberries, and cranberries grow?
- What birds come to the selected habitat? What do they feed on?

Habitats and Populations

Tasks for Instruction and/or Assessment

Journal

- Finish the sentences in your journal.
 - The things that I think I will see on my field trip are ...
 - The questions that I would like answered are ... (204-1)
 - My understanding of habitat, population, and community is ... (104-6)

Paper and Pencil

- Compare two communities. What types of populations are found in each? (104-6)

Interview

- What different populations of organisms do you think you will find in a seashore habitat? A field habitat? (104-6)

Resources/Notes

Science and Technology 4

Teachers Guide: Habitats

Launch: A Place to Live, p.8

1. What is Habitat? p.10

2. Field Trip, p.14

7. Building Food Chains, p.31

Design Project: Habitat Help, p.56

Special Places: Eco-lessons from the National Parks in Atlantic Canada

(CD-ROM). These creative activities are designed to be teacher friendly and student centered and combine research, discussion and group work. Each lesson plan includes learning outcomes, materials, background information and detailed procedures. You will also find a map locating the national parks within Atlantic Canada, illustrated black line masters on the national parks and their species, as well as an extensive teacher's glossary. Activities that address science curriculum outcomes at the grade 4 level are referenced in this curriculum guide. Also available on the internet at www.parkscanada.gc.ca (Click on *Educational Resources*, then *Teachers Guide* and finally *eco-lessons*)

Lesson 1.1: Creature Features

Lesson 2.1: More Than a Campground

Lesson 3.1: Conservation Advice for National Parks

Habitats and Populations (continued)

Outcomes

Students will be expected to

- identify various methods for finding answers to questions related to their local habitat, and select one that is appropriate (204-6)
- make observations and collect information related to local habitats and their associated populations of plants and animals (205-5, 302-1)
- identify their own and their families' impact on habitats, and describe how personal actions help conserve habitats (108-6, 108-3)

Elaborations—Instructional Strategies/Suggestions

Students should develop a plan to investigate their field study area. Things to consider in the plan are collection and recording of relevant data, habitat conditions, counting procedures, presentation of data, and equipment needed to carry out the study. Students can work in groups. A standard area size should be decided upon, such as 1 square metre, or the area bordered by a hula hoop.

Once a plan has been completed students should go on a field trip to the habitat they have chosen to examine. Observations made and data collected should be relevant to the questions and plan. No attempt should be made to try to determine total population numbers from the sample results; however, groups would be expected to compare their results.

Technology link: Where possible use technology to collect data (eg. computer-based portable data collectors, video cameras).

As students collect and record information about the types of organisms at the site, and note the conditions around them, they should take care to minimize the disturbance of the organisms in the habitat. Respect for the environment should be stressed.

Teachers can pose environmental questions or situations for students, such as, "Should we pick all the pretty flowers?", "Do you think it is good to carve your initials into a tree trunk?". Students should realize that care for the environment starts with individuals like themselves, and that they have important decisions to make about how they treat the organisms in their environment.

Habitats and Populations (continued)

Tasks for Instruction and/or Assessment*Performance*

- Produce a table with your observations (printed or drawn) from your habitat study. (205-5, 206-2, 302-1)
- Compare your table with other groups.

Habitat Study

Living Things	Description or drawing	Number in hula hoop	Habitat Preference
e.g., dandelions	bright yellow flowers, green leaves, deep roots	5	grow practically everywhere
e.g., beetles	dark, about 1/2 cm, hard body	7	like the dark
:			
:			

Journal

- A habitat close to my house that I enjoy visiting is ... I enjoy going there because ... (108-3, 108-6, 204-6)

Presentation

- Describe a habitat close to home in which you enjoy spending time. Include pictures and drawings of plants, bugs, and animals found in this habitat. What do you enjoy about this habitat? What steps do you take to ensure that it stays unpolluted. (108-3, 108-6)

Interview

- What impact do you and other organisms have on the habitat you investigated? (108-3, 108-6)

Resources/NotesScience and Technology 4**Teachers Guide: Habitats**

2. Field Trip, p.14

5. Basic Needs of Plants and Animals, p.24

10. Changing Habitats, p.41

11. Habitats and Humans, p.44

12. Logs of Habitat, p.48

Design Project: Habitat Help, p.56

Special Places: Eco-lesson from the National Parks in Atlantic Canada (CD-ROM)

Lesson 1.1: Creative Features

Lesson 2.1: More Than a Campground

Lesson 3.1: Conservation Advice for National Parks

Project WILD, developed by the Canadian Wildlife Federation, is based on the premise that young Canadians have a vital interest in learning about their natural world, and how their actions affect the sustainability of life on our planet. The activity guide is a K-12 resource which features a substantial collection of hands-on, pedagogically-sound activities that can be used to address science curriculum outcomes from the topic **Habitats and Communities** at the grade 4 level.

Animal Charades, p.4

Microtrek Scavenger Hunt, p.20

Habitats and Populations (continued)

Outcomes

Students will be expected to

- compile and display the data collected in the habitat study using tallies, tables, and/or bar graphs (206-2)
- present the procedures and results of their habitat studies, compare their results with those of other class members, recognizing that results may vary, and suggest explanations for these discrepancies (104-4, 206-3)

Elaborations—Instructional Strategies/Suggestions

Students should develop a way to communicate their findings. Students can display their work through graphs, drawings, written descriptions, tape, and video recordings of the sounds and sights of the habitat, and multimedia and/or web page presentations.

Technology link: Students could create a data base of the organisms, or use a spread sheet to enter data and then display graphs.

Students should compare their results with others in their class. Students should discuss why their results might differ. This will lead to discussions about particular aspects of that habitat, such as the type of soil, the degree to which the sample was shaded, and how these factors would affect the number and type of organisms found.

 Habitats and Populations (continued)

Tasks for Instruction and/or Assessment
Performance

- Students or groups of students could do an independent study on a local habitat. Components of the study would be as follows:
 - Making careful observations. (205-5, 302-1)
 - Making inferences about the existence of organisms from evidence they have left. (e.g., tracks, holes in a log). Avoid harming any organisms found and minimize impact on that habitat throughout the study. (205-5, 302-1, 108-6, 108-3)
 - Recording types of organisms found and details about the habitat in which they were found. (206-2)
 - Expressing results in table and bar graph format.
 - Working cooperatively with other students to identify and count organisms. (205-5, 302-1)

Interview

- Were there differences in the results of the various habitat studies? If so, what were the differences? Suggest reasons why. (104-4, 206-3)

Presentation

- Prepare a group presentation (e.g., poster, video, pictures from a digital camera) showing what your group did on the field study, and the results obtained. Include some pictures or drawings of organisms that were that were found in the habitat. (207-2)

Resources/Notes
Science and Technology 4
Teachers Guide: Habitats

- 2. Field Trip, p.14
- 4. Plant Growth Experiments, p.20
- 10. Changing Habitats, p.41

Project WILD Activity Guide

- Habitat Lap Sit, p.28
- Habittracks, p.32
- Habitat Rummy, p.38

Collecting Scientific Information using Models of Natural Habitats

Outcomes

Students will be expected to

- construct and/or maintain a model of a natural habitat, and use it to make observations and collect information about organisms in this habitat (205-10, 205-5)
- suggest improvements to the model of the natural habitat to make it more realistic and habitable for organisms (206-6)

Elaborations—Instructional Strategies/Suggestions

Caution: It is advisable that students wear gloves when handling soil.



A rotting log makes a good habitat study. Part of it can be brought to the classroom for a period of time. Students can dig through it to find organisms or signs of organisms and examine how the organisms survive in the habitat. Students should show respect for the organisms they find. At the end of the study, the log and its inhabitants should be returned to a natural setting.

Students can continue their observations and data collection by maintaining a habitat in their classroom or constructing one that models some features of the one under investigation. Samples such as plants, soil, and insects could be used.

Encourage students to observe their aquarium/terrarium for visible organisms, those visible with a magnifying glass, and changes in algae growth. In their journal students could note observations of the classroom habitat, specifically observing increases or decreases in the growth of plants/algae, number of insects, changes in the appearances of organisms, and evidence of how these organisms meet their needs. Students should be considerate of the organisms that they have captured, and try to make the habitat as much like the natural one as possible. This also encourages attitudes related to being sensitive to the welfare of living things and the environment.

Collecting Scientific Information Using Models of Natural Habitats

Tasks for Instruction and/or Assessment

Journal

- In your journal, list the organisms in your model habitat. Observe each organism and note any changes in appearance and behaviour. (205-5, 205-10)
- What other organisms might live in your model habitat? (205-5, 205-10)

Paper and Pencil

- As you observe the organisms, complete the chart. (205-5, 205-10)

Observing Organisms in My Classroom Habitat

Organism	Appearance	Needs	Actions
Spider	8 legs (student may draw the organism)	Food: flies	spins a web to trap flies
Pitcher Plant	yellow flower	eat insects	flowering stage
:			
:			

Interview

- What can be done to make this model habitat more like the organism's natural habitat? (206-6)

Informal/Formal Observation

- Observe student's ability to ask questions about how the organisms are suited for their habitat.

Resources/Notes

Science and Technology 4

Teachers Guide: Habitats

3. Earthworm Habitat P.17

Project WILD Activity Guide

Designing a Habitat, p.70

Behavioural and Structural Features of Animals that Enable them to Survive in their Habitat

Outcomes

Students will be expected to

- compare the external features and behavioural patterns of various animals and relate these features to their ability to meet their basic needs in their natural habitats (302-2, 300-1)
- carry out procedures and ensure a fair test to explore how appearance affects visibility (205-1)
- predict the structural and/or behavioural adaptations needed for an animal to live in a particular habitat, real or imagined (204-3)

Elaborations—Instructional Strategies/Suggestions

As students investigate habitats at the natural site or in the classroom, they should start to focus on how animals meet their needs. Needs include food, protection, and the ability to reproduce. Students could select a few organisms in the habitat and observe them closely to determine the parts of the habitat on which they depend.

Students could use a variety of sources to investigate animal features and the behavioural adaptations that enable them to survive in their habitat (e.g., defensive structures, body movements and behaviors).

Students can investigate external features that serve to camouflage organisms. They should design an organism from common materials such as newspaper, scraps of fabric, or virtually any odds and ends, and place it where it is well camouflaged. Time how long it takes other students to find it. Students can also carry out more controlled investigations to determine how effective camouflage can be. They should time how long it takes to find various colours of confetti on a carpet, floor, or in grass. Discussions concerning a fair test might involve debating the fairness of having different sized confetti (e.g., larger green pieces than red) or having more of one colour than another.

Students could use their knowledge of structural and/or behavioral adaptations to invent features to help an animal adapt to a habitat. Model organisms could be produced.

Behavioural and Structural Features of Animals that Enable them to Survive in their Habitat

Tasks for Instruction and/or Assessment

Performance

- Design a diorama, and illustrate how an animal can be camouflaged in one part of the scenery, but not in another. (205-1)

Paper and Pencil

- Write a story about an animal that lives in a forest where the trees are really close together. It rains almost every day, and the leaves the animal eats are on branches well above its head. Include in your story what the animal looks like, what kind of features it would have, and how it survives in this habitat. (204-3)

Interview

- We are going to see how many of each colour of confetti we can find in five minutes. This will help us show how an object's appearance can affect how easily we can see it. What results would you expect if I had larger red pieces than blue? Would this be a fair test? What are some things that we would have to do to make sure it is a fair test? (205-1)

Presentation

- Research the adaptations of an animal. Try to link the adaptation with how the animal meets its basic needs in its habitat. (302-2, 300-1)
- Develop a presentation in the form of a creative essay, skit, video, or model which relates how an animal has adapted to a habitat. (302-2, 300-2, 204-3)

Informal/Formal Observation

- Observe students' abilities to design a animal that is camouflaged in its habitat. (205-1)
- Observe students' abilities to suggest a suitable adaptation for an animal in order for it to survive in a certain habitat. (204-3)

Resources/Notes

Science and Technology 4

Teachers Guide: Habitats

6. Procedures and Consumers, p.27

8. Adaptations, p.34

9. The Perfect Beak, p.38

Special Places: Eco-lessons from the National Parks in Atlantic Canada (CD-ROM)

Lesson 1.1: Creature Feature

Lesson 2.1: More than a Campground

Lesson 3.1: Conservation Advice for the National Parks

Structural Features of Plants that Enable them to Survive in their Habitat

Outcomes

Students will be expected to

- use appropriate terminology to compare the structural features of plants that enable them to thrive in different kinds of places (300-2, 104-6)
- describe how scientists' knowledge of plant growth has led to agricultural innovations and techniques (106-4)
- describe current investigations into local or regional habitat issues (105-1)

Elaborations—Instructional Strategies/Suggestions

Students should investigate the variety of structural features for different plants and how these adaptations enable them to thrive in their habitat.

Students have explored the parts of plants (root, stem, flower, leaf and seed) and their life cycles in grade 3. The focus in this section is on adaptations plants are able to make to help them survive in their habitat. Plants in different types of habitats (e.g., bog, forest, ocean, school yard, neighbourhood) should be explored. Students can look for plants growing in unusual places, like in cracks in the sidewalks, through thick layers of driveway gravel, or on the seashore.

A wide variety of plants can be explored using videos, or computer software, to determine how they survive in various habitats. Some good examples include seaweeds, which have holdfasts instead of roots and air sacs that keep them afloat; pitcher plants, which trap insects as food; and dandelions, whose flowers produce puffy seeds that blow in the wind, and whose long, strong roots penetrate deep into the ground.

Students could construct a greenhouse using soil or hydroponics (liquid/mineral solutions) to investigate the growth of plants using various agricultural innovations and techniques.

Students could be encouraged to discuss how plant growth has been enhanced due to agricultural innovations. Students could be encouraged to discuss the positive and negative aspects of technological innovations such as fertilizers, herbicides, pesticides and hydroponics.

Students could investigate local or regional habitat issues (e.g., the use of pesticides or herbicide spray, insect infestation, oil pollution or sewage treatment).

Structural Features of Plants that Enable them to Survive in their Habitat

Tasks for Instruction and/or Assessment

Performance

- As a class, discuss how you can fairly compare some of the different ways that humans help plants grow. Discuss variables to control, such as the amount of light, heat, and water a plant receives. In smaller groups, grow the plant using the treatment that has been assigned to you (e.g., solid fertilizer). Measure and record growth in the chart. (106-4)

People Helping Plants Grow

Treatment	Number of days for first sprout to appear	Growth in cm			
		Day 7	Day 14	Day 21	...
e.g., with compost	20	0	0	0.5	...
Liquid Fertilizer					
Solid Fertilizer					
Hydroponics					
:					
:					

Journal

- I thought all plants needed the same amount of water, sunlight, and the same type of soil. Now I know that different plants need different things. For example, ... (300-2, 104-6)

Paper and Pencil

- Draw and describe features of plants that help them thrive in their habitat (examples of plants you might include are, cactus, picture plant, dandelion). (300-2, 104-6)

Presentation

- Complete a presentation on a relevant local or regional habitat issue using either artwork, a collage, a skit, a video or multimedia. (105-1)

Resources/Notes

Science and Technology 4

Teachers Guide: Habitats

- 8. Adaptations, p.34
- 11. Habitats and Humans, p.44
- 12. Loss of Habitat, p.48

Special Places: Eco-lessons from the National Parks in Atlantic Canada (CD-ROM)

Lesson 1.1: Creature Features

Lesson 2.1: More than a Campground

Lesson 3.1: Conservation Advice for National Parks

Greenwing "Adopt-A-Class" Program

Sponsored by Ducks Unlimited; offers classroom teachers and their students an opportunity to learn about the importance of wetland habitats to wildlife and people. All materials are provided directly to registered teachers free of charge and include, for each student in your class, the following items:

- an *official Greenwing* membership certificate with yearly decals
- a one year subscription to the quarterly *Puddler* magazine
- a *Marsh World* handbook about the wonders found in wetland habitats
- a *Wetland Wizard* adventure comic book

Also included is a teachers guide which includes a number of instructional strategies and student activities that can be used to address provincial science curriculum outcomes at grade 4. For more information contact Ducks Unlimited at 506-458-8848 or email Colleen Martin, Atlantic Education Coordinator at c_martin@ducks.ca

Food Chains

Outcomes

Students will be expected to

- classify organisms according to their role in a food chain and draw a diagram to illustrate the food chain (302-3, 104-6, 206-1)
- predict how the removal of a plant or animal population affects the rest of the community (301-1)
- relate habitat loss to the endangered or extinction of plants and animals (301-2)

Elaborations—Instructional Strategies/Suggestions

Teachers should ensure when introducing the food chain that “prey” and “predator” relationships in a natural habitat are discussed. Ocean prey and predator relationships should be investigated (e.g., fish and seals). Students should investigate how various organisms obtain and eat food to support their basic needs for life. Students should focus their investigation on organisms as producers, consumers, and decomposers. If possible students should examine owl, hare/snowshoe rabbit, moose, or caribou pellets for evidence of what they have consumed.

Students could take pictures of organisms cut from print resources and organize them in a food chain, or draw a diagram illustrating a food chain of organisms in their habitat.

Students should predict the consequences of what happens when one type of organism in a food chain is removed completely by predators, loss of camouflage, shortage of main food source, disease outbreak, and/or human activity. Students could participate in a population simulation game that illustrates the roles of predators and prey, the importance of a suitable habitat to the survival of an organism, and how the removal of one organism affects others within that habitat. The data from these simulations should be represented graphically. Students could assume the roles of predators, prey, food, and variations in the population (young and old). These roles could be incorporated in a game.

Students could investigate a local example of habitat loss (e.g., forest fire, forest cutting, housing construction, insect infestation, and pollution) to understand its effect on plants and animals. Computer and/or game population simulations allow students to have total control over a habitat. They can create their own habitat and organisms, and cause human or natural disasters to occur. They can then continue the simulation to determine how the populations rise and fall with the conditions imposed.

Food Chains

Tasks for Instruction and/or Assessment

Performance

- Sort and classify the contents of a pellet investigation. Use this classification to construct a food chain. (104-6, 206-1, 302-3)
- Draw or collect pictures of living organisms and organize them in a food chain. (104-6, 206-1, 302-3)
- Using a computer simulation, make one type of organism completely disappear. Record what happens to the other organisms. If computers are not accessible, students can play simulation games such as “Oh Deer!” (Project Wild, Canadian Wildlife Federation) (301-1)

Journal

- It is important to try to preserve natural habitats because ... (301-2)

Interview

- What would happen to the remainder of the living things in a given area if there was a forest fire or major oil spill on the seashore? (301-1, 301-2)

Presentation

- Research an animal/plant deemed endangered. Why is the living thing endangered? What must be done to help save this organism? Present your findings. (301-2)

Resources/Notes

Science and Technology 4

Teachers Guide: Habitats

5. Basic Needs of Plants and Animals, p.24
6. Procedures and Cosumers, p.27
7. Building Food Chains, p.31
11. Adaptations, p.34
12. Loss of Habitat, p.48
13. Gone Forever, p.51

Special Places: Eco-lessons from the National Parks in Atlantic Canada (CD-ROM)

Lesson 1.1: Creature Features!

Lesson 2.1: More than a Campground

Lesson 3.1: Conservation Advice for National Parks

Project WILD Activity Guide

Oh Deer! p.206

Here Today, Gone Tomorrow, p.216

The Impact of Technology on Natural Habitats

Outcomes

Students will be expected to

- identify examples of positive and negative effects of technological developments on natural habitats (108-1)

Elaborations—Instructional Strategies/Suggestions

In this section, students should focus once more on how they can affect natural habitats. The focus is how human use of technological products can affect natural habitats.

Some examples could be

- intensive forest harvesting
- offshore oil development
- housing development in a forest or farming area
- over fishing

Students can engage in discussions about the ways in which their use of technological products may impact a habitat and result in the endangerment or extinction of plants and animals. Examples might include: the detrimental effect the use of an all-terrain vehicle on a marsh can have on the habitat; the use of jet skis on lakes, and how their loud noise can drive away animals; constructing a road or building on a previously unspoiled habitat. Care should be taken not to blame the technology for negative effects on habitats. Humans choose these products, and have a choice in how they are used. For example, the impact of all terrain vehicles would be minimized if they were used on appropriate trails.

Human impact on habitats and populations can be illustrated through music. Songs like “The Last of the Great White Whales” by the Irish Descendants tie in many of the concepts addressed throughout the unit (predator-prey, positive and negative effects of human impact) and will appeal to students’ musical intelligence. Students can be encouraged to find other songs that illustrate this theme.

Students can also learn more about preserving natural habitats by visiting a local park or wilderness area and take part in any presentation or program they have on preserving the local habitat. Some organizations have funds for community or school groups who wish to start their own project.

The Impact of Technology on Natural Habitats

Tasks for Instruction and/or Assessment

Journal

- Talk with an adult in your community to find out how the local area has changed in his/her lifetime. Can he/she notice differences in the amount of wildlife and vegetation? What does he/she think has caused these changes? In your journal, write about the conversation, and what you hope will or will not happen to your local area in your lifetime. Also write about ways that you might make certain your local habitats are preserved. (108-1)

Paper and Pencil

- Describe two ways that people have tried to restore natural habitats and help endangered species. (108-1)

Interview

- What are some of the good things that will happen with building the new highway subdivision; parking lot? What are some of the bad things that will happen? (108-1)
- What would be the impact if all the fish in your area were caught?

Presentation

- Write a verse, lyric, poem or skit on the positive and/or negative effect of technological developments on natural habitats. (108-1)
- Find a song/songs that relate to the effects of technology on the natural habitat and dramatize the song. (108-1)

Portfolio

- Select a piece of work you completed during this unit and add it to your portfolio. Describe its strengths and where it may be improved.

Resources/Notes

Science and Technology 4

Teachers Guide: Habitats

11. Habitats and Humans, p.44

12. Loss of Habitat , p.48

13. Gone Forever, p.51

Design Project: Habitat Help, p.56

Physical Science: Light

Introduction

Students become familiar with the properties of light by observing how light interacts with various objects in the environment. These observations help them gain an understanding of light sources and of materials that block or change the path of light and reflect light. From these investigations, students begin to infer that light travels in straight lines, and can use this to construct simple optical devices.

Focus and Context

The main focus in this unit is on inquiry, with an emphasis on observing and making inferences. Students become involved with light interacting with a variety of materials. Some materials are opaque, transparent or translucent; some materials will reflect, refract or disperse light. These interactions will lead students to make qualitative inferences about the behaviour of light. The unit also has a strong technology focus, with students exploring the functions of various optical devices that have been developed over time. Towards the end of the unit, students will be involved in making some of these devices using given procedures, or may even design their own devices to suit some purpose. Students will start to become familiar with the difference between technological products and technological processes.

Comparing the science and technology of light could provide a context for this unit. Students will be involved in doing investigations of a pure inquiry type to explore the properties of devices have allowed scientists to enhance their senses, and learn more about the universe.

Science Curriculum Links

In grade 1, students are introduced to shadows through observing the position of the sun and tracking their shadows throughout the day. In this unit, a more in-depth look into the properties of light is initiated. This treatment will continue to deepen in grade 8 with the unit *Optics*.

pan-Canadian Science Learning Outcomes

N.B. The following pan-Canadian Science Learning Outcomes were used as the framework in the development of the Atlantic Canada Science Curriculum at this grade level. For planning, instructional, and assessment purposes, teachers should refer to the PEI/APEF Specific Curriculum Outcomes found on the next page.

STSE	Skills	Knowledge
<p><i>Students will be expected to</i></p> <p>Nature of Science and Technology</p> <p>104-6 demonstrate that specific terminology is used in science and technology contexts</p> <p>106-1 describe examples of tools and techniques that extend our senses and enhance our ability to gather data and information about the world</p> <p>106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications</p> <p>Social and Environmental Contexts of Science and Technology</p> <p>107-1 describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs</p> <p>107-4 provide examples of how science and technology have been used to solve problems in the home and at school</p> <p>107-10 identify women and men in their community who work in science- and technology-related areas</p> <p>108-1 identify positive and negative effects of familiar technologies</p> <p>108-6 identify their own and their family's impact on natural resources</p>	<p><i>Students will be expected to</i></p> <p>Initiating and Planning</p> <p>204-7 plan a set of steps to solve a practical problem and to carry out a fair test of a science-related idea</p> <p>Performing and Recording</p> <p>205-3 follow a given set of procedures</p> <p>205-5 make observations and collect information that is relevant to a given question or problem</p> <p>205-10 construct and use devices for a specific purpose</p> <p>Analysing and Interpreting</p> <p>206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying</p> <p>206-5 draw a conclusion, based on evidence gathered through research and observation, that answers an initial question</p> <p>Communication and Teamwork</p> <p>207-1 communicate questions, ideas, and intentions, and listen to others while conducting investigations</p>	<p><i>Students will be expected to</i></p> <p>303-3 distinguish between objects that emit their own light and those that require an external source of light to be seen</p> <p>303-8 compare how light interacts with a variety of optical devices such as kaleidoscopes, periscopes, telescopes, and magnifying glasses</p> <p>303-2 demonstrate that light travels in all directions away from a source</p> <p>303-4 investigate how a beam of light interacts with a variety of objects, in order to determine whether the objects cast shadows, allow light to pass, or reflect light</p> <p>303-5 predict the location, shape, and size of a shadow when a light source is placed in a given location relative to an object</p> <p>303-6 demonstrate and describe how a variety of media can be used to change the direction of light</p> <p>303-7 demonstrate that white light can be separated into colours</p>

PEI/APEF Specific Curriculum Outcomes

Optical Devices

Students will be expected to

- describe that knowledge of the properties of light has led to the development of optical devices that extend our ability to observe (106-1, 106-4)
- compare how light interacts with a variety of optical devices (107-1, 303-8)
- construct an optical device that performs a specific function (205-10)
- identify women and men in their community who have careers that deal directly with lenses, mirrors, and prisms (107-10)

Sources of Light

Students will be expected to

- distinguish between objects that emit their own light and those that require an external source to be seen (303-3)
- make observations and collect information during investigations to determine if an object emits its own light, and draw conclusions based on the evidence gathered (205-5, 206-5)
- provide examples of how human-made sources of light have been designed to solve problems in the home and at school (107-4)
- identify positive and negative effects of exposure to light (108-1)
- identify ways of conserving energy through conservative use of home lighting (108-6)

Light Radiates from a Source

Students will be expected to

- make observations about how light is dispersed from a variety of light sources (205-5)
- demonstrate that light travels in all directions away from a source (303-2)
- conclude that light travels in a straight line based on evidence gathered through their own research and observation (206-5)

Objects that Absorb, Transmit, and/or Reflect Light

Students will be expected to

- investigate how light interacts with a variety of objects, in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light (303-4)
- classify objects as opaque, transparent, or translucent (206-1)
- provide changes in the location, shape, and relative size of a shadow when an object is placed in different positions and orientations relative to the light source and screen (303-5)
- plan a procedure and make observations to determine changes in a shadow's location, shape, and relative size when an object is placed in different positions and orientations relative to a light source and screen (204-7, 205-5)
- make observations and collect information about the reflective properties of surfaces of different shapes and textures (205-5)

Bending Light

Students will be expected to

- demonstrate and describe how a variety of media can be used to change the direction of light (303-6)
- make observations and collect information about the refractive properties of materials of different shapes (205-5)

Dispersion of Light

Students will be expected to

- demonstrate that white light can be separated into colours, and use the term "dispersion" for this process (303-7, 104-6)
- follow a set of procedures to make and use a colour wheel (205-3)
- communicate and listen to others during investigations with colour wheels (207-1)

Optical Devices

Outcomes

Students will be expected to

- describe that knowledge of the properties of light has led to the development of optical devices that extend our ability to observe (106-1, 106-4)
- compare how light interacts with a variety of optical devices (107-1, 303-8)
- construct an optical device that performs a specific function (205-10)
- identify women and men in their community who have careers that deal directly with lenses, mirrors, and prisms (107-10)

Elaborations–Instructional Strategies/Suggestions

The outcomes from this section should be integrated throughout this unit.

Investigate how the knowledge of properties of light have led to the development of optical devices in the past, present, and could lead to further development in the future. For example, past-microscope, present-laser disc walkman, fibre optics.

The relationship between science and technology should be emphasized throughout the unit. Students will learn that mirrors and lenses change the way objects appear, sometimes making them appear larger/smaller, closer/further away, and/or upright/inverted. As students develop an awareness that these optical devices work using scientific principles, they should also learn how science has progressed by using them to enhance the ability to observe. As students explore these instruments, they can see how the images formed by these devices fill a need. For example, microscopes make visible objects that are too small to be seen with the naked eye, and binoculars extend our ability to see far away objects.

Students should explore various optical devices, such as magnifying glasses, binoculars, reading glasses, telescopes, microscopes, fibre optics, mirrors, projection units, kaleidoscopes, and periscopes. The focus should be on exploring what the device allows you to see, and how the student's view of the object (the image) is enhanced or changed.

In groups students should construct a simple optical device using mirrors, and/or lenses to perform a simple function. Equipment could consist of lenses, mirrors, light sources, various size paper tubes, and supporting materials. Students should be encouraged to be as creative as possible.

Invite a person who works with light to visit the class. For example, telecommunication or Internet personnel, opticians, photographers, amateur astronomers, or lab technicians. The prevalence of optical devices and their practical applications in the community should be emphasized. Care should be taken to include both genders and a variety of cultural backgrounds in any career discussion so as to encourage an attitude that recognizes that women and men of any cultural background can contribute equally to science and technology.

Caution: Any construction of devices using mirrors has a potential for cuts or broken glass. Teachers may want to substitute reflective mylar sheets (sometimes called mirrored polyester, chrome mylar or chrome vinyl), since these can be easily cut and pasted onto cardboard. The image is not as good as a real mirror, but it is safer to use, less expensive, and easier to shape, cut, and use.



Optical Devices

Tasks for Instruction and/or Assessment

Performance

- Explore the various optical principles of different devices and chart your observations. (303-8, 107-1)

Optical Devices

Device	Image Size (larger, smaller)	Image Position (upside down, left/right)	Image Distance (closer, further)
Microscope			
Binoculars			
Reading Glasses			
: :			

Paper and Pencil

- Explore the role of light in modern day devices. These could include but are not be limited to; X-rays, radiation therapy, photocopies, radio telescopes (SETI), or space telescopes. (106-1, 106-4, 107-10)

Informal/Formal Observation

- When assessing an optical device design activity; assess students' ability to
 - work with team members to plan the construction, or follow procedures
 - solve problems
 - test and retest the device
 - use and manipulate tools (205-10)

Resources/Notes

Science and Technology 4

Teachers Guide: Light

4. Building Optical Devices, p.22

8. A Bend in the Path, p.33

9. Lenses All Around You, p.36

10. Rainbowa and Prisms, p.40

Design Project: Invention Convention
p.50

Sources of Light

Outcomes

Students will be expected to

- distinguish between objects that emit their own light and those that require an external source to be seen (303-3)

- make observations and collect information during investigations to determine if an object emits its own light, and draw conclusions based on the evidence gathered (205-5, 206-5)

- provide examples of how human-made sources of light have been designed to solve problems in the home and at school (107-4)

- identify positive and negative effects of exposure to light (108-1)

- identify ways of conserving energy through conservative use of home lighting (108-6)

Elaborations–Instructional Strategies/Suggestions

Students could brainstorm a list of objects that emit their own light and those that require an external source of light to be seen (e.g., lightsticks, arm bracelets, insects, and phytoplankton). This is an opportunity for teachers to distinguish between objects that emit light and objects that can only be seen when light reflects from them and into the eyes of the viewer. This concept will be further developed in a later section. One special case which the teacher may want to have students examine is glow-in-the-dark toys and watches. These will emit their own light for a limited amount of time. The class can then develop an operational definition of a source of light.

This introduction will give the teacher the opportunity to address many common misconceptions which students may have regarding sources of light. For example, students may identify the window as a source of light or the moon as producing its own light. Care should be taken not to dismiss such ideas. It takes a great deal of time, evidence, and experience to alter the explanations which students have created to account for their world. This activity can encourage students to demonstrate a desire to understand.

In groups students should investigate manufactured sources of light that have been designed to solve problems. Students could record the results of their investigation and report to the class.

Students should discuss the positive and negative aspects of exposure to light in their home and school. On the positive side, light sources allow us to see in dark places, and exposure to the sun can increase our production of vitamin D. Exposure to some sources of light have health implications, and students should be cautioned, for example, about extended exposure to the sun and ways to prevent health effects resulting from sun burn and looking at a bright light source.

At this grade level the focus can be restricted to ways to conserve electrical energy and reduce cost. In grade 6, students will take a more critical and in-depth look at the advantages and disadvantages of the various ways of generating electricity.

Students should discuss ways to reduce the use of home lighting and how it will help to conserve energy. Students' suggestions could be posted in the classroom.

Sources of Light

Tasks for Instruction and/or Assessment*Performance*

- Investigate possible sources of light in the home and school and record your observations. (205-5, 206-5, 303-3)

Light Investigation

Object	Prediction		Observations		Conclusion	
	light source	not a light source	can see	cannot see	light source	not a light source
ball						
mirror						
window						
television (off and on)						
etc:						

- Over the period of a week use a table to note the electrical lights that are being used wastefully (such as lights left on for long periods of time). Where possible, note the amount of time the light source was efficiently used. (108-6)

Journal

- The things I think are good about the sun shining on me are ...
- The things I think are bad about the sun shining on me are ...

Presentation

- Make a poster to show how people have solved problems using light. Find or draw as many pictures of artificial sources of light as possible, and write underneath each picture the problem the source of light solves. Examples might include street light, watches that light up, bright, shadowless lights, and lights that indicate when a computer is turned on. (107-4)

Resources/Notes

Science and Technology 4

Teachers Guide: Light

Launch: Light in Our Lives, p.9

2. Reflecting Light, p.15

3. Good Reflections, p.18

11. Investigating Colors, p.43

12. Inventions Using Light, p.46

Light Radiates from a Source

Outcomes

Students will be expected to

- make observations about how light is dispersed from a variety of light sources (205-5)
- demonstrate that light travels in all directions away from a source (303-2)
- conclude that light travels in a straight line based on evidence gathered through their own research and observation (206-5)

Elaborations–Instructional Strategies/Suggestions

Many of the light sources that students are familiar with are designed to send light in a particular direction. Therefore, it may take some time and experience to have them conclude that light travels in all directions away from the source. Teachers may want to begin this section by offering students a variety of light sources to observe the differing ways that light is dispersed from them. For example, a flashlight will direct light in one direction, while a candle will direct light to the surrounding room. Note that the dispersal of light can only be seen if the light has something from which to reflect. A slight clapping of chalk dusters will put some chalk dust in the air, and the light can then more easily be seen.

Caution: Care should be taken to ensure that any students with asthma are not exposed to the chalk dust.



Students should conduct investigations on the light sources to determine where light is distributed. For example, students can take the flashlight apart and use the batteries and some wire to light the bulb without using the reflecting mirror that comes with the light bulb. This will provide evidence that the bulb itself produces light in all directions, but that it is redirected in an attempt to focus the light in one area. A similar effect can be created by the teacher using a candle and a tin plate. By using the pie plate to cover one side of the candle, the light is directed to the other side.

Students can examine different types of lighting devices at home and at school to determine how the light is focused or directed in each. Discussion may focus on the shape, material, and colour of the reflecting material which directs the light.

Students can observe light traveling in straight lines using two experiments. In a dark room, cover a small lamp with a box having several holes. Use chalk dust to indicate the beams of light escaping through the holes. Another activity involves students viewing an object, then, holding a book in front of it, noting that they can no longer see it. Light cannot be reflected from the object, around the book, and into their eyes.

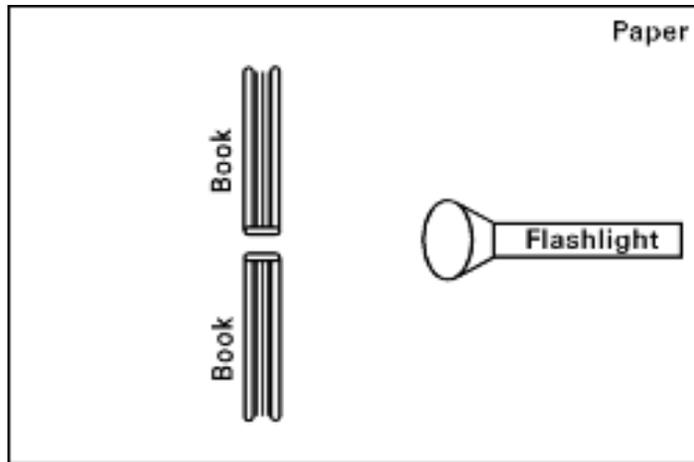
Students can explore an example of light travelling in a straight line by making a pinhole camera using a small covered box (see P.19 of Teachers Resources Guide). By pointing the pinhole towards a light or window, they will be able to see the inverted image through the other side. They can draw pictures of their camera, the object, and the image in their journal. Light rays could be drawn on the pictures to illustrate the inverted image.
Enrichment Activity: Compare a camera to the human eye.

Light Radiates from a Source

Tasks for Instruction and/or Assessment

Performance

- Using different household materials observe and record the dispersal of light. (205-5)
- Set up the materials as shown. (The books should be balanced upright, and positioned so that there is about 0.5 cm between them. Anything that has a narrow opening can be substituted.)



Trace the outline of the books and flashlight on the paper. Turn out the lights, and lightly clap a chalk eraser. Trace the path of the light for the flashlight. Write a conclusion about the path that light travels. (206-5)

Paper and Pencil

- From your observations of light sources, make a sketch to illustrate how light comes from each object. (Include pictures such as a candle, overhead projector, light bulb, or flashlight.) (205-5, 302-2)

Resources/Notes

Science and Technology 4

Teachers Guide: **Light**

1. How Light Travels, p.12

Objects that Absorb, Transmit, and/or Reflect Light

Outcomes

Students will be expected to

- investigate how light interacts with a variety of objects, in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light (303-4)
- classify objects as opaque, transparent, or translucent (206-1)
- predict changes in the location, shape, and relative size of a shadow when an object is placed in different positions and orientations relative to the light source and screen (303-5)

Elaborations—Instructional Strategies/Suggestions

Students should investigate how light interacts with a variety of materials, which allow light to pass through, and others that do not. Students should predict whether some, all, or none of the light will pass through the materials. (*Background: many objects allow some light to pass through as well as reflect light (a glass pop bottle, or a translucent mirror (mira) that is used in the mathematics program, for example). Note that an object does not have to be shiny or mirror-like to reflect light. Smooth objects reflect light uniformly, and reflections can be seen in them. Other objects reflect light in a more scattered, random fashion, and clear reflections cannot be seen. (A piece of crumpled tinfoil can be used to demonstrate this.)*)

Teachers should challenge students to think about how they can see objects. Where is the light coming from so that these objects are visible? A common misconception is that objects emit light from within them, and it is this light that makes the object visible. Demonstrate that these objects cannot be seen without a light source by taking the objects into a dark room with no windows. The objects can only be seen when the light that hits them reflects into your eyes.

Students should be introduced to the terms transparent, translucent, and opaque. They should investigate how light interacts with a variety of materials, such as wax paper, construction paper, and plastic wrap. Students should explore these materials to see that, depending on the thickness of the material being tested, they can see through some of them to varying degrees. Students should classify these materials based on their observations.

Students should explore the factors that affect the location, shape, and size of the shadow produced by an object. Working in pairs use a flashlight to cast a shadow of an object on a wall or screen. This is an exercise in controlling variables. Many factors come into play: the distance from the object to the light source; the distance from the object to the screen; the way the object is held (its orientation) and the size of the light source. Students should have opportunities to draw diagrams that include the light source, object, screen, shadow, and light rays coming from the light source. This allows them to understand why the shadow is the shape and size it is. Repeated observations enable students to make predictions which can be tested.

Objects that Absorb, Transmit, and/or Reflect Light

Tasks for Instruction and/or Assessment

Performance

- Plan and write a procedure to test your shadow predictions. Record your results in the table below. (303-5, 204-7, 205-5, 204-7, 205-5)

Finding Out About Shadows

Change	Location		Shape		Size	
	Predicted	Actual	Predicted	Actual	Predicted	Actual
e.g., pencil is moved closer to light source	behind the pencil, in line with the light source	as predicted	(Drawing)	(Drawing)	same size	larger
pencil is turned sideways						
etc:						

- Shine light from an overhead projector on the objects listed, and complete the chart. (303-4, 206-1)

Can I see Through It?

Object	Observations	Transparent, Translucent, and/or Opaque
ball	I can't see through the ball. When light hits it, a shadow forms behind it.	Opaque
window		
wax paper		
etc.		

Journal

- Shadows always project different images around me; this is caused by... (305-5)

Resources/Notes

Science and Technology 4

Teachers Guide: Light

- Reflecting Light, p.15
- Transparent, Translucent and Opaque, p.25
- Casting Shadows Outside, p.28
- Indoor Shadows, p.31
- Investigating Colors, p.43

Objects that Absorb, Transmit, and/or Reflect Light (continued)

Outcomes

Students will be expected to

- plan a procedure and make observations to determine changes in a shadow's location, shape, and relative size when an object is placed in different positions and orientations relative to a light source and screen (204-7, 205-5)
- make observations and collect information about the reflective properties of surfaces of different shapes and textures (205-5)

Elaborations—Instructional Strategies/Suggestions

Challenge students with a variety of shadow problems. For example, using a simple object such as a pencil, try to make a shadow that is larger than the object, smaller than the object, or in the shape of a line. How can one make the shadow clear and well defined? When does it become fuzzy?

Students can work in groups to produce shadow skits and plays.

Opaque objects reflect light; this is how they can be seen. Students may think that only smooth surfaces, like mirrors or metallic surfaces reflect light. As a means of showing how the surface shape and texture affects how light is reflected, students can explore the difference between the reflective ability of crumpled versus smooth aluminium foil. As the aluminium foil becomes more crumpled, the reflection becomes less defined. This can be extended to examine the reflective properties of other materials.

This can lead into an exploration of mirrors and uniformly reflective materials. These reflect light in a very orderly way due to their smooth surfaces. A translucent mirror (mira) that is used in the math program would be a good way for students to start their exploration of reflections by smooth surfaces. They can use the miras to determine the characteristics (same size, same distance from the mirror, left/right inversion) of the image of an object when reflected from a plane mirror. A common misconception students have in relation to plane mirrors is that, given a small (e.g., 100 cm²) mirror, they will be able to see their entire image as long as they stand back far enough. Students can be asked how much of their face they can see in a small mirror, and then asked if they can see more of their face by changing their position relative to the mirror.

They can extend this exploration to convex and concave mirrors by exploring the differences in their reflected images from the concave curve of a spoon, and then turn it around to see their image using the convex curve. Different shaped mirrors can be made with chrome mylar, mirrored polyester, or chrome vinyl (it has reflective material on one side, and an adhesive backing on the other), which can be purchased from science supplies, craft, or glass stores.

These activities encourage attitudes such as perseverance, a desire to understand, and a willingness to observe, question, and investigate.

Objects that Absorb, Transmit, and/or Reflect Light

Tasks for Instruction and/or Assessment

Performance

- Try to see your image (or the image of an object such as a pencil) in each of the materials listed. Note your observations. From your observations, answer the following questions: What are the best types of materials for seeing your image? Is your image always upright? What could you do to some mirrored polyester to make your image bigger? Smaller? Upside down? (205-5)

Reflections

Object	Description of Image
aluminum foil (smooth)	Blurry image that seems to be the same size, right-side-up
aluminum foil (crumpled)	
spoon (front)	
paper	
etc.	

Paper and Pencil

- Draw arrows to show how you think a light beam is reflected by the objects. Include pictures or drawings of a variety of objects (e.g., plane mirror, paper, tin foil, spoon). (303-4)

Interview

- What evidence do you have that an object reflects light even when you don't see your image in it as you do in a mirror? (205-5)

Resources/Notes

Science and Technology 4

Teachers Guide: Light

2. Good Reflections, p.18

7. Indoor Shadows, p.31

Bending Light

Outcomes

Students will be expected to

- demonstrate and describe how a variety of media can be used to change the direction of light (303-6)
- make observations and collect information about the refractive properties of materials of different shapes (205-5)

Elaborations–Instructional Strategies/Suggestions

Students can explore the bending of light as it travels from one medium to another. Examples of activities include the following:

- Put a stick or pencil in a glass of water so half of it is sticking out. The object appears bent or broken.
- Put a coin in a bowl of water. Students, standing to the side of the bowl, can extend their arms to drop small stones in the water to see if they can touch the coin. They will have trouble hitting it because the coin will not be where it seems to be.
- Put a coin in a cup, and back away until the coin is hidden by the rim of the cup. While another student slowly pours water into the cup, the coin will slowly reappear for the student who backed away.

Refraction is caused by light changing speed when it travels from one medium to another. An activity that can be done to model refraction is to roll two wheels connected by an axle from a bare floor to a carpeted area. If the wheels are perpendicular to the carpet, the wheels do not change direction, they simply slow down when they hit the carpet. If they are rolled towards the carpet at an angle other than 90°, then the wheel that hits the carpet first will slow down, and the wheels will bend towards the carpet. This is similar to the direction of light when it goes from a less optically dense medium to a more optically dense one (e.g., air to water).

Students can investigate the properties of images produced by lenses in a similar manner to that of mirrors. They can use water droplets or lenses to see how images can be magnified or made smaller, depending on the types of lens used. Convex, concave, and variations of these shaped lenses can be explored, and students can record their observations in charts that detail the shape of the lens, and the characteristics (relative size, orientation, relative distance) of the image.

Bending Light

Tasks for Instruction and/or Assessment

Performance

- Complete the table. (205-5)

Bending Light

Description of lens	Description of image
small water droplet	
large water droplet	
convex lens	
concave lens	
etc.	

Journal

- I couldn't believe my eyes when I stuck my pencil in a glass of water. The pencil looked ... (303-6)

Interview

- You are trying to get a big key ring that you have dropped into a swimming pool. If you are standing at the edge of the pool, where should you aim a stick with a hook at the end of it in order to successfully snag the ring? (303-6)

Informal/Formal Observation

- While students are investigating light, the Process Skills Checklist (such as the one below) could be used.
 - Observing: Student observes carefully and accurately.
 - Classifying: Student compares the refractive properties of the materials thoughtfully.
 - Predicting: Student makes predictions based on evidence about the path of light as it travels through various media. (205-1, 303-6)

Resources/Notes

Science and Technology 4

Teachers Guide: Light

8. A Bend in the Path, p.33

9. Lenses All Around You, p.36

10. Rainbows and Prisms, p.40

Design Project: Invention Convention
p.50

Dispersion of Light

Outcomes

Students will be expected to

- demonstrate that white light can be separated into colours, and use the term “dispersion” for this process (303-7, 104-6)
- follow a set of procedures to make and use a colour wheel (205-3)
- communicate and listen to others during investigations with colour wheels (207-1)

Elaborations–Instructional Strategies/Suggestions

Students may have already noticed dispersion of light through rainbows and prisms. Students should have opportunities to direct light into prisms made of glass, or triangular-shaped dishes filled with water, and observe the pattern of colours that emerge. As they investigate with prisms, they should see that glass prisms and lenses are basically the same thing, but have different shapes. Students should see that the white light entering the prism bends (refracts), but that the different colours that make up light do not all bend to the same degree. By the time the light comes out of the prism, the various colours have been separated. Students might note that the pattern or sequence of colours is always the same, and they may want to make up mnemonics, like “Robert Of York Gained Battles In Vain” or “ROY G BIV” to remember this sequence. It is the same sequence as the colours in a rainbow.

Observant students may have noticed thin rainbows using lenses in the previous section. These lenses are shaped and laminated in such a way as to minimize dispersion effects.

Students can make colour wheels from circular Bristol board divided into pie shaped sections with various colours. Spinning them shows how all the colours blend into white. Attaching the wheels to a small, hand-held fan would enhance this effect. The same effect can be noticed by making “buzzer buttons”, or button-sized discs coloured in a similar manner to a colour wheel, and then threaded in two places with string. When wound up and spun, the colours blend into white. This will reinforce the idea that white light is a mixture of all colours. Using this notion, students can begin to understand why objects appear coloured: white light, composed of coloured light, hits an object but only certain colours are reflected. The reflected colours give the object colour. For example, a red object is red because when white light hits it, only red light is reflected.

These activities encourage attitudes such as perseverance, a desire to understand, and a willingness to observe, question, and investigate.

Dispersion of Light

Tasks for Instruction and/or Assessment

Interview

- How could you show me that ordinary light is made up of different colours? Can you give me an example of this occurring naturally? Where have you ever seen this happening outside? (303-7, 104-6)

Portfolio

- Select a piece of work from this unit for your portfolio. Assess the work using a given portfolio self-assessment rubric.

Informal/Formal Observation

- Assess the students on criteria such as the following:
 - Their ability to follow the correct procedure for making a colour wheel (205-3)
 - their willingness to share ideas about the colours of light during the colour wheel investigation (207-1)

Resources/Notes

Science and Technology 4

Teachers Guide: Light

10. Rainbows and Prisms, p.40

Physical Science: Sound

Introduction

Sound is a phenomenon that can be sensed, measured, and controlled in various ways. Learning how sound is caused by vibrations is important as students explore both how sound travels and factors that affect the sounds that are produced. The varying ability of humans and other animals to detect sound is also examined, which leads to discussions about the necessity of protecting your sense of hearing.

Focus and Context

This unit has a dual focus of inquiry and design technology. Students will inquire about sound production, and how pitch and intensity can be varied. Using this knowledge, they will be able to design their own musical instruments or sound-making devices.

Music provides an appropriate context for this unit. Students could explore sound production music, and see how various musical instruments can impart different qualities of sound.

Science Curriculum Links

Students have already been introduced to the concept of sound in grade 1 through the unit *Materials and Our Senses*. In this unit, the concept is developed further so that students explore how sounds are made, and the factors that can affect sound. Sound is studied again as an application to wave theory in high school Physics.

pan-Canadian Science Learning Outcomes

N.B. The following pan-Canadian Science Learning Outcomes were used as the framework in the development of the Atlantic Canada Science Curriculum at this grade level. For planning, instructional, and assessment purposes, teachers should refer to the PEI/APEF Specific Curriculum Outcomes found on the next page.

STSE	Skills	Knowledge
<p><i>Students will be expected to</i></p> <p>104-6 demonstrate that specific terminology is used in science and technology contexts</p> <p>105-1 identify examples of scientific questions and technological problems that are currently being studied</p> <p>Relationships Between Science and Technology</p> <p>106-1 describe examples of tools and techniques that extend our senses and enhance our ability to gather data and information about the world</p> <p>Social and Environmental Contexts of Science and Technology</p> <p>107-1 describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs</p> <p>107-12 provide examples of Canadians who have contributed to science and technology</p> <p>108-1 identify positive and negative effects of familiar technologies</p> <p>108-3 describe how personal actions help conserve natural resources and care for living things and their habitats</p>	<p><i>Students will be expected to</i></p> <p>Initiating and Planning</p> <p>204-1 propose questions to investigate and practical problems to solve</p> <p>204-2 rephrase questions in a testable form</p> <p>204-3 state a prediction and a hypothesis based on an observed pattern of events</p> <p>Performing and Recording</p> <p>205-2 select and use tools in manipulating materials and in building models</p> <p>205-8 identify and use a variety of sources and technologies to gather pertinent information</p> <p>Analysing and Interpreting</p> <p>206-7 evaluate personally constructed devices with respect to safety, reliability, function, efficient use of materials, and appearance</p> <p>206-9 identify new questions or problems that arise from what was learned</p> <p>Communication and Teamwork</p> <p>207-6 work with group members to evaluate the processes used in solving a problem</p>	<p><i>Students will be expected to</i></p> <p>303-9 identify objects by the sounds they make</p> <p>303-10 relate vibrations to sound production</p> <p>303-11 compare how vibrations travel differently through a variety of solids and liquids and through air</p> <p>301-3 demonstrate and describe how the pitch and loudness of sounds can be modified</p> <p>300-3 describe how the human ear is designed to detect vibrations</p> <p>300-4 compare the range of sounds heard by humans to that heard by other animals</p>

PEI/APEF Specific Curriculum Outcomes

Objects That Make Sound

Students will be expected to

- Identify objects by the sound they make (303-9)
- describe examples of sound technologies that are used by people to meet their everyday needs (107-1)

Sound Vibrations

Students will be expected to

- relative vibrations to sound production (303-10)
- compare how vibrations travel differently through a variety of solids and liquids and through air (303-11)

Pitch, Loudness, and Sound Technology

Students will be expected to

- identify and rephrase questions about ways to change pitch and loudness in a testable form (104-6, 204-1, 204-2)
- state a prediction and hypothesis about the effect a modification will have on the pitch and loudness of the sound produced, based on the pattern of sounds produced (204-3)
- demonstrate and describe how the pitch and loudness of sounds can be modified (301-3)
- use the term “decibels” in descriptions of sound intensity (104-6)
- demonstrate processes for solving technology problems by designing and constructing a device which has the ability to create sounds of variable pitch and loudness (104-1, 205-2)
- evaluate personally constructed musical devices with respect to their ability to vary their pitch and loudness (206-7)
- identify and use a variety of sources and technologies to gather pertinent information about Canadians who have contributed to sound technology (107-12, 205-8)

The Ear, Hearing Loss, and Noise Pollution

Students will be expected to

- describe and illustrate how the human ear is designed to detect vibrations (300-3)
- compare the range of sounds heard by humans to that heard by some animals (300-4)
- describe examples of devices that enhance our abilities to hear and collect sound data, such as hearing aids, sonar, amplifiers, oscilloscopes, and ultrasound (106-1)
- demonstrate processes for investigating the extent of noise pollution in their surroundings, and work with group members to evaluate the processes used in investigating noise pollution (104-1, 207-6)
- identify the positive and negative effects of technological devices that produce loud sounds and identify the need for protection from and prevention of hearing loss (108-1, 206-9)
- describe specific personal actions or products that can help reduce this noise pollution (108-3)
- identify examples of current research related to sound (105-1)

Objects that Make Sounds

Outcomes

Students will be expected to

- identify objects by the sounds they make (303-9)

- describe examples of sound technologies that are used by people to meet their everyday needs (107-1)

Elaborations—Instructional Strategies/Suggestions

Students should explore the many objects they can identify by the sound they make. Teachers or students can challenge other students to identify the source of the sounds they make while they are hidden from view. For example, students could drop objects into water to make splashing noises, blow over the tops of bottles, crunch a breakfast cereal on the desktop, or fan the pages of a book. Computers or keyboards that are programmed to make different sounds can also be used. Students could record their voice using a computer application, the simplest being “*Sound Recorder*”, a program that comes with most versions of Windows. They can then manipulate the recording to do things such as add an echo, slow it down, or reverse it.

Students can also focus on the large amount of background noise they tune out most of the time. They can quietly lower their heads for 30–60 seconds and note all the sounds that they can hear. Through class discussion, these sounds can be identified and listed.

In many cases, sounds are used for the purpose of communicating a message. Communication, be it person to person, machine to person (e.g., an alarm clock), and person to machine (e.g., talking to a message recorder), relies to a large extent, on sound.

Examples of sound technologies include: radios, fire alarms, home security devices, and whistling steam kettles. Perception and recognition of sound is important. Students can listen to some common recorded sounds, and then try to determine the message that is being relayed. For example, record the sound of a dump truck backing up, and see if they can identify the message being relayed by the “beep ... beep ... beep”. Other sounds that relay a message are the school bell, the timer on an oven, or a fire alarm. Students can make recordings at home, and bring them in for others to identify.

Advertisers use the association of sounds to a message by having a consistent theme song or melody in their advertisements. Students can listen to short clips of some of the music used by advertisers to see if they can identify the product being advertised. This should illustrate how powerful sounds can be in conveying a message.

Objects that Make Sounds

Tasks for Instruction and/or Assessment

Performance

- Make recordings of various sounds, such as a pencil sharpener, boiling whistling kettle, clock ticking, fluorescent lights, the beep of a microwave when it is finished. Listen to the recording of various sounds created by a fellow student. Identify as many of them as possible. (303-9)

Journal

- Make a list of things in your daily life that make sounds. Describe the use or purpose of the sounds. (107-1)

Paper and Pencil

- Describe two sounds that tell you to do something. Describe two sounds that tell you that something is going to happen. Describe two sounds that you listen to for enjoyment. (107-1)

Presentation

- Create a poster which displays a wide variety of sound devices. Underneath each picture or drawing, describe the role of sound in the device, for example, warning, or task completed. (posters are ideal for portfolios once displays are completed. Good sources of pictures are catalogues, magazines, computer graphics, or hand drawn). (107-1)

Resources/Notes

Science and Technology 4

Teachers Guide: Sound

Launch: Sounds Are All Aound, p.9

1. What Causes Sound? p.11

2. Good Vibrations, p.14

8. Shape and Sound, p.34

9. Yogurt Cup Telephones, p.38

10. Sounds and Solids, p.42

11. Turn Up the Volume, p.45

12. Sound, Hearing and the Environment, p.48

Sound Vibrations

Outcomes

Students will be expected to

- relate vibrations to sound production (303-10)

- compare how vibrations travel differently through a variety of solids and liquids and through air (303-11)

Elaborations—Instructional Strategies/Suggestions

Attitudes related to willingness to observe, question, explore and investigate, and work collaboratively can be encouraged while completing the investigations described below. As students start to explore the role of vibrations in sound production, encourage them to use the terms “pitch” and “loudness” in their descriptions of sound. The factors that affect pitch and loudness of sound will be developed in the next section, but they should be able to distinguish between these terms as they explore vibrations. Students can feel and see the effect of sound vibrations. For example, students may

- feel for voice box vibrations as they speak
- observe a vibrating tuning fork dipped in water
- touch a radio/tape speaker in operation
- blow on a blade of grass held tightly between their hands to hear a whistling sound

Have students do an experiment to show how vibrations travel through a variety of solids, liquids, and air. Some examples could include the following:

- Students can listen to a noise or voice through air, through a balloon filled with water, or through a piece of wood.
- Students can make string and can telephones to illustrate how sound travels through string.
- Students can experiment the next time they go swimming by comparing the sounds when they tap their fingers on the side of the pool with their hands and head above water, and then tap the sides of the pool with their head and hands under water.

To model how sound travels faster in denser media, dominoes can be lined up. To simulate sound travelling through air, which is not very dense, space a long line of dominoes so that they just hit off the next one if tipped. Next to these, make another long line of dominoes that are very closely spaced, to simulate water or some denser media. Tip the first domino in each line at the same time, and students will be able to see and hear how the domino wave travels more slowly through the dominoes that are further spaced (air) than through the closer spaced dominoes (water). This will also model how sound, unlike light, needs a medium to be transmitted: no dominos, no sound.

Sound Vibrations

Tasks for Instruction and/or Assessment

Performance

- This activity will compare how well sound travels through air, wood, string, and water. Materials required: meter stick, 1m of string, a large pan, water, and a stethoscope. Follow the steps with a partner. Switch positions, and record your observations.

Sound Travels!

Medium	Procedure	Partner's Observations
Air	Stand 1 m apart from partner. Hold metre stick straight down. Tap metre stick.	
Wood	Stand 1 m apart from partner. Hold metre stick so that the end is next to partners ear. Tap metre stick.	
Water	Fill pan with water, hold one end of metre stick in water at one end of pan (don't touch side of pan with stick.) (On opposite side, hold sound sensor of stethoscope in water (don't touch side of pan.) Listen in stethoscope while partner taps end of metre stick. Does sound travel through water?	
String	Use tin can telephone.	

When did the scratching noise sound the loudest? clearest? Give reason(s) why you think the sound changed. (303-11)

Paper and Pencil

- List three examples of vibrations which produce sound. Identify the material(s) which vibrated to produce the sound. (303-10)

Resources/Notes

Science and Technology 4

Teachers Guide: Sound

1. What Causes Sound, p.11
2. Good Vibrators, p.14
3. The Human Ear, p.17
4. Did You Hear That? p.20
5. Pop Music, p.24
6. Make a Guitar, p.27
7. Stringing Along, p.30
8. Shape and Sound, p.34
9. Yogurt Cup Telephones, p.38
10. Sounds and Solids, p.42

Design Project: Form a Band, p.52

Pitch, Loudness, and Sound Technology

Outcomes

Students will be expected to

- identify and rephrase questions about ways to change pitch and loudness in a testable form (104-6, 204-1, 204-2)
- state a prediction and hypothesis about the effect a modification will have on the pitch and loudness of the sound produced, based on the pattern of sounds produced (204-3)
- demonstrate and describe how the pitch and loudness of sounds can be modified (301-3)
- use the term “decibels” in descriptions of sound intensity (104-6)

Elaborations—Instructional Strategies/Suggestions

Through classroom discussion, review the role of vibrations in sound production. Do all vibrations sound the same? In what ways are they different? The concepts of pitch and loudness can be brought to the discussion. As a means of studying these concepts further, students can propose questions to investigate. Students should practice asking questions, and then examine each question to determine if it is testable. For example, the question, “What will make the pitch higher?” is not testable. Encourage the students to ask questions in testable forms such as “Will tightening a string make the pitch higher?” or “Will faster vibrations make the pitch higher?”. The question “How can I make the sound louder?” can be rephrased to “Will striking the tuning fork harder increase the loudness?”

Students should observe the relationship between how fast something vibrates and the pitch (how high or low a vibration of sound appears to be) by investigating questions such as: How will speeding up or slowing down a wheel on a bike change the sound of a card hitting the spokes? How will rolling a coin faster and faster inside an inflated balloon change the sound? (Make sure the coin has edges—smooth-edged coins do not work as well.)

The pitch can be altered by changing the length of a column of air in which vibrations are produced:

- adding water to a steel bowl as the side is tapped
- tapping or blowing over similar bottles having various amounts of water
- running a finger over the top edge of a glass with different amounts of water in it (crystal works the best)

Caution: Be careful glass does not have nicks or sharp edges.



Students can investigate questions related to the loudness of sound in a similar way to pitch. They should be introduced to the term “decibels” as a unit of measuring the level of intensity of sound. Some examples of different loudness levels should be introduced so that students will relate the number of decibels with an extremely loud sound and compare it to the number of decibels of a much softer sound (for example, whisper–20, normal conversation–60, lawn mower–90, chainsaw–110, firecracker–140).

Challenge students to find ways to increase the loudness of the sounds without changing the pitch. Students can try increasing the amount of energy supplied to the vibration, for example, hitting a drum harder or plucking a string further will increase the loudness of the sound without affecting the pitch.

Pitch, Loudness and Sound Technology

Tasks for Instruction and/or Assessment

Performance

- Conduct an experiment to test your questions about the factors that affect pitch or loudness of sound and record the procedures and results. (204-3)

Journal

- Write two testable questions about how the pitch of a sound can be changed. (204-2)
- Write two testable questions about how the loudness of a sound can be changed. (204-2)

Paper and Pencil

- Given the results of sound level testing for each of the following classrooms, match the level to the likely classroom activity.

Room A–84 decibels	silent reading
Room B–25 decibels	band practice
Room C–65 decibels	class discussion

Presentation

- Give an oral report and a demonstration of the factors that affect pitch and loudness, based on the results of your experiment.

Resources/Notes

Science and Technology 4

Teachers Guide: Sound

2. Good Vibrations, p.14
4. Did You Hear That? p.20
5. Pop Music, p.24
6. Make a Guitar, p.27
7. Stringing Along, p.30
8. Shape and Sound, p.34
9. Yogurt Cup Telephones, p.38
11. Turn Up the Volume, p.45
12. Sound, Hearing, and the Environment, P.48

Design Project: Form a Band, p.52

Pitch, Loudness, and Sound Technology

Outcomes

Students will be expected to

- demonstrate processes for solving technological problems by designing and constructing a device which has the ability to create sounds of variable pitch and loudness (104-1, 205-2)
- evaluate personally constructed musical devices with respect to their ability to vary their pitch and loudness (206-7)
- identify and use a variety of sources and technologies to gather pertinent information about Canadians who have contributed to sound technology (107-12, 205-8)

Elaborations—Instructional Strategies/Suggestions

Students could observe differences in the patterns made by sounds of low and high pitch, and increasingly louder sounds, by talking and singing into a microphone that is connected to an oscilloscope. An oscilloscope could be borrowed from a high school Physics lab.

The stages of technological design include proposing, creating, and testing. Students can demonstrate this process by proposing, constructing, and testing simple sound devices using materials such as boxes, rubber bands, nails, wood, metal tubing, and bottles. Students should be able to refer to the vocabulary of sound as they construct, describe and use their devices. Their devices should have the ability to modify pitch and loudness.

As students test out their sound devices, they should be given opportunities to make adjustments in order to improve their ability to play a variety of pitches. Encourage students to listen to other students' suggestions. Students can attempt to play a simple tune on their instrument for the class, and perhaps play together as an ensemble. Connections to the music program are appropriate in this section of the unit.

Teachers may want the class to focus on a specific Canadian inventor of a sound technology (for example, Alexander Graham Bell - the telephone and Hugh Le Caine - the electronic synthesizer) or ask students to search various library and electronic resources to choose their own inventor. Other examples:

- Douglas Shearer (1899–1971), sound recording technician born November 17, 1899, Westmount, Quebec. Shearer won 12 Academy Awards for “best sound recording” and for such achievements as developing an improved recording system and a method for reducing unwanted noise.
- Reginald Aubrey Fessenden, born in East Bolton, Quebec, was one of the earliest pioneers of radio. On December 23, 1900, he successfully transmitted the sound of a human voice between two 50-foot towers. Only Morse code had been transmitted before this.
- Andrew Mercer, software developer in Newfoundland. Mercer developed software that allowed musicians, or a teacher and student, to play music together in real time from different locations, almost as if they were sitting in the same room together.

Pitch, Loudness, and Sound Technology

Tasks for Instruction and/or Assessment

Performance

- Taking into account what you know about pitch and loudness, design and construct a musical device that can produce sounds with different pitch and loudness. (104-1, 205-2, 206-7)

The following draft scoring rubric for building and demonstrating a simple sound device may be used to assess the process.

LEVEL FOUR: Device is complete. There is evidence of careful planning and construction. Device is creative and original. Device can produce sounds with a wide variety of pitches and can vary degree of loudness

LEVEL THREE: Device is complete. Planning is evident. Some creativity is demonstrated. Device has average product performance; there is some variability in pitch and loudness.

LEVEL TWO: Basic device is complete. There is very little evidence of planning and device performance is poor. There is little variability of pitch and loudness.

LEVEL ONE: Insufficient work completed, evaluation not possible.

Journal

- I just finished making a musical instrument. I can vary the pitch by ... I can vary the loudness by ... I like my instrument because ... I might be able to improve it by ... (206-7)

Presentation

- Research, using books, magazines, encyclopedias, videos, reference CD-Roms, and/or the Internet, to find information on a Canadian inventor, or innovator of sound technology. Record information under the following headings:
 - Personal information (name, place and date of birth)
 - The invention/innovation (What is the invention/innovation? Why is it important?) (107-12, 205-8)

Resources/Notes

Science and Technology 4

Teachers Guide: Sound

2. Good Vibrations, p.14

5. Pop Music, p.24

6. Make a Guitar, p.27

7. Stringing Along, p.30

8. Shape and Sound, p.34

Design Project: Form a Band, p.52

The Ear, Hearing Loss and Noise Pollution

Outcomes

Students will be expected to

- describe and illustrate how the human ear is designed to detect vibrations (300-3)
- compare the range of sounds heard by humans to that heard by some animals (300-4)
- describe examples of devices that enhance our abilities to hear and collect sound data, such as hearing aids, sonar, amplifiers, oscilloscopes, and ultrasound (106-1)
- demonstrate processes for investigating the extent of noise pollution in their surroundings, and work with group members to evaluate the processes used in investigating noise pollution (104-1, 207-6)

Elaborations—Instructional Strategies/Suggestions

Having investigated the properties of sound, students are now in a position to investigate how sound vibrations are collected by the ear. Students can complete activities that illustrate why the ear is shaped as it is. Using the same noise (a soft recording, for example), ask students to close their eyes and tell you when they can hear it. Record the distance at which they are able to hear the noise. They can then close their eyes, and “cup” their outer ear towards you, and repeat the activity. They can also enhance their outer ear size by positioning a piece of paper behind their ears, or use a plastic funnel held to the ear. They should repeat the experiment and record results.

Diagrams and three-dimensional models will help students understand the function of the various parts of the human ear, and how these parts work together to hear sounds. As a project, students may even make their own models of the ear. Students should not be expected to name the parts of the ear for summative tests.

The above activities can lead into investigations about the ability of animals to hear differently from humans. Some good examples of animals with which to compare hearing are dogs, bats, dolphins, and elephants. Students may also compare the hearing abilities of people of various ages. This activity can lead to questions about why some students have better hearing than others, and how students need to protect their ears from loud noises to prevent hearing loss.

Students can investigate the effect of simple sound amplifying devices such as megaphones, parabolic dishes, hearing aids, radios, televisions, CD players, tape recorders, etc. They can compare the effectiveness of these devices by seeing how far they can move away and still be able to hear a sound that has been amplified. Other examples of more sophisticated instruments, such as sonar and oscilloscopes, can be introduced so that students are familiar with their name and function.

An inquiry process would be appropriate for investigating the extent of noise pollution. Students can demonstrate this process by identifying a question to investigate, selecting equipment and tools with which to collect data, making and recording observations, compiling their results and drawing conclusions. Questions to investigate could include: “Where is the noise level the highest in this school?” or “Which materials are best for absorbing sound?” A sound meter could be used to determine noise levels. Alternatively, a microphone connected to computer interface equipment or a tape recorder with a sound meter could be used. If these are not available, students could measure how far away they are from the sound source when they can no longer hear it. Students can collect noise level data from a variety of areas, and compare which types of devices make the most noise, which areas are the noisiest, or which material provides the best sound insulation. As they work together to investigate noise pollution, the importance of considering their own observations and ideas, as well as those of others, before drawing conclusions is encouraged.

The Ear, Hearing Loss, and Noise Pollution (continued)

Tasks for Instruction and/or Assessment

Performance

- Investigate the noise levels at various locations. Record and present your findings.(104-1, 207-6)
- Stand next to an object that is making a soft constant noise, like a clock. Slowly walk away from the object, and measure how far away you are when you cannot hear the sound. Repeat, the activity but this time hold a piece of paper that has been shaped into a funnel close to your ear. What difference does this make? (300-3)
- Observe the human ear. What shape does it have? (funnel) Take a large plastic funnel and hold the tube part at the entrance to your ear. Then point the funnel part at someone speaking. What did you notice about the sound level? Early hearing aids used funnels to improve hearing. (300-3)

Paper and Pencil

- Dogs can hear sounds humans cannot hear. Using print and/or electronic sources, investigate what other animals can hear sounds that we cannot hear. Make a list of chart to show your findings. (300-4)

Presentation

- Research to discover if animals hear sounds of higher pitch and/or lower pitch compared to the hearing of humans. Try to find the use of their enhanced hearing ability. Complete the chart to organize your findings. (300-4)

Can Some Animals Hear Better Than Us?

Animal	Higher Pitch	Lower Pitch	Hearing Used for ...
Bat	much higher	no	Used to help move around in dark caves, and help catch their prey
Dog			
Dolphin			
Elephant			

- Create a poster to show devices that measure and use sound waves. Under each picture, describe briefly what the device is used for. (106-1)

Resources/Notes

Science and Technology 4

Teachers Guide: Sound

3. The Human Ear, p.17

11. Turn Up the Volume, p.45

12. Sound,Hearing, and the Environment, p.48

The Ear, Hearing Loss and Noise Pollution (continued)

Outcomes

Students will be expected to

- identify the positive and negative effects of technological devices that produce loud sounds and identify the need for protection from and prevention of hearing loss (108-1, 206-9)
- describe specific personal actions or products that can help reduce this noise pollution (108-3)
- identify examples of current research related to sound (105-1)

Elaborations—Instructional Strategies/Suggestions

Students will have had opportunities throughout this unit to learn about technological products that make loud noises, such as personal stereo systems, jackhammers, and jets. All of the devices have been designed for a purpose, for example, a jack hammer is needed to break up concrete or rock. However, some of these devices also produce loud noises that can damage hearing. Students can research the effects that intensity of sound and length of exposure sound can have on their hearing. Very loud, short duration sounds damage hearing quickly, while continuous, loud sound has long term effects on hearing. Discuss the technological products used in various occupations to reduce noise levels, or protect their ears. This discussion helps students appreciate that the applications of science and technology can have both intended and unintended effects.

Students should be given opportunities to discuss their findings about noise levels around the school, in various occupations, and in their own home. Students can brainstorm suggestions about how to prevent hearing loss. As well as highlighting the need to avoid situations in which hearing loss is possible, students may explore technological solutions such as ear plugs or sound absorbing materials.

Students should be able to give examples of current sound-related issues that are being studied. These may include how human-generated noise can upset a habitat, occupational noise, and advances in technology for the hearing impaired. Notice the high fences on major highways next to residential locations. Why would such fences be placed there?

The Ear, Hearing Loss, and Noise Pollution (continued)

Tasks for Instruction and/or Assessment

Journal

- If I worked in a noisy factory, lived near a low-level aircraft flight path, or played in a band, I would be worried about ... I would write or call ... I would suggest ... (108-1, 108-3, 206-9)

Paper and Pencil

- Read/talk with classmates about devices which make loud noises, and then complete the table below. (108-1, 108-3, 206-9)

Loud Technology

Loud Device	Positive Points	Negative Points	Potential for Hearing Loss (low, med., high)	Safety Procedures
e.g., personal stereo	I can listen to my favourite songs	If it is too loud, I may damage my hearing	Depends on how loud I play it.	Don't turn it up too loud
Jackhammer				
etc.				

- Write a paragraph about efforts to reduce noise levels, sound amplification, the effects of noise pollution, sound technology, or a related topic. (105-1)

Portfolio

- Select several of your best pieces of work from this unit for your portfolio.
- Select a piece of work from your portfolio from a unit you have already completed (such as "Light"). What do you think about this work now? Do you think you would have done anything differently if you could redo the work? Has your work improved over the year?

Resources/Notes

Science and Technology 4

Teachers Guide: Sound

10. Sounds and Solids, p.42

12. Sound, Hearing, and the Environment, p.48

Earth and Space Science: Rocks, Minerals, and Erosion

Introduction

In addition to exploring the living things around them, students should also become familiar with the earth materials that make up their world. They should be provided with opportunities to learn that rocks are used for many things within a community and that rock characteristics help determine their use. Students can then explore the changing landscape by examining the processes of erosion, transport, and deposit; and determine how wind, water, and ice reshape the landscape. An examination of these processes also leads to discussions of ways that humans prevent landscape from changing or adapt to a changing landscape.

Focus and Context

The unit provides many opportunities for students to practice their inquiry skills. From observing, recording descriptions, and classifying the rocks and minerals in their local habitat, to exploring the make-up of soil and the fossils that can be found in it, students can hone their inquiry skills.

This unit can be set into the context of Our Changing Earth. In this context, students can explore both the impact of humanity and nature on the Earth, and will come to realize that the Earth is really a dynamic, ever-changing planet.

Science Curriculum Links

In grade 3, students explored the composition of the soil. In this unit, students extend this treatment to look at the factors that affect landscape changes. This will lead into the grade 7 unit, *Earth's Crust*, in which students investigate how various types of rocks are formed, and how the Earth's crust moves.

pan-Canadian Science Learning Outcomes

N.B. The following pan-Canadian Science Learning Outcomes were used as the framework in the development of the Atlantic Canada Science Curriculum at this grade level. For planning, instructional, and assessment purposes, teachers should refer to the PEI/APEF Specific Curriculum Outcomes found on the next page.

STSE	Skills	Knowledge
<p><i>Students will be expected to</i></p> <p>Nature of Science and Technology</p> <p>104-4 compare the results of their investigations to those of others and recognize that results may vary</p> <p>104-6 demonstrate that specific terminology is used in science and technology contexts</p> <p>Relationships Between Science and Technology</p> <p>106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications</p> <p>Social and Environmental Contexts of Science and Technology</p> <p>107-1 describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs</p> <p>107-5 provide examples of how science and technology have been used to solve problems in their community and region</p> <p>108-1 identify positive and negative effects of familiar technologies</p> <p>108-3 describe how personal actions help conserve natural resources and care for living things and their habitats</p> <p>108-6 identify their own and their family's impact on natural resources</p>	<p><i>Students will be expected to</i></p> <p>Initiating and Planning</p> <p>204-1 propose questions to investigate and practical problems to solve</p> <p>204-2 rephrase questions in testable form</p> <p>204-3 state a prediction and a hypothesis based on an observed pattern of events</p> <p>204-8 identify appropriate tools, instruments, and materials to complete their investigations</p> <p>Performing and Recording</p> <p>205-1 carry out procedures to explore a given problem and to ensure a fair test of a proposed idea, controlling major variables</p> <p>205-5 make observations and collect information that is relevant to a given question or problem</p> <p>205-7 record observations using a single word, notes in point form, sentences, and simple diagrams and charts</p> <p>Analysing and Interpreting</p> <p>206-1 classify according to several attributes and create a chart or diagram that show the method of classifying</p> <p>206-9 identify new questions or problems that arise from what was learned</p> <p>Communication and Teamwork</p> <p>207-2 communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawings, and oral language</p>	<p><i>Students will be expected to</i></p> <p>300-6 describe rocks and minerals according to physical properties such as colour, texture, lustre, hardness, crystal shape (minerals)</p> <p>300-5 compare different rocks and minerals from their local area with those from other places</p> <p>300-8 relate the characteristics of rocks and minerals to their uses</p> <p>301-6 demonstrate a variety of methods of weathering and erosion</p> <p>301-5 describe effects of wind, water, and ice on the landscape</p> <p>301-4 describe ways in which soil is formed from rocks</p> <p>300-7 identify and describe rocks that contain records of Earth's history</p> <p>301-7 describe natural phenomena that cause rapid and significant changes to the landscape</p>

PEI/APEF Specific Curriculum Outcomes

Collecting and Comparing Rocks and Minerals

Students will be expected to

- demonstrate respect for the habitats of animals and the local environment when collecting rocks and/or minerals from their local area (108-3)
- describe the distinction between minerals and rocks (104-6)

Properties of Rocks and Minerals

Students will be expected to

- use appropriate tools to make observations and collect information in order to describe rocks and minerals according to physical properties (204-8, 205-5, 200-6)
- record observations of their rocks and minerals in chart form, and/or using notes in point form (205-7)
- compare different rocks and/or minerals from their local area with those from other places (300-5)
- classify their rocks and minerals according to several properties and create a chart or diagram that show the method of classifying (206-1, 207-2)
- compare their classification schemes of the rocks/minerals to those of others and recognize that results may vary (104-4)

Uses for Rocks and Minerals

Students will be expected to

- describe how rocks and minerals are used (107-1)
- relate the characteristics of rocks and minerals to their uses (300-8)
- use appropriate terms to describe some positive and negative effects of the extraction and/or utilization of rocks and minerals (104-6, 108-1)

Erosion and Weathering

Students will be expected to

- describe effects of wind, water and ice on the landscape (301-5)
- demonstrate a variety of methods of weathering and erosion (301-6)

Soil Formation and Composition

Students will be expected to

- describe ways in which soil is formed from rocks (301-4)

Record in Rocks

Students will be expected to

- identify and describe rocks that contain records of Earth's history (300-7)

Sudden and Significant Changes in the Land

Students will be expected to

- describe natural phenomena that cause sudden and significant changes to the landscape (301-7)

Collecting and Comparing Rocks and Minerals

Outcomes

Students will be expected to

- demonstrate respect for the habitats of animals and the local environment when collecting rocks and/or minerals from their local area (108-3)

- describe the distinction between minerals and rocks (104-6)

Elaborations–Instructional Strategies/Suggestions

Students can bring rock samples to school from their driveway, backyard, and gardens. Encourage them to bring in as wide an assortment as possible. Alternatively, students can go on a rock hunt around the school grounds. This outside excursion presents an opportunity to reinforce outcomes from the *Habitats* unit studied in Grade 4. Students can take the time to explore plants and animals in the habitat from which they are collecting rocks, while taking care not to disrupt this habitat. Note: Rocks may not be removed from provincial or federal parks.

If students live near a beach or lake, they can bring in samples of beach rocks. They can compare and contrast the differences between beach rocks and the silty soil usually found in lakes. Later on in this unit they will be exploring erosion and the effect of water on the land, so this would be a good lead-in to that topic. They can also bring in rocks from mountainous areas, building lots, and farmland.

Using a variety of mineral and rock samples, students will investigate the similarities and differences between them. Rocks are made up of one or more minerals. Students should look through their collection to see if they can distinguish which ones they think are rocks and which ones they think are minerals. This will only be obvious when a rock is visibly composed of more than one mineral. Some rocks are composed of only one mineral (e.g., limestone is composed of calcite or calcium carbonate). Field guides may help them to identify their rocks and minerals; however, many rocks and minerals can be difficult to identify when they are weathered.

Collecting and Comparing Rocks and Minerals

Tasks for Instruction and/or Assessment

Paper and Pencil

- From a collection of a variety of common rocks and minerals, sort the collection using a dichotomous key to differentiate. (104-6)

Presentation

- Start a collection of different rocks and minerals. Plan a way to display your rocks. You may decide to leave space for written notes under each rock or you may decide to do a display with your own field guide. At this time, note where each rock was found, and, if possible, identify which are rocks and minerals. (108-3, 204-8, 2-5-5, 300-6, 205-7, 300-5)

Informal/Formal Observation

An observation checklist could be used when watching students collect rocks:

Do they take care....

- not to leave garbage
- not damage plants, trees, and shrubs and other habitats.

(108-3)

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

1. Become a Rockhound, p.10
3. Rock or Mineral, p.16

Properties of Rocks and Minerals

Outcomes

Students will be expected to

- use appropriate tools to make observations and collect information in order to describe rocks and minerals according to physical properties (204-8, 205-5, 300-6)
- record observations of their rocks and minerals in chart form, and/or using notes in point form (205-7)
- compare different rocks and/or minerals from their local area with those from other places (300-5)

Elaborations–Instructional Strategies/Suggestions

Students should use a wide variety of vocabulary to describe the properties of their rocks and minerals. Brainstorm terms that they can use. Encourage them to be as descriptive as possible and use similes (e.g., “like the colour of teeth) to enhance their descriptions. They should go beyond simple observations to investigate various properties, such as hardness. Students could test their rocks and discover that a paper clip might scratch two of their rocks but not a third one, while a penny might scratch all three. This would allow them to organize the rocks from softest to hardest. Students might want to use materials with varying degrees of hardness such as paperclips, shale, granite, and pennies. Scratch tests are normally reserved for minerals, since different parts of rocks will have different degrees of hardness. Results will vary using rocks. This activity is meant to show that some rocks are harder than others.

Students should record their observations in chart form as they complete the investigation. If they are working on a presentation of their rock collection, they may wish to transfer the data they collect on each rock onto separate file cards to be pasted under each rock.

Students should compare rocks and minerals found in their local area with those from other places. Students can use a prepared or published field guide or other geology resources (the Internet and various software are good sources for these) to compare their rocks to others, or they can prepare their own local rock guide. It is helpful to have a class set of rocks and minerals from various locations to make comparisons. This activity will encourage an attitude of showing an interest and curiosity about objects and events within different environments.

Properties of Rocks and Minerals (continued)

Tasks for Instruction and/or Assessment

Performance

- As a rock hound (a collector of rocks and minerals), you can conduct a series of tests for each individual specimen of rocks and minerals you find. A good detective always keeps a careful record of what he or she does. Complete the chart using your observations. Use your chart and choose a rock or mineral and tell about a possible use for it. (204-8, 205-5, 300-6, 205-7)

Observations of Rocks and Minerals

Property	Sample 1	Sample 2	Sample 3	Sample 4
colour	red/brown			
texture	smooth			
hardness	fingernail won't scratch it but a penny will			
lustre	dull			
possible uses				
name (optional)				

Journal

- One of the rocks you collected is smooth, while another one is angular and jagged. Write a story, including pictures, that describes where the rocks might have originated and why they are different shapes. (300-5)

Presentation

- Work on your rock/mineral display. Make sure that the properties that you determined through investigation are included in your display or field guide. (300-5, 204-8, 205-5, 300-6, 205-7)

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

- Become a Rockhound, p.10
- Rock or Mineral? p.16
- Rock Types, p.19
- Testing Rocks and Minerals, p.23

Properties of Rocks and Minerals (continued)

Outcomes

Students will be expected to

- classify their rocks and minerals according to several properties and create a chart or diagram that show the method of classifying (206-1, 207-2)
- compare their classification schemes of the rocks/minerals to those of others and recognize that results may vary (104-4)

Elaborations–Instructional Strategies/Suggestions

Students should design their own classification scheme. Two criteria they might want to use are texture or colour. Encourage students to develop a dichotomous key. They may start by classifying their rocks as “White” and “Not White”. They can further classify each of these into “Smooth” and “Not Smooth”. Teachers can model this way of classifying for students, but students should not be expected to use the term “dichotomous key”.

Students should work together to develop large labelled charts in which they can sort the rocks. These can be laid out on a desk so that other students can see how they have classified them. When the groups have finished developing their classification schemes, they can remove all their rocks and let other classmates see if they can sort the rocks using their scheme.

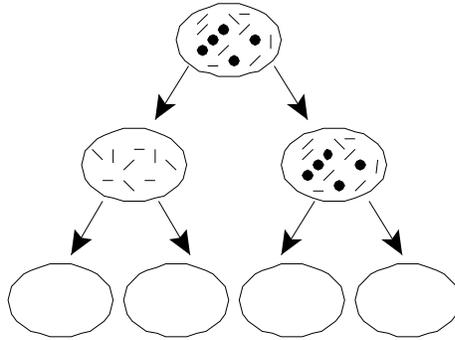
Since the classification scheme will be of their own making, different groups will undoubtedly come up with different schemes, and even groups that do use the same scheme may classify the same rocks differently. This is a good opportunity to discuss the fact that classification schemes are useful inventions, but some rocks may not fit neatly into any scheme, and that in many cases the dividing line between the different classifications may not be nearly as clean as we might like.

It is not necessary at this point for students to be able to distinguish between igneous, sedimentary and metamorphic rocks. This will be addressed in grade 7 science. However, depending on the local geology, these terms may be introduced as appropriate. Prince Edward Island sandstone, for example, is a good example of sedimentary rock.

Properties of Rocks and Minerals (continued)

Tasks for Instruction and/or Assessment

- In groups of two or three, decide on the properties you will use to classify your rocks. Start with one property, (e.g., a colour, hardness, or texture) with which to divide your rocks into two groups. Continue to select properties to further sort your rocks. Label your scheme so that your classmates can try it. See example to the right. (206-1, 207-2, 104-4)



Paper and Pencil

- List the properties that your group chose to classify your rocks. View two other classification schemes and try to use their scheme to sort your rock collection.
 - Were the properties that they used to sort the rocks the same as your groups? Were there some rocks that you thought should have been in different groups? (104-4)

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

2. Rock Groups, p.13

5. Testing Rocks and Minerals, p.23

Uses for Rocks and Minerals

Outcomes

Students will be expected to

- describe how rocks and minerals are used (107-1)
- relate the characteristics of rocks and minerals to their uses (300-8)
- use appropriate terms to, describe some positive and negative effects of the extraction and/or utilization of rocks and minerals (104-6, 108-1)

Elaborations–Instructional Strategies/Suggestions

Students should be provided with samples of ores and finished goods then asked to match the ore with the correct item (e.g., talc with powder). The uses of rock and mineral products in construction should be highlighted. Make a display of ores that contain iron, nickel, zinc, and other commonly used metals together with samples of goods made from these metals (such as bauxite with an aluminium chalk holder, or other objects made with aluminium). Students will see that only in rare instances can the metal be seen in the ore, since it is usually not present in its pure form. Buildings, highways, and bridges are examples of structures that require rocks and minerals.

Students should explore the wide variety of ways rocks and minerals are used. They should try to connect the properties of the rocks/minerals and their major uses. For example, some refined metals, such as gold, silver, and copper are shiny, malleable, and not very abundant, which makes them appropriate and valued for jewellery. Hard granite rocks weather quite well, and are often used in road construction. Students can select and use earth materials, such as clay, sand, gravel, and soapstone, to make various objects, such as bricks, sculptures, mud bricks, and necklaces.

While rock and mineral products are valued and useful, the processes involved in extracting them from the earth and the products made from them can have negative effects. Students should explore the effects of mining/refining on the surrounding land and air quality and the effect of run off from slag (mineral residues) on natural habitats.

Students should explore the positive and negative effects resulting from the extraction and/or utilization of rocks and minerals. Students could do a number of activities to simulate some mining techniques; they could try “panning for gold”, a separation technique that was used during the gold rush. *(Give students a mixture of silt, soil, and one or two dense objects (such as painted ball bearings) in a metal pie pan. Using a plastic dishpan with water, have the students swirl water around their pan, draining off the silt and larger gravel into the dishpan, until the coloured ball bearings appear. A local prospector or geologist could be invited into the classroom to demonstrate panning techniques as an example of low-impact mining.)*

Students can do other activities in which they separate various types of rock from the surrounding soil. Simulate mineral deposits by alternately layering various rocks in a paper cup with “Plaster of Paris”. When the mixture dries, remove it from the cup. Students can use toothpicks and popsicle sticks to try to extract the rocks. Alternatively, cookies such as chocolate chip or raisin can be used. What happens to the unused ore (cookie)? Coal tips and sulphur hills are excellent illustrations of how leftover earth materials become part of the landscape.

Uses for Rocks and Minerals

Tasks for Instruction and/or Assessment

Performance

- Investigate the ores below and try to match them to the given products.
Ores: nickel, gypsum, halite, limestone, granite, clay, talc
Products: five-cent piece, wall board, table salt, cement mix, memorial stone, brick, powder

Journal

- Make lists of objects in your home that are made from rocks and minerals and objects that are not made from rocks and minerals. Do you think that other materials could be used to make these objects? Ask older people in your household and/or community if something that was once made with rocks and minerals is now made with different materials. (107-1, 300-8)

Paper and Pencil

- Classroom or homework activity: Using a variety of sources, determine which mineral material is used in the various parts of your home. (107-1)

pipes: _____

roof: _____

floors: _____

walkways: _____

Add three items of your own choosing:

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

5. Testing Rocks and Minerals, p.23

6. Useful Rocks and Minerals, p.26

9. What is soil? p.37

12. Changing the Landscape, p.48

Design Project: The Disappearing Shore, p.52

Uses for Rocks and Minerals (continued)

Outcomes

Students will be expected to

- use appropriate terms to, describe some positive and negative effects of the extraction and/or utilization of rocks and minerals (104-6, 108-1)

Elaborations–Instructional Strategies/Suggestions

Another refining activity could involve using vinegar to dissolve one component of a mixture of earth materials, while leaving the wanted material for easy extraction. Students could add vinegar to a mixture of powdered baking soda and gravel. In this simulation, the gravel is the part of the soil that is wanted, while the baking soda will be discarded once they have been separated. When the vinegar is added, the baking soda will fizz and seem to disappear or dissolve, leaving the gravel. The gravel is now easily removed from the mixture. Students could reflect on the vinegar/baking soda mixture that is left over and how it could be disposed of. Parallels to the mining process (e.g., tailings, holding ponds) could be made. The problem of what to do with the vinegar mixture can highlight the difficulties in disposing or storing the waste (slag) products from the refining process.

Where possible, students can go on a field trip to a local mine to see how ores are retrieved. Alternately, they can view videos or use software that illustrate the various techniques. Students can research some environmental problems associated with mining and smelting. They may want to explain what a local company is doing to alleviate these problems. School groups may want to get involved in writing letters to enquire about the issues. This will help students realize that the applications of science and technology can have both intended and unintended effects. It also encourages students to be sensitive to and develop a sense of responsibility for the welfare of other people, living things, and the environment.

Alternatively, students could focus on the positive and negative effects of earth products or structures. Examples could be the use of pottery and gasoline which contain lead or other poisonous metals, or the effect of the construction of a highway or dam through natural habitats. Students may be interested in exploring archeological displays in museums. Old pottery, arrowheads, and jewellery show alternative ways rocks and minerals were used in the past. Connections to the *Habitats* unit earlier in grade 4 could be made.

Teachers may want to invite artists or artisans in as guest speakers.

Uses for Rocks and Minerals (continued)

Tasks for Instruction and/or Assessment

Presentation

- In groups, prepare a presentation: (written, oral, or web page) of a mine in your province or region. The following aspects should be researched and each person in the group should choose one aspect as his/her part in the group project.
 - What rocks or minerals are mined? Describe their properties?
 - What the rocks or minerals used for?
 - What is the economic benefit to the community?
 - What, if any, are the environmental issues associated with the mine. (108-1, 300-8)

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

- 5. Testing Rocks and Minerals, p.23
- 12. Changing the Landscape, p.48

Erosion and Weathering

Outcomes

Students will be expected to

- describe effects of wind, water, and ice on the landscape (301-5)
- demonstrate a variety of methods of weathering and erosion (301-6)

Elaborations–Instructional Strategies/Suggestions

Students should explore the differences between weathering (the wearing down and breaking up of rocks) and erosion (the movement of rocks and other material), and be able to demonstrate an understanding of both concepts. Rocks, in the process of moving (erosion) can weather other rocks.

Students can look at the ground near an eaves trough runoff. There should be an indentation of the ground where the force of the runoff has swept away loose gravel and soil (erosion). Larger gravel should be much more pronounced. In cases where the runoff is directly on concrete, the concrete should be worn so that the larger stones embedded in the concrete are most pronounced (weathering).

Sandy beaches provide evidence of the effect of waves and other moving rocks on the beach rocks. Beach rocks are often quite smooth. The rocks in a lake are often less smooth because the waves are not as strong (weathering). Often a storm or high waves will wash the sand out to sea. (erosion).

Lakes often have silty bottoms due to the settling of runoff (erosion of the river banks).

Highlight local areas that have evidence of coastline erosion and glacial deposits (erosion) and areas where glacier have carved out sections of land (weathering).

Students should investigate the action of waves by putting rocks that crumble fairly easily (e.g., shale) in a hard plastic container with water. Shake the container for ten minutes, and note any changes on the rock. Filter the water through a coffee filter and note all the small bits of rock that have broken loose (weathering by both water and the action of other rocks). Erosion by water can be simulated by running water down a pile of sand or soil.

Other weathering effects such as water freezing in cracks of rocks can be simulated by filling a plastic container with water and freezing it. Students can place a balloon filled with water in Plaster of Paris. When the plaster has set, put it in a freezer, and observe how the plaster splits open. Students can use a snow shovel to simulate how ice or glaciers move rocks from place to place. They can also collect snow that has been plowed, let it melt, and observe the rocks that were swept along with the snow and ice (erosion).

The weathering effect of wind is harder to illustrate in the classroom, since the effects take a long time to become evident. It usually acts in combination with moving rocks and sand. Displays of rocks that have been sandblasted will help to illustrate the effect of wind. Erosion can be demonstrated by students by setting up fans to show the movement of sand and silt.

Erosion and Weathering

Tasks for Instruction and/or Assessment

Performance

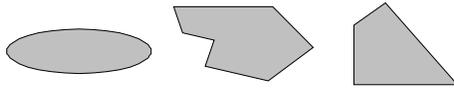
- Note places where you see signs of weathering and erosion around your school and community. Complete a chart of your observations similar to the one below. (301-6)

Weathering and Erosion

Location	Signs of Weathering	Signs of Erosion	Ice, Wind, or Water?
At the downspout of an eavestrough			
Seashore			
Rivers			
Fields			

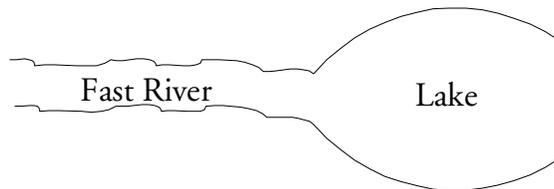
Paper and Pencil

- Which rock shape would you most likely find on a beach? Give reasons for your answer. (301-5)



- Rock and sandy material are washed down stream. Where the river widens or enters a lake or ocean, the speed of the water decreases and the heavier material settles first on the river bed.

On the diagram below, draw large circles (O) to show where the larger rocks would be found. Draw small dots (•) to show where the smaller rock particles would be found. Explain your reasons for the location of both items.



- Where does the sand on a beach come from? Use the terms “weathering” and “erosion” in your answer. (301-5)

Interview

- What would happen to pavement if water seeps into its cracks, and then freezes during the winter? (301-5)

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

10. Rocks do Change! p.41

11. Soil Erosion, p.45

12. Changing the Landscape p.48

Design Project: The Disappearing Shore, p.52

Soil Formation and Composition

Outcomes

Students will be expected to

- describe ways in which soil is formed from rocks (301-4)

Elaborations–Instructional Strategies/Suggestions

Students should explore how bedrock and large rocks can be weathered and eroded into smaller rocks. If local sites are not available students can use selected videos, library resources, and internet sites. Students will discover how erosion removes rock fragments using water, ice, wind, and gravity.

Using a large cylindrical container, students could mix samples of rock, such as shale, sandstone, chalk, granite. By rolling the container for a period of time, these rock samples will exhibit many of the features of weathered rocks in nature. By repeating the activity with water added to the container, students will see the effects of water weathering on rocks.

Once students have observed how large rocks can be weathered into smaller rocks, they should take a closer look at soil. Soil is composed of rocks and minerals of various sized particles, and humus (decayed organic material).

Students could explore the composition of soil. They might take soil samples, mix them with water in a clear plastic jar, and then let the mixture settle into its components. Before students do this activity, ask them to make predictions about what is likely to happen. Will all the particles sink at the same rate? Will some sink faster than others? Which ones do they think will sink the fastest (perhaps the biggest, heaviest)? The various layers should be quite pronounced. Students should see from this activity that soil is composed of particles of various sizes and types, that results from weathering and erosion.

Soil Formation and Composition

Tasks for Instruction and/or Assessment

Performance

- Put three or four small shale or sandstone samples into a plastic jar with some water. Shake the jar vigorously. Describe what happens to the pieces of shale. Pour the water from the jar through a coffee filter, and record your observations. (301-4)

Interview

- a. Explain, using the terms weathering and erosion, how soil can be formed from larger rocks.
- b. Is this a fast or slow process compared to the life time of a person? Explain
- c. Are smaller pieces of weathered rocks the only components of soil? Explain. (301-4)

Presentation

- Develop a collage of drawings, or pictures of local or regional areas that show different forms of erosion and weathering. (301-6, 301-5, 301-4)
- Write a poem, song or story on the weathering of local shorelines or geological features. (301-4, 301-5, 301-6)

Resources/Notes

Science and Technology 4

Teacher's Guide: Rocks, Minerals and Erosion

9. What is Soil? p.37
10. Rocks Do Change! p.41
11. Soil Erosion, p.45

Record in Rocks

Outcomes

Students will be expected to

- identify and describe rocks that contain records of Earth's history (300-7)

Elaborations–Instructional Strategies/Suggestions

Students should simulate the various ways fossils are formed. In the last section, students explored how soil components settle in layers. They also determined that soil is made up of organic material, or the decaying material of living plants and animals. Both of these concepts can be tied together to introduce the concept of fossils. Pictures or displays of fossils can be used to illustrate the different ways of forming fossils.

Students should reexamine their collection of rocks to look for evidence of fossils. Students should identify and describe any fossil evidence they find

Visit a site that has fossilized rocks and examine them to study the historical records they contain or examine fossilized rocks brought to class.

Imprints are the simplest type of fossil, and differ from the others in that the organism leaves evidence that it was there (footprints or tracks, burrowing holes) but then moves on. Students can make imprint fossils by making foot prints or tracks in wet clay, and then letting it dry.

Moulds are similar to imprints in that an impression of the organism is left, but in this case, the organism was actually left in the soil or sediment. The impression or cavity left after the organism slowly decays and washes away is called a mould.

If this cavity fills with rocks and minerals, it makes a fossil cast. Students can make cast fossils by firmly pressing a shell or some other hard object into some soft clay to make an impression of the shell in the clay. Pour a plaster mixture into the indentation in the clay, and allow the plaster to dry. When the plaster is dry, carefully remove the clay from the plaster, which represents the fossil cast.

Records in Rocks

Tasks for Instruction and/or Assessment

Performance

- Visit a site where fossils are present. (300-7)

Journal

- Given a fossil, draw it or make a rubbing. Display your rubbings and create a story about your fossil. (300-7)
- Imagine you have become a fossil. Write about what it was like to fossilize.

Presentation

- Compile a display of fossils and the different materials in which they were found. (300-7)

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

7. Fossils p.30

8. Making Fossils p.34

Sudden and Significant Changes in the Land

Outcomes

Students will be expected to

- describe natural phenomena that cause sudden and significant changes to the landscape (301-7)

Elaborations–Instructional Strategies/Suggestions

Students should look around their own region to see if they can identify features of the land that may have been caused by drastic events.

Natural disasters like tidal waves, flash floods, hurricanes, mud slides, volcanoes, earthquakes, avalanches, and tornadoes can cause a dramatic change in the landscape. Students could collect articles on natural disasters, and display them on a poster or in a scrapbook as part of a project. Students could focus, in part, on the preventative action taken before the disaster to reduce its impact.

Students could watch for any coverage of active volcanoes. They can research volcanic activity like Mount St. Helen's, or the volcanoes around Hawaii, or Japan, or the "Ring of Fire".

Avalanches can change the landscape dramatically. Students may be able to see evidence of past avalanches (trees missing from a strip of mountain side, for example) from their local area or from pictures.

Students could report on visits that they have made to areas that have been burned by a forest fire. Forest fires can change the land. In the aftermath of a forest fire, a lot of soil can simply blow or wash away. However, forest fires can also be positive; they may clear away old growth, and allow different plants to grow.

Students could research the effect of meteors or asteroids impacting the Earth. Craters are formed from the impact. Besides the craters on Earth, students may wish to research moon craters to illustrate the impact of asteroids and meteors.

Records in Rocks

Tasks for Instruction and/or Assessment

Presentation

- Select one of the natural events: (tidal wave, hurricane, ice storm, flash flood, mud slide, volcano, earthquake, avalanche, or tornado) and design a presentation that describes the event and how it affects the landscape. (301-7)

Portfolio

- Select a piece of work from your portfolio from a unit you have already completed. Describe why you have chosen this piece and what makes it important for you.

Resources/Notes

Science and Technology 4

Teachers Guide: Rocks, Minerals and Erosion

12. Changing the Landscape, p.48

Elementary Science Safety

Although experimentation in the elementary years may not be in as much depth as in secondary school, and the equipment and chemicals may not be as sophisticated, the attention to safety is just as important. Safety is an important concern in the elementary science classroom because students are learning new skills and working with unfamiliar equipment and materials that can pose some degree of hazard. Safety in the elementary school science classroom depends upon the wise selection of experiments, materials, resources and field experiences as well as consistent adherence to correct and safe techniques. Some work procedures require thorough planning, careful management and constant monitoring of students' activities. Teachers should be knowledgeable of the properties, possible hazards, and proper use and disposal of all materials used in the classroom.

The Safe Classroom

Some general principles of safe science classroom management may be identified:

- Prepare, maintain, and prominently display a list of emergency telephone numbers.
- Identify people within the school who are qualified to administer first aid.
- Annually review and complete the safety checklists relevant to your situation.
- Familiarize yourself with the relevant medical histories of individual students.
- Review basic first aid procedures regularly.
- Formulate, in consultant with administration and other teachers, an action plan to deal with accidents in the classroom and also on extracurricular activities such as field trips.

Non-Hazardous Chemicals

The following chemicals can be used safely by students (but remember that any substance, even salt, can be harmful if taken in sufficient quantity). Be aware that any substance in a fine powder or dust form can be inhaled and thus harm health.

Aluminum foil	Detergents, hand-washing types (but not dishwashing)	Soap
Baking powder (sodium bicarbonate and tartaric acid)	Food colouring	Starch
Baking soda (sodium bicarbonate)	Glycerine (glycerol)	Steel wool
Bath salts/Epsom salts (magnesium sulfate)	Iron filings	Sugar
Borax (sodium borate)	Lemon juice (contains citric acid)	Tea (contains tannic acid)
Carbonated (fizzy) drinks	Marble chips (calcium carbonate)	Universal (pH) indicator paper or solution
Chalk (calcium carbonate)	Litmus paper or solution	'Vaseline'
Charcoal (carbon)	Milk	Vinegar (dilute acetic acid)
Citric acid crystals	Oils, vegetable and mineral (but not motor oil)	Vitamin C (ascorbic acid)
Clay (moist)	Plaster of Paris or cellulose fillers ('Polyfilla')	Washing powder, hand-washing types
Copper foil	Salt (sodium chloride)	Zinc foil
Cream of tartar (tartaric acid and potassium hydrogen tartrate)	Sand	

Dangerous Household Chemicals

Some common products are potentially hazardous and should not be used in the elementary classroom. Consider warning the students about the dangers in their homes.

Bleach	Fine powdered substances	Paint strippers
Caustic soda (sodium hydroxide)	Fireworks, sparklers and party poppers	Pesticides, fungicides, and insecticides
Rust-removal solution	Gasoline and other fuels	Some plant growth substances
Dishwasher detergents	Hydrogen peroxide	(e.g. rooting powders)
Drain cleaner	(more than a 3% solution)	Scale removers
Dry cleaning fluids	Laundry detergents	Toilet cleansers
Some fertilizers	Oven cleaners	Weed killers

Disposing of Chemicals

- The disposal of non-hazardous, water-soluble liquid wastes (e.g. liquid handsoap, vinegar) should involve diluting the liquid waste before pouring it down the drain, then running tap water down the drain to further dilute the liquid.
- Non-hazardous solid wastes (e.g. iron filings, table salt) should be disposed of in a waste container.
- Hazardous wastes should be placed in specially marked waste containers and disposed of in an appropriate manner.

Science Safety Rules and Procedures for Elementary Science Students

(not a conclusive list)

1. Never do any experiment without the approval and direct supervision of your teacher.
2. Read all written instructions before doing an activity.
3. Listen to all instructions and follow them carefully.
4. Make sure you understand all the safety labels.
5. Always ask your teacher if you do not understand.
6. Wear proper safety protection as instructed by teacher.
7. Never remove your goggles during an activity.
8. Tie back long hair and avoid wearing loose clothing such as scarves, ties or long necklaces.
9. Know the location of safety and first aid equipment.
10. Work carefully and make sure that your work area is not cluttered.
11. Always cut away from yourself and others when using a knife.
12. Always keep the pointed end of scissors or any other sharp object facing away from yourself and others if you have to walk with it.
13. Dispose of broken glass as your teacher directs.
14. Do not smell a substance directly. Fan the smell toward you with your hand.

Science Safety Rules and Procedures for Elementary Science Students (not a conclusive list) (continued)

15. Never eat or drink in the laboratory.
16. Never drink or taste any substances.
17. Never use cracked or broken glassware.
18. Make sure that your hands are dry when touching electrical cords, plugs, or sockets.
19. Handle hot objects carefully.
20. Tell your teacher immediately if an accident or spill occurs, no matter how minor.
21. Clean equipment before you put it away.
22. Dispose of materials as directed by your teacher.
23. Clean up your work area upon completion of your activity.
24. Wash hands carefully with soap and water after handling chemicals, after all spills and at the end of each activity.

Plant and Animal Care in the Classroom

(<http://www.sasked.gov.sk.ca/docs/elemsci/corgesc.html>)

Teachers should familiarize themselves with any local, provincial, or federal statutes pertaining to the care of plants or animals. If in doubt, inquire. Pet shops may have useful information. Remember that there are regulations preventing the picking of some wild flowers, or the captive use of migratory birds or endangered species. The following are some guidelines for the care of plants and animals in the classroom:

- Be wary of any possible signs of allergic reactions among students to any plants or animals.
- Inform the administration before bringing any animals into the school.
- Inquire about specific feeding and facility requirements for classroom pets.
- Be wary of possible diseases that may be spread by animals, or by people to animals.
- Poisonous animals and plants, or other potentially dangerous animals such as venomous snakes and spiders should not be kept in the classroom.
- Wear gloves when handling animals in the classroom. Over-handling can put the animals under excessive stress.
- Involve students in helping to care for plants and animals.
- Make arrangements to have the plants and animals looked after over holidays and on weekends.

(Adapted and used with permission from the Ministry of Education, British Columbia)

Attitude Outcome Statements

For grades 4-6, it is expected that students will be encouraged to

Appreciation of Science	Interest in Science	Scientific Inquiry
<p>409 appreciate the role and contribution of science and technology in their understanding of the world</p> <p>410 realize that the applications of science and technology can have both intended and unintended effects</p> <p>411 recognize that women and men of any cultural background can contribute equally to science</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> • recognize that scientific ideas help explain how and why things happen • recognize that science cannot answer all questions • use science inquiry and problem-solving strategies when given a question to answer or a problem to solve • plan their actions to take into account or limit possible negative and unintended effects • are sensitive to the impact their behaviour has on others and the environment when taking part in activities • show respect for people working in science, regardless of their gender, their physical and cultural characteristics, or their views of the world • encourage their peers to pursue science-related activities and interests 	<p>412 show interest and curiosity about objects and events within different environments</p> <p>413 willingly observe, question, explore, and investigate</p> <p>414 show interest in the activities of individuals working in scientific and technological fields</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> • attempt to answer their own questions through trial and careful observation • express enjoyment in sharing and discussing with classmates science-related information gathered from books, magazines, newspapers, videos, digital discs, the Internet, or personal discussions with family members, teachers, classmates, and experts • ask questions about what scientists in specific fields do • express enjoyment from reading science books and magazines • willingly express their personal way of viewing the world • demonstrate confidence in their ability to do science • pursue a science-related hobby • involve themselves as amateur scientists in exploration and scientific inquiry, arriving at their own conclusions rather than those of others 	<p>415 consider their own observations and ideas as well as those of others during investigations and before drawing conclusions</p> <p>416 appreciate the importance of accuracy and honesty</p> <p>417 demonstrate perseverance and a desire to understand</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> • ask questions to ensure they understand • respond positively to the questions posed by other students • listen attentively to the ideas of other students and consider trying out suggestions other than their own • open-mindedly consider nontraditional approaches to science • seek additional information before making a decision • base conclusions on evidence rather than preconceived ideas or hunches • report and record what is observed, not what they think ought to be or what they believe the teacher expects • willingly consider changing actions and opinions when presented with new information or evidence • record accurately what has been seen or measured when collecting evidence • take the time to repeat a measurement or observation for greater precision • ask questions about what would happen in an experiment if one variable were changed

Attitude Outcome Statements

For grades 4-6, it is expected that students will be encouraged to

Collaboration	Stewardship	Safety in Science
<p>418 work collaboratively while exploring and investigating</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> • complete group activities or projects • willingly participate in cooperative problem solving • stay with members of the group during the entire work period • willingly contribute to the group activity or project • willingly work with others, regardless of their age, their gender or their physical or cultural characteristics • willingly consider other people's views of the world 	<p>419 be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> • choose to have a positive effect on other people and the world around them • frequently and thoughtfully review the effect and consequences of their actions • demonstrate willingness to change behaviour to protect the environment • respect alternative views of the world • consider cause and effect relationships that exist in environmental issues • recognize that responding to our wants and needs may negatively affect the environment • choose to contribute to the sustainability of their community through individual positive actions • look beyond the immediate effects of an activity and identify its effects on others and the environment 	<p>420 show concern for their safety and that of others in planning and carrying out activities and in choosing and using materials</p> <p>421 become aware of potential dangers</p> <p><i>Evident when students, for example,</i></p> <ul style="list-style-type: none"> • look for labels on materials and seek help to interpret them • ensure that all steps of a procedure or all instructions given are followed • repeatedly use safe techniques when transporting materials • seek counsel of the teacher before disposing of any materials • willingly wear proper safety attire, when necessary • recognize their responsibility for problems caused by inadequate attention to safety procedures • stay at their own work area during an activity, to minimize distractions and accidents • immediately advise the teacher of spills, breaks, or unusual occurrences • share in cleaning duties after an activity • seek assistance immediately for any first aid concerns like cuts, burns, and unusual reactions • keep the work station uncluttered, with only appropriate materials present