Atlantic Canada
Science Curriculum

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Education

CURRICULUM

Science
Grade 4

Atlantic Canada Science Curriculum: Grade 4

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Atl;antic Canada Science Curriculum: Science, Grade 4

Prepared by the Department of Education

Cataloguing-in-Publication Data

Main entry under title.

Atlantic Canada science curriculum: Grade Four/
Nova Scotia. Department of Education.

ISBN: 1-55457-018-2

1. Science - Study and teaching - Handbooks, manuals, etc.
2. Science - Nova Scotia - Handbooks, manuals, etc. I. Nova Scotia. Department of Education.
507 – dc 22 2006

Acknowledgments

The Council of Atlantic Ministers of Education and Training, formerly the Atlantic Provinces Education Foundation, expresses its indebtedness to members of the regional science committees for their professional expertise and insights in developing this regional science curriculum guide. In addition, pilot teachers and others who contributed comments and suggestions are commended for their commitment to developing exemplary science programs.

Foreword

The pan-Canadian *Common Framework of Science Learning Outcomes K to 12* (1997) provides the basis for the curriculum described in *Foundation for the Atlantic Canada Science Curriculum* (1998) and in guides for grades primary–10 science.

Science 4 includes the following units:

- Life Science: Habitats
- Physical Science: Light
- Physical Science: Sound
- Earth and Space Science: Rocks, Minerals, and Erosion

This guide is intended to provide teachers with the outcomes framework for the course. It also includes some suggestions to assist teachers in designing learning experiences and assessment tasks.

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Introduction

Background

The curriculum described in *Foundation for the Atlantic Canada Science Curriculum* and related curriculum guides 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 that students need to develop inquiry, problem-solving, and decision-making abilities; to become lifelong learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment.

Program Design and Components

Learning and Teaching Science

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

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

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

The development of scientific literacy in students is a function of the kinds of tasks in which they engage, 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.

The Science Lesson—Links to the World

It is very important for children to learn through experiences in science. Students can engage in problem solving, decision making, and inquiry only through a hands-on approach to learning. Using their senses, and the power of observation, and recording their findings—in writing, by illustration, or verbally—are key to a meaningful experience and understanding.

Before starting a science activity, the teacher should take the time to engage students in dialogue on their prior knowledge of a topic and to record key vocabulary words and thoughts to be used as a reference as the activity progresses. The teacher should also articulate and discuss expectations for communication and teamwork with the students before they engage in any hands-on learning experiences that require them to be involved in groups.

During the lesson, the teacher should walk among the groups and listen, prompt discovery through questioning, and respond to the students' work. The teacher should act as a guide and support person to help students see themselves as capable and successful. This is an ideal opportunity to assess students' ability to meet the outcomes through the activity being done. Assessment can be in the form of notes, check-off lists, sticky notes, or thoughts to be written down at a later time. Recording assessments during an activity is sometimes a challenge, as the teacher is managing the class, as well as answering individual or group questions. Recording can be done during follow-up time or at a time more manageable for the teacher.

The follow-up to a lesson is crucial as it allows students the opportunity to communicate the ideas, discoveries, and questions that arise from engaging in a hands-on learning experience. This occurs when the results of the activity are pulled together and groups or individuals discuss with the whole class their findings from the activity. Additional vocabulary is often developed and should be recorded for future reference. Without follow-up to a lesson, an opportunity for students to achieve knowledge, skills, and attitude outcomes can be missed. It is important to use this as a time for students to ask questions that might lead to exploration and investigation throughout the unit. Oftentimes the follow-up discussions will lead to further investigations to be done at another time.

Follow-up time can also be an ideal time to *link* other subject areas with science. This could include, for example, reflection on prior activities in math such as in measurement or data management, a shared or read-aloud experience related to the activity during language arts time, or an art activity. The science activity should not be an activity done for the sake of doing an activity. Discussion and links to other areas are key to students' continuing to view learning as an integrated whole.

Writing in Science

Learning experiences should provide opportunities for students to use writing and other forms of representation as ways of 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 an intrinsic part of learning in science, helping students to better record, organize, and understand information from a variety of sources. The process of creating word webs, maps, charts, tables, graphs, drawings, and diagrams to represent data and results helps 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. Through opportunities to talk and write about the concepts they need to learn, 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 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, needs of the diverse range of learners in their classes. 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 students' 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 provides access for a wide range of learners. Similarly, the suggestions for a variety of assessment practices provide multiple ways for learners to demonstrate their achievements.

Assessment and Evaluation

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

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

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

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

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

Instructional Time

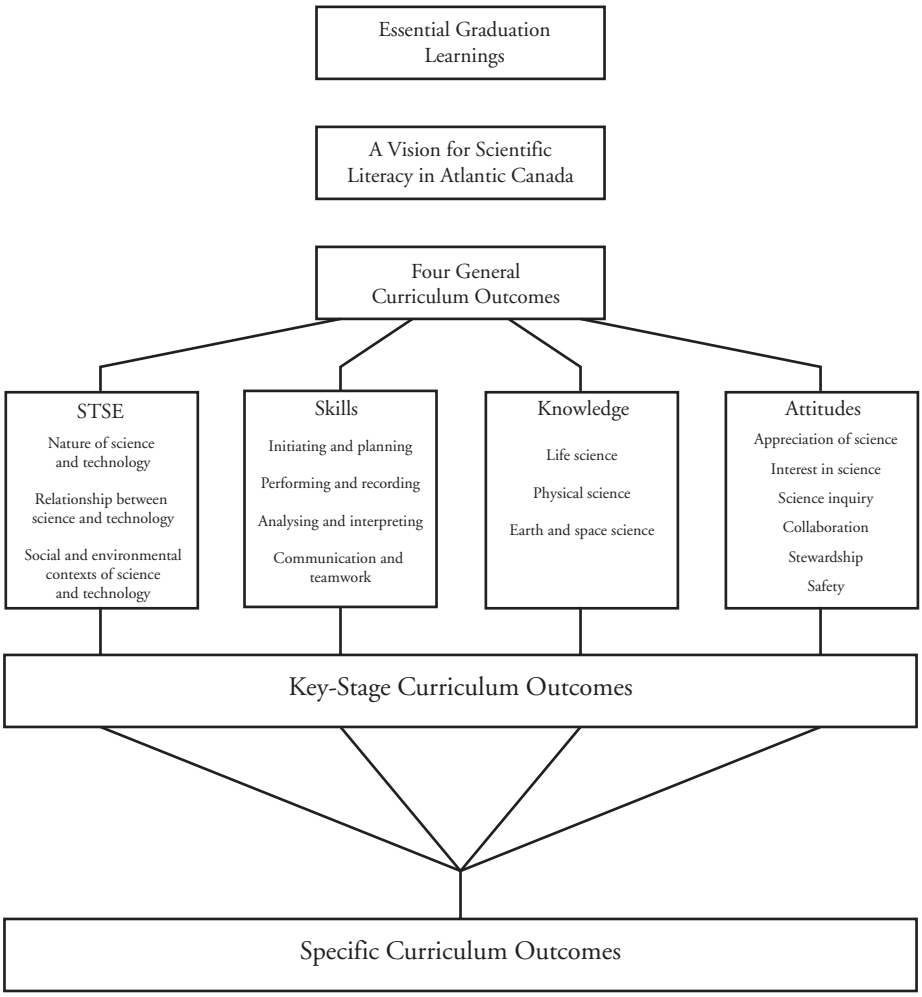
It is expected that a minimum of 110 minutes per week will be the allotment of instructional time for Science 4 curriculum. In addition, there are many opportunities to address science curriculum outcomes in the context of other subject areas in the elementary program, such as health education, language arts, mathematics, music, social studies, and visual arts.

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 C*ommon Framework of Science Learning Outcomes K to 12*. The diagram below provides the blueprint of the outcomes framework.

Outcomes Framework



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 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 described below.

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 continue to learn and to pursue an active, healthy lifestyle.

Problem Solving

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.

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 (STSE)

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

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 will 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 of Science Learning Outcomes K to12*.

Specific Curriculum Outcomes

This curriculum guide outlines specific curriculum outcomes for grade 4 science and provides suggestions for learning, teaching, assessment, and resources to support students' achievement of these outcomes. Teachers should consult *Foundation for the Atlantic Canada Science Curriculum* for descriptions of the essential graduation learnings, vision for scientific literacy, general curriculum outcomes, and key-stage 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 four units. Each unit is organized by topic. Science 4 units and topics follow.

Life Science: Habitats

- Habitats and Populations
- Collecting Scientific Information Using Models of Natural Habitats
- Behavioural and Structural Features of Animals That Enable Them to Survive in Their Habitat
- Structural Features of Plants That Enable Them to Survive in Their Habitat
- Food Chains

Physical Science: Light

- Optical Devices
- Sources of Light
- Light Radiates from a Source
- Objects That Absorb, Transmit, and/or Reflect Light
- Bending Light
- Dispersion of Light

Physical Science: Sound

- Objects That Make Sounds
- Sound Vibrations
- Pitch, Loudness, and Sound Technology
- The Ear, Hearing Loss, and Noise Pollution

Earth and Space Science: Rocks, Minerals, and Erosion

- Collecting and Comparing Rocks and Minerals
- Properties of Rocks and Minerals
- Uses for Rocks and Minerals
- Erosion and Weathering
- Soil Formation and Composition
- Record in Rocks
- Sudden and Significant Changes in the Land

The following pages outline specific curriculum outcomes for Science 4 grouped by units and topics.

Life Science: Habitats

Students will be expected to

Habitats and Populations

- identify questions to investigate the types of plants and/or animals at a local habitat using the terms **habitat**, **population**, and **community** (104-6, 204-1)
- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)
- identify their own and their families' impact on habitats and describe how personal actions help conserve habitats (108-3, 108-6)

Collecting Scientific Information Using Models of Natural Habitats

- construct and/or maintain a model of a natural habitat and, through observations, suggest improvements to make it more habitable for organisms (205-5, 205-10, 206-6)

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

- compare the external features, behavioural patterns, structural, and/or behavioural adaptations for an animal to survive a particular habitat, real or imagined (204-3, 300-1, 300-2, 302-2)

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

- describe how scientists' knowledge of plant growth has led to agricultural and technological innovations and the impact on local and regional habitat issues (105-1, 106-4, 108-1)

Food Chains

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

Physical Science: Light

Students will be expected to

Optical Devices

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

Sources of Light

- plan an investigation and communicate questions and ideas with others about light emitted from an object, its own or an external source (204-7, 207-1, 303-3)

Light Radiates from a Source

- observe, demonstrate, and make conclusions about how light travels and is dispersed from a variety of light sources (206-5, 303-2)

Objects That Absorb, Transmit, and/or Reflect Light

- investigate and predict how light interacts with a variety of objects (including changes in the location, shape, and relative size of a shadow) in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light (303-4, 303-5)
- classify objects as opaque, transparent, or translucent (206-1)
- make observations and collect information about the reflective and refractive properties of various materials of different shapes (205-5)

Bending Light

- demonstrate and describe how a variety of media can be used to change the direction of light (303-6)

Dispersion of Light

- demonstrate that white light can be separated into colours (dispersion) and follow a set of procedures to make and use a colour wheel (104-6, 205-3, 303-7)

Physical Science: Sound

Students will be expected to

Objects That Make Sounds

- identify objects by the sounds they make and describe examples of devices that enhance our abilities to hear and collect sound data (106-1, 107-1, 303-9)

Sound Vibrations

- relate vibrations to sound production and compare how vibrations travel differently through a variety of materials (303-10, 303-11)

Pitch, Loudness, and Sound Technology

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

The Ear, Hearing Loss, and Noise Pollution

- describe and illustrate how the human ear is designed to detect vibrations and compare the range of sound heard by humans to that heard by some animals (300-3, 300-4)
- use decibel in descriptions of sound intensity while investigating the extent of noise pollution and how to reduce it around them and identify devices that produce loud sounds (104-6, 108-1)
- identify examples of current sound research and technology, including Canadian contributions (105-1, 107-12, 205-8)

Earth and Space Science: Rocks, Minerals, and Erosion

Students will be expected to

Collecting and Comparing Rocks and Minerals

- demonstrate respect for the local environment (108-3)
- investigate rocks and minerals and record questions and observations (204-1, 205-7)

Properties of Rocks and Minerals

- explore physical properties of local rocks and minerals, using appropriate tools to collect and compare with those from other places (204-8, 205-5, 300-5, 300-6)
- classify rocks and minerals by creating a chart or diagram that illustrates the classification scheme and compare results with others (104-4, 206-1, 207-2)

Uses for Rocks and Minerals

- relate characteristics of rocks and minerals to their uses (300-8)

Erosion and Weathering

- describe ways in which soil is formed from rocks and demonstrate and describe the effects of wind, water, and ice on the landscape (301-4, 301-5)

Soil Formation and Composition

- demonstrate and record a variety of methods of weathering and erosion, including human impact on the landscape (301-6, 108-6)

Record in Rocks

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

Sudden and Significant Changes in the Land

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

Attitudes 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 section 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 readiness for responsible application of what students learn.

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

The following pages present the attitude outcomes from the pan-Canadian *Common Framework of Science Learning Outcomes K to 12* for the end of grade 6.

Key-Stage Curriculum Outcomes: Attitudes

From grade 4 through grade 6, students will be expected to

Appreciation of Science	Interest in Science	Scientific Inquiry
409 appreciate the role and contribution of science and technology in their understanding of the world **410** realize that the applications of science and technology can have both intended and unintended effects **411** recognize that women and men of any cultural background can contribute equally to science *Evident when students, for example,* • 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	**412** show interest and curiosity about objects and events within different environments **413** willingly observe, question, explore, and investigate **414** show interest in the activities of individuals working in scientific and technological fields *Evident when students, for example,* • 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 • ask to use additional science equipment to observe objects in more detail • express the desire to find answers by exploring and conducting simple experiments	**415** consider their own observations and ideas as well as those of others during investigations and before drawing conclusions **416** appreciate the importance of accuracy and honesty **417** demonstrate perseverance and a desire to understand *Evident when students, for example,* • 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 • listen to, recognize, and consider differing opinions • open-mindedly consider non-traditional 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 • complete tasks undertaken or all steps of an investigation • express the desire to find answers by conducting simple experiments

Key-Stage Curriculum Outcomes: Attitudes

From grade 4 through grade 6, students will be expected to

Collaboration	Stewardship	Safety
418 work collaboratively while exploring and investigating *Evident when students, for example,* • complete group activities or projects • willingly participate in co-operative 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	**419** be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment *Evident when students, for example,* • choose to have a positive effect on other people and the world around them • frequently and thoughtfully review the effects 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 • willingly suggest how we can protect the environment	**420** show concern for their safety and that of others in planning and carrying out activities and in choosing and using materials **421** become aware of potential dangers *Evident when students, for example*, • 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

Curriculum Guide Organization

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

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

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

Unit Organization

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

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

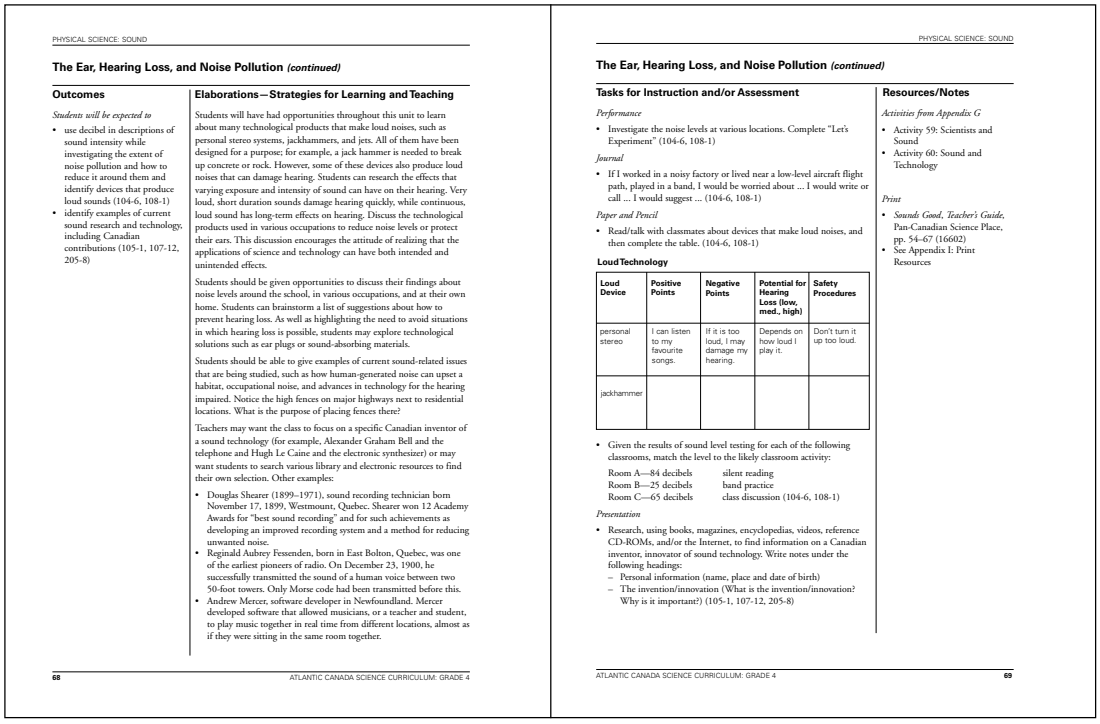
- 100s—Science-Technology-Society-Environment (STSE) outcomes
- 200s—Skills outcomes
- 300s—Knowledge outcomes
- 400s—Attitude outcomes (see pages 17–19)

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

The Four-Column Spread

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

Two-Page, Four-Column Spread



PHYSICAL SCIENCE: SOUND

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

Outcomes

Students will be expected to

- use decibel in descriptions of sound intensity while investigating the extent of noise pollution and how to reduce it around them and identify devices that produce loud sounds (104-6, 108-1)
- identify examples of current sound research and technology, including Canadian contributions (105-1, 107-12, 205-8)

Elaborations—Strategies for Learning and Teaching

Students will have had opportunities throughout this unit to learn about many technological products that make loud noises, such as personal stereo systems, jackhammers, and jets. All of them 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 varying exposure and intensity of 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 encourages the attitude of realizing 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 at their own home. Students can brainstorm a list of 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, such as 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. What is the purpose of placing fences there?

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

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PHYSICAL SCIENCE: SOUND

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

Tasks for Instruction and/or Assessment

Performance

- Investigate the noise levels at various locations. Complete "Let's Experiment" (104-6, 108-1)

Journal

- If I worked in a noisy factory or lived near a low-level aircraft flight path, played in a band, I would be worried about ... I would write or call ... I would suggest ... (104-6, 108-1)

Paper and Pencil

- Read/talk with classmates about devices that make loud noises, and then complete the table. (104-6, 108-1)

Loud Technology

Loud Device	Positive Points	Negative Points	Potential for Hearing Loss (low, med., high)	Safety Procedures
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				

- 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 (104-6, 108-1)

Presentation

- Research, using books, magazines, encyclopedias, videos, reference CD-ROMs, and/or the Internet, to find information on a Canadian inventor, innovator of sound technology. Write notes under the following headings:
  - Personal information (name, place and date of birth)
  - The invention/innovation (What is the invention/innovation? Why is it important?) (105-1, 107-12, 205-8)

Resources/Notes

Activities from Appendix G

- Activity 59: Scientists and Sound
- Activity 60: Sound and Technology

Print

- *Sounds Good, Teacher's Guide*, Pan-Canadian Science Place, pp. 54–67 (16602)
- See Appendix I: Print Resources

ATLANTIC CANADA SCIENCE CURRICULUM: GRADE 4 69

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 parentheses 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 sequences to meet the learning needs of their students.

In grade 4, the STSE and knowledge outcomes are combined.

Column one and column two define what students are expected to learn and be able to do.

Column Two: Elaborations—Strategies for Learning and Teaching

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

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

Column Three: Tasks for Instruction and/or Assessment

The third column provides suggestions for ways in which 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 parentheses after the item.

Column Four: Resources/Notes

This column includes activities to support student achievement in meeting specific curriculum outcomes. These activities are found in Appendices E–H of this guide; National Geographic Windows on Literacy activities and text; *Science Everywhere* teacher's guide; print resources available through the Nova Scotia School Book Bureau (order numbers are listed beside titles); videos available through Education Media Library, Learning Resources and Technology (call numbers listed beside title); as well as links to other curriculum areas, where applicable. This column also provides an opportunity for teachers to make notes about other useful resources.

Specific Curriculum Outcomes

Life Science: Habitats

Introduction

By grade 4, students should be familiar with the basic needs of living things and able to 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 to 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 focusses 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 that drives this unit.

Science Curriculum Links

The needs and characteristics of living things were investigated in grade 1. This led 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 more formal classification systems in the grade 6 unit Diversity of Life.

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

Curriculum Outcomes

The following outcomes have been developed from *Common Framework of Science Learning Outcomes K to12*, pan-Canadian outcomes. See Appendix J for the original outcomes that these were derived from.

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
108-3, 108-6 identify their own and their families' impact on habitats and describe how personal actions help conserve habitats	**104-6, 204-1** identify questions to investigate the types of plants and/or animals at a local habitat using the terms **habitat**, **population**, and **community**	**204-6, 302-1** examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals
105-1, 106-4, 108-1 describe how scientists' knowledge of plant growth has led to agricultural and technological innovations and the impact on local and regional habitat issues	**205-5, 205-10, 206-6** construct and/or maintain a model of a natural habitat and, through observations, suggest improvements to make it more habitable for organisms	**204-3, 300-1, 300-2, 302-2** compare the external features, behavioural patterns, and structural and/or behavioural adaptations for an animal to survive a particular habitat, real or imagined
		206-1, 302-3 classify organisms and draw diagrams to illustrate their role in a food chain
		301-1, 301-2 predict how the removal of a plant or animal population affects the rest of the community and relate habitat loss to the endangerment or extinction of plants and animals

Habitats and Populations

Outcomes

Students will be expected to

- identify questions to investigate the types of plants and/or animals at a local habitat using the terms **habitat**, **population**, and **community** (104-6, 204-1)

Elaborations—Strategies for Learning and Teaching

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.

The following are examples of questions that might be developed:

- 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 affected 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 ...
  - My understanding of habitat, population, and community is ... (104-6, 204-1)
- 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, ... (104-6, 204-1)

Interview

- What different populations of organisms do you think you will find in a seashore habitat? a field habitat? (104-6, 204-1)

Paper and Pencil

- Compare two communities. What types of populations are found in each? (104-6, 204-1)
- Draw and describe features of plants that help them thrive in their habitat (for example, cactus, picture plant, dandelion). (104-6, 204-1)

Resources/Notes

Activities from Appendix E

- Activity 1: Where I Live
- Activity 2: What Do I Need to Survive?
- Activity 3: Understanding the Terms "Habitat, Community, and Population"

Print

- *Healthy Habitats*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 15–39 (16600)
- *Ahmed and the Nest of Sand: A Piping Plover's Story* (13067)
- *Exploring Tide Pools* (Windows on Literacy) (13646)

Videos

- *Animal Homes* (10 min.) (23276)
- *Habitats* (18 min.) (23318)
- *Habitats: Homes for Living Things* (15 min.) (23324)
- *How to Study Ecology* (14 min.) (V2385)

Habitats and Populations *(continued)*

Outcomes

Students will be expected to

- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)
- identify their own and their families' impact on habitats and describe how personal actions help conserve habitats (108-3, 108-6)

Elaborations—Strategies for Learning and Teaching

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 results of data, and equipment needed to carry out the study. Students can be grouped. A standard area size should be decided upon, such as one square metre or the area bordered by a hula hoop.

Once their plan has been completed, students should go on their field trip to the habitat to be examined. 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—groups would simply be expected to compare their results.

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 encouraged. Teachers can pose environmental questions or situations for students, such as, "Should we pick all of these 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.

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

Students should develop a way to communicate their findings. Students can display their work in graphs, drawings, and descriptions of the types and numbers of plants and animals studied in their sample; tape and video recordings of the sounds and sights of the habitat; and multimedia and/or web page presentations.

Students could create a database of the organisms or use a spreadsheet to enter their data and display their graphs.

Students should compare their results with those of 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 or the degree to which the sample was shaded, that would affect the number and type of organisms found.

Habitats and Populations *(continued)*

Tasks for Instruction and/or Assessment

Performance

- Produce a table with your observations (printed or drawn) from your habitat study. (204-6, 302-1)
- Compare your table with other groups.

Habitat Study

Living Things	Description or Drawing	Number in Hula Hoop	Habitat Preference
dandelions	bright yellow flowers, green leaves, deep roots	5	grow practically everywhere
beetles	dark, about 1/2 cm, hard body	7	like the dark

- Students or groups of students could do an independent study on a local habitat. Components of the study would be as follows:
  - Make careful observations. (204-6, 302-1)
  - Make 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 your impact on that habitat while studying it. (204-6, 302-1)
  - Record types of organisms found and details about the habitat in which it was found. (204-6, 302-1)
  - Express results in table and bar-graph format. (204-6, 302-1)
  - Work co-operatively with other students in identifying and counting organisms. (204-6, 302-1)

Journal

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

Interview

- What impact do you and other organisms have on the habitat you investigated? What actions would you tell others to take to conserve this habitat? (108-3, 108-6)

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 and preserved? (108-3, 108-6)

Resources/Notes

Activities from Appendix E

- Activity 4: What I Want to Find Out about My Habitat
- Activity 5: Observing Our Habitat
- Activity 6: Analysing the Data from Our Habitat
- Activity 7: Displaying Plants
- Activity 8: Our Habitat
- Activity 9: A Closer Look

Print

- *Healthy Habitats*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 15–20, 33–39, 56–68 (16600)
- *Sci-Tech Connections 4*, Unit 4C, pp. 52–57 (17025)
- *On the Wild Side* (13839)
- *Wild Planet* (13845)

Videos

- *Life in the City Habitat* (15 min.) (22433)
- *Habitat and Dependence* (20 min.) (20956)

Curriculum Links

- See Social Studies SCO 4.3.3
- See Mathematics SCO F1, F3, F5, F8

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, through observations, suggest improvements to make it more habitable for organisms (205-5, 205-10, 206-6)

Elaborations—Strategies for Learning and Teaching

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

A rotting log makes a good habitat study. Students can dig through it and see how many organisms or signs of organisms they can find and how the organisms survive in this habitat. Students should show respect for organisms that they find. At the end of this study, the log and its inhabitants should be returned to a natural setting.

Students can continue their observations and data collection by constructing or maintaining a habitat in their classroom 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 changes in algae growth and visible organisms with a magnifying glass. In their journals they could note their observations of their 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 should try to make their habitat like the natural one as much 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

Informal/Formal Observation

- Observe the student's ability to ask questions about how the organisms are suited for their habitat. (205-5, 205-10, 206-6)
- Observe the student's ability to infer from his or her observations the needs of organisms, and how these needs are met in their habitat. (205-5, 205-10, 206-6)

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, 206-6)
- What other organisms might live in your model habitat? (205-5, 205-10, 206-6)

Interview

- What can be done to make this model habitat more like the organism's natural habitat? (205-5, 205-10, 206-6)

Paper and Pencil

- As you observe the organisms, fill in the chart. (205-5, 205-10, 206-6)

Observing Organisms in My Classroom Habitat

Organism	Appearance	Needs	Actions
spider	8 legs (students may draw the organism)	food: flies	spins a web to trap flies
pitcher plant	yellow flower	eats insects	flowering stage

Resources/Notes

Activities from Appendix E

- Activity 10: Making a Habitat
- Activity 11: The Rotting Log
- Activity 12: Creating a Model of an Artificial Habitat

Print

- *Healthy Habitats*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 21–26, 40–44, 50–55, 76–88 (16600)
- See Appendix I: Print Resources

Videos

- *Animals around You* Series (15 min.) (23202, 23256, 23179)
- *Eco Explorers* (22 min. each) (23330, 23331)
- *Puzzle of the Rotting Log* (15 min.) (22432)

Curriculum Links

- See Visual Arts: SCOs 1.11, 1.21, 4.1.1, 4.2.1, 4.3.1, 6.1.1

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

Outcomes

Students will be expected to

- compare the external features, behavioural patterns, and structural and/or behavioural adaptations for an animal to survive a particular habitat, real or imagined (204-3, 300-1, 300-2, 302-2)

Elaborations—Strategies for Learning and Teaching

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

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

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; place it where it is well camouflaged; and time how long it takes other students to find it. They can also carry out more controlled investigations to determine how effective camouflage can be.

Students could use their knowledge of structural and/or behavioural adaptations to invent features to help an animal adapt to a habitat. Students should be encouraged to be creative in this activity. 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

Informal/Formal Observation

- Observe the student's ability to suggest a suitable adaptation for an animal in order for it to survive in a certain habitat. (204-3, 300-1, 300-2, 302-2)

Performance

- Design a diorama and illustrate how an animal is camouflaged in one part of the scenery, but not in another. (204-3, 300-1, 300-2, 302-2)

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 it 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 its habitat. (204-3, 300-1, 300-2, 302-2)

Presentation

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

Resources/Notes

Activities from Appendix E

- Activity 13: Animals and Their Habitats
- Activity 14: Camouflage
- Activity 15: Parts of a Plant

Print

- *Healthy Habitats*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 27–39 (16600)
- *Animal Hiding Places* (Windows on Literacy) (13646)
- *Beneath the Waves* (13829)
- *Grassland Safari* (13827)
- *Shifting Sands* (13841)
- *Waterbirds* (13692)

Videos

- *Animals That Build* (14 min.) (22239)
- *Backyard Safari Series: Home Sweet Home* (30 min.) (23321)
- *Great Cover-up* (15 min.) (22237)
- *Seeing Things* Series (15 min.) (21054, 21051)

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

Outcomes

Students will be expected to

- describe how scientists' knowledge of plant growth has led to agricultural and technological innovations and the impact on local and regional habitat issues (105-1, 106-4, 108-1)

Elaborations—Strategies for Learning and Teaching

Students should investigate the structural adaptations of various plants and how these adaptations enable them to thrive in their habitat.

Students have explored the parts of plants (root, stem, flower, seed) and their life cycles in grade 3—a review may be necessary. The focus in this section is on plant adaptations that help them survive in their habitat. Plants in different types of habitats (e.g., bog, forest, ocean, schoolyard, 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 first hand, with videos or software, to show how they can survive in various habitats. Good examples are 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 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 that have been developed based on this knowledge.

Students could investigate local or regional habitat issues (e.g., pesticides, herbicide spraying, 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. In smaller groups, grow the plant using the conditions that have been assigned to you (such as solid fertilizer), and measure and record the growth in the chart. (105-1, 106-4, 108-1)

Helping Plants Grow

Treatment	**Number of Days for First Sprout to Appear**	**Growth in cm**			
		Day 7	Day 14	Day 21	
with compost	20	0	0	0.5	
liquid fertilizer					
solid fertilizer					
hydroponics					

Journal

- Talk with an adult in your community to find out how the local area has changed in his/her lifetime. Are there noticeable differences in the amount of wildlife and vegetation? What does he or she think has caused these changes? In your journal, write about your 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 sure that your local habitats are preserved. (105-1, 106-4, 108-1)

Resources/Notes

Activities from Appendix E

- Activity 16: Supporting the Growth of Agriculture
- Activity 17: Technology and Habitats

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

(continued)

Outcomes

Students will be expected to

- describe how scientists' knowledge of plant growth has led to agricultural and technological innovations and the impact on local and regional habitat issues (105-1, 106-4, 108-1)

Elaborations—Strategies for Learning and Teaching

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

Some examples could be

- forest-harvesting issues
- offshore oil development
- housing development in a forest or farming area
- overfishing

Students can engage in discussions about the ways that their use of technological products affect habitat and may result in the endangerment or extinction of plants and animals. Examples might include the following:

- how using an all-terrain vehicle on a marsh can have an extremely detrimental effect 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 natural habitat

Care should be taken not to blame the technology for negative effects on habitats. Humans choose to use these products and have a choice over 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 "Last of the Great Whales" by The Irish Descendants tie in many of the concepts brought in 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 taking part in any presentation or program they have on preserving the local habitat. Some organizations have funds for community or school groups that want to start their own projects.

Structural Features of Plants That Enable Them to Survive in Their Habitat
(continued)

Tasks for Instruction and/or Assessment

Interview

- What are some of the positive effects of the building of a new highway (building development, parking lot)? What are some of the negative effects? (105-1, 106-4, 108-1)
- What would be the impact if all the fish in your area were caught? (105-1, 106-4, 108-1)

Paper and Pencil

- Describe two ways that people have tried to restore natural habitats and help endangered species. (105-1, 106-4, 108-1)

Presentation

- Complete a presentation using either artwork, collage, skit, video, or multimedia on a relevant local or regional habitat issue. (105-1, 106-4, 108-1)
- Write a verse, lyric, poem, or script on the positive and/or negative effect of technological developments on the natural habitat. (105-1, 106-4, 108-1)
- Find a song(s) that relates to the effects of technology on the natural habitat and act out the song. (105-1, 106-4, 108-1)

Portfolio

- Select a piece of work you did from this unit. (105-1, 106-4, 108-1)

Resources/Notes

Print

- *Healthy Habitats*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 27–39, 56–58, 69–75 (16600)
- See Appendix I: Print Resources

Food Chains

Outcomes

Students will be expected to

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

Elaborations—Strategies for Learning and Teaching

When introducing the food chain, ensure 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 the basic needs for life. Students should focus their investigation on organisms as producers, consumers, and decomposers. Students could 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 put them in a food chain or draw a diagram illustrating a food chain of organisms in their habitat.

Students should predict the consequences when one type of organism in a food chain is removed completely by predators, loss of camouflage, shortage of 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, or 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 as they see how the populations rise and fall with the conditions that they have 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. (206-1, 302-3)
- Draw or collect pictures of living organisms and put them in a food chain. (206-1, 302-3)
- Using a computer simulation, make all of one type of organism 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, 301-2)

Journal

- It is important to try to preserve natural habitats because ... (301-1, 301-2)

Interview

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

Presentation

- Research an animal/plant that is endangered. What factors contribute to this animal/plant's endangerment? What must be done to help save this organism? Present your findings. (301-1, 301-2)

Resources/Notes

Activities from Appendix E

- Activity 18: Food Chains
- Activity 19: Food Webs
- Activity 20: Loss of a Habitat

Print

- *Healthy Habitats*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 40–49, 56–68 (16600)
- *Sci-Tech Connections 4*, Unit 4C, pp. 49–51 (17025)
- *Endangered or Extinct!* (The News Library Pack) (13567)
- *Endangered Species* (National Geographic Reading Expeditions) (13501)
- *What Do I Eat?* (big book) (13342)
- *Who Eats What?* (The News II Library Pack) (13568)

Videos

- *Biodiversity: Garbage* (50 min.) (23115)
- *I Need the Earth and the Earth Needs Me* (20 min.) (20319)
- *Plight of the Piping Plover* (20 min.) (V2502)

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 they 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 they 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 light, but should also examine the optical devices that have been designed to make use of these properties. These same optical devices have allowed scientists to enhance their senses and learn more about the universe.

Science Curriculum Links

In grade 1, students were 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.

Curriculum Outcomes

The following outcomes have been developed from *Common Framework of Science Learning Outcomes K to12*, pan-Canadian outcomes. See Appendix J for the original outcomes that these were derived from.

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
106-1, 106-4 describe properties of light that have led to the development of optical devices that enhance our ability to observe **107-10** identify women and men in their community who have careers using optics	**204-7, 207-1, 303-3** plan an investigation and communicate questions and ideas with others about light emitted from an object, its own or an external source **206-1** classify objects as opaque, transparent, or translucent **205-5** make observations and collect information about the reflective and refractive properties of various materials of different shapes **104-6, 205-3, 303-7** demonstrate that white light can be separated into colours (dispersion) and follow a set of procedures to make and use a colour wheel	**107-1, 205-10, 303-8** compare and describe how light interacts with a variety of optical devices and construct an optical device that performs a specific function **206-5, 303-2** observe, demonstrate, and make conclusions about how light travels and is dispersed from a variety of light sources **303-4, 303-5** investigate and predict how light interacts with a variety of objects (including changes in the location, shape, and relative size of a shadow) in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light **303-6** demonstrate and describe how a variety of media can be used to change the direction of light

Optical Devices

Outcomes

Students will be expected to

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

Elaborations—Strategies for Learning and Teaching

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 and present and could develop 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 that objects appear, sometimes making them appear larger or smaller, closer or further, and/or upright or inverted. As students develop an awareness that these optical devices work using scientific principles, they should also see how science has progressed by using the devices 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 sizes of paper tubes, and supporting materials. Students should be encouraged to be 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

Informal/Formal Observation

- Assessment of optical device design activity: Assess the student's ability to
  - work with team members to plan the construction or follow procedures
  - solve problems, testing and re-testing the device
  - use and manipulate tools (107-1, 205-10, 303-8)

Performance

- From your observations, explore the various optical principles of different devices by using a chart. (107-1, 205-10, 303-8)

Optical Devices

Device	Image Size (larger, smaller)	Image Position (upside down, left/right)	Image Distance (closer, farther)
microscope			
binoculars			
reading glasses			

Paper and Pencil

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

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 the problem they solve. Examples include street lights, watches that light up, bright, shadowless lights, and lights that indicate when a computer is turned on. (106-1, 106-4)

Resources/Notes

Activities from Appendix F

- Activity 21: Looking at Prior Knowledge—Light
- Activity 22: Optical Devices
- Activity 23: Uses of Optical Devices
- Activity 24: Camera Obscura
- Activity 25: People and Light
- Activity 26: Human-made Sources of Light

Print

- *Light Up Your Life*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 31–41, 49–80, 96–107 (16601)
- *Light* (Windows on Literacy) (13646)
- *Light* (The News II Library Pack) (13568)

Sources of Light

Outcomes

Students will be expected to

- plan an investigation and communicate questions and ideas with others about light emitted from an object, its own or an external source (204-7, 207-1, 303-3)

Elaborations—Strategies for Learning and Teaching

Students could brainstorm a list of objects that emit their own light and those that require an external source of light to be seen (for example, lightsticks, arm bracelets, insects, and phytoplankton). This is an opportunity to distinguish between objects that emit light and objects that can be seen only 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 you 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 you an opportunity to address many common misconceptions that 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 those explanations that 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 investigations and report to the class.

Sources of Light

Tasks for Instruction and/or Assessment

Performance

- Investigate possible sources of light in the home and school. (204-7, 207-1, 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		X		X		X
mirror						
window						
television (off and on)						

Resources/Notes

Activities from Appendix F

- Activity 27: Light Sources

Print

- *Light Up Your Life*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 16–23, 81–107 (16601)
- *Sci-Tech Connections 4*, Unit 4B, pp. 39–44 (17025)
- See Appendix I: Print Resources

Light Radiates from a Source

Outcomes

Students will be expected to

- observe, demonstrate, and make conclusions about how light travels and is dispersed from a variety of light sources (206-5, 303-2)

Elaborations—Strategies for Learning and Teaching

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. You may want to begin this section by offering students a variety of light sources, and students should 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 be seen only if the light has something to reflect from. A slight clapping of chalk dusters will put some chalk dust in the air, and the light can then be seen more easily.

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 how light is distributed. For example, students can take the flashlight apart and use the batteries and some wire to light the bulb without 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. You can demonstrate a similar effect to the students 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 focussed or directed in each. Discussion may focus on the shape, material, and colour of the reflecting material that houses the light.

Students should investigate the concept of light travelling in a straight line. Following are some guidelines: In a dark room, with a small bulb or flashlight in a box with a few small holes in it, students can make some chalk dust by clapping together chalk dusters. Students should be able to clearly see the straight beams of light reflected from the dust particles. 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. If ray boxes are available, they are an excellent demonstration source.

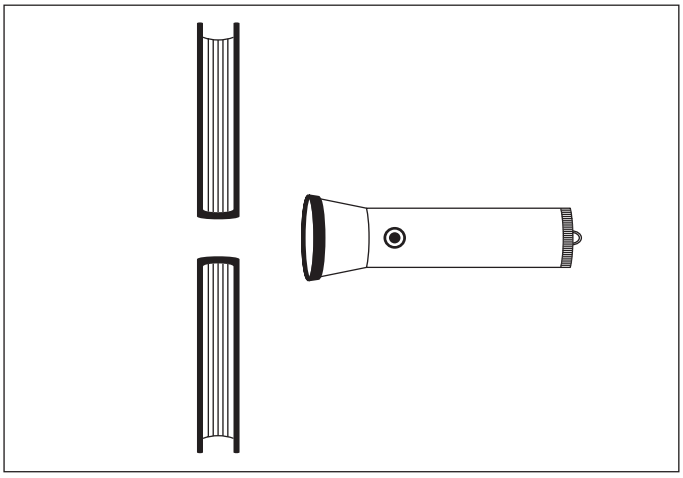
Students can explore an example of light travelling in a straight line by making pinhole cameras using a small covered box. By pointing the pinhole towards a light or window, they will be able to see the inverted image through the other side. They can draw pictures of their camera, the object, and the image in their journal. Light rays could be used on the pictures to illustrate the inverted image. **Enrichment**: 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. (206-5, 303-2)
  - 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, 303-2)

Paper and Pencil

- From your observations of light sources, make a sketch to illustrate how light comes from each object. (Include pictures of a candle, overhead projector, light bulb, or flashlight.) (206-5, 303-2)

Resources/Notes

Activities from Appendix F

- Activity 28: Dispersement of Light
- Activity 29: Changes in the Direction of Light
- Activity 30: How Light Travels

Print

- *Light Up Your Life*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 24–41 (16601)
- See Appendix I: Print Resources

Objects That Absorb, Transmit, and/or Reflect Light

Outcomes

Students will be expected to

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

Elaborations—Strategies for Learning and Teaching

Students should investigate how light interacts with a variety of materials that allow light to pass through and with 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.

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 (take the objects into a dark room with no windows). These objects can be seen only when the light that hits the object 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, students 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 source; the distance from the object to the screen; the way the object is held (its orientation); 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 experience allows them to understand why the shadow is the shape and size it is. Repeated observations enable students to be able to make predictions that 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. (303-4, 303-5)

Finding Out about Shadows

Change	Location		Shape		Size	
	predicted	actual	predicted	actual	predicted	actual
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						

- Shine light from an overhead projector on the objects listed, and complete the chart. (206-1, 303-4, 303-5)

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		

Resources/Notes

Activities from Appendix F

- Activity 31: Light Travels through or Not
- Activity 32: Opaque, Transparent, and Translucent
- Activity 33: Shadows and Light

Print

- *Light Up Your Life*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 24–30, 42–57, 81–95 (16601)
- *Sci-Tech Connections 4*, Unit 4B, pp. 45–51 (17025)
- See Appendix I: Print Resources

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

Outcomes

Students will be expected to

- make observations and collect information about the reflective and refractive properties of various materials of different shapes (205-5)

Elaborations—Strategies for Learning and Teaching

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

Students can work in groups to produce shadow skits and plays (connection to language arts).

Opaque objects reflect light; that is how they can be seen. Students may think that only smooth surfaces, like mirrors or metallic surfaces, reflect light. As a means of observing how the surface shape and texture affect how light is reflected, students can explore the difference between the reflective abilities of crumpled versus smooth aluminium foil. As the aluminium foil becomes more crumpled, the reflection becomes less defined. This can be extended to look at 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 that students have related to plane mirrors is that, given a small (e.g., 100 cm^2) mirror, they will be able to see their whole selves in it 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 be 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 image from the concave curve of a spoon and then turn it around to see their image using the convex curve. Differently 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 *(continued)*

Tasks for Instruction and/or Assessment

Performance

- Try to see your image in each of the materials listed. Note your observations.

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	

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)

Journal

- Shadows always project different images around me ... (303-4, 303-5)

Interview

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

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 (plane mirror, paper, tin foil, spoon). (303-4, 303-5)

Resources/Notes

Activities from Appendix F

- Activity 34: Reflective Surfaces
- Activity 35: Mirrors (Concave, Convex, Flat)
- Activity 36: Making a Periscope
- Activity 37: Making a Kaleidoscope

Print

- *Light Up Your Life*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 24–30, 42–65 (16601)
- *Sci-Tech Connections 4*, Unit 4B, pp. 52–63 (17025)
- See Appendix I: Print Resources

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)

Elaborations—Strategies for Learning and Teaching

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

- A stick or pencil appears bent or broken when half of it is sticking out of a glass of water.
- Put a coin in the water. Students, standing to the side of the bowl, can stretch out 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 bowl and back away until the coin is hidden by the rim of the bowl. While another student slowly pours water into the bowl, the coin will slowly reappear for the students 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 90º, 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.

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 lenses 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

Informal/Formal Observation

- While students are investigating light, the Process Skills Checklist 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.

  (303-6)

Performance

- Complete the table. (303-6)

Bending Light

Object	Description of Image
small water droplet	
large water droplet	
convex lens	
concave lens	

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)

Resources/Notes

Activities from Appendix F

- Activity 38: Bending Light
- Activity 39: Water Drops
- Activity 40: Concave and Convex Lenses
- Activity 41: Converging and Diverging Light Rays

Print

- *Light Up Your Life*, Teacher's Guide, Pan-Canadian Science Place, pp. 31–65 (16601)
- See Appendix I: Print Resources

Videos

- *Fourways Farm Series: On Reflection* (10 min.) (21659)
- *Learning about Light* (9 min.) (22253)
- *Science in Action Series: Lenses and Mirrors* (16 min.) (V2355)

Curriculum Links

- See Math: SCO D5

Dispersion of Light

Outcomes

Students will be expected to

- demonstrate that white light can be separated into colours (dispersion) and follow a set of procedures to make and use a colour wheel (104-6, 205-3, 303-7)

Elaborations—Strategies for Learning and Teaching

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, but these lenses are shaped and laminated in such a way as to minimize dispersion effects.

Students can make colour wheels (circular Bristol board divided into pie-shaped sections with various colours) and spin them to show how all the colours blend into white. Attaching the wheels to a small, hand-held fan would enhance this effect. The same effect will 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. Example: A red object is red because when white light hits it only red light is reflected.

These learning experiences foster 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

Informal/Formal Observation

- Assess the students on their ability to follow the correct procedure for making the colour wheel. (104-6, 205-3, 303-7)

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? (104-6, 205-3, 303-7)

Portfolio

- Select a piece of work from this unit for your portfolio. Fill out the portfolio self-assessment. (104-6, 205-3, 303-7)

Resources/Notes

Activities from Appendix F

- Activity 42: Prisms
- Activity 43: Colour Wheels

Print

- *Light Up Your Life*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 66–80 (16601)
- *Sci-Tech Connections 4*, Unit 4B, pp. 64–70 (17025)
- *Switch It On!* (13838)

Videos

- *Scientific Eye Series: Colour* (20 min.) (22399)
- *Bill Nye: The Science Guy, Physical Science 1* (36 min.) (21650)

Curriculum Links

- See Visual Arts: SCO 1.3.1

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 using 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.

Curriculum Outcomes

The following outcomes have been developed from *Common Framework of Science Learning Outcomes K to12*, pan-Canadian outcomes. See Appendix J for the original outcomes that these were derived from.

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
104-6, 108-1 use **decibel** in descriptions of sound intensity while investigating the extent of noise pollution and how to reduce it around them and identify devices that produce loud sounds **106-1, 107-1, 303-9** identify objects by the sounds they make and describe examples of devices that enhance our abilities to hear and collect sound data	**105-1, 107-12, 205-8** identify examples of current sound research and technology, including Canadian contributions **104-1, 205-2, 206-7, 301-3** demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness	**303-10, 303-11** relate vibrations to sound production and compare how vibrations travel differently through a variety of materials **300-3, 300-4** describe and illustrate how the human ear is designed to detect vibrations and compare the range of sound heard by humans to that heard by some animals

Objects That Make Sounds

Outcomes

Students will be expected to

- identify objects by the sounds they make and describe examples of devices that enhance our abilities to hear and collect sound data (106-1, 107-1, 303-9)

Elaborations—Strategies for Learning and Teaching

Students should explore the many objects they can identify by the sound they make. Challenge students or have them challenge each other to identify the source of the sounds made while 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 voices 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, and reverse it.

Students can also focus on the large amount of background noise that they may tune out most of the time. Individually, 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 a purpose: to communicate 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 are important. Students can listen to some recorded common 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.

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 back 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 names and functions.

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 experience should illustrate how powerful sounds can be in conveying a message.

Objects That Make Sounds

Tasks for Instruction and/or Assessment

Performance

- Listen to the recording of various sounds. Identify as many of them as possible. Make recordings of sounds such as a pencil sharpener, boiling whistling kettle, clock ticking, fluorescent lights, the beep of a microwave when it is finished. (106-1, 107-1, 303-9)

Journal

- Make a list of all of the things in your daily life that make sounds. Describe what the sounds are used for. (106-1, 107-1, 303-9)

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. (106-1, 107-1, 303-9)

Presentation

- Create a poster that 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 on letter-size media (8.5" × 11") are ideal for portfolios after display time. Good sources of pictures are catalogues, magazines, computer graphics, or hand drawings. (106-1, 107-1, 303-9)
- Create a poster that show devices that measure and use sound waves. Under each picture, describe briefly what the device is used for. (106-1, 107-1, 303-9)

Resources/Notes

Activities from Appendix G

- Activity 44: Activating Prior Knowledge—Sound
- Activity 45: Name That Sound
- Activity 46: Sounds and Our Everyday Needs
- Activity 47: Technology and Sound

Print

- *Sounds Good*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 16–26, 36–40, 60–67 (16602)
- See Appendix I: Print Resources

Videos

- *Fourways Farm Series 1: The Sound of Music* (10 min.) (21660)
- *What Is ...?* Series (4 min. each) (23341–23345)

Curriculum Links

- See Visual Arts: SCO 6.2.1

Sound Vibrations

Outcomes

Students will be expected to

- relate vibrations to sound production and compare how vibrations travel differently through a variety of materials (303-10, 303-11)

Elaborations—Strategies for Learning and Teaching

Attitudes related to willingly observing, questioning, exploring and investigating, and working collaboratively while exploring and investigating can be encouraged during these investigations. 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 when they 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 each just hits 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 medium. 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 dominoes, 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: metre stick, 1 m 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	Observations
air	Listen to a sound that a student makes. Listen to the same sound that a student whispers. Does the sound travel through air in both situations?	
wood	Stand 1 m apart from partner. Hold metre stick so that the end is next to partner's 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? What did you notice about how sound vibrations travel through the various media? (303-10, 303-11)

Paper and Pencil

- List three examples of vibrations that produce sound. Identify the material(s) that vibrated to produce the sound. (303-10, 303-11)

Resources/Notes

Activities from Appendix G

- Activity 48: Sound Vibrations
- Activity 49: Pitch and Loudness
- Activity 50: Vibrations in Liquids
- Activity 51: Good Vibrations!

Print

- *Sounds Good*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 16–35, 68–76 (16602)
- *Sci-Tech Connections 4*, Unit 4B, pp. 8–13, 28–38 (17025)
- See Appendix I: Print Resources

Video

- *Scientific Eye Series: Hearing and Sound* (20 min.) (20948)

Pitch, Loudness, and Sound Technology

Outcomes

Students will be expected to

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

Elaborations—Strategies for Learning and Teaching

In classroom discussion, review the role of vibrations in sound production. Did all vibrations sound the same? In what ways were they different? The concepts of pitch and loudness can be brought into the discussion. As a means of studying these concepts further, students can propose questions to investigate. Students should practise asking operational 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) through 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 don't work as well.)

The pitch can be altered by changing the length of a column of air:

- 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 that the glass does not have nicks or sharp edges.

Students can investigate questions related to sound loudness in a similar way to pitch. They should be introduced to the term **decibel** 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).

Pitch, Loudness, and Sound Technology

Tasks for Instruction and/or Assessment

Performance

- Conduct and write up an experiment to test your questions about the factors that affect pitch (or loudness) of sounds. (104-1, 205-2, 206-7, 301-3)

Journal

- Write two testable questions about how the pitch of a sound can be changed. (104-1, 205-2, 206-7, 301-3)

Presentation

- Give an oral report and a demonstration of the factors that affect pitch and loudness, based on the results of your experiment. (104-1, 205-2, 206-7, 301-3)

Resources/Notes

Activities from Appendix G

- Activity 52: Modifying the Pitch
- Activity 53: Sound Pitch and Water
- Activity 54: Decibels and Sound Intensity

Print

- *Sounds Good*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 45–59, 68–76 (16602)
- *Sci-Tech Connections 4*, Unit 4B, pp. 22–26 (17025)
- *Sound* (Windows on Literacy) (13646)

Video

- *Sound: A First Look* (17 min.) (23316)

Curriculum Links

- See Music: SCO 2.2.1
- See Visual Arts: 1.2.1, 1.3.1, 2.1.1, 3.1.1

Pitch, Loudness, and Sound Technology *(continued)*

Outcomes

Students will be expected to

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

Elaborations—Strategies for Learning and Teaching

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 a high school physics lab oscilloscope.

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 simple tunes on their instruments for the class and, perhaps, play together as an ensemble. Connections to the music program are appropriate here.

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 to collect data, making and recording observations, and compiling their results and drawing conclusions. Questions to investigate could be, 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, attitudes are encouraged related to considering their own observations and ideas, as well as those of others, before drawing conclusions.

Pitch, Loudness, and Sound Technology *(continued)*

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, 301-3)

  The following draft scoring rubric can be used to evaluate building and demonstrating a simple sound device:

One	Insufficient work completed; evaluation not possible
Two	Basic completed device; very little planning evident, poor device performance (very little variability of pitch and loudness)
Three	Device is complete; planning is evident. Some creativity is demonstrated. Device has average product performance (some variability in pitch and loudness)
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 in degree of loudness.

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 ... (104-1, 205-2, 206-7, 301-3)

Resources/Notes

Activities from Appendix G

- Activity 55: Musical Instruments
- Activity 56: My Musical Instrument

Print

- *Sounds Good*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 68–76 (16602)
- *Sci-Tech Connections 4*, Unit 4B, pp. 14–21, 27 (17025)
- See Appendix I: Print Resources

Video

- *Wonderstruck Series: Making Music* (30 min.) (22596)

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 and compare the range of sound heard by humans to that heard by some animals (300-3, 300-4)

Elaborations—Strategies for Learning and Teaching

Having investigated the properties of sound, students are now in a position to investigate how sound vibrations are collected by the ear. Students can do 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. They can then close their eyes, and press their outer ears towards you, and repeat. They can enhance outer ear size by positioning a piece of paper behind the ear, or using a plastic funnel held to the ear, and repeat the experiment.

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. Students may even make their own models of the ear as part of a project. Students should not be expected to name the parts of the ear for summative tests.

This can lead into an investigation about the ability of animals to hear differently from humans. Some good examples of animals to compare are dogs, bats, dolphins, elephants. Students may also compare the hearing abilities of people of various ages. This activity can also lead to questions exploring possible reasons some students have better hearing than others and how students need to protect their ears from loud noises in order to prevent hearing loss.

The Ear, Hearing Loss, and Noise Pollution

Tasks for Instruction and/or Assessment

Performance

- 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 can't hear it any more. Repeat, 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, 300-4)
- 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 (the sound level should increase). What did you notice about the sound level? Early hearing aids used funnels to improve hearing. (300-3, 300-4)

Paper and Pencil

- Dogs can hear sounds that we cannot. Using print and/or electronic sources, investigate which other animals can hear sounds that we cannot hear. Make a list or chart to show your findings. (300-3, 300-4)

Presentation

- Research each animal to discover if it hears sounds of higher pitch and/or lower pitch compared to the hearing of humans. Try to find out the uses for their enhanced hearing ability. Complete the chart to organize your findings. (300-3, 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			

Resources/Notes

Activities from Appendix G

- Activity 57: The Human Ear and Sound
- Activity 58: Noise Pollution

Print

- *Sounds Good*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 36–44, 54–63 (16602)
- See Appendix I: Print Resources

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

Outcomes

Students will be expected to

- use **decibel** in descriptions of sound intensity while investigating the extent of noise pollution and how to reduce it around them and identify devices that produce loud sounds (104-6, 108-1)
- identify examples of current sound research and technology, including Canadian contributions (105-1, 107-12, 205-8)

Elaborations—Strategies for Learning and Teaching

Students will have had opportunities throughout this unit to learn about many technological products that make loud noises, such as personal stereo systems, jackhammers, and jets. All of them 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 varying exposure and intensity of sound can have on their hearing. Very loud sounds of short duration damage hearing quickly, while continuous, loud sound has long-term effects on hearing. Discuss the technological products used by workers in various occupations to reduce noise levels or protect their ears. This discussion encourages the attitude of realizing 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 at their own homes. Students can brainstorm a list of 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, such as 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. What is the purpose of placing fences there?

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

- Douglas Shearer (1899–1971), sound recording technician, born November 17, 1899, Westmount, Quebec, 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, 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.

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

Tasks for Instruction and/or Assessment

Performance

- Investigate the noise levels at various locations. Complete "Let's Experiment" (104-6, 108-1)

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 ... (104-6, 108-1)

Paper and Pencil

- Read/talk with classmates about devices that make loud noises, and then complete the table. (104-6, 108-1)

Loud Technology

Loud Device	Positive Points	Negative Points	Potential for Hearing Loss (low, med., high)	Safety Procedures
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				

- 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 (104-6, 108-1)

Presentation

- Research, using books, magazines, encyclopedias, videos, reference CD-ROMs, and/or the Internet, to find information on a Canadian inventor/innovator of sound technology. Write notes under the following headings:
  - Personal information (name, place and date of birth)
  - The invention/innovation (What is the invention/innovation? What contributions has it made and how has it benefited society?) (105-1, 107-12, 205-8)

Resources/Notes

Activities from Appendix G

- Activity 59: Scientists and Sound
- Activity 60: Sound and Technology

Print

- *Sounds Good*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 54–67 (16602)
- See Appendix I: Print Resources

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 practise 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 the impact of both 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.

Curriculum Outcomes

The following outcomes have been developed from *Common Framework of Science Learning Outcomes K to12*, pan-Canadian outcomes. See Appendix J for the original outcomes that these were derived from.

STSE/Knowledge	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
108-3 demonstrate respect for the local environment	**204-1, 205-7** investigate rocks and minerals and record questions and observations	**300-7** identify and describe rocks that contain records of Earth's history
301-6, 108-6 demonstrate and record a variety of methods of weathering and erosion, including human impact on the landscape	**104-4, 206-1, 207-2** classify rocks and minerals by creating a chart or diagram that illustrates the classification scheme and compare results with others	**300-8** relate characteristics of rocks and minerals to their uses
	204-8, 205-5, 300-5, 300-6 explore physical properties of local rocks and minerals, using appropriate tools to collect and compare with those from other places	**301-4, 301-5** describe ways in which soil is formed from rocks and demonstrate and describe the effects of wind, water, and ice on the landscape
		301-7 describe natural phenomena that cause rapid and significant changes to the landscape

Collecting and Comparing Rocks and Minerals

Outcomes

Students will be expected to

- demonstrate respect for the local environment (108-3)
- investigate rocks and minerals and record questions and observations (204-1, 205-7)

Elaborations—Strategies for Learning and Teaching

Students can bring rock samples from their driveways, backyards, and gardens to school. Encourage them to bring in as wide an assortment as possible. Alternatively, students can go on a rock hunt around the school grounds. The Habitats unit may be done before or after this unit, but this outside excursion presents an opportunity to reinforce outcomes from the Habitats unit. Students can take the time to explore plants and animals in the habitat that they are collecting rocks from, while taking care not to disrupt this habitat or leave refuse on the ground. **Teacher Note:** Rocks may not be removed in provincial and 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 be obvious only 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

Informal/Formal Observation

- Observation Checklist:
  - Student takes care not to leave garbage and does not unnecessarily damage plants, trees, and shrubs while rock hunting on school grounds or other suitable location. (108-3)
  - Student can identify an instance where respect for habitat when collecting rocks has been neglected. (108-3)
  - Student makes observations that help to distinguish between rocks and minerals. (204-1, 205-7)

Paper and Pencil

- From a collection of a variety of common rocks and minerals, sort the collection using a dichotomous key to differentiate. (204-1, 205-7)

Presentation

- Start a collection of different rocks and minerals. Plan a good 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, 204-1, 205-7)

Resources/Notes

Activities from Appendix H

- Activity 61: My Favourite Rock
- Activity 62: Looking at Rocks and Minerals

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 16–20, 26–33, 74–84 (16603)

Properties of Rocks and Minerals

Outcomes

Students will be expected to

- explore physical properties of local rocks and minerals, using appropriate tools to collect and compare with those from other places (204-8, 205-5, 300-5, 300-6)

Elaborations—Strategies for Learning and Teaching

Students should use a wide variety of vocabulary for their descriptions of the properties of their rocks and minerals. Brainstorm terms that they can use. Encourage them to be as descriptive as possible and use similes ("like the colour of teeth," for example) to enhance their descriptions. They should go beyond simple observations to investigate various properties, such as hardness. Students could test their minerals and find out 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 sequence the rocks from softest to hardest. Students might want to scratch test with 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 minerals are harder than others.

Rocks are classified based on composition (crystal or particle) and texture (size of particles). Students may begin by looking at composition "What is in the rock?" and texture "How big are the particles?" These two characteristics later allow us to infer the origin of the rock.

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 a variety of locations to help them make comparisons. This activity will encourage an attitude of showing an interest and curiosity about objects and events within different environments.

Teachers can use and expand the property charts for rocks and minerals.

For any existing rock, two things may happen over time. The rock may become buried over time and be changed by heat and pressure or it may be exposed on the surface and become weathered. When using geologic maps, the colours indicate the geologic period, not the rock types.

Properties of Rocks and Minerals

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 the rocks and minerals you find. A good detective always keeps a careful record of what he or she does. Fill in the chart with your observations. Use your chart and choose a rock or mineral and tell about a possible use for it. (204-8, 205-5, 300-5, 300-6)

Observations of Rocks and Minerals

Property	Sample 1	Sample 2	Sample 3	Sample 4
colour	red/brown			
texture	smooth			
composition	fingernail won't scratch it, but a penny will			
lustre	dull			
possible uses				

Journal

- One of the rocks that you have collected is smooth, while another one is angular and jagged. Write a story, with pictures, that describes where these rocks might have come from and what might have caused their different shapes. (204-8, 205-5, 300-5, 300-6)

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. (204-8, 205-5, 300-5, 300-6)

Resources/Notes

Activities from Appendix H

- Activity 63: Streak
- Activity 64: Taste
- Activity 65: Lustre
- Activity 66: Colour

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 16–33, 40–47, 74–84 (16603)
- *Sci-Tech Connections 4*, Unit 4D, pp. 10–14, 24, 35–36, 39 (17025)
- *Rock Hunters* (13693)
- *Rocklands* (13844)

Properties of Rocks and Minerals *(continued)*

Outcomes

Students will be expected to

- classify rocks and minerals by creating a chart or diagram that illustrates the classification scheme and compare results with others (104-4, 206-1, 207-2)

Elaborations—Strategies for Learning and Teaching

Students should design their own classification scheme. Some criteria they might want to use might be 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." You 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 place the rocks in the appropriate space. 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.

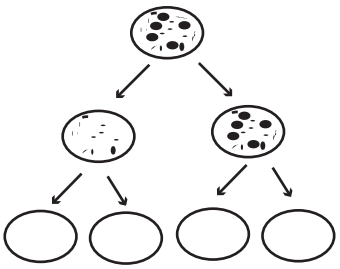
It is not necessary at this point that students be able to distinguish between igneous, sedimentary, and metamorphic rocks. This will be addressed in grade 7 science. However, depending on the local geology, these terms may be introduced as appropriate.

Properties of Rocks and Minerals *(continued)*

Tasks for Instruction and/or Assessment

Performance

- In groups of two or three, decide on the properties that you will use to classify your rocks. Start with one property, a colour, composition, or texture (crystal or particle size), for example, to divide your rocks into two groups, and then continue to pick properties to further sort your rocks. Use a dichotamous key as shown. Label your scheme so



that your classmates can try it. See example below. (104-4, 206-1, 207-2)

Paper and Pencil

- List the properties that your group decided on to classify your rocks. View two other classification schemes and try to use their schemes to sort the rock collection. Were the properties that they used to sort the rocks the same as those used by your group? Were there some rocks that you thought should have been in different groups? (104-4, 206-1, 207-2)

Resources/Notes

Activities from Appendix H

- Activity 67: Hardness
- Activity 68: Magnetite
- Activity 69: Crystals
- Activity 70: The Acid Test

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 21–33 (16603)
- *Sci-Tech Connections 4*, Unit 4D, pp. 20–22, 37–39 (17025)

Video

- *Minerals and Their Properties* (20 min.) (23198)

Uses for Rocks and Minerals

Outcomes

Students will be expected to

- relate characteristics of rocks and minerals to their uses (300-8)

Elaborations—Strategies for Learning and Teaching

Students should be provided with samples of ores and finished goods, then asked to match the ore with the correct item (such as talc and 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 that 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 runoff from slag (mineral residues) on natural habitats.

Students should explore the positive and negative effects of the extraction and/or utilization of rocks and minerals. Students could do a number of activities to simulate some mining techniques, such as 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 filled 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.

They can also do other activities where they separate various types of rock from the surrounding soil. Simulate mineral deposits by layering various rocks in a paper cup alternately with plaster of Paris. When it dries, remove it from the cup, and students can use toothpicks and stir sticks to try to retrieve the rocks. Alternatively, cookies such as chocolate chip or raisin can be used. What happens to the unused ore? 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

- Try to investigate the ores below and match them to products given. (300-8)

  Ores: nickel, gypsum, halite, limestone, granite, clay, talc

  Products: five-cent piece, wallboard, table salt, cement mix, memorial stone, brick, powder

Journal

- Make lists of objects in your home that are made using rocks and minerals and objects that are not made using 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 made with rocks and minerals is now made with different materials. (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. (300-8)

  Pipes: _____

  Roof: _____

  Floors: _____

  Walkways: _____

  Add three of your own choosing:

  _____

  _____

  _____

Resources/Notes

Activities from Appendix H

- Activity 71: Made from Minerals
- Activity 72: Mass and Volume of Rocks and Minerals

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 34–47 (16603)

Uses for Rocks and Minerals *(continued)*

Outcomes

Students will be expected to

- relate characteristics of rocks and minerals to their uses (300-8)

Elaborations—Strategies for Learning and Teaching

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 up and appear to disappear or dissolve, while the gravel will be left. 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 (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 refining ores.

Where possible, students can go on a field trip to a local mine to see how it retrieves the ores. Alternatively, 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 try to find out what a local company is doing to alleviate these problems. School groups may want to get involved in writing letters to inquire about these issues. This will encourage student attitudes of realizing 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 with lead or other poisonous metals in it or the effect of the construction of a highway or dam through natural habitats. Students may be interested in exploring archeological displays in museums where old pottery, arrowheads, and jewellery can provide a way to see how rocks and minerals were used in the past. Connections to the Habitats unit earlier in grade 4 science could be made.

You may want to invite an artist or artisan as a guest speaker.

Uses for Rocks and Minerals *(continued)*

Tasks for Instruction and/or Assessment

Presentation

- In groups, do a presentation—such as written, oral, or web page—about a mine in your province or region. The following aspects should be researched. Each person in the group should choose one aspect as their part in the group project.
  - What rocks or minerals are mined?
  - What are their properties?
  - What will the rocks or minerals will be used for?
  - What is the economic benefit to the community?
  - What are the environmental issues associated with the mine?

  (300-8)

Resources/Notes

Activities from Appendix H

- Activity 73: The Three Rock Groups
- Activity 74: A Research Project
- Activity 75: Rocks or Minerals?

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 34–39 (16603)
- *Sci-Tech Connections 4*, Unit 4D, pp. 52–57 (17025)

Videos

- *Mineral Vignettes* (30 min.) (V9991)

Erosion and Weathering

Outcomes

Students will be expected to

- describe ways in which soil is formed from rocks and demonstrate and describe the effects of wind, water, and ice on the landscape (301-4, 301-5)

Elaborations—Strategies for Learning and Teaching

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 their understanding of both of these concepts. Rocks, in the process of moving (erosion), can weather other rocks.

Students can look at the ground near an eavestrough runoff. There should be a 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 are most pronounced (weathering).

Beaches with sand 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 with evidence of coastline erosion and glacial deposits (erosion) and areas where glaciers 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 10 minutes, and note any changes to 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 sand or soil pile.

Students should investigate the effect of water freezing in cracks of rocks by filling a plastic container with water and freezing it. Students can set a water balloon in plaster of Paris, and when the plaster has set, putting it outdoors or in a freezer, and seeing how the plaster splits open (weathering). Students can use a snow shovel to simulate how ice or glaciers can move rocks from place to place. They can collect snow that has been plowed, let it melt, and collect all 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. (301-4, 301-5)

Weathering and Erosion

Location	Signs of Weathering	Signs of Erosion	Ice, Wind, or Water?
under eavestrough			
seashore			

Interview

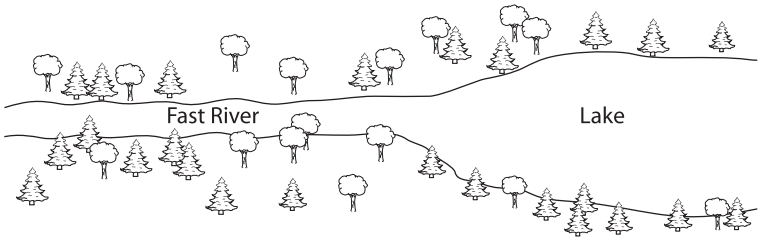
- What would happen to pavement if water seeps into its cracks and then freezes, during the winter? (301-4, 301-5)

Paper and Pencil

- Which rock would you most likely find on a beach? Give reasons for your answer. (301-4, 301-5)

- As rock and sandy material are washed downstream to where the river widens or enters a lake or ocean, the speed of the water decreases and the heavier material settles on the river bed first.

  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 both.



- Where does the sand on a beach come from? Use the terms **weathering** and **erosion** in your answer. (301-4, 301-5)

Resources/Notes

Activities from Appendix H

- Activity 76: Weathering and Erosion Overview

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 48–84 (16603)

Videos

- *Water Erosion and Landforms* (15 min.) (V2371)
- *Scientific Eye Series: Weather and Rocks* (20 min.) (20958)

Soil Formation and Composition

Outcomes

Students will be expected to

- demonstrate and record a variety of methods of weathering and erosion, including human impact on the landscape (301-6, 108-6)

Elaborations—Strategies for Learning and Teaching

Students should explore how bedrock and large rocks can be weathered and eroded into smaller rocks. Students can use selected videos, library resources, and Internet sites if local sites are not available. 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, students will find that these rock samples 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 seen how big 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. Students could 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 going 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 could see from this activity that soil is composed of particles of various sizes and types, the results of 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 happened to the pieces of shale. Pour the water from the jar through a coffee filter, and record your observations. (301-6, 108-6)

Interview

- Explain, using the terms **weathering** and **erosion**, how soil can be formed from larger rocks.
  - Is this a fast or slow process compared to, say, building a house or going on a vacation or even the lifetime of a person
  - Are these smaller pieces of weathered rocks the only components of soil? (small rocks, plants, and other living or dead, rotting material). Explain. (301-6, 108-6)

Presentation

- Develop a collage of drawings or pictures of local or regional areas that show different forms of erosion and weathering. (301-6, 108-6)
- Write a poem, song, or story about the weathering of local shorelines or geological features. (301-6, 108-6)

Resources/Notes

Activities from Appendix H

- Activity 77: How Does the Soil Stack Up?

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 68–73 (16603)
- *Sci-Tech Connections 4*, Unit 4D, p. 18 (17025)
- *From Rocks to Sand: The Story of a Beach* (12699)
- *Shifting Sands* (13841)

Video

- *The Secrets of Dr. Soil* (30 min.) (21558)

Record in Rocks

Outcomes

Students will be expected to

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

Elaborations—Strategies for Learning and Teaching

Students should simulate the various ways of forming fossils. 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 re-examine their collection of rocks to look for evidence of fossils. Students should identify and describe the fossil evidence they find.

Visit a site that has fossilized rocks and examine them to study the historical records contained therein 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 cast fossil.

Record 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. (300-7)

Presentation

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

Resources/Notes

Activities from Appendix H

- Activity 78: Fossils—Records of the Earth's History

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 21–25 (16603)
- *Sci-Tech Connections 4*, Unit 4D, p. 18 (17025)

Video

- *Fossils in Nova Scotia* (27 min.) (V2405)

Sudden and Significant Changes in the Land

Outcomes

Students will be expected to

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

Elaborations—Strategies for Learning and Teaching

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 posters or in scrapbooks 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. Helens, USA, or the volcanoes around Hawaii, 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 hit 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.

Students could report on tsunamis in the Indian Ocean. These are natural phenomena like underwater earthquakes or sudden and catastrophic storm systems.

Sudden and Significant Changes in the Land

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, tornado. Design a presentation that describes the event and how it affects the landscape. (301-7)

Resources/Notes

Activities from Appendix H

- Activity 79: A Research Project and Presentation

Print

- *Rockhound*, *Teacher's Guide*, Pan-Canadian Science Place, pp. 48–54 (16603)

Appendices

Appendix A: Equipment Lists

School Materials

This suggested school list consists of items that each school should have to do the hands-on, minds-on science activities as outlined in this guide. This does not include items in the class or consumables list.

	Habitats	Light	Sound	Rocks, Minerals, and Erosion
Supply List				
aluminum foil		X		
aluminum pans		X		
aluminum pie plates, large				X
aluminum pie plates, small		X		
aluminum tray			X	
aquarium	X	X		
attribute rings	X			
audio tape			X	
balances				X
ball bearings				X
bell wire		X		
binoculars		X		
bowls				X
Bristol board	X	X		
candles		X		
chalkboard brushes		X		
chart paper	X			
clay (Plasticine)	X	X		X
clipboards	X	X		X
combs			X	
computers (access to the Internet)	X	X	X	X
construction paper	X	X	X	
crystal samples				X
diagram of the ear			X	
digital camera	X			

	Habitats	Light	Sound	Rocks, Minerals, and Erosion
dominoes			X	
eye droper		X		
fibre optics		X		
flashlights		X		
geometric solids (wooden or opaque)		X		
headphones			X	
hula hoops	X			
Intel Microscope	X			X
kaleidoscope		X		
lamp (high intensity)		X		
laser level		X		
LCD projector	X			
lenses (concave and convex)		X		
light bulbs (compact fluorescent and incandescent)		X		
limestone chips				X
magnifying lenses	X	X		X
markers		X		
masking tape		X		X
measuring cups/beakers				X
metre stick			X	
metric tape measures	X	X		
microscopes	X	X		
mineral samples				X
miras		X		
mirrors (concave, convex, and flat rectangular)		X		
Mohs Hardness Scale				X
musical instruments			X	
overflow jars				X
overhead projector		X		
paper clips			X	X
periscope		X		
pictures of living things that emit their own light		X		

	Habitats	Light	Sound	Rocks, Minerals, and Erosion
pins		X		
plastic cups, clear		X		X
plastic dishpan				X
plastic rulers			X	X
prisms		X		
radio alarm			X	
Rive Ray Box		X		
rock samples				X
rubber bands, various			X	
rubber gloves	X			
ruler, metric	X	X		
safety goggles			X	X
self-stick clear plastic	X			
shiny metal spoons		X		
soil sampler	X			
stethoscope			X	
streak plates				X
string		X		X
tape	X	X	X	
television			X	
telescope		X		
terrarium	X			
ticketboard		X		
tissue paper	X			
tracing paper		X		
trowels	X			
tuning forks			X	
video camera	X			
watering can				X

Classroom Supplies

This suggested classroom list consists of items that each class should have to do the hands-on, minds-on science activities outlined in this guide. This does not include items listed in the other lists.

	Habitats	Light	Sound	Rocks, Minerals, and Erosion
Supply List				
coloured pencils	X			
crayons	X	X		
glue	X			
pencils	X	X	X	X
scissors	X	X	X	
Consumables				
batteries		X		
bean seeds or dried beans			X	
cereal			X	
coloured cellophane		X		
corn syrup			X	
cotton balls			X	
flour		X		
ice cubes				X
light sticks (glow sticks/bracelets)		X		
matches		X		
paint (tempra)	X			
paint brushes	X			X
paper	X	X	X	X
paper cups			X	
paper towel				X
pipe cleaners	X			
plaster of Paris				X
plastic wrap (clear)		X	X	
rice			X	
salt				X
sponges				X
stir sticks				X
straws (various diameters)		X	X	

	Habitats	Light	Sound	Rocks, Minerals, and Erosion
sugar				X
tea bags		X		
toothpicks				X
vegetable oil			X	
vinegar			X	X
wax paper		X		X

Recyclables and Collectibles

This suggested recyclables and collectibles list consists of items that each class should have to do the hands-on, minds-on science activities as outlined in this guide. This does not include items listed in the other lists.

	Habitats	Light	Sound	Rocks, Minerals, and Erosion
Supply List				
cardboard		X		
cardboard boxes	X			
coins		X		
fabric	X			
gravel	X			X
Gyproc				X
jars		X		
milk cartons (1 L)		X		
newspaper	X		X	X
paper towel rolls		X	X	
pebbles	X		X	
pennies		X		X
petroleum jelly				X
plants	X			
plastic bags	X			
plastic bottles			X	
plastic containers (1 L and 2 L)			X	
pop bottles (2 L)	X			
pop bottles, glass		X		
rocks				X
samples of insulation to reduce sound			X	
sand	X			X
shoe boxes	X		X	
soil samples	X			X
steel nails				X
stereo speakers			X	
toilet paper rolls		X	X	
washers				X
watch (waterproof)			X	
watch (with LED light)		X		
wooden stir sticks				X

Appendix B: Video Resources

Education Media Library

The Education Media Library has over 5000 titles in its video collection. All programs have been evaluated for curriculum fit and are intended to support the Nova Scotia Public School Program. They may be used by teachers and others engaged in public education in Nova Scotia. Public performance rights have been purchased so that all videos can be shown in classroom settings to students and educators.

The Media Library offers video loans and video-dubbing services. Loan videos have an assigned number that begins with the number 2, e.g., 23456. These videos may be borrowed and returned. The videos that are available through dubbing begin with a V, e.g., V1123. The Media Library makes a copy of these videos, which is then retained by the client. Dubbing services are provided for the nominal recovery cost of the videocassette on which the program is taped. Tape prices range from $1.44 for a 20-minute tape to $2.59 for a two-hour tape. Programs can be stacked onto one tape (e.g., four 30-minute programs onto one tape) or be dubbed on separate tapes.

The Learning Resources and Technology website <http://lrt.EDnet.ns.ca> provides a rich variety of curriculum-related resources to help teachers in their classrooms. Teachers can search the video database, find out about educational software, search the database of curriculum-related websites, download curriculum catalogues, access workshops on web safety, and find tips on integrating technology into the classroom.

Title	Description
Life Science: Habitat	
Animal Homes (23276) 10 min., 1980	This short program designed for young audiences shows the wide variety of homes used by insects, birds, turtles, mammals, and others.
Animals around Us Series (V2505, V2506, V2507) 14 min., 2001	Join naturalist Paul Fuqua in this series as he travels around the world explaining the characteristics of our planet's animal groups.
Animals around You Series (23202, 23256, 23179) 15 min., 1992	This series of programs introduces students to habitats of animals around them. Titles include: *Animal Life Spans*, *Animals on the Farm*, and *At Home with Zoo Animals*.
Animals That Build (22239) 14 min., 1983	Humans are not the only animals that build. Beaver dams and bird and wasp nests are also familiar animal homes. The stickleback builds an underwater nest to house its young. African termites construct towers. Beautiful coral reefs are the work of coral polyps.
Animals: Wonder Why (23247) 23 min., 1994	From the popular CTV program *Wonder Why*. There are so many different animals in the world, and they all have different behaviours. Some live in the forest and others in the ocean. By looking at animals we learn that animals today are being threatened by people, and many are becoming extinct because they have no place to live. Even though many people don't like to see animals in zoos, they are places where people can learn about animals and help them to survive.
Backyard Safari Series: Home Sweet Home (23321) 30 min., 1998	Animal builders build homes suitable to their needs, using materials from nature around them. Students will see a beaver and weaverbird build their homes and will look at the animals and plants in a pond. Students will be able to identify and describe behaviours that enable animals to survive.
Biodiversity—Garbage (23115) 50 min., 1995	This tape has two 25-minute programs. **Biodiversity**: In any given environment there are hundreds of varieties of plants and animals living together creating ecosystems. Bill Nye, the Science Guy, sets up shop in an ocean, a forest, and a field to commune with nature and show what happens when one link falls out of nature's chain. **Garbage**: By digging up the dirt on garbage in ever-expanding landfills, Bill Nye, the Science Guy, exposes the vast amount of non-biodegradable waste humans create.

Title	Description
Common Nova Scotia Garden Birds: An Introduction (V0316) 13 min., 1989	The program is a video transfer of a filmstrip program. Bird watchers learn how to identify many common birds that inhabit Nova Scotia gardens at varying times of the year.
Eco Explorers: Backyard Surprises (23330) 22 min., 2001	In this program, students will discover that they have an ecosystem in the schoolyard or their backyard. Familiar birds and animals include robins, hummingbirds, squirrels, and spiders. Students will look at the life cycle and feeding habits of these creatures and learn how to attract wildlife to their backyards.
Eco Explorers: Wetland Wonders (23331) 22 min., 2001	In this program, students will discover the secrets of a wetland, an ecosystem that many students have access to in their own community or neighbourhood. Students will identify a wetland, learn about types of plants, the life cycle of frogs, and the social structure of a flock of Canada geese, and observe the benefits of wetlands to the environment.
Eyewitness Series (22447, 22448, 22450, 22451, 22468, 22452, 22453) 34 min., 1994	Eyewitness is a series of 13 half-hour videos about the natural world of wild animals. Titles in this series include *Bird*, *Cat*, *Dog*, *Elephant*, *Fish*, *Horse*, and *Jungle*.
Getting to Know Shore Birds of Nova Scotia (V0290) 11 min., 1989	This program provides a useful introduction to the shore birds that students will likely encounter on a field trip to the beach.
Great Cover-up (22237) 15 min., 1988	Many animals, both common and exotic, owe their existence to camouflage, to their ability to escape detection by potential predators, while other animals are unable to escape detection. This program introduces the most important kinds of camouflage and shows some of the ways animals look like objects in their environment.
Habitats (23318) 18 min., 2000	This program features the importance of habitats of plants and animals with live action and animation. Students will explore the tundra, desert, grassland, forests, and waterways of the world and learn about the plants and animals that live there.
Habitat and Dependence (20956) 20 min., 1989	Habitats provide living things with their basic requirements. Different habitats contain many different species. Examining food chains, the program shows the interdependence of living things in a habitat and explores how human influence can have profound effects on habitat.

Title	Description
Habitats: Homes for Living Things (23324) 15 min., 2000	This program explores how plants and animals meet their needs to live and grow. Students will visit a pond, a desert, a forest, a rainforest, and other habitats to discover how plants and animals adapt to survive in different environments and landscapes.
How to Study Ecology (V2385) 14 min., 1998	In this program, young viewers learn what an ecosystem is and witness some examples. The concept that all plants and animals within an ecosystem are interrelated is explored.
I Need the Earth and the Earth Needs Me (20319) 20 min., 1990	This program explains that all plants and animals, including people, rely on the air, water, and soil for survival and enjoyment. In focussed sections, the program outlines sources of pollution and the efforts scientists and ordinary citizens are taking to preserve the quality of air, water, and land environments.
Life Habitat (22428, 22433, 22427, 22434) 15 min., 1992	The Life Habitat Series offers six video field trips into the heart and substance of the natural world. In the videos, children are seen exploring the food chain, the water cycle, the Earth's recycling system, and countless unique wonders of the Earth. Titles in this series include *Down on the Forest Floor*, *Life in the City Habitat*, *Secret of the Pond*, *What's in Your Backyard?*
Plight of the Piping Plover (V2502) 20 min., 1995	This program portrays the life cycle and habitat of the piping plover, listed as an endangered species since 1985, and encourages students and the public to become guardians of this fragile bird and be aware of the beauty it provides to our shores and the coast of the Maritimes.
Puzzle of the Rotting Log (22432) 15 min., 1990	Nature guide Jim poses the question to a group of elementary children, "If trees have been living and dying on Earth for thousands of years, why isn't the Earth covered with dead trees?" The children in this video explore the woods in an effort to solve the puzzle and learn about decomposition and nature's unique recycling system.
Seeing Things Series (21054, 21051) 15 min., 1988	Dr. David Suzuki and the neighbourhood children explore the natural world together. Children use their skills of observation, and Suzuki inserts interesting facts about each creature and plant discussed. Titles in this series include *Habitats: A Science Walk with David Suzuki* and *See Things: A Science Walk with David Suzuki*.

Title	Description
Physical Science: Light	
Bill Nye: The Science Guy Physical Science 1 (21650) 36 min., 1994	Bill Nye uses wacky humour and interesting experiments to demonstrate basic physical science properties. There is a section on light and colour (white light, prisms, pure colours, pigments, neon tubes, and laser light). There is also a segment on sound.
Fourways Farm Series: On Reflection (21659) 10 min., 1995	Are there really animals at the bottom of the pond or is it just a trick of the light? This video explains light and reflection.
Learning about Light (22253) 9 min., 1985	The program develops basic concepts about light. Children demonstrate a variety of simple practical experiments to understand the natural and human-made sources that produce light and how the human eye makes use of light, how lenses and mirrors affect light, and how to distinguish between reflection and refraction.
Science in Action Series: Lenses and Mirrors (V2355) 17 min., 1996	This program defines different types of lenses and mirrors and the ways that light is refracted and reflected from lighthouses to telescopes.
Scientific Eye Series: Colour (22399) 20 min., 1996	A photographic fashion shoot is used to demonstrate the basic principles of coloured light.
Seeing Is Believing (20946) 20 min., 1986	This program covers how we use our eyes in everyday life, how we see, and how our eyes can play tricks on us.

Title	Description
Physical Science: Sound	
Fourways Farm Series 1: The Sound of Music (21660) 10 min., 1995	There are lots of ways to make sounds, but not all sounds are musical. The video covers the concept of sound patterns.
Scientific Eye Series: Hearing and Sound (20948) 20 min., 1986	This program illustrates that sounds are vibrations that can travel through air, liquid, and solids. Our ears catch these vibrations and send messages to the brain. Simple ideas of pitch and volume are explained. Also addressed is the problem of noise pollution.
Sound: A First Look (23316) 17 min., 2001	This program introduces students to what sound is, how sounds are made, and how sounds are different. It explains the difference between pitch and volume and how musical instruments work. Students are engaged in a variety of activities and experiments on how to make a simple musical instrument out of materials found from home or school.
What Is ... ? Series 23341–23345 4 min. each, 1998	There are five videos in this series that fit for the unit on sound. They include *What Is a Fence? What Is a Garden? What Is a Wall? What Is a Window? What Is a Door?* (Reference numbers 23341–23345)
Wonderstruck Series: Making Music (22596) 30 min., 1989	Students explore the science of sound and music.

Title	Description
Earth and Space Science: Rocks, Minerals, and Erosion	
Fossils in Nova Scotia (V2405) 27 min., 2000	This program is intended to accompany the Nova Scotia Museum School Kit, Fossils in Nova Scotia. It explains what sorts of fossils are found where in the province and advises viewers what they should do if they find a fossil.
Mineral Vignettes (V9991) 30 min., 1987	Several vignettes explore the process of mining for minerals.
Minerals and Their Properties (23198) 20 min., 2001	Major mineral groups and basic mineral crystal systems are discussed. The six major physical properties are outlined. The video uses terminology and concepts of inorganic, lustre, streak, colour, cleavage, fracture, hardness, gemstones, and more.
Scientific Eye Series: Weather and Rocks (20958) 20 min., 1989	This program examines how wind is generated and how weather conditions can be important in some occupations. Wind and water erosion and rock fossils are also discussed.
The Secrets of Dr. Soil (21558) 30 min.	*The Secrets of Dr. Soil* is about soil (not dirt!): what's in it, how it forms, what builds it up, what breaks it down, and what everyone—students included—can do to preserve this precious, renewable resource. It's relevant and trendy and provides a core curriculum around which the teacher can make a practical focus.
Water Erosion and Landforms (V2371) 15 min., 1998	The Earth's landforms are always being changed as they are broken down by weathering and washed away by erosion. Water is one of the most powerful forces shaping and sculpting the Earth. This program looks at how it creates some of our most dramatic landforms.

Appendix C: Performance Assessment

A comprehensive evaluation of a student's progress in science should include a performance-based assessment. Areas for consideration may include

- problem comprehension
- co-operative learning
- problem solving
- equipment use
- communication of results

The rubrics on the following page may be used for performance-based assessment. Ideally, a student will be assessed every few weeks, and one or more students may be observed during each activity. The child is informally observed during the activity, and the observed levels of achievement are highlighted on the rubric. The dated rubrics may then be added to the child's assessment portfolio and referred to for evaluation. Levels of performance and progress are easily tracked and any areas of concern identified.

The use of a clipboard and highlighter allows for ease of recording as observations are made.

Performance Assessment Rubric

Name:	**Date:**
Activity:	

Problem Comprehension

4 has complete understanding of the problem
3 understands most of the problem
2 understands some of the problem
1 tries but does not understand the problem
0 makes no attempt to understand the problem

Problem Solving

4 has a plan that could lead to the correct solution
3 follows basic procedure with minor error or omission
2 follows partially correct procedure with major error
1 plans inappropriately
0 makes no attempt to solve the problem

Co-operative Learning

4 consistently encourages work toward the group goals with skill and sensitivity
3 fulfils individual role with skill and sensitivity without prompting
2 fulfils individual role with sensitivity but needs occasional prompting
1 contributes only when prompted and needs reminders regarding sensitivity
0 refuses to work as a group member and/or shows no consideration for others

Equipment Use

4 accurately uses all appropriate tools to gather data
3 effectively uses some of the appropriate tools to gather data with minor errors
2 attempts to use the appropriate tools resulting in inaccurate data
1 does not use the appropriate tools
0 makes no attempt to collect data using the tools

Communication of Results

4 gives concise explanation of method with conclusion based on data collected
3 gives satisfactory explanation of method with conclusion based on data collected
2 gives incomplete explanation of method and/or conclusion partially supported by data
1 gives explanation that cannot be understood/makes no reference to data
0 gives no explanation/gives no conclusion/presents no data

Appendix D: Journals and Logbooks

Logbooks and journals are a part of many occupations and as such are highly reflective of the world of work. Many highly successful people keep a daily journal as a habit that helps them develop insights into their work. A journal can include sketches, diagrams, notes, quotes, questions, excerpts, and drafts. Scientists recording this way are keeping track of all their observations and so on. This is their "private science."

The logbook or journal may be used to develop a final product, such as a report, design, profile, fictional text, or dramatization, or it may be a way of tracking progress and developing ideas and insights. The final product is the young scientist's "public science."

Students need to see the value of their science log writing, not only through frequent responses from the teacher, including assessments that "count," but also through assignments that provide linkages to previous and subsequent learning or that meet specific learning and/or personal needs for the student.

Since the logbook or journal can contain very personal thoughts and ideas stimulated by thought-provoking questions, the teacher must make provisions to honour the confidentiality of students' work, except where legally required to do otherwise.

Elements of the following journal assessment rubrics can be used in various combinations.

Journal Comment Rubric

Name:	**Comments**:
Ideas • interprets and analyses issues • describes new insight(s)	
Critical Thinking • identifies assumptions underlying an issue, problem, or point of view • probes beneath the surface for layers of significance • explains an issue from multiple perspectives	
Ethical Reasoning • uses rules or standards of right/wrong or good/bad to guide debate/reflection	
Personal Experience • connects insights/thoughts to personal experience	
Development • develops content thoroughly	

Journal Scoring Rubric					
	1	2	3	Assessment	
				Student	Teacher
Ideas	states facts	interprets and/or analyses an issue	interprets, analyses, and describes a new insight(s)		
Critical Thinking	identifies a stated issue, problem, or point of view	identifies assumptions underlying an issue, problem, or point of view	questions assumptions underlying an issue, problem, or point of view		
Critical Thinking	responds to a stated issue, problem, or point of view	identifies more than one layer of significance	probes beneath the surface for multiple layers of significance		
Critical Thinking	describes a single response to a situation or problem	describes several responses to a situation or problem	sees implications of alternative responses to a situation or problem		
Critical Thinking	explains an issue from one perspective	explains an issue from more than one perspective	explains an issue from multiple perspectives		
Ethical Reasoning	does not consider ethical aspects of issues	recognizes and often applies standards/rules	uses rules or standards of right/wrong or good/bad to guide debate/reflection		
Personal Experience	does not personalize journal	makes some connection to personal experience	connects insights and thoughts to personal experience		
Development	develops content minimally	develops content adequately	develops content thoroughly		
Name:			**Score:**		

Appendices E–H

Introduction

In the following appendices (E–H), you will find activities you may wish to use or modify to support student achievement of specific curriculum outcomes at the grade 4 level. These activities are referenced under column four, Resources/Notes, in each unit on the two-page spreads and are meant to add to other hands-on learning experiences teachers may provide to address curriculum outcomes.

You may also find well-written, easy-to-follow activities and curriculum links to science in the following resource in your school:

Pan-Canadian Science Place, Complete Grade Four Unit (NSSBB #16587)

Appendix E: Activities for Life Science: Habitats

Activity 1: Where I Live

Outcome

Students will be expected to

- identify questions to investigate the types of plants and/or animals at a local habitat using the terms **habitat**, **population**, and **community** (104-6, 204-1)

Assessment

- Students will be able to illustrate the type of plants and/or animals that live in a particular habitat.

Question

- Using your prior knowledge, what types of plants and/or animals live in a particular habitat?

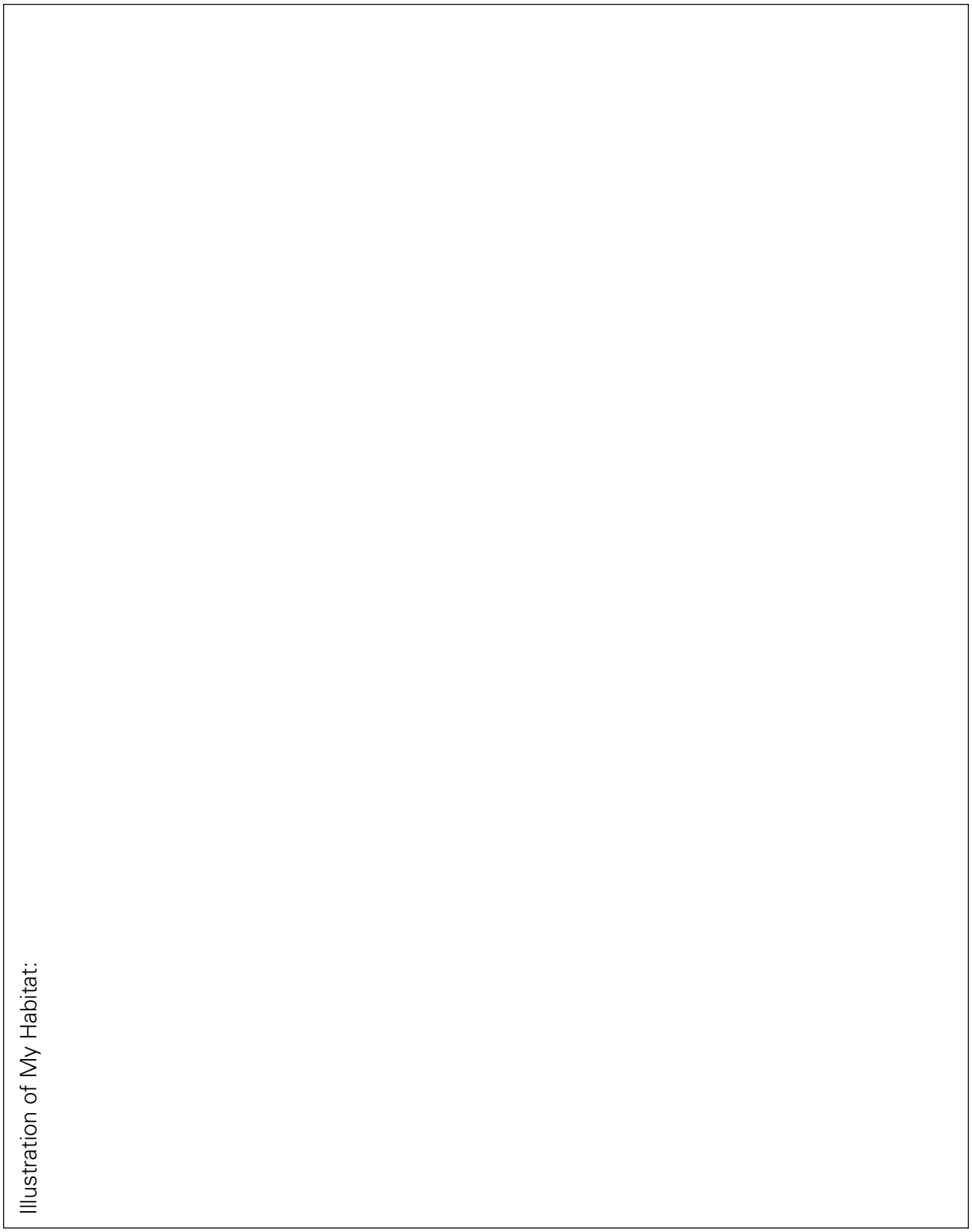
Materials

- plain paper
- crayons or coloured pencils

Procedure

This learning experience is designed to see what students know about a particular habitat (woodlands, meadows, fields, oceans, streams, ponds, lakes, etc.). Ask students to choose a particular habitat and have them illustrate in detail what organisms live in the habitat they chose. They should include as much detail as possible. Students should share their illustrations with the class. At this point, the students may not know what the term **habitat** means. This will be developed in Activity 3: Understanding the Term "Habitat."

Activity Sheet 1:: Where I Live



Activity 2: What Do I Need to Survive?

Outcome

Students will be expected to

- identify questions to investigate the types of plants and/or animals at a local habitat using the terms **habitat**, **population**, and **community** (104-6, 204-1)

Assessment

- Students will be able to identify the needs of an organism.

Questions

- What does a tree need to survive?
- What does a raccoon need to survive?

Materials

- **optional**: LCD projector, computer, software such as Kidspiration

Procedure

Choose a plant or animal and brainstorm with students what the particular organism needs to survive. This learning experience can be done through the use of a web diagram, either on the board or by using the software program Kidspiration.

Have students take their ideas and put them into a paragraph.

English language arts: Students could make a story about a particular organism and how it survives.

Visual arts: Students could illustrate a particular organism and what it depends on to survive, using various media (sketch, paint, clay).

Activity 3: Understanding the Terms "Habitat, Community, and Population"

Outcome

Students will be expected to

- identify questions to investigate the types of plants and/or animals at a local habitat using the terms **habitat**, **population**, and **community** (104-6, 204-1)

Assessment

- Students will be able to develop a working definition and understanding of the term **habitat** and give examples of habitats.
- Students are able to develop a working definition and understanding of the term **population**.
- Students are able to develop a working definition and understanding of the term **community**.

Questions

- What does the term **population** mean?
- What does the term **community** mean?
- What does the term **habitat** mean?
- What does a plant/animal need to survive?

Materials

- **optional**: LCD projector, computer, software such as Kidspiration, activity sheet

Procedure

This lesson is designed to build students' basic understanding of the terms **habitat**, **community**, and **population**. This learning experience can be done in groups or as a whole class. A web diagram could be used to develop a working definition and understanding of each term.

Visual arts: Students could illustrate their definitions.

Technology: The program Kidspiration could be used to develop a web diagram and a working definition. This could be done on a group basis or as an entire class using an LCD projector.

Have students give examples of large and small habitats (ocean, forest, rotting log, ant hill, under a rock ...) and what might live there. Tie in students' prior knowledge and what they learned from the activities Where I Live and What Do I Need to Survive?

Habitats: The place where an organism lives and finds what it needs to survive (food, water, space, shelter).

Community: A collection of living things; plants and animals that interact with each other in a shared location.

Population: The number of organisms that live in a particular area.

Activity Sheet 3: Understanding the Terms "Habitat, Community, and Population"

Habitat:	What you might find in this habitat:

Habitat:	What you might find in this habitat:

Activity Sheet 3: Understanding the Term "Habitat" *(continued)*

Community:	Illustration:
_____ _____ _____ _____ _____ _____ _____ _____ _____	

Population:	Illustration:
_____ _____ _____ _____ _____ _____ _____ _____ _____	

Activity 4: What I Want to Find out about My Habitat

Outcome

Students will be expected to

- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)

Assessment

- Students will be able to develop questions to be answered when viewing a local habitat.
- Students will develop a plan to follow when investigating a local habitat.

Questions

- What do we want to find out about our habitat?
- What methods are we going to use to gather and record our information?

Materials

- activity sheet

Procedure

In this learning experience students are to develop a list of questions they want to answer when viewing their habitat. From these questions they will need to decide how they will record their information. Questions should be related to data they want to collect about their habitat and what lives there. This activity can be done in groups. Groups will share their ideas and come to consensus as a class as to what questions they will answer.

Questions should be typed and put in a form that is useable during the field study. The form could be in chart format, such as those in Activity Sheet 4. This sample form might also be used in Activity 6: Analysing the Data from Our Habitat or in question form.

Sample questions include, but are not limited to, the following:

- What equipment will be needed to carry out the field study?
- What are the soil and ground terrain like?
- What living things did you observe?
- What types of animals did you observe?
- What types of plants did you observe?
- What types of non-living things did you observe?
- Where do the plants get their food and water?
- Where do the animals get their food, shelter, and water?

Activity Sheet 4: What I Want to Find out about My Habitat

Living thing:	Illustration:
Number in area:	
Habitat preference:	
Description:	

Living thing:	Illustration:
Number in area:	
Habitat preference:	
Description:	

Activity Sheet 4: What I Want to Find out about My Habitat *(continued)*

Non-living thing:	Illustration:
Number in area:	
Location where found:	
Description:	

Non-living thing:	Illustration:
Number in area:	
Location where found:	
Description:	

Activity 5: Observing Our Habitat

Outcome

Students will be expected to

- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)

Assessment

- Students are able to work in groups to collect data about their habitat.
- Students show an appreciation and respect for the habitat they are working in.
- Students are able to collect and record relevant data on various living and non-living things in their habitat.
- Students are able to describe through words and drawings what they observed in their habitat.

Questions

- What types of living things did you observe in your habitat?
- What types of non-living things did you observe in your habitat?
- What types of challenges did you encounter while collecting your data?

Materials

- video camera
- digital camera
- paper for recording data
- clipboards
- pencils
- trowels
- magnifying lenses
- soil sampler
- resealable bags
- first-aid kit
- metric measuring tapes or rulers
- hula hoops or attribute rings
- parent volunteers
- disks

Procedure

Students should be divided into groups of three or four. This learning experience may require more than one hour depending on the location and distance from the school of the habitat you are going to observe. You may want to do a trial run around the school to see how the children work in groups prior to going to the actual field study area.

Prior to departing from the school you should review safety procedures. Once students have reached their habitat(s) have them use their hoops or metric tape measures to define their area. Groups should begin recording their observations. Each group should take a digital picture of their area and of anything they cannot identify. They can then use this picture as a reference back at school. Samples of plants, soil, etc., could be brought back to the school for further analysis. The soil samples could be used for more detailed observations using the Intel Microscope. When collecting samples, students should be careful to respect the habitat.

Activity 6: Analysing the Data from Our Habitat

Outcome

Students will be expected to

- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)

Assessment

- Students are able to interpret and analyse the data they collected from their field study of their habitat.
- Students are able to work in groups to review their data.
- Students are able to use reference materials to find out additional information about their habitat.

Questions

- Now that we have our data, what are we going to do with it?
- How can we organize the data to make it interesting for other students?

Materials

- data from Activity 5: Observing Our Habitat
- reference material

Procedure

In this learning experience students need to be given time to review what they observed in their field study and organize their information in such a way that they can then start preparing it for display and presentation to the class. Students should be given the opportunity to use reference materials from other sources to find the names of plants and animals that they observed.

Activity 7: Displaying Plants

Outcome

Students will be expected to

- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)

Assessment

- Students are able to take samples of the plants they observed and make a display with them.

Question

- How would we dry weeds or parts of plants to make a display?

Materials

- parts of plants
- glue
- cardboard
- Bristol board
- construction paper
- self-stick clear plastic
- catalogues or books

Procedure

This activity is designed to give students an opportunity to creatively display some of the plants they found during their field study. Weeds/ plants should be placed between sheets of wax paper and pressed in a catalogue or old phone book for approximately one week. After they are ready, have students arrange them on a dark background (this could be felt, construction paper, or material). The background should be glued to cardboard or Bristol board. Students can make a vase out of construction paper. After the vase and plants are designed cover them with self-stick plastic. This could then be mounted on a larger sheet of a different coloured Bristol board.

Activity 8: Our Habitat

Outcome

Students will be expected to

- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)

Assessment

- Students are able to put their data together in a manner so that other students can understand it.
- Students are able to work in groups to analyse and discuss their data.

Questions

- How will you put your data together to present it to other students?
- What types of information would be of interest to a wider audience?

Materials

- paper
- chart paper
- activity sheets
- computers

Procedure

After the students have completed their field study they will need to have time to review the data they collected and decide how they will display it. This could be done as a class or in groups. Students will need directions and support with part of the activity. Pictures taken on the field study could be uploaded to the computer and printed off using software such as Microsoft Word or Microsoft PowerPoint. Students could write about each picture.

English language arts: The writing and oral presentations could be incorporated into this area.

Activity Sheet 8: Our Habitat

Living thing:	Illustration:
Number in area:	
Habitat preference:	
Description	

Living thing:	Illustration:
Number in area:	
Habitat preference:	
Description:	

Activity Sheet 8: Our Habitat *(continued)*

Non-living thing:	Illustration:
Number in area:	
Location where found:	
Description:	

Non-living thing:	Illustration:
Number in area:	
Location where found:	
Description:	

Activity 9: A Closer Look

Outcome

Students will be expected to

- examine and investigate, using various methods and questions, local habitats and their associated populations of plants and animals (204-6, 302-1)

Assessment

- Students are able to use microscopes or magnifying lenses to record data about items collected from their habitat (Activity 5: Observing our Habitat).
- Students are able to illustrate and record their findings.

Questions

- How does a magnifying lens and/or a microscope help you make more detailed observations?
- What were you able to observe?

Materials

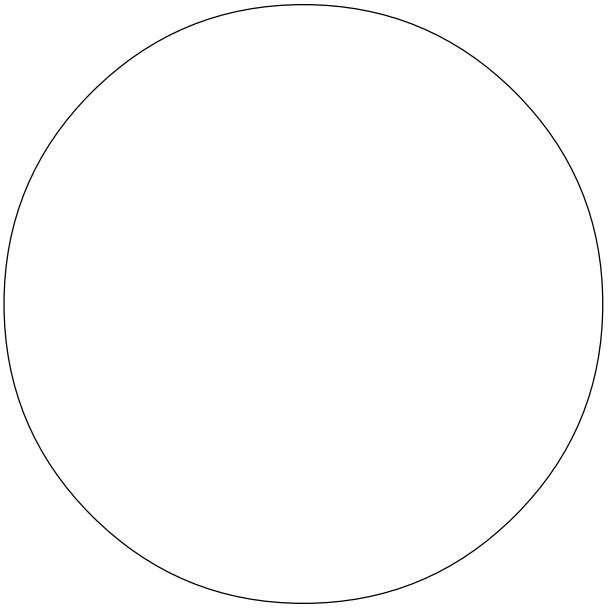
- hand-held magnifying lenses
- microscopes
- Intel Microscope
- soil samples
- water samples
- plant samples
- activity sheet

Procedure

Students will use samples of soil and plants brought back from their field study. Through the use of microscopes or hand-held lenses, students will be able to make more-detailed observations. Students should draw what they observed and record it for their classroom display and presentation.

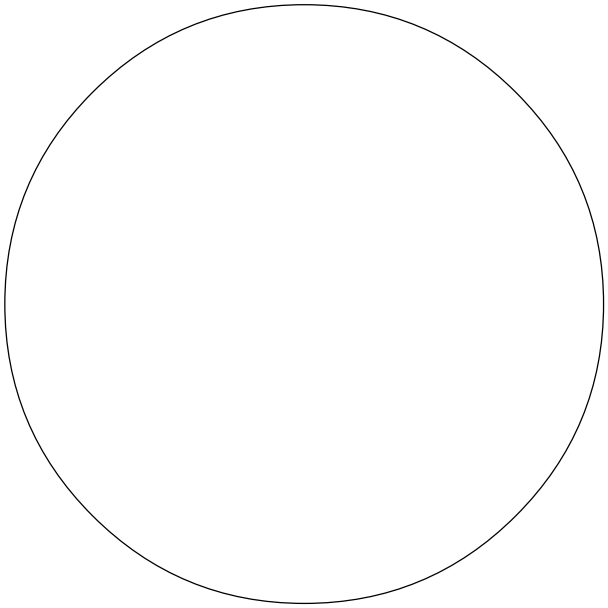
Activity Sheet 9: A Closer Look

My Picture of Soil



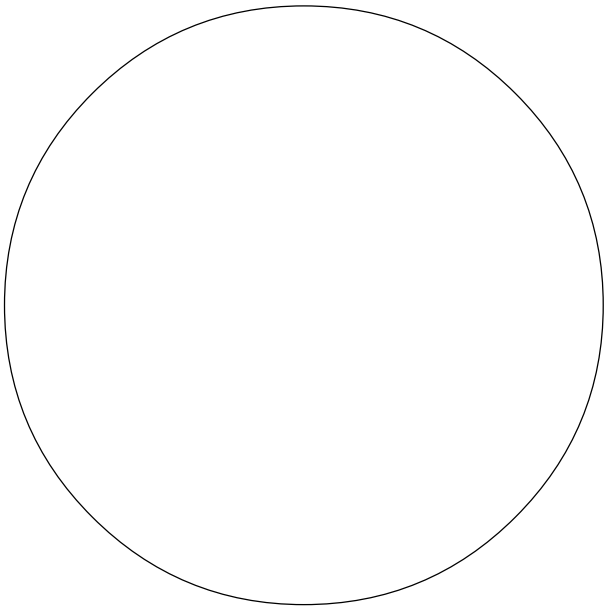
Description:

My Picture of a Plant



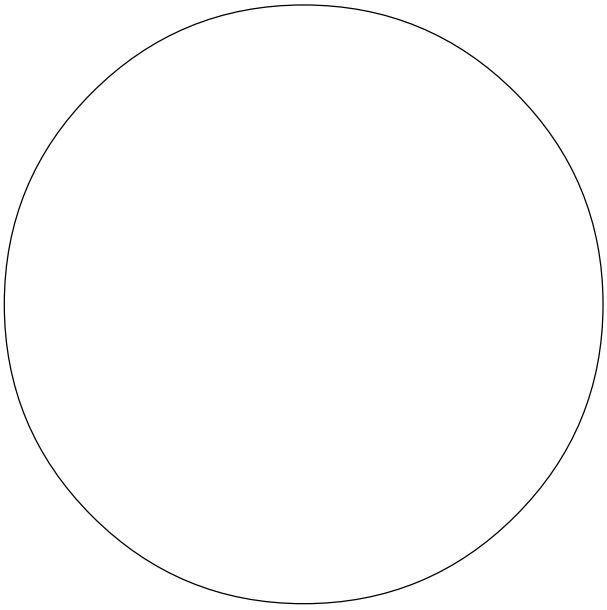
Description:

My Picture of Water



Description:

My Picture of _____



Description:

Activity 10: Making a Habitat

Outcome

Students will be expected to

- construct and/or maintain a model of a natural habitat and, through observations, suggest improvements to make it more habitable for organisms (205-5, 205-10, 206-6)

Assessment

- Students are able to draw on their experiences from the field study to make a habitat indoors.
- Students are able to make observations about their habitat and make improvements to it.

Questions

- How will you make an indoor habitat that will model an outdoor habitat?
- What will you need to maintain the habitat?
- What will you put in your habitat?

Materials

- terrarium(s)
- aquarium(s)
- large jars
- 2-L pop bottles
- items for the habitat

Procedure

Discuss with students what they learned about the habitats they observed in their field study. Have them decide what they would need to build their habitat. Have students return to their field study area to gather what they need to make their model of a habitat. Make sure that they do not cause too much disruption to the outdoor habitat. Have them record their observations of the model habitat over a period of time.

Activity Sheet 10: Making a Habitat

Diagram of habitat:

Description of what is in the habitat:

Activity 11: The Rotting Log

Outcome

Students will be expected to

- construct and/or maintain a model of a natural habitat and, through observations, suggest improvements to make it more habitable for organisms (205-5, 205-10, 206-6)

Assessment

- Students are able to observe a habitat indoors to see what organisms live in it.
- Students are respectful of the habitat and the organisms located in it.

Questions

- What kinds of organisms were found in the rotting log?
- How many of the various organisms were found?
- What did the organisms use for food and shelter?

Materials

- rotting logs
- paper
- cardboard boxes (to hold the rotting logs)
- rubber gloves (optional)
- magnifying lenses
- activity sheet

Procedure

Prior to the lesson, a number of rotting logs should be gathered for students to do their study. Students should be instructed to take care while exploring the log so they do not injure or destroy the living things. Students should keep a record of the types and quantity of living things they find.

After the study has been completed, the logs should be returned to their natural habitat.

Activity Sheet 11: The Rotting Log

Type of living thing:	Illustration:
Quantity:	
Description:	

Non-living thing:	Illustration:
Number in area:	
Location where found:	
Description:	

Activity 12: Creating a Model of an Artifical Habitat

Outcome

Students will be expected to

- construct and/or maintain a model of a natural habitat and, through observations, suggest improvements to make it more habitable for organisms (205-5, 205-10, 206-6)

Assessment

- Students are able to construct an artificial habitat based on the one they observed in their field study.
- Students are able to construct an artificial habitat based on a living or natural habitat.

Questions

- What materials will you need to make an artificial habitat?
- How will you be able to make the habitat look realistic?

Materials

- straw
- twigs
- construction paper
- cardboard
- clay
- tissue paper
- paint
- paint brushes
- shoe boxes or a large refrigerator or stove box (optional)

Procedure

This learning experience is linked to visual arts outcomes for grade 4. Have students create an artificial habitat that represents one they observed in their field study or one they have observed from books or videos, e.g., caves or oceans. Have the students display their models.

On a larger scale, the classroom could be transformed into a habitat. For example; an ocean habitat could be created by hanging a fishing net from the ceiling, and attaching models of ocean life to it. Rocks could be put on the floor to represent the ocean floor.

Students could also work as a class to make a large habitat using a stove or refrigerator box.

Activity 13: Animals and Their Habitats

Outcome

Students will be expected to

- compare the external features, behavioural patterns, and structural and/or behavioural adaptations for an animal to survive a particular habitat, real or imagined (204-3, 300-1, 300-2, 302-2)

Assessment

- Students are able to carry out research on a particular animal to see how it meets its needs.
- Students are able to look at a local habitat and describe an animal that lives there and how the habitat helps it meet its needs.

Questions

- What does an animal need to survive?
- How does the habitat it lives in help it to survive?

Materials

- books on animals and their habitats

Procedure

This learning experience is designed to help students use what they have learned from their field study and relate it to other habitats and animals that might live in them. Students should choose a particular animal and research where it lives, what it needs to survive, and how its habitat provides its basic needs. Students may want to look at animals that do not live in their community. Students should be given the opportunity to present their findings to the class. The write-up could be done using a word processor or the software program PowerPoint.

English language arts: This learning experience also addresses grade 4 English language arts outcomes.

Activity 14: Camouflage

Outcome

Students will be expected to

- compare the external features, behavioural patterns, and structural and/or behavioural adaptations for an animal to survive a particular habitat, real or imagined (204-3, 300-1, 300-2, 302-2)

Assessment

- Students are able to design an organism that features external camouflage.
- Students are able to explain how organisms need camouflage.
- Students are able to design and make a habitat that their organism can exist in by using its camouflage.

Questions

- What will you make your organism out of?
- What type of organism will you make?
- How does the colour of an organism help to protect it in its natural environment?

Materials

- modelling clay (various colours)
- construction paper
- tissue paper
- pipe cleaners
- shoe box
- fabric
- newspaper
- paint
- paint brushes

Procedure

Explain to students that they are going to make an organism that uses its natural camouflage to hide and then build a habitat that it can live in. This learning experience could be done individually or in groups. It could also be linked to the activity Creating a Model of an Artificial Habitat.

Students should be given the opportunity to display their organism and explain how its camouflage helps to protect it.

Activity 15: Parts of a Plant

Outcome

Students will be expected to

- compare the external features, behavioural patterns, and structural and/or behavioural adaptations for an animal to survive a particular habitat, real or imagined (204-3, 300-1, 300-2, 302-2)

Assessment

- Students are able to explain the functions of the main parts of a plant (roots, stems, flowers, and seeds).

Questions

- What are the main parts of a plant?
- How do these parts help the plant grow and survive?

Materials

- pictures of plants
- diagram of a plant illustrating the main parts

Procedure

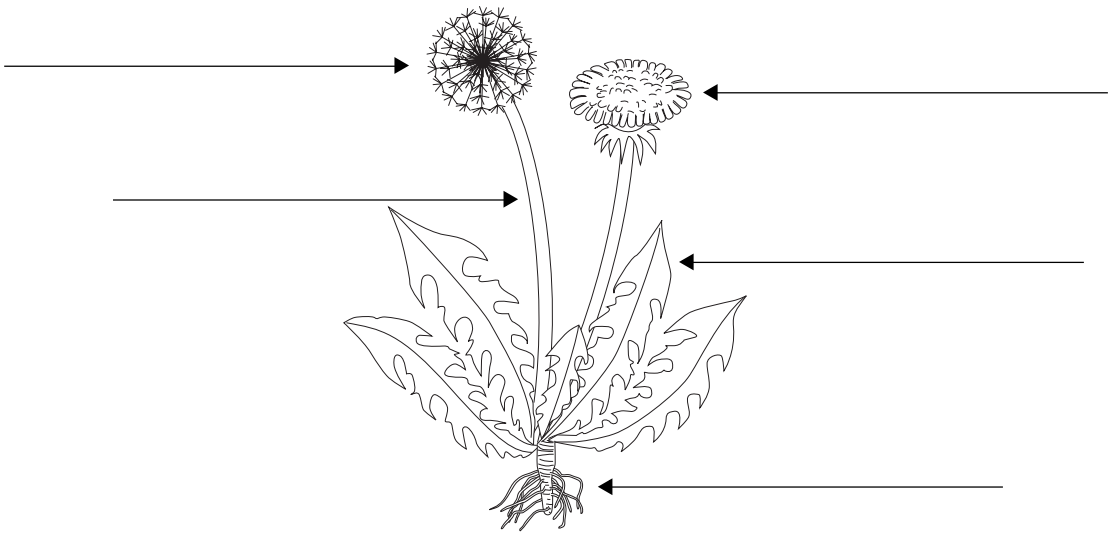
This learning experience is a review of the concepts learned in the grade 3 unit on plants. Students should be given the opportunity to look at live plants and discuss their various parts. From these discussions, students should illustrate and define the various parts of a plant and their uses.

Activity Sheet 15: Parts of a Plant

Use for the parts of a plant:

stems	leaves
roots	seeds
flowers	

Label the parts of the plant.



Activity 16: Supporting the Growth of Agriculture

Outcome

Students will be expected to

- describe how scientists' knowledge of plant growth has led to agricultural and technological innovations and the impact on local and regional habitat issues (105-1, 106-4, 108-1)

Assessment

- Students will gain a better understanding as to how scientists have helped farmers to produce better crops.
- Students will gain a better understanding of the effects of pesticides, herbicide spray, oil pollution, and sewage treatment on local habitats.

Questions

- How has the research of scientists supported farmers and their ability to provide food for a growing population?
- What impact do chemicals have on local habitats?
- What have local governments done to reduce pollution through the banning of pesticides?

Materials

- speakers from the Ecology Action Centre, farmers, marine biologists

Procedure

This learning experience is designed to help students realize the impact humans have had on local habitats. Guest speakers will provide insight into local and regional initiatives to support and maintain safe and healthy habitats.

Activity 17: Technology and Habitats

Outcome

Students will be expected to

- describe how scientists' knowledge of plant growth has led to agricultural and technological innovations and the impact on local and regional habitat issues (105-1, 106-4, 108-1)

Assessment

- Students are able to demonstrate an understanding of the impact technology has had on natural habitats.

Questions

- How has technology had a negative impact on natural habitats?
- How has technological developments had a positive impact on local habitats

Materials

- speakers

Procedure

This learning experience will provide students with the opportunity to discuss their views on technology and the environment. Students could be divided into positive and negative sides and debate the issue. Speakers from various business communities, e.g., oil industry, ocean industries, agriculture, could be invited in to discuss their views.

Activity 18: Food Chains

Outcome

Students will be expected to

- classify organisms and draw diagrams to illustrate their role in a food chain (206-1, 302-3)

Assessment

- Students are able to show an understanding of the terms **producers**, **consumers**, **decomposers**, **prey**, and **predators**.
- Students are able to illustrate and explain their own food chain.

Questions

- What do the terms **producers**, **consumers**, **decomposers**, **prey**, and **predators** mean?
- What types of food chains are in the community around our school?
- What is a food chain?

Materials

- pictures of producers, consumers, decomposers, prey, and predators
- computers, and software program Kidspiration (optional)
- activity sheets

Procedure

This learning experience will introduce students to the concept of food chains. A review of the field study completed earlier in this unit should be carried out to identify what lives in the local habitats. Examples and definitions of producers, consumers, and decomposers should be developed through class discussions.

After an understanding of the terminology has been developed, the students should develop simple food chains and explain how they work.

Teacher reference:

Producer: Plants are producers. They use the sun's light energy to produce food.

Consumer: A living thing that uses rather than produces food

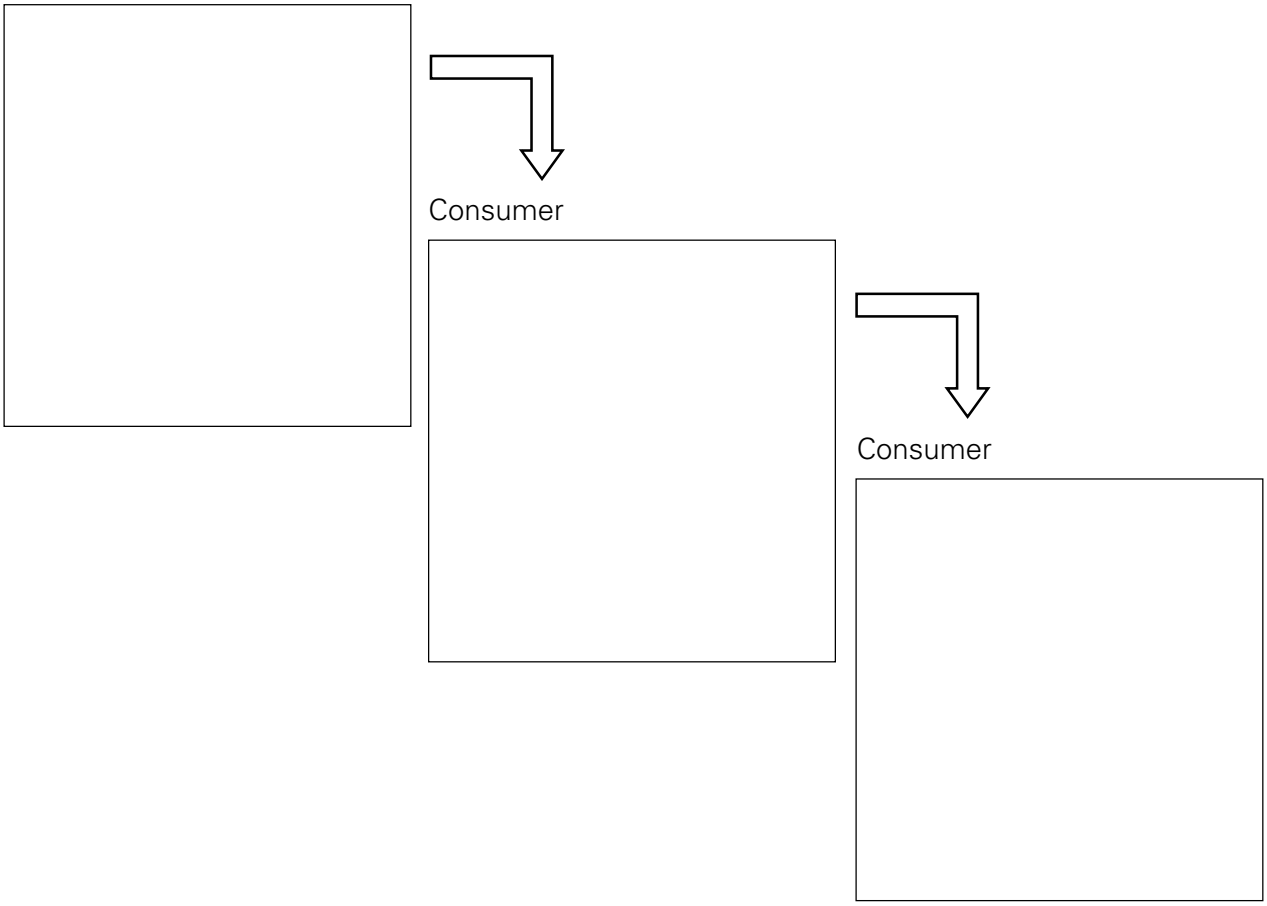
Decomposer: An organism that helps to decompose (decay or rot) dead plants and/or animals

Prey: An animal that is hunted for food

Predator: An animal that hunts other animals and eats them for food

Activity Sheet 18: Food Chains

Producer



Explanation of my food chain:

Activity Sheet 18: Food Chains *(continued)*

	Definition of What It Is	**Example**
Producer		
Consumer		
Decomposer		
Prey		
Predator		

Activity 19: Food Webs

Outcome

Students will be expected to

- classify organisms and draw diagrams to illustrate their role in a food chain (206-1, 302-3)

Assessment

- Students are able to build a food web by combining several food chains.
- Students are able to show an understanding of the difference between a food web and a food chain.
- Students' vocabulary is increased to understand such terms as **carnivore**, **omnivore**, and **herbivore**.

Questions

- What is the difference between a food web and a food chain?
- What do the terms **carnivore**, **omnivore**, and **herbivore** mean?

Materials

- a variety of pictures of carnivores, omnivores, and herbivores
- optional: Kidspiration, computers

Procedure

Students should review their understanding of a food chain. Examples could be placed on the board. Discussions and a working understanding of the terms **carnivore**, **omnivore**, and **herbivore** should be developed. From these discussions, a working understanding of a food web should be developed. Students should be given the opportunity to build food webs. They should record their webs in their science journals. Local or world habitats could be used. Food webs could be made using Kidspiration.

Teacher Note:

Food web: a series of food chains that are joined together

Herbivores: animals that only live on plants

Carnivores: meat-eating animals

Omnivores: animals that eat both plants and animals

Activity 20: Loss of a Habitat

Outcome

Students will be expected to

- predict how the removal of a plant or animal population affects the rest of the community and relate habitat loss to the endangerment or extinction of plants and animals (301-1, 301-2)

Assessment

- Students will show an understanding of what effect the loss of a habitat (local or otherwise) would have on the plants and animals that were located in the lost habitat.

Questions

- What impact would a fire have on a habitat?
- What impact would the destruction of a grassland or woodland for the purpose of building a housing development have on the plants and animals?

Materials

- none

Procedure

This learning experience will provide students with the opportunity to examine human impact on living organisms in a habitat. Students should be given the opportunity to relate this activity to local habitats. When and where possible, students should be given the opportunity to observe first-hand what happens when a forest fire, hurricane, or other natural disaster destroys a natural habitat.

Appendix F: Activities for Physical Science: Light

Activity 21: Looking at Prior Knowledge—Light

Outcome

- Students in grades primary and 1 were exposed to outcomes using sight. This activity is a review. (106-1, 106-4)

Assessment

- Students are able to explain what it felt like to not be able to see when there wasn't enough light.
- Students are able to explain the importance of light and how it helps us in our everyday lives.

Questions

- What did it feel like when you were unable to see anything due to the absence of light?
- How do we depend on light in our everyday experiences?

Materials

- masks or some type of blindfold

Procedure

This learning experience is designed to have students realize and think about the importance of light. The experiences they gain from this activity will act as a foundation to the bigger picture of the way we use light and the optical devices that have been invented to help us in our daily lives.

An emphasis will need to be placed on trust, co-operation, and safety when doing this activity. It should be done where there is a minimal amount of materials (such as a gymnasium or hallway). Have students work in pairs. Have one student put the blindfold on while the other student gives him/her directions on where to move (left, right, forward, backwards). Pairs should take turns in being the person blindfolded and giving directions.

Have students discuss how it felt not to be able to see. Discuss with them what it is like when there is a power outage and they do not have any light.

Activity 22: Optical Devices

Outcome

Students will be expected to

- describe properties of light that have led to the development of optical devices that enhance our ability to observe (106-1, 106-4)

Assessment

- Students are able to explore a variety of optical devices and record how they have extended our ability to observe.
- Through discussions students are able to identify each optical device.

Questions

- What are the names of the optical devices you have explored?
- How has each device helped to extend our ability to observe?

Materials

- mirrors
- fibre optics
- microscopes
- telescopes
- magnifiers
- periscope
- binoculars
- overhead projector
- laser level
- kaleidoscope
- activity sheet

Procedure

This learning experience is designed to get students thinking about various optical devices that use light. Have students work in groups. In order to reduce the quantity of each optical device, have the devices rotate between groups or have the groups rotate amongst optical devices.

Part 1: Have the question, What am I? by each device. Have the students rotate from device to device, allowing them about five minutes per station. Have them use the item and write on the card what they think it is. **Note:** *For safety reasons an adult should be by the telescope and laser level*. Discuss with the class what they thought the items were.

Part 2: Have each group describe its optical device and how it has helped us extend our ability to observe. Have students fill in the activity sheet. This will be used for further discussion in Activity 23: Uses for Optical Devices. Allow students the opportunity to use the devices.

Activity Sheet 22: Optical Devices

Optical Device	How It Helps Us Observe Things	Where/How the Device Is Used

Activity Sheet 22: Optical Devices *(continued)*

Optical Device	How It Helps Us Observe Things	Where/How the Device Is Used

Choose an optical device and describe how it has helped us.

Activity 23: Uses of Optical Devices

Outcome

Students will be expected to

- describe properties of light that have led to the development of optical devices that enhance our ability to observe (106-1, 106-4)

Assessment

- Students are able to explain how and where optical devices are used in our daily lives.
- Students are able to describe the importance of at least one optical device and how it has helped humans.

Questions

- Where can the optical devices used for Activity 22: Optical Devices be found?
- How are the optical devices used to enhance our ability to observe?

Materials

- mirrors
- fibre optics
- microscopes
- telescopes
- magnifiers
- periscope
- binoculars
- overhead projector
- laser level
- kaleidoscope
- activity sheet from Activity 22: Optical Devices

Procedure

In this learning experience students are to discuss where the optical devices are used and how they have helped humans. Students should be given the opportunity to use the devices. From their discussion, students should choose one optical device and describe how it has helped humans. Students should share their findings with the class.

Activity 24: Camera Obscura

Outcome

Students will be expected to

- compare and describe how light interacts with a variety of optical devices and construct an optical device that performs a specific function (107-1, 205-10, 303-8)

Assessment

- Students are able to construct a workable camera obscura.
- Students are able to describe and draw what they observed using a camera obscura.

Questions

- What did you observe when you looked through the camera obscura?
- How was the image different when it was viewed through the camera obscura, compared to observing it with the naked eye?

Materials

- paper towel rolls
- toilet paper rolls
- masking tape
- wax paper
- aluminum foil
- pins
- candles

Procedure

Making the Camera Obscura

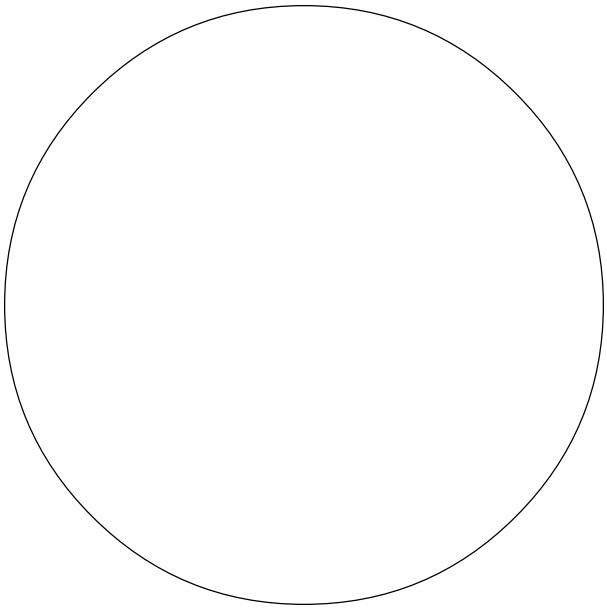
1. Cover one end of a tube with a piece of aluminum foil. Tape the foil to the tube.
2. Place a pinhole in the centre of the foil.
3. On a second tube, cover one end with wax paper; tape it to the first tube.
4. Tape the wax paper end of the tube to the foil tube (opened end).

Have students aim their camera obscura at an object that is in bright light. Have them describe what they see. Students could also observe a candle and describe what it looks like. Have students discuss and record what they observed. An explanation of how the camera obscura works can be found on page 17, *Light up Your Life!*, Pan-Canadian Science Place.

Activity Sheet 24: Camera Obscura

My object is _____

Illustration of the object as viewed through the camera obscura.



Description as viewed through the camera obscura.

_____

_____

_____

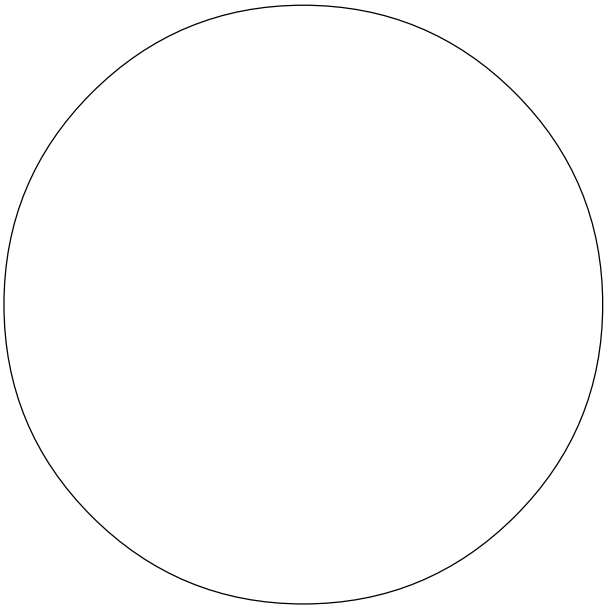
_____

_____

_____

_____

Illustration of the object as viewed without the camera obscura.



Description of the object as viewed without the camera obscura.

_____

_____

_____

_____

_____

_____

_____

Activity 25: People and Light

Outcome

Students will be expected to

- identify women and men in their community who have careers using optics (107-10)

Assessment

- Students are able to demonstrate an understanding of how women and men use lenses, mirrors, and prisms in their careers.
- Students are able to identify careers associated with light.
- Students are able to do research to find inventions and inventors who pioneered the use of optical devices.

Questions

- Who in our community would use lenses, mirrors, and/or prisms?
- Who invented various optical devices, and how have these devices helped us?

Materials

- computers
- Internet
- reference material

Procedure

This learning experience is designed to broaden students' understanding on how optical devices are used in careers. It also helps to further build a background of information for future reference in this unit. Guest speakers from local optical companies, lab technicians, or photographers could be invited to speak in the class. Research on famous inventors and innovations of optical devices would be carried out during the English language arts program. Information would be shared with the class.

Additional Activity: Perform a dramatic sketch based on the life of a famous light scientist. Students can act out the discoveries made by the scientist.

Teacher Reference: Grade 4 Research Project on Light

The aim of this research project is to have students investigate the development of optical devices or materials. Students will be expected to find information on the devices and/or materials that include the following:

- the purpose of the device
- where and how the device is used
- who invented the optical device
- when and where it was invented
- how it has helped humans

Students may do their research on one of the following devices (or one that they have approved by their teacher). Each class should have one of each optical device researched.

- microscope
- laser light
- fibre optics
- telescope
- mirrors
- kaleidoscope
- periscope
- lenses
- binoculars
- reading glasses
- overhead projectors
- cameras

Activity 26: Human-made Sources of Light

Outcome

Students will be expected to

- describe properties of light that have led to the development of optical devices that enhance our ability to observe (106-1, 106-4)

Assessment

- Students are able to identify sources of light that humans have developed.
- Students are able to explain how these sources of light have solved problems in the school and at home.

Questions

- What sources of light have been developed by humans?
- How have these sources of light helped to solve problems both at school and at home?

Materials

- examples of sources of light (laser level, fluorescent bulb)
- fibre optics
- incandescent bulb
- compact fluorescent bulb

Procedure

In groups, have students discuss sources of light that humans have developed. Have each group share their ideas, and have them put them on chart paper. Have groups discuss how these sources of light have solved problems. Record their answers. Have students record class results in their science journals. Show students examples of human-made sources of light.

Activity Sheet 26: Human-made Sources of Light

Human-made Sources of Light	Problems They Have Solved

Activity 27: Light Sources

Outcome

Students will be expected to

- plan an investigation and communicate questions and ideas with others about light emitted from an object, its own or an external source (204-7, 207-1, 303-3)

Assessment

- Students are able to present their ideas on objects that emit their own light and those that require an external source.
- Students are able to demonstrate an understanding of the term **emit**. Students are able to sort objects by those that emit their own light and those that require an external source.

Questions

- What does the term **emit** mean?
- How did you determine which objects emit their own light and which need an external source?

Materials

- light sticks
- watch (with LED light)
- flashlights
- pictures of windows
- pictures of a firefly
- book
- paper

Procedure

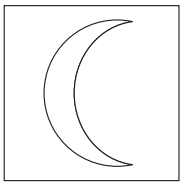
Discuss with students the term **emit**. Develop a working definition for it and have students record the definition in their science journals. Give students a variety of materials and have them sort them into those that emit their own light and those that require an external source to be seen. Have students explain their sorting rules. Have them record their findings in their science journals, discuss with students other items that emit their own light.

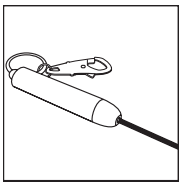
Additional Information: A light source is an object that emits its own light, either natural or artificial. An illuminated object such as the moon reflects the light of the sun and therefore needs an external light source to be seen.

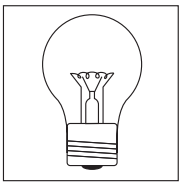
Additional Activity: What if the only sources of light were natural sources? Ask your students to think about how their lives would be different if this was so. Have them write about a typical day in a "natural light only" world.

Activity Sheet 27: Light Sources

Decide whether the following emit their own light or if they need a light source to be seen.

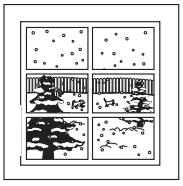
Moon 

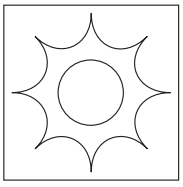
Laser 

Light bulb 

Fire 

Candle 

Window 

Sun 

Watch 

Activity 28: Dispersement of Light

Outcomes

Students will be expected to

- make observations and collect information about the reflective and refractive properties of various materials of different shapes (205-5)
- observe, demonstrate, and make conclusions about how light travels and is dispersed from a variety of light sources (206-5, 303-2)

Assessment

- Students are able to present their prior knowledge on their understanding of the term **dispersement**. Students are able to observe, note, and record the differing ways in which light is dispersed from various sources.

Questions

- What does the term **disperse** mean?
- How did the light that was dispersed from a flashlight differ from the light dispersed from a candle?
- What differences are there in the various light sources available to us regarding dispersing of light (fluorescent, floodlights)?

Materials

- flashlights
- candles
- aluminum foil
- matches
- laser level

Procedure

In this learning experience, the word **disperse** should be reviewed with the students. As the lesson progresses, a working definition of the word should be developed as it relates to light. Darken the classroom and give students a flashlight. Ask them to decide if the light is directed in a specific direction or if it scatters the rays of light. Then have the students use a candle. (Have them place it on aluminum foil to protect the desk.) Have the students compare the two light sources. Have them discuss the light sources they have observed.

Activity Sheet 28: Dispersement of Light

Illustrate and describe the dispersement of light from various light sources.

Name of light source:	Illustration of dispersement of light:
Description of what I observed:	

Name of light source:	Illustration of dispersement of light:
Description of what I observed:	

Activity 29: Changes in the Direction of Light

Outcome

Students will be expected to

- observe, demonstrate, and make conclusions about how light travels and is dispersed from a variety of light sources (206-5, 303-2)

Assessment

- Students are able to observe, demonstrate, and record how light is able to be directed away from a source.
- Students are able to observe, demonstrate, and record how light travels in all directions away from a source.

Questions

- What did you observe about the light coming from a candle and a flashlight?
- How did using only the light bulb from a flashlight change the direction of the light?
- What effect did placing the aluminum plate behind the candle have on the direction of light?

Materials

- flashlights
- bell wire
- candles
- aluminum foil (to place candle on)
- matches
- small aluminum pie plate

Procedure

Have the students repeat Activity 28: Dispersement of Light, noting the direction of the light from a candle and a flashlight. Have the students carefully take the light bulb out of the flashlight and have them light it using a battery and wire. Ask them to compare the two ways. Now have the students put an aluminum pie plate behind the candle. Have them note any differences they observed in the dispersement/direction of the light. Discuss with students what they observed and what conclusions they came to as to the reasons there were differences.

Activity 30: How Light Travels

Outcome

Students will be expected to

- observe, demonstrate, and make conclusions about how light travels and is dispersed from a variety of light sources (206-5, 303-2)

Assessment

- Students are able to observe and illustrate that light travels in a straight line.

Question

- What were you able to observe about how light travels?

Materials

- dark room
- chalkboard brushes
- flour
- a strong flashlight
- flashlight
- laser level (optional)

Procedure

This is a teacher-directed activity. One should be aware of students' sensitivity to chalk dust (flour can be used as an alternative to chalk dust). Have students discuss if they think light travels in a straight line. From the discussions demonstrate how light does travel in a straight line.

Option 1: Clap chalkboard brushes or use chalkboard brushes covered in flour to create a dusty environment in the classroom. Use a strong flashlight or film projector and have the students illustrate and describe what they observed.

Option 2: Teacher (not students) uses a laser level to show that light travels in a straight line. Make sure that students do not look directly into the laser light.

Activity Sheet 30: How Light Travels

Illustration of the path of light:

Description of what was observed:

Activity 31: Light Travels through or Not

Outcome

Students will be expected to

- investigate and predict how light interacts with a variety of objects (including changes in the location, shape, and relative size of a shadow) in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light (303-4, 303-5)

Assessment

- Students are able to sort objects based on whether they will allow light to pass through them or not.
- Students are able to explain their sorting rules.
- Students are able to observe and record objects that cast a shadow when light is directed at them.

Questions

- What were the characteristics of the objects that allowed light to pass through them?
- What were the characteristics of the objects that would not allow light to pass through them?
- What objects cast a shadow when light was directed at them?

Materials

- miras
- water
- pop bottles
- geometric solids (wooden)
- books
- wax paper
- coloured cellophane
- Bristol board
- flashlights
- activity sheet

Procedure

Give each group of students a variety of objects. Have them use a flashlight to see whether light will pass through them or not. Have students sort the objects accordingly. Have students record their answers in their science journals or on the activity sheet. Have the students shine the flashlight on the objects. Have them record which objects give a shadow when light is directed at them. Have students describe what they observed and discuss what happened. Ask students to discuss whether there is a correlation between objects that will not allow light through them and shadows. Have students illustrate an object and its shadow.

Activity Sheet 31: Light Travels through or Not

Objects that allowed light to travel through them.	**Characteristics of the objects that allowed light to travel through them.**
Objects that did not allow light to travel through them.	**Characteristics of the objects that did not allow light to travel through them.**

Illustration of an object and its shadow when light was directed at it:

Activity 32: Opaque, Transparent, and Translucent

Outcome

Students will be expected to

- classify objects as opaque, transparent, or translucent (206-1)

Assessment

- Students are able to sort materials according to the properties of opaque, transparent, and translucent.
- Students are able to explain their sorting rules.

Questions

- What does the term **opaque** mean?
- What does the term **transparent** mean?
- What does the term **translucent** mean?

Materials

- miras
- water
- pop bottles
- books
- solids
- geometric solids (wooden)
- wax paper
- coloured cellophane
- Bristol board
- tissue paper
- flashlights
- activity sheet

Procedure

Review with the students what they learned from the previous activity, Light Travels through or Not. Introduce and discuss the terms **opaque**, **transparent**, and **translucent**. Have students sort their objects according to these characteristics. Have students explain their sorting rules. Have students write definitions and examples of each term in their science journals. Discussions could take place around the importance/use of materials that are opaque, translucent, or transparent.

Have students give examples of transparent, opaque, and translucent that are not within the classroom.

Teacher Note:

Opaque: Object absorbs or reflects light, but does not allow light to pass through it.

Transparent: Light can pass directly through an object, and you can see the light fully on the opposite side.

Translucent: Object transmits light, but allows no real detail to pass through.

Additional Activity: Working with different colours of transparent, opaque, and translucent materials create collages. Place the collages in a window that receives direct sunlight so that children can observe what happens when light strikes the collage.

Activity Sheet 32: Opaque, Transparent, Translucent

List the objects under the following headings:

Transparent	Translucent	Opaque

Characteristics of an object that is transparent.

Characteristics of an object that is translucent.

Characteristics of an object that is opaque.

Activity 33: Shadows and Light

Outcome

Students will be expected to

- investigate and predict how light interacts with a variety of objects (including changes in the location, shape, and relative size of a shadow) in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light (303-4, 303-5)

Assessment

- Students are able to demonstrate their knowledge of shadows through illustrations and explanations.
- Students are able to explain both verbally and in written form how the direction and position of a light source affects the shape, location, and size of a shadow.

Questions

- What causes a shadow?
- How did the size of the shadow change when the position of the light source changed?
- How did the shape of the shadow change when the position of the light source changed?

Materials

- geometric solids (wooden)
- flashlights
- white ticket board (9 × 12) sheets to act as a screen

Procedure

This learning experience is designed to have students explore shadows and what effect the direction and location of a light source have on the size and shape of a shadow. In pairs, students should be given the opportunity to explore making shadows. Students should share their observations with the class. Using these observations, students should design a question to investigate. They should experiment and record the shadows they made. Students should decide what variable(s) to control. For example, students could hold the light source parallel to an object and a set distance from it and record/illustrate the shadow it made. They could then change the angle, keeping the same distance. It is important for students to keep a record of these results. This could be shared with the class.

Activity 34: Reflective Surfaces

Outcome

Students will be expected to

- make observations and collect information about the reflective and refractive properties of various materials of different shapes (205-5)

Assessment

- Students are able to demonstrate an understanding of the term **reflective surfaces**.
- Students are able to record and explain what happens when a smooth reflective surface becomes crumpled and wrinkly.

Questions

- What do we mean by the term **reflective surface**?
- How does an image appear when the reflective surface is smooth, flat, and clear?
- How does the image change in appearance when the surface is wrinkled and crumpled?

Material

- aluminum foil

Procedure

Give students a piece of aluminum foil. Have them observe the reflection of themselves or an object in it. From this, build a working meaning of the term **reflective surfaces**. Now have the students wrinkle the aluminum foil. Have them look at the same image. How has the image changed in appearance? How has the surface of the aluminum foil changed the reflective properties of light?

Activity 35: Mirrors (Concave, Convex, Flat)

Outcome

Students will be expected to

- make observations and collect information about the reflective and refractive properties of various materials of different shapes (205-5)

Assessment

- Students are able to demonstrate and explain what they observed when using a mirror.
- Students are able to demonstrate and explain how the shape of a mirror changes the shape of an image.
- Students are able to explain the differences between the shape of concave and convex mirrors.

Questions

- What did you observe when you used a plain, flat mirror?
- How is the shape of a concave and a convex mirror different?
- What differences did you notice in the reflective image of an object through a concave and through a convex mirror?

Materials

- plain mirror
- concave mirror
- convex mirror
- shiny spoons (in place of concave and convex mirrors)
- activity sheet

Procedure

Allow students time to explore plain, concave, and convex mirrors. After they have had time to explore their properties, give students a plain mirror and have them discuss what they observed about the reflected image. Give students a concave mirror and a convex mirror and have them record and discuss the differences in them. Have them use the mirrors to view objects. Have them record what they observed. Discuss as a class what they observed. Ask students where mirrors are used in daily life.

Activity Sheet 35: Mirrors (Concave, Convex, Flat)

Mirror Type	Illustration of the Image as Viewed in the Mirror	Description of the Image as Viewed in the Mirror
plain, flat		
concave		
convex		

Activity 36: Making a Periscope

Outcome

Students will be expected to

- make observations and collect information about the reflective and refractive properties of various materials of different shapes (205-5)

Assessment

- Students are able to build a periscope.
- Students are able to explain how mirrors make the periscope work.
- Students are able to discuss where periscopes are used.

Questions

- What is a periscope?
- Where do we use periscopes?
- How do the mirrors enable the periscope to work?

Materials

- 2 mirrors (6.5 cm × 9 cm) per group
- masking tape (optional)
- 1-L milk cartons (cartons with screw on tops and those without will work)

Procedure

This activity is an extension in addressing this particular outcome.

Students should be asked to bring in clean milk cartons prior to this lesson. It would be good to have extra cartons in case their first design does not work. Students should be allowed to work in groups.

In Activity 22: Optical Devices, students were given the opportunity to use a periscope. If they did not do this activity, discussions should take place around what a periscope is, where it is used, and the properties or components that make it work. An example of a periscope, either real or a picture, could be made available to students.

After these discussions, allow students the opportunity to design their own periscopes. Students should be invited to draw a sketch of what their periscopes will look like using the materials they will be given.

Give students the materials needed to make a periscope. Ask them to build a periscope. Have them use their periscopes to view objects. As a class discuss where periscopes are used and how the mirrors enable them to work. Have students draw their periscopes in their science journals. Have them describe and draw what they saw and how their periscopes worked.

Teacher Reference:

Step 1: Cut out a small, square hole in the bottom and top of the milk carton. The square holes should be on opposite sides.

Step 2: Cut slits in the sides of the milk carton to hold the mirrors. The angle and location of the mirror will have an impact on making the periscope work.

Step 3: Place the mirrors in the slots and test the periscope.

Step 4: View an object through your periscope.

Activity 37: Making a Kaleidoscope

Outcome

Students will be expected to

- make observations and collect information about the reflective and refractive properties of various materials of different shapes (205-5)

Assessment

- Students are able to build a kaleidoscope.
- Students are able to explain how mirrors make the kaleidoscope work.

Questions

- What is a kaleidoscope?
- Where do we use kaleidoscopes?
- How do the mirrors enable the kaleidoscope to work?

Materials

- 3 mirrors (6.5 cm × 9 cm) per group or 3 mirrors of the same size per group
- masking tape
- construction paper or Bristol board
- tracing paper
- small beads

Procedure

Students should be allowed to work in groups.

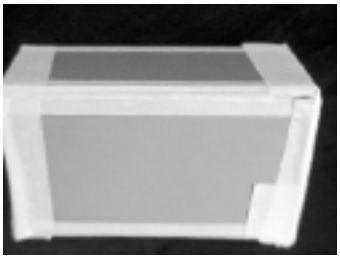
In Activity 22: Optical Devices, students were given the opportunity to use a kaleidoscope. If they did not do this activity, discussions should take place around what a kaleidoscope is, where it is used, and the properties or components that make it work. An example of a kaleidoscope, either real or a picture, could be made available to students.

After these discussions are completed, allow students the opportunity to design their own kaleidoscopes. Students should be invited to draw a sketch of what their kaleidoscopes will look like using the materials they will be given.

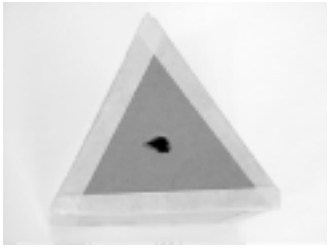
Give students the materials needed to make a kaleidoscope. Ask them to build it. Have them use their kaleidoscopes to view objects. As a class, discuss where kaleidoscopes are used and how the mirrors enable them to work. Have students draw their kaleidoscopes in their science journals. Have them describe and draw what they saw and how their kaleidoscopes worked.

Teacher Reference:

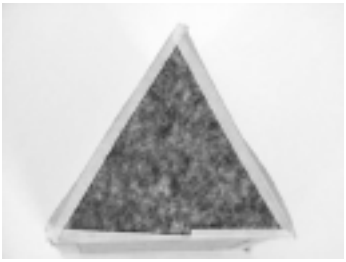
Step 1: Tape the three mirrors together with the reflective surfaces facing inward to form a triangle.



Step 2: Stand the mirrors on the construction paper and trace around them. Have the students cut the triangle out and tape it to the bottom of the mirrors. Using a pencil, place a small hole in the middle of the construction paper.



Step 3: Follow step 2 using tracing paper and tape the triangle to the other end of the mirrors.



Step 4: Through the hole in the construction paper place a number of small beads inside the mirrors.

Step 5: Looking through the hole in the construction paper and aiming a flashlight at the end with the tracing paper, turn the kaleidoscope and view what happens.

Activity 38: Bending Light

Outcome

Students will be expected to

- demonstrate and describe how a variety of media can be used to change the direction of light (303-6)

Assessment

- Students are able to demonstrate and observe that light bends as it travels from one medium to another.
- Students are able to understand the term **refraction**.
- Students are able to illustrate and describe the bending of light rays.

Questions

- What happened to the rays of light as they travelled from one medium to another?
- What is meant by the term **refraction of light**?

Materials

- water
- clear plastic cups
- pencil
- coin
- aquarium
- flashlight

Procedure

Give each group of students a clear plastic cup with water in it. Have them stand a pencil in the water. Have them draw and explain what they observed when they looked at the pencil from the air into the water. Now have the students put a coin in the water. Have them stand to the side of the water and drop stones in to try to touch the coin. Have them explain what happened.

Teacher Demonstration: Fill a small aquarium three-quarters full of water. Add some milk to the water to make it cloudy. Using a strong flashlight, hold it at an angle and shine it into the water. Ask the students where the rays of light are. Then, by using a ruler or metre stick, demonstrate where the rays of light would be if they hadn't been refracted going from air into water. Have them illustrate and explain in their science journals what they observed.

Teacher Note: The reason why the coin appeared to move is because the light bends or changes direction when it moves into a substance of a different density. This will also happen when light moves from colder air, which is less dense, into warmer air. That is why objects have a shimmering effect on a hot day, such as asphalt on the highway and sand on the desert. The effect is a mirage.

Activity 39: Water Drops

Outcome

Students will be expected to

- demonstrate and describe how a variety of media can be used to change the direction of light (303-6)

Assessment

- Students are able to observe how water drops are able to magnify an image.
- Students are able to observe that the higher and more rounded a water drop is, the more it magnifies.

Questions

- What effect do water drops have on an image?
- How did the size and shape of the water drop change the amount of magnification?
- What does the term **magnify** mean?

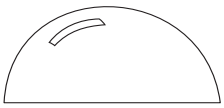
Materials

- wax paper
- eye dropper
- water
- cups to hold water
- newspaper
- activity sheet

Procedure

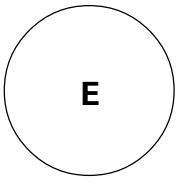
Have students place a piece of wax paper over a piece of newspaper. Using an eye dropper, have the students experiment with various sizes of water drops. Have them illustrate and write what they observed. As a class, have the students share their findings. This learning experience will help students develop a working understanding of magnification.

Teacher Reference:



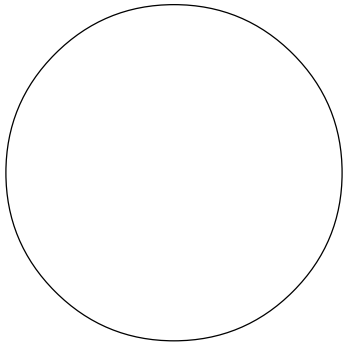
small, rounded water drop

large, flat water drop

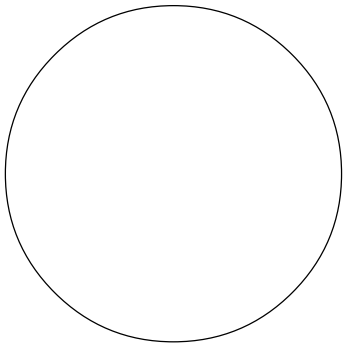


A small, round drop magnifies more than a large, flat water drop.

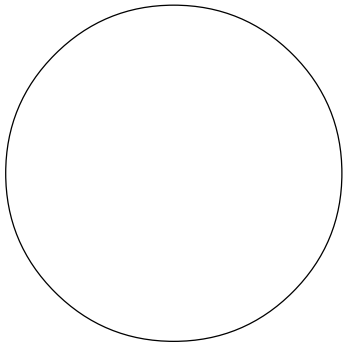
Activity Sheet 39: Water Drops



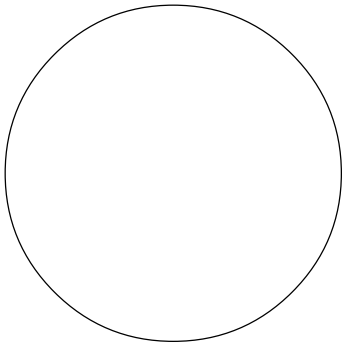
size of print without looking through a water drop



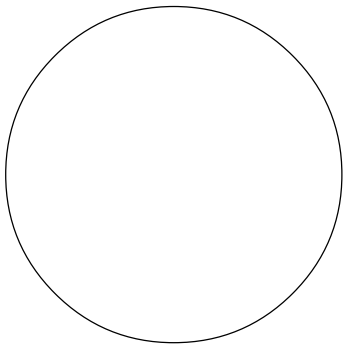
size of print looking through a water drop



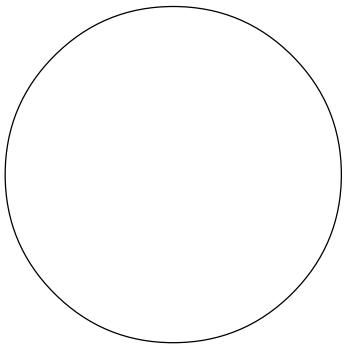
shape of the water drop



size of the print



shape of the water drop



size of the print

What I observed.

Activity 40: Concave and Convex Lenses

Outcome

Students will be expected to

- demonstrate and describe how a variety of media can be used to change the direction of light (303-6)

Assessment

- Students gain an understanding of the terms **concave** and **convex**.
- Students are able to illustrate and explain the physical characteristics of concave and convex lenses.
- Students are able to illustrate, describe, and explain how an object appears when viewed it through a convex or concave lens.
- Students are able to illustrate and describe what they observed when using a concave or convex lens in placing an image on a screen.

Questions

- What do the terms **concave** and **convex** mean?
- What are the physical differences between a concave and convex lens?
- How were you able to distinguish between the two lenses when trying to put an image on the screen?
- How were you able to distinguish between the two different types of lenses when viewing an object?

Materials

- concave lenses
- convex lenses
- candles
- aluminum foil
- matches
- 8.5 × 11 pieces of ticket board
- darkened room
- newspaper
- water
- activity sheet

Procedure

Part 1: Give students a concave and a convex lens. Have them compare their shapes to those of concave and convex mirrors. Ask students if they are able to tell by the shape which lens is concave and which is convex. Once they have established the physical differences between the two lenses, have them view objects with them. Ask them to describe and illustrate the differences in the appearances of the objects when using the two different types of lenses. Discuss their findings as a class.

Caution: Do not allow students to look at the sun with the lenses.

Part 2: Prior to beginning this learning experience, discuss with the class safety procedures for using candles. You should light the candles. In this part of the learning experience the room should be darkened as much as possible. Give each group of students a concave and a convex lens, a candle, aluminum foil to place the candle on, a piece of ticket board, and water. Pose the following challenge: By using either a concave or a convex lens, project the image of the lit candle on a white screen/paper. Allow the students time to experiment with the position of the lenses, candle, and screen. Have the students illustrate and write what they observed. As a class, discuss their observations.

Activity Sheet 40: Concave and Convex Lenses

Illustration of the Object without a Lens	**Illustration of the Object Viewed through a Concave Lens**	**Illustration of the Object Viewed through a Convex Lens**
Description	Description	Description

Illustration of a concave lens.

Describe it.

Illustration of a convex lens.

Describe it.

Activity 41: Converging and Diverging Light Rays

Outcome

Students will be expected to

- demonstrate and describe how a variety of media can be used to change the direction of light (303-6)

Assessment

- Students are able to illustrate and describe diverging light rays as they pass through a concave lens.
- Students are able to illustrate and describe converging light rays as they pass through a convex lens.
- Students are able to demonstrate an understanding of the terms **converge** and **diverge** as they relate to rays of light.

Questions

- What does the word **diverge** mean as it relates to light?
- What does the term **converge** mean as it relates to light?
- How did the light rays differ as they went through a convex lens compared to that of a concave lens?

Materials

- Rive Ray Box (optional) (purchased from a science company)
- concave lenses
- convex lenses
- chalkboard erasers
- flour (optional)
- darkened room
- flashlight

Procedure

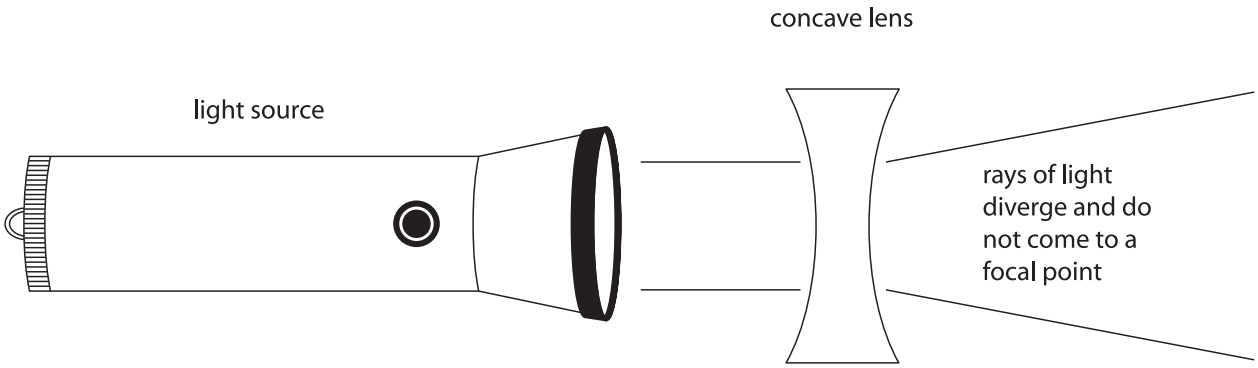
This learning experience is teacher directed.

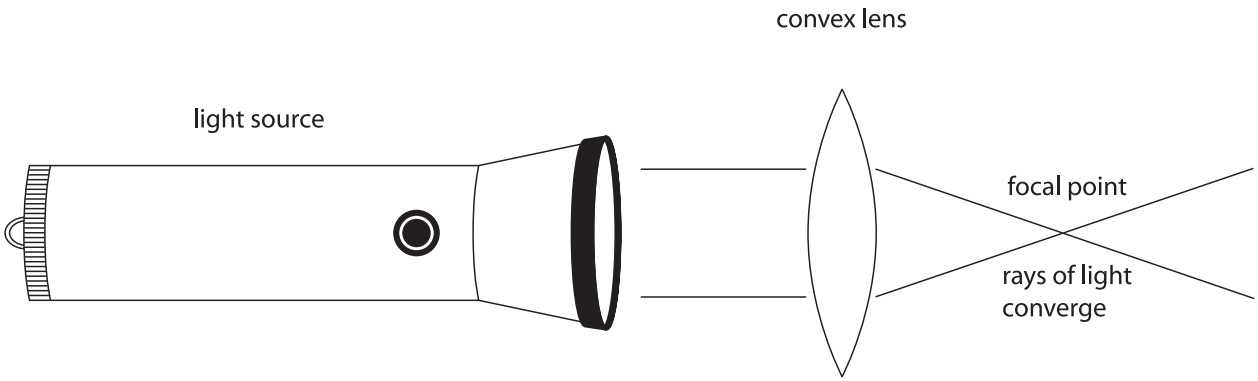
Clap chalk brushes together to create "dusty" air. (If students are sensitive to chalk dust, flour can be used instead.) Using a flashlight, shine the rays of light through a concave lens. Have students observe how the rays of light react as they pass through the lens. Now do the same using a concave lens.

Discuss with students what they observed. Have them illustrate and describe what they observed in their science journals.

Discuss the uses of concave and convex lenses in everyday life.

Teacher Reference





Activity 42: Prisms

Outcome

Students will be expected to

- demonstrate that white light can be separated into colours (dispersion) and follow a set of procedures to make and use a colour wheel (104-6, 205-3, 303-7)

Assessment

- Students are able to show an understanding of the term **dispersion** as it relates to light.
- Students are able to make a rainbow using a prism.
- Students are able to illustrate and describe what they observed as light travelled through a prism.

Questions

- What do we mean by the term **dispersion of light**?
- Where have you observed rainbows?
- What happens to white light as it passes through a prism?

Materials

- prisms
- flashlights
- darkened room

Procedure

Discuss with students where they have observed rainbows. Record their responses on chart paper. In groups, give students a prism and a flashlight and ask them to create a rainbow. After they have created a rainbow, have them describe and illustrate what they have observed.

Additional Activity: Using a large, round coffee filter, eye droppers, food colouring, water, and small containers, experiment with mixing colours. Drop single colours on the coffee filter in their own spaces and record what happens in your science journal. Now make a drop of one colour on top of a different colour and record what happens. Now add a drop of water to either the single or mixed drop of colours and record what happens.

Additional Activity: Have students work in groups to research the different meanings associated with different colours. For example, some cultures use white for east, yellow for north, blue for west, and red for south. Other cultures use black for death or mourning and white for happiness, etc. (multicultural).

Activity 43: Colour Wheels

Outcome

Students will be expected to

- demonstrate that white light can be separated into colours (dispersion) and follow a set of procedures to make and use a colour wheel (104-6, 205-3, 303-7)

Assessment

- Students are able to follow directions and make a colour wheel.
- Students are able to describe what happens to the colours on a colour wheel as it turns.

Questions

- What are the colours you used to make the colour wheel?
- What happened when the colour wheel was spun around?

Materials

- ticket board
- coloured pencils/crayons and/or markers
- string

Procedure

Discuss with students the colours they observed when viewing their rainbows in the activity Prisms. Explain to students that they are going to make a colour wheel. Give each student a piece of ticket board with a circle on it. Have them divide the circle into equal sections based on the number of colours they are going to use. Have them colour in the sections. After they have coloured the circle, have them cut the circle out. Have them spin it around by poking a hole in the middle of the circle and placing it on a sharpened pencil point. Ask students to describe what they observed. Depending on the colours used, students may not be able to have all the colours blend together to make white. Students could try to make "buzzer buttons" as another form of a colour wheel. Refer to the Dispersion of Light section in this guide.

Appendix G: Activities for Physical Science: Sound

Activity 44: Activating Prior Knowledge—Sound

Outcome

- identify objects by the sounds they make and describe examples of devices that enhance our abilities to hear and collect sound data (106-1, 107-1, 303-9)

Assessment

- Students are able to explain what it felt like when there was a lot of noise.
- Students are able to explain what it felt like when there was no noise.
- Students were able to describe whether they like it better with a lot of noise or when it is quiet.

Questions

- What did it feel like when there was so much noise?
- What did it feel like when it was very quiet?
- What did it feel like when you knew there was a lot of noise, but couldn't hear it?

Materials

- headphones

Procedure

This learning experience is designed to have students realize and think about the importance of sound. The experiences they gain from this activity will act as a foundation for the bigger picture of the way we use sound and the devices that have been invented to help reduce noise.

Have half of the students take out a book and begin to read it. As they are reading have the other half of the class make as much noise as possible. After a minute or two have the class switch roles. Discuss how they felt.

Now have the whole class be quiet and reading. Have them describe how this experience felt.

Have half of the students put on headphones. In groups of two, have the person without headphones on try to carry out a conversation with the student with headphones. Have them describe their experience. Now, have the students switch roles.

Have all of the students put on headphones. Have them make a lot of noise. Then have them take the headphones off and make a lot of noise. Have them describe this experience.

Activity 45: Name That Sound

Outcome

Students will be expected to

- identify objects by the sounds they make and describe examples of devices that enhance our abilities to hear and collect sound data (106-1, 107-1, 303-9)

Assessment

- Students are able to describe and identify mystery sounds.
- Students are able to challenge other students to identify sounds they make.

Questions

- How do we rely on our hearing to identify sounds?

Materials

- tape(s) with various sounds
- materials or objects that make sounds
- activity sheet (optional)

Procedure

Part 1: Make a tape(s) that has various sounds (a truck backing up, running water, a door closing, a school bell, music, students talking, etc.). In groups or as a class, play the tape(s) and have students identify the type of sound and what made it. Have students compare their answers.

Part 2: Play the tapes with increased volume. Then have students sit quietly for 30–60 seconds. Have them describe how they felt when the tape(s) were playing and when it was quiet.

Activity Sheet 45: Name That Sound

Description of the Sound	What Made the Sound?	Illustration of the Item That Made the Sound

How do we depend on our hearing to identify sounds?

Take two of the above sounds and tell whether it is important that they can be heard or not. Explain your answer.

Activity 46: Sounds and Our Everyday Needs

Outcome

Students will be expected to

- identify objects by the sounds they make and describe examples of devices that enhance our abilities to hear and collect sound data (106-4, 107-1, 303-9)

Assessment

- Students will be able to identify sounds and describe how they are used in our everyday lives.

Question

- How do sounds help us in our daily lives?

Materials

- tape(s) from Activity 45: Name That Sound
- Activity Sheet 45: Name That Sound

Procedure

Have students discuss how the sounds they heard help them in their daily lives. Have them record their discussions. Have students describe other sounds they have heard and how these sounds help them to meet their everyday needs. Groups should share their discussions with the class.

Activity 47: Technology and Sound

Outcome

Students will be expected to

- identify objects by the sounds they make and describe examples of devices that enhance our abilities to hear and collect sound data (106-1, 107-1, 303-9)

Assessment

- Students are able to describe the type of technology needed to make various sounds.
- Students are able to explain how sound and technology have helped to make the world safe.

Questions

- How has technology helped to produce sounds that we use in our daily lives?
- How has this technology helped to make the world around us safe?

Materials

- radio alarm
- TV
- pictures of objects that make sounds
- activity chart

Procedure

Part 1: This learning experience is designed to help students recognize how sound helps to provide a safer environment for us. It is also designed to have students begin to understand how technology produces sound. Give students examples (real or pictures) of various items that produce sound. Have them discuss the type of technology needed to produce the sound and how it helps to provide safety. Have students record their discussions and share them with the class.

Part 2: Have students bring in either examples or pictures of items that produce sound. Have them discuss the type of technology used and the safety aspect of the item. Have them share their discussions with the class.

Activity Sheet 47: Technology and Sound

Object/Item	Technology Used to Make the Sound	How the Sound/Item Is Used to Make Our Lives Safe

How has technology helped to produce sounds that we use in our daily lives?

How has this technology helped to make the world around us safe?

Activity 48: Sound Vibrations

Outcome

Students will be expected to

- relate vibrations to sound production and compare how vibrations travel differently through a variety of materials (303-10, 303-11)

Assessment

- Observe students as they work in groups to see what effect vibrations have on objects.
- Students are able to determine the impact of various substances (solids, liquid, air) as they relate to vibrations.

Questions

- How did the type of substance (solid, liquid, air) affect the vibration produced?
- What did you observe about sound vibrations when a plastic cup was filled with various substances?

Materials

- clear plastic cups
- plastic wrap
- water
- a solid
- air
- tuning forks
- rice or sand
- activity chart
- elastic band

Procedure

Explain to the class that in this activity they are going to compare vibrations and the movement of an object. Give each group three plastic cups, rice, plastic wrap, a solid, water, an elastic band, a tuning fork, and rice or sand. Have students put plastic wrap over a plastic cup and hold it in place with an elastic band. Have them put a few grains of rice or sand on top of the plastic wrap. Have them touch the side of the plastic cup with a vibrating tuning fork. Have them record what they observed. Students should follow the same procedure when the cup is filled with a solid or a liquid. As a class discuss the differences they noticed.

Activity Sheet 48: Sound Vibrations

Diagram of the object and sound vibrations:	What I observed:
Diagram of the object and sound vibrations:	What I observed:

How did the type of substance (solid, liquid, air) affect the vibrations produced?

Activity 49: Pitch and Loudness

Outcome

Students will be expected to

- relate vibrations to sound production and compare how vibrations travel differently through a variety of materials (303-10, 303-11)

Assessment

- Students are able to distinguish between pitch and loudness.

Questions

- How does the pitch of various objects differ?
- What do the terms **pitch** and **loudness** mean?

Materials

- plastic rulers
- tuning forks
- drinking glasses
- blades of grass
- radio or stereo speakers
- voice

Procedure

This learning experience is designed to give students an opportunity to understand the terms **pitch** and **loudness** through their own experiences. You may wish to do this activity in a centres format to reduce the number of materials required.

Plastic rulers: Have students vibrate (snap) rulers of various sizes on their edge of the desk. Have them note whether the sound is low, high, or loud.

Tuning forks: Using various pitched tuning forks, have students decide whether they have a high or low sound.

Glasses: Fill the same size glasses with various amounts of water. Have students tap the outside of the glasses and decide which ones have a high or low sound.

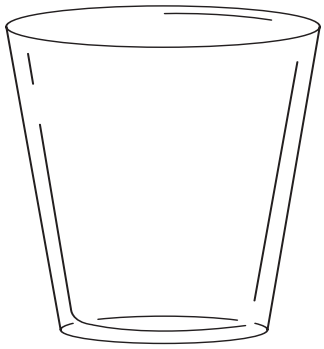
Blades of grass: Holding a blade of grass tightly between their two thumbs have students make various sounds by blowing air through it. Have them decide whether the sounds are low or high.

Stereo/radio: Have students vary the volume on a stereo or radio. Have them discuss its loudness.

Voice: Have students change the loudnes and the low and high of their voices. Have students record their results and share them with the class. From these discussions, develop a working definition of the term **pitch** (highness or lowness of a sound). Discuss how this is different from loudness.

Activity Sheet 49: Pitch and Loudness

Indicate the type of liquid, the amount of the liquid, and the pitch of the sound when tapped with an object.

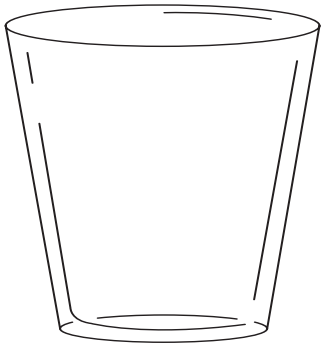


Type of liquid:

_____

Type of pitch:

_____

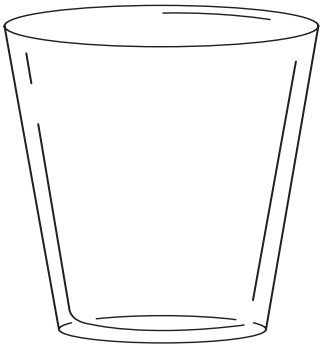


Type of liquid:

_____

Type of pitch:

_____



Type of liquid:

_____

Type of pitch:

_____

What I think the term **pitch** means:

_____

The difference between pitch and loudness is

_____

Activity 50: Vibrations in Liquids

Outcome

Students will be expected to

- relate vibrations to sound production and compare how vibrations travel differently through a variety of materials (303-10, 303-11)

Assessment

- Students are able to observe and record the vibrations of sound as they travel through various liquids.
- Review what students wrote and drew in their observations of sound travelling through various liquids.

Questions

- What will happen to a liquid when a vibrating tuning fork comes in contact with various liquids?
- What, if any, differences were noticed between the liquids and sound vibrations?

Materials

- 1-L plastic tubs (margarine, desert topping, ice cream, etc.)
- water
- vegetable oil
- vinegar
- corn syrup
- tuning forks

Procedure

Have students work in groups. Give each group 1-L tubs containing water, vegetable oil, vinegar, and corn syrup. Have them predict and record what they think will happen to the liquid when a vibrating tuning fork touches it. Have them test their predictions and have them record what they observed. From their observations, discuss what caused the liquid to move and if there was a difference in the movement of the liquid in relation to its colour or density. (You may need to review the term **density**.)

Option: Have students try tuning forks with different pitches and discuss the differences in the movement of the liquids.

Activity Sheet 50: Vibrations in Liquids

Type of liquid:	What I observed:
Type of liquid:	What I observed:
Type of liquid:	What I observed:
Illustration of what I observed:	

Describe the differences noted between the liquids and sound vibrations.

Activity 51: Good Vibrations!

Outcome

Students will be expected to

- relate vibrations to sound production and compare how vibrations travel differently through a variety of materials (303-10, 303-11)

Assessment

- Observe students as they become involved in various learning experiences to explore how sound waves travel.
- Do they notice that sound travels differently through solids, liquids, and air?
- Can they describe and compare the sounds?
- When they describe the differences in how they hear sounds, are they using the terms **source**, **sound wave**, and **vibration**?

Questions

- How do sound waves travel?
- In which direction or directions do they travel?
- In what ways does the sound change as you listen to the source through solid, liquid, and air?
- Did the softest sound seem to occur through air, water, or liquid? What about the loudest?
- Which sounds were low? Which sounds were high?
- What new questions do we have that might lead to other experiments that can explore how sound travels through air, liquid, and solids?

Materials

For launch activity:

- tuning fork
- plastic rulers
- radio/computer speaker
- plastic bottles
- dominoes

For air, liquid, and solid explorations:

- plastic combs
- waterproof watch
- containers to hold water

Procedure

The following learning experiences are some examples of explorations that can be presented to encourage students to think about the role vibrations play in creating sound waves and that sound travels in all directions, weakening as it moves away from its source. Teachers may wish to use only one of the learning experiences or to use several as a part of rotating activities.

Part 1: As a launch to student exploration, allow students some time to observe the effect of sound vibration. Students can

- feel voice box vibrations as they speak or sing
- observe a vibrating tuning fork dipped in water

- touch a radio/computer speaker that is in operation
- snap rulers on the edge of a desk
- blow across the mouth of a plastic bottle (using various sizes and shapes of the opening will alter the pitch)

Introduce the terms **pitch** and **loudness** by telling students to think about how they might define these terms through comparison of how sound travels. The class can then come up with a working definition of the two terms during final sharing time.

Part 2: Exploring How Sound Travels through Liquid, Air, and Solid

Tell the students before they begin these activities that they need to find a way, using all their group members, to find out which direction or directions sound waves travel.

Have students tap a pencil lightly on a table. Next, listen to the tap using the same intensity with their ear to the table. Lastly, fill a container with water and tap the same pencil on the side of the container, again with the same intensity. Have students place their ear on the adjacent side of the container. Have students discuss their observations as a group and have one person take jot notes so the group can refer to their observations for whole class discussions.

Using a comb, strum the comb with your thumb. Next, listen as you place your ear on a table and strum the comb against the table. Lastly, strum the comb under water. Discuss and record your observations.

Using a waterproof watch that ticks loudly, listen as the watch ticks on your wrist, through a cookie sheet or aluminum pan immersed in water. Discuss and record your observations.

At the end of the explorations, ask one student to report the group's observations.

To model how sound travels faster in denser media, dominoes can be used. Line up and space the dominoes so that each domino just hits off the next one if tipped to simulate sound travelling through air, which is not very dense. Now line up, next to the first set, another long line of dominoes that are very closely spaced (simulating denser media like water or wood). Tip the first domino in each line at the same time, and students will be able to see and hear how the domino waves travel more slowly through the dominoes that are further spaced (air) than those that are more closely spaced (water, wood). This will also model how sound, unlike light, needs a medium through which to travel (there is no sound in space). No dominoes, no sound!

If observations do not lend themselves to discussion on varying pitch and loudness, refer to questions above on soft, loud, low, and high sound. Tell students that they will have the opportunity to explore how pitch and loudness of sound can be modified through air, liquid, and solid. Record new questions that students may have suggested that could be explored. Talk about operational questions. These are questions that students can "do" something with (i.e., operate on).

Activity 52: Modifying the Pitch

Outcomes

Students will be expected to

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

Assessment

- Students are able to explain the differences in pitch using various lengths of straws.
- Students are able to demonstrate the difference in pitches of the various lengths of the straws.
- Students are able to predict what will happen to the pitch when they blow into various lengths of straws.

Questions

- What do you think will happen when you blow into the end of a straw?
- How will the pitch change as you shorten the straw?
- What caused the change in pitch of air as it went through various lengths of the straws?

Materials

- straws (same diameter and length to start the activity)
- activity sheet (optional)

Procedure

Ask students to predict what would happen if they blew air across a straw. Write their predictions on the board or on chart paper. Give each student a straw and have them try it. Discuss as a class what they observed. Pose the question: What do you think will happen to the pitch if the length of the straw is changed? Have students discuss this in their groups and then have them share their ideas with the class. Give students straws and have them cut them to various lengths. Have the students blow air through the straws and record what they observed. Groups should share their findings with the class.

An extension of this activity could be to change the diameter of the straws and have students record the differences in pitch as it relates to the length and diameter of the straw.

Teacher Note: A shorter straw will produce a higher pitch because it produces shorter sound waves. The shorter the sound wave, the higher the pitch.

Students could put various lengths of straws together to make a musical instrument. This could be done as a follow-up to this activity, or it could be used as an option for the activity My Musical Instrument.

Activity Sheet 52: Modifying the Pitch

Length of the Straw (cm)	Diameter of the Straw (mm)	Pitch
Illustration		

What I observed about the pitch in relation to the length of the straw.

What I observed about the pitch in relation to the diameter and length of the straw.

Activity 53: Sound Pitch and Water

Outcome

Students will be expected to

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

Assessment

- Students are able to predict what will happen to the pitch when sound travels through air and water.
- Students are able to observe and record what happens to the pitch when sound travels through air and water.

Questions

- How can we use straws to see how the pitch changes when using air and water?
- What happens to the pitch as the straw moves up and down in water as air is being blown across it?

Materials

- 2-L plastic containers
- water
- straws

Procedure

Review with students what they learned about modifying the pitch in the activity Modifying the Pitch. Have students predict what will happen to the pitch produced by air blowing across a straw when part of it is immersed in water. Write their predictions on the board or on chart paper. In groups have students test their predictions and share the results of their test with the class. Now have students move the straw up and down in the water as they blow across it. Have them record what they observed in the change of the pitch. Students could use various lengths and diameters of the straw to see if there were changes in the pitch. Have groups share their results with the class. Discussions could take place about any musical instruments that change the pitch.

Activity Sheet 53: Sound Pitch and Water

My prediction of what will happen when a straw is placed in water and air is blown across it.

What I observed:

Diagram

Results of various lengths of straws and the pitch of the sound produced as they moved up and down in the water.

Activity 54: Decibels and Sound Intensity

Outcomes

Students will be expected to

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

Assessment

- Students are able to distinguish between pitch and decibels.
- Observe students as they experiment with the concept of decibels.
- Students are able to change the decibel without changing the pitch.

Questions

- What is the difference between pitch and decibel?
- How are you able to change the decibel of your voice?
- How do people who play musical instruments change the decibel of the instrument without changing the pitch?

Materials

- possible materials:
  - drums
  - recorders
  - rubber bands

Procedure

Review with students the term **pitch**. Have the class talk very softly. Then have them increase the volume of their voices. Discuss with the class whether the volume or the pitch of their voices changed. Discuss with students that as the volume increases and the pitch remains the same the change would be measured in decibels. Have students try to make an elastic band, when plucked, become louder without changing the pitch. Have the students try other items to see how the loudness can be increased without changing the pitch.

Activity 55: Musical Instruments

Outcome

Students will be expected to

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

Assessment

- Students will observe and listen to various musical instruments and be able to distinguish between pitch and loudness.
- Students are able to discuss how musical instruments make sound and are able to change the pitch and loudness coming from them.

Questions

- What causes the sound that instruments make?
- How is the pitch changed in musical instruments?
- How is the loudness changed in musical instruments?

Materials

- various musical instruments (if you have a grade 6 band or a violin program, students could be brought to class to demonstrate their instruments)

Procedure

This learning experience is designed to give students a first-hand look at various musical instruments. The knowledge they gain from this experience should help them in the activity My Musical Instrument. Have various types of band/string instruments demonstrated to the class. Have students discuss how the pitch and the loudness are changed in the instruments. Discuss with students the materials used to make the instruments and how the sounds are produced.

Activity 56: My Musical Instrument

Outcome

Students will be expected to

- demonstrate and describe how the pitch and loudness of sounds can be modified; design, construct, and evaluate a device that has the ability to create sounds of variable pitch and loudness (104-1, 205-2, 206-7, 301-3)

Assessment

- Students are able to outline the materials and steps required to make their musical instrument.
- Students are able to gather materials needed to make their musical instrument.
- Students are able to demonstrate how their instruments are able to change their pitch and loudness.
- Students are able to demonstrate problem-solving skills when adjusting the design of their instrument to make it work.

Questions

- What materials are you going to need to make your instrument?
- How will you change the pitch of your instrument?
- How will you change the loudness of your instrument?
- What problems did you encounter and how did you solve them?

Materials

- as required by students
- activity sheet

Procedure

Part 1: Have students work in groups to discuss and complete Activity Sheet 56: My Musical Instrument (The Design).

Part 2: Have the students collect the materials they will need to make their musical instruments.

Part 3: Have students build/construct their musical instruments. Have them complete Activity Sheet 56: My Musical Instrument (Design Changes).

Part 4: Have students demonstrate their instruments to the class. Have them explain how they made them, problems they encountered, and how they resolved them. Students should note the change in pitch and loudness of the various instruments. The class may wish to develop their own tune and play it to other classes.

Activity Sheet 56: My Musical Instrument (The Design)

Name of the instrument:

Materials needed to make it:

How it will produce sound:

Illustration/diagram of the proposed instrument:

How the pitch of the musical instrument will be changed:

How the loudness of the musical instrument will be changed:

Activity Sheet 56: My Musical Instrument (Design Changes)

Name of the instrument:

Design changes made from the original plan:

Problems that were encountered and how they were solved:

Illustration

Activity 57: The Human Ear and Sound

Outcome

Students will be expected to

- describe and illustrate how the human ear is designed to detect vibrations and compare the range of sound heard by humans to that heard by some animals (300-3, 300-4)

Assessment

- Students are able to demonstrate a basic understanding of how the ear works.
- Students are able to notice a difference in sounds when they cover their ears compared to when they are not covered.

Questions

- How do our ears help us to hear?
- How does covering your ears affect the sounds that you hear?
- How does the sense of hearing help us in our daily lives?

Materials

- model or diagram of an ear
- various items that produce sound

Procedure

Discuss with the students how hearing is important in their daily lives. Have them record their thoughts in their science journals. Use various devices to produce sound. Have students cover their ears and describe what they hear. Now have them uncover their ears and listen to the same sounds. Have students describe the differences they noticed. Using a diagram or model of the ear discuss with the students how the ear's various parts help them to hear.

Discussions around the concept that some animals are able to hear sounds that humans cannot should take place. You might wish to bring in a local veterinarian to talk about this concept.

Teacher Note: The human ear and its function is part of the grade 5 health and science program. Students should not be expected to memorize the various parts of the ear.

Activity 58: Noise Pollution

Outcome

Students will be expected to

- use **decibel** in descriptions of sound intensity while investigating the extent of noise pollution and how to reduce it around them and identify devices that produce loud sounds (104-6, 108-1)

Assessment

- Students are able to demonstrate ways to reduce noise pollution.
- Students are able to describe various types of noise pollution.
- Students are able to explain reasons for reducing noise pollution

Questions

- What is noise pollution?
- How can we reduce noise pollution?
- What impact does noise pollution have on your health?

Materials

- examples of insulation to reduce noise pollution
- activity sheet (optional)

Procedure

In groups have students discuss what they think the term **noise pollution** means. Have each group share their ideas with the class. Have groups describe various types of noise pollution and how the noise can be reduced. Have them share their ideas with the class. Have students discuss ways in which society protects itself from noise pollution. Have students discuss and give examples of devices that produce sounds that have a positive effect on them.

Activity Sheet 58: Noise Pollution

Type of Noise Pollution	Ways It Can Be Reduced	Ways We Can Protect Our Hearing from Noise Pollution

What is noise pollution?

What impact does noise pollution have on your health?

Activity 59: Scientists and Sound

Outcome

Students will be expected to

- identify examples of current sound research and technology, including Canadian contributions (105-1, 107-12, 205-8)

Assessment

- Students show the ability to use a variety of resources to gather information.
- Students are creative in the form they use for their presentation.

Questions

- What are the areas of current research that are being conducted in sound?
- How have Canadians contributed to sound technology?

Materials

- non-fiction books
- encyclopedias
- access to the Internet

Procedure

Students should use a variety of resources to research a particular person related to sound technology. Students should be encouraged to be creative in their presentations to the class. This could include dressing up as the scientist/inventor they have researched or developing a PowerPoint presentation. Students may also wish to interview a person at a sound studio or an audio store about changes in technology regarding sound. This activity could be incorporated with Activity 60: Sound and Technology. This could also be carried out as part of the language arts curriculum.

Activity 60: Sound and Technology

Outcome

Students will be expected to

- identify examples of current sound research and technology, including Canadian contributions (105-1, 107-12, 205-8)

Assessment

- Students are able to carry out research on devices that enhance sound.
- Students have gained an understanding of the importance of sound and technology in our daily lives.

Questions

- How does the device you researched help people?
- What is the name of your device?
- Where is your device used?

Materials

- non-fiction books
- encyclopedias
- access to the Internet

Procedure

Brainstorm in groups devices that students are aware of that use sound. Make a class list. From this list give students the opportunity to research a device that they are interested in finding more information about. Have them present their research findings to the class. Speakers from sound studios and audio stores could be brought in to speak to the class.

This activity could be done as a part of the English language arts program.

Appendix H: Activities for Earth and Space Science: Rocks, Minerals, and Erosion

Activity 61: My Favourite Rock

Outcomes

Students will be expected to

- demonstrate respect for the local environment (108-3)
- investigate rocks and minerals and record questions and observations (204-1, 205-7)

Assessment

- Students are able to explain what it was about their rocks that made them unique for them.
- Students are able to explain where they found their rocks and how they went about getting them.
- Students are able to discuss the importance of respecting the habitats of animals and the local environment when looking for a favourite rock.

Questions

- How would you describe your rock?
- Where did you find it and what types of living things were around it?
- What are some reasons that we should be careful of our local habitats and the animals that live there when looking for a rock?
- What makes your rock special to you?

Materials

- rocks

Procedure

This activity lends itself as an introduction to the understanding of rocks and minerals. Students will each be given the opportunity to explore a rock without having to be familiar with scientific terminology. They will be given the opportunity to explore their rock further as the unit progresses and their understanding of the scientific characteristics of rocks and minerals is expanded.

Have students each bring in a rock that they consider to be their favourite. Have them write stories about their rocks, expanding on the questions and assessment suggestions indicated above. Prior to writing, students should work in groups and discuss their rocks with an emphasis on the questions indicated above. Later in this unit students will be able to make their rocks into creatures or "pet rocks."

Activity 62: Looking at Rocks and Minerals

Outcomes

Students will be expected to

- demonstrate respect for the local environment (108-3)
- investigate rocks and minerals and record questions and observations (204-1, 205-7)

Assessment

- Students are able to distinguish between various rock and mineral samples.
- Students are able to use descriptive vocabulary as it relates to describing their rock and mineral samples.
- Students are able to illustrate their rock/mineral samples by size, shape, and colour.

Questions

- How are the various samples the same?
- How are the various samples different?

Materials

- bags with samples of rocks and minerals
- sheet indicating the type of rock or mineral samples
- activity sheets

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work. Many of the activities will include Notes for Teacher. These notes will have some background information that can be used to teach information students will need to complete some activities. It is suggested that after students have had several experiences with the activities a lesson be used to present this information to the students. When and how will be at your discretion.

The science area could be set up with cards for each activity, and students could pick the ones they want to work on. A sample recording sheet is provided as a blackline master.

In this activity, each student in a group picks a bag with labelled rock and mineral samples. Each bag contains only one type of rock or mineral. Students in their group then compare their samples and talk about them. Students can record their observations and vocabulary words they use on the activity sheet provided.

After students have completed this, they should make sure that the samples are put back in the correct bag and made ready for the next group.

Teacher Note

Rocks: Rocks are made up of minerals. There are three types of rocks:

Igneous Rocks: These rocks were once hot and in a liquid form that geologists call magma. As the molten rock cooled, minerals contained in them formed crystals. The more slowly they cooled, the larger the crystals. The faster they cooled, the smaller the crystals were. A few examples of igneous rocks are granite, felsite, and pumice.

Sedimentary Rocks: Sedimentary rocks are composed of weathered fragments of sediments of igneous rocks and sedimentary rocks. These rocks have a layered look. Some examples of sedimentary rocks are shale, sandstone, limestone, and conglomerate.

Metamorphic Rocks: Metamorphic rocks have been altered by tremendous pressures and heat. They are harder than sedimentary rocks, and the crystals in them are more lined up than in igneous rocks. Some examples of metamorphic rocks are schist, gneiss, slate, and marble.

Minerals: Minerals make up rocks. They consist of only one part. Some examples are diamonds, rubies, sapphires, iron oxide, and copper.

Activity Sheet 62: Looking at Rocks and Minerals

Activity Recording Sheet

Date	Activity	Observations/Questions

Activity Sheet 62: Looking at Rocks and Minerals

Each student in the group picks a bag with labelled rock and mineral samples. Each bag contains only one type of rock or mineral. Compare your samples and talk about them. Record your observations and vocabulary words on the activity sheet provided.

After you have completed this activity please make sure that the samples are put back in the correct bag and made ready for the next group.

Name	Rock or Mineral	Description/Discussion/Illustration

Activity 63: Streak

Outcome

Students will be expected to

- explore physical properties of local rocks and minerals, using appropriate tools to collect and compare with those from other places (204-8, 205-5, 300-5, 300-6)

Assessment

- Students are able to demonstrate an understanding of the term **streak** as it relates to classifying minerals.

Question

- Do some minerals rub against a hard surface?

Materials

- streak plates
- minerals (labelled)

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Have the students rub the mineral sample over the streak plate. What colour is the powdered rock? Students will be able to use the data collected from this activity to help identify minerals.

Teacher Note: The streak test is used to identify a mineral by the colour it leaves when it is rubbed on a streak plate. The colour may differ from the mineral itself. If a mineral is harder than the streak plate, it has a colourless streak.

Activity Sheet 63: Streak

Rub the mineral sample on the streak plate. Record the colour left by the rub.

Mineral	Colour and Illustration of the Mineral	Colour Left on the Streak Plate

How would this test help you to identify a mineral?

Activity 64: Taste

Outcome

Students will be expected to

- explore physical properties of local rocks and minerals, using appropriate tools to collect and compare with those from other places (204-8, 205-5, 300-5, 300-6)

Assessment

- Students are able to identify a mineral by its taste.
- Students are aware of the safety and health issues surrounding identifying a mineral by its taste.

Question

- How does the taste of a mineral help to identify it?

Materials

- halite

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Prior to doing this activity, students should wash their hands. Teachers should ensure that the rock has been washed. Have the students dip the tips of their fingers in water. Have them rub their finger on the mineral and taste it. Have them describe what it tastes like.

Teacher Note: Prior to doing this activity a safety note should be made regarding the tasting of unknown items. Indicate that only those items that a teacher says are safe to taste should be tasted.

Activity Sheet 64: Taste

Dip the top of a clean finger in water. Rub it on the mineral provided. Taste it.

Name of the Mineral	Description of the Taste and Illustration of the Mineral

How can a taste test of a mineral help to identify it?

What safety measures should be taken when doing a taste test?

Activity 65: Lustre

Outcome

Students will be expected to

- explore physical properties of local rocks and minerals, using appropriate tools to collect and compare with those from other places (204-8, 205-5, 300-5, 300-6)

Assessment

- Students are able to identify the characteristics of minerals according to their lustre.

Questions

- What do we mean by the term **lustre** as it relates to minerals?
- How does the lustre of a mineral help to identify it?

Materials

- minerals

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Have a variety of minerals in a bag and have students examine them for their lustre or ability to reflect light. Have them fill in the chart by sorting the samples in three categories (metallic, glossy, or dull).

Teacher Note: Lustre is the degree and kind of brightness.

Mineral	**Lustre**
chalk	dull
galena	metallic
quartz	glassy
diamond	brilliant

Activity Sheet 65: Lustre

Examine the mineral samples in the bag. Decide for each sample which category its lustre or shine falls under and record it on the chart below.

Mineral	Lustre—Glassy	Lustre—Dull	Lustre—Metallic

What do we mean by the term **lustre** as it relates to minerals?

How does the lustre of a mineral help to identify it?

Activity 66: Colour

Outcome

Students will be expected to

- explore physical properties of local rocks and minerals, using appropriate tools to collect and compare with those from other places (204-8, 205-5, 300-5, 300-6)

Assessment

- Students are able to identify the characteristics of rocks or minerals according to their colours.

Questions

- Can we tell a rock or mineral by its colour?
- How does the colour of a rock or mineral help us to identify it?

Materials

- samples of gypsum

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Have a variety of samples of gypsum for students to observe. Gypsum can be found in several colours. Ask students to identify the colours and discuss how colour is a way to identify a rock or mineral.

Activity Sheet 66: Colour

All of the samples in this activity are gypsum. Examine them to see how they are different.

Colour of the Gypsum	Description and Illustration of the Gypsum Sample

What makes the samples of the gypsum different?

What can you learn about identifying minerals from these samples?

Activity 67: Hardness

Outcome

Students will be expected to

- classify rocks and minerals by creating a chart or diagram that illustrates the classification scheme and compare results with others (104-4, 206-1, 207-2)

Assessment

- Students are able to distinguish minerals by their hardness.

Questions

- How can we tell how hard a mineral is?
- How does the hardness of a rock or mineral help us classify it?
- What is the importance of knowing the hardness of a rock or mineral?

Materials

- samples of minerals
- pieces of glass (with smooth edges)
- copper penny
- dull knife

⚠ **Caution: Be sure that the glass used has smooth edges like beach glass. Sanding/smoothing the edges is important for safety.**

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

There are two parts to this activity.

Part 1: Give students a variety of mineral samples and ask them to see if they can make a scratch mark on them with a fingernail. Have them sort the minerals accordingly.

Part 2: Give the students samples of minerals. Have them try to put a scratch on the samples with a penny, a knife, piece of glass, or a fingernail. Have them see if the samples can make a scratch on these items. This will tell their hardness.

Teacher Note:

For Part 1, the softer the mineral, the easier it will be to make a scratch mark on it with a fingernail. The harder the sample, the less easy it will be to make a scratch mark on it with a fingernail. Students will be able to classify or sort their samples from this.

Part 2: The Mohs Hardness scale was developed in 1812 by the German mineralogist Frederich Mohs. This scale is somewhat arbitrary but is useful in classifying minerals by their hardness. Talc is the softest or 1 on the scale, and diamonds are the hardest or 10 on the scale.

Mohs Scale of Hardness for Minerals

Hardness	Mineral
1	talc
2	gypsum
3	calcite
4	fluorite
5	apatite
6	orthoclase
7	quartz
8	topaz
9	corundum
10	diamond

The following are samples of hardness.

Hardness	Material
2.5	fingernail
3	copper penny
5.5	knife
5.5	glass
6.5	steel

Activity Sheet 67: Hardness—Part 1

Use a variety of mineral samples and see whether you can make a scratch mark on them with your fingernail. Sort the minerals and rocks accordingly.

Mineral Sample	Scratched with a Fingernail	Didn't Scratch with a Fingernail

Which samples do you think were the hardest?

Which samples were the softest?

How did you make your decisions as to the answers above?

Activity Sheet 67: Hardness—Part 2

Use the samples of minerals. Try to put a scratch on the mineral sample with a penny, knife, glass, or fingernail. See if the samples can make a scratch on these items. This will tell their hardness. Sort the minerals by hardness. When scratched with a fingernail—softest, penny—harder, knife—hardest.

Mineral	**Fingernail—Will/ Won't Scratch**	**Penny—Will/Won't Scratch**	**Knife—Will/Won't Scratch**

Describe how you sorted your mineral samples.

Activity 68: Magnetite

Outcome

Students will be expected to

- classify rocks and minerals by creating a chart or diagram that illustrates the classification scheme and compare results with others (104-4, 206-1, 207-2)

Assessment

- Students are able to test a variety of samples of rocks and minerals to see which ones are able to attract objects like a magnet.
- Students are able to use their results as another form to help identify minerals.

Questions

- Are there rocks or minerals that have the properties of a magnet?
- What type of test(s) could you do to find if a rock or mineral has the properties of a magnet?

Materials

- samples of rocks and minerals that include magnetite
- magnet

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Students are to test samples of rocks and minerals to see if they are attracted to a magnet. The samples should be sorted into "attracted," "not attracted." Students should give reasons for how they sorted the samples.

Teacher Note: Magnetite is an iron oxide. Magnetite is generally found in the unmagnetized state.

Activity Sheet 68: Magnetite

Test the samples of rocks and minerals to see if they are attracted to a magnet or not. The samples should be sorted into "attracted" or "not attracted."

Sample	Attracted	Not Attracted

Explain the reasons for your sorting.

Did the size, shape, or colour have an influence on whether the sample attracted or not?

Activity 69: Crystals

Outcome

Students will be expected to

- classify rocks and minerals by creating a chart or diagram that illustrates the classification scheme and compare results with others (104-4, 206-1, 207-2)

Assessment

- Students are able to describe and illustrate various crystals.
- Students are able to observe crystals (such as salt crystals) under a microscope to see their properties.
- Students are able to record their observations in a chart format.
- Students are able to grow their own crystals.

Questions

- How does the shape of a crystal help to distinguish what it is?
- How does using a microscope help to make clearer observations regarding the characteristics of crystals?

Materials

- samples of crystals
- salt
- sugar
- Intel Microscope or a microscope(s)
- hand-held magnifiers
- water
- jars
- string
- washers
- pencil

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

There are three parts to this activity.

Part 1: Students are given a variety of crystal samples and asked to fill in the chart provided in Activity Sheet 69: Crystals.

Part 2: Students are given salt crystals and asked to observe them first without a microscope and then with one. They are to illustrate and describe what they observed.

Part 3: Students are given the opportunity to grow their own crystals. Growing crystals does not always work the first time.

Teacher Note

Crystals: A homogeneous portion of matter that has a specific shape and plane surfaces.

Activity Sheet 69: Crystals

Examine the crystal samples provided. Fill in the chart as indicated.

Crystal	Shape/Diagram/Description
A	
B	
C	
D	

Activity Sheet 69: Crystals *(continued)*

Fill in the chart using the salt crystals provided.

Description and illustration of how salt looks without using a microscope	Description and illustration of how salt looks using a microscope

How did the microscope help in your observations of the salt crystals?

What are some of the distinct characteristics of salt crystals?

Activity Sheet 69: Crystals *(continued)*

Fill a jar or glass half-full of hot water. Add sugar or salt and stir the solution until no more of the salt or sugar will dissolve. Tie a washer to one the end of a string and a pencil to the other. Drop the washer into the salt or sugar solution and place the pencil over the top of the glass or jar. Observe what happens (it may take several days).

Illustration of your salt or sugar solution:

Illustration of your solution after several days:

Description of what you observed:

Activity 70: The Acid Test

Outcome

Students will be expected to

- classify rocks and minerals by creating a chart or diagram that illustrates the classification scheme and compare results with others (104-4, 206-1, 207-2)

Assessment

- Students are able to see how doing an acid test helps to identify a rock or mineral.

Questions

- What happens when a weak solution of hydrochloric acid is placed on a rock or mineral?
- Does the same reaction take place on all rocks and minerals?

Materials

- weak solution of hydrochloric acid
- samples of rocks and minerals (which include calcite and limestone)
- eye dropper

Procedure

This activity is a teacher-demonstrated activity. Care should be taken to store the hydrochloric acid solution in a safe and secure place. Some minerals begin to fizz when they are exposed to acids. This identifies the mineral. It can detect calcite in rocks. Limestone also has the same reaction. Drop 1 mL of hydrochloric acid on the rock. Observe what happens. Have students record their observations.

Activity 71: Made from Minerals

Outcome

Students will be expected to

- relate characteristics of rocks and minerals to their uses (300-8)

Assessment

- Students are able to distinguish between materials that are made up of minerals and those that are not.

Questions

- Are there materials we use in our daily lives that are made of minerals?
- How can we tell if materials are made from minerals?
- How does the use of minerals change the lifestyle of humans?

Materials

- Gyproc
- hammer
- spoon
- pencil (carbon)
- coins
- cotton balls
- soil
- piece of wood

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Give students a bag with a variety of materials in it. Have them sort them into materials made from minerals, and materials in which no minerals are used. Have students explain how they sorted the materials.

Activity Sheet 71: Made from Minerals

Sort the materials in the bag into two categories: those that are made of minerals and those that are not. Complete the chart below and answer the questions.

Material	Made of Minerals	Not Made with Minerals

How can we tell if materials are made from minerals?

How does the use of minerals change the lifestyle of humans?

Activity 72: Mass and Volume of Rocks and Minerals

Outcome

Students will be expected to

- relate characteristics of rocks and minerals to their uses (300-8)

Assessment

- Students are able to find the mass and volume of various rock and mineral samples.

Questions

- What is meant by the term **mass**?
- What is meant by the term **volume**?
- How can we find the volume and mass of rocks and minerals?

Materials

- samples of rocks and minerals
- water
- overflow jar
- plastic measuring beakers
- balances
- masses

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

There are two parts to this activity.

Part 1: Give students a variety of rock and mineral samples and ask them to find the mass of each. Have them compare the size of the sample to its mass.

Part 2: Have the students find the volume of each of their rocks and mineral samples.

Teacher Note: You may need to review the use of the balances as well as discuss the term **displacement** prior to this activity.

Activity Sheet 72: Mass and Volume of Rocks and Minerals

Part 1: Use a variety of rock and mineral samples and find the mass of each. Use the balances and samples provided.

Part 2: Use a variety of rock and mineral samples and find the volume of each. To find the volume, place water in the overflow jar. Have a measuring beaker under the spout of the overflow jar. Add the rock or mineral sample. The volume of the rock or mineral sample is the water that is displaced into the measuring beaker.

Mineral or Rock Sample	Mass	Volume

How did the size of the sample relate to its mass?

How did the size of the sample relate to its volume?

Was there a relationship between the mass of a sample and its volume? If so, explain it.

Illustration of the mass of a sample of rocks or minerals:

Illustration of the volume of a sample of rocks or minerals:

Activity 73: The Three Rock Groups

Outcomes

Students will be expected to

- relate characteristics of rocks and minerals to their uses (300-8)

Assessment

- Through teacher presentations and hands-on experiences, students are able to gain knowledge and understanding of the three types of rock groups.
- Students are able to sort samples of rocks into the three different types and explain their reasons for how they sorted them.

Questions

- What are the three rock groups?
- What are the properties of each group that make them unique?
- How do these properties help to classify rocks into different groups?

Materials

- samples of sedimentary, metamorphic, and igneous rocks
- hand-held lenses

Procedure

This activity should be started as a teacher-directed one. Groups of students should be given a variety of samples of rocks from the three different types. Students should be asked to describe the rocks, and a list of descriptive words should be put on chart paper. Students should develop a chart as illustrated below to act as a reference in distinguishing the properties of the three different types of rocks. Some of the words that could be used to describe the various properties are

- molten
- heat
- compaction
- pressure
- magma
- fossil
- volcano
- liquid
- mud
- change
- lava
- crystal
- deposited
- sand
- water
- wind
- conglomerate
- ice
- particles

Notes on the three different rock types can be found in Activity 62: Looking at Rocks and Minerals.

On completion of the background lesson, give students a variety of rocks and have them sort them according to the three types. Have them explain how they sorted them.

Rock Type	**Properties**
Igneous	
Sedimentary	
Metamorphic	

Activity Sheet 73: The Three Rock Groups

Sample Number	Rock Type	Properties

Explanation of how the rock samples were sorted.

Activity 74: A Research Project

Outcome

Students will be expected to

- relate characteristics of rocks and minerals to their uses (300-8)

Assessment

- Students are able to use reference books and/or the Internet to find out information on geologists, rocks, and/or minerals.
- Students are able to present their research to their peers.

Questions

- What are the properties that geologists use to classify rocks?
- What is the difference between rocks and minerals?
- How does the work of geologists help in the identification and use of rocks and minerals?

Materials

- books about rocks and minerals
- books about geologists
- geological maps
- sheets with descriptions of rocks and how they are classified
- pictures of rocks and minerals
- computers with access to the Internet

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Have students find information on how geologists classify rocks. Have them write down the properties (characteristics) of each group. Have students find five rocks and minerals and record their uses or where they are used.

Activity Sheet 74: A Research Project

Find information on how geologists classify rocks.

Write down the properties (characteristics) of each group.

Find five rocks and minerals and record their uses or where they are used.

Using a geological map, locate where your rocks and minerals are located.

Activity 75: Rocks or Minerals?

Outcome

Students will be expected to

- relate characteristics of rocks and minerals to their uses (300-8)

Assessment

- Students are able to sort samples into rocks and minerals.

Question

- What strategies did you use to sort the rocks and minerals?

Materials

- numbered or lettered samples of rocks and minerals
- paper or plastic bag

Procedure

This is one of several activities that is designed to be used in a rotating centres approach. This will limit the number of materials that you will need for each activity. It will also provide students the opportunity to work in groups and be responsible for recording the activities they have completed. This improves on students' skills and responsibilities of organizing their information and their learning so that they are clear about the outcomes of their work.

Give the students a bag with a variety of rocks and minerals and have them sort them into the two groups.

Activity Sheet 75: Rocks or Minerals

Sample Number	Rock/Reason	Mineral/Reason

Activity 76: Weathering and Erosion Overview

Outcomes

Students will be expected to

- describe ways in which soil is formed from rocks and demonstrate and describe the effects of wind, water, and ice on the landscape (301-4, 301-5)
- demonstrate and record a variety of methods of weathering and erosion, including human impact on the landscape (301-6, 108-6, 105-1)
- describe natural phenomena that cause sudden and significant changes to the landscape (301-7)

Assessment

- Students are able to demonstrate effects of wind, water, and ice in shaping the landscape of the Earth through making a model of mountains, valleys, and cracked Earth to simulate weathering and erosion.

Question

- How are soils, weathering, and landscapes linked to rocks and minerals?

Materials

- water
- plastic wrap
- modelling clay
- blocks of wood
- straws
- thick glass jar with lid
- small chunks of brick
- wooden stir sticks
- sand
- mud
- tray
- aluminum cake pan
- watering can

Procedure

Prior to this series of activities that could be done in small groups as rotating stations or a series of stations that groups complete on their own time, the teacher should give some background information if other learning experiences have not already explored soil, weathering and erosion.

Teacher Note: When we look at the ground around us, the most common thing we see is soil, yet it is easy to forget that the Earth is made up of rock that is mostly solid. The Earth's crust is made up of plates of rock that change the landscape of the Earth over time from weathering and erosion.

Erosion happens when ice, wind, and water (rivers, oceans) change the Earth's shape through movement. Weathering happens when ice, wind, and water crack and split the Earth's surface, wearing down and breaking up the rocks.

Bedrock (large, solid, bottom layer of soil) is weathered and eroded to make smaller rocks, then eventually sand and the small bits of rock found in top layers of soil over thousands of years.

Activity 1: Cracking Up

First, roll some modelling clay into a ball. Several balls of different diameters could be formed and tested to compare the sizes of the cracks. Wrap each ball in plastic wrap, label with the group name, and freeze overnight. Next day, unwrap the plastic wrap; the clay will have cracked to represent frozen earth.

- What happens to our landscape when ice weathers it?
- What effect can this have on living things?
- Is it useful?
- Is it harmful? In what ways?
- How has ice changed the Earth over time?

Activity 2: Making a Mountain

Make long, flat rectangles out of modelling clay. Layer three or four on top of each other. Bookend the clay with a block of wood and slowly push the two ends together. A mountain forms when the Earth's plates push together.

Activity 3: Making a Valley

Fill a pan/tray with sand and raise one end with an item from the classroom (book, block of wood). Pour a gentle stream of water into the tray in the middle. As the water runs down, a valley will form in the sand. If you have a deep tray or pan, you may be able to simulate how a river (water flowing from mountain tops or ice from glaciers) can erode the Earth from mountains as it runs through steep valleys.

Activity 4: Changing Coastlines

Using a large pan, use mud to build a coastline. Add packed sand along the coastline (in front of the mud) to build the coastline further. Elevate the side a few inches. Place wooden stir sticks throughout the sand, marking each with a line to show its depth in the sand. Use a watering can to simulate rain. Hold the watering can in different places.

- How does the nature of erosion change?
- How do the stir sticks show erosion?
- In what ways can moving water be the most damaging form of erosion to living things?
- Can you think of instances in the news?

Rebuild the coastline using same or a lighter consistency of sand. Now blow through use a straw to simulate wind. How do the stir sticks show erosion? How does wind cause erosion and weathering?

Activity 5: A Field Experience

Find a place outside to make a mountain, coastline, or valley or mark an existing one in the schoolyard. Mark wooden stir sticks and observe over a few days, noting what natural forces do to change the landscape.

Record in science journal.

These activities can happen over a course of several science periods/days.

One of the most powerful teachers of the link between soil, erosion, and weathering to rocks and minerals is to visit any number of natural resources Nova Scotia has in terms of coastline, provincial parks, and changing landscapes. Consult your local recreation and tourist guide to find a place nearest to you to explore with your class.

Activity 77: How Does the Soil Stack Up?

Outcomes

Students will be expected to

- demonstrate and record a variety of methods of weathering and erosion, including human impact on the landscape (301-6, 108-6)

Assessment

- Students are able to identify and represent the three layers of soil pictorially through a cross-section.

Question

- What are the three layers of soil? What makes up each layer?

Materials

- access to the outdoors
- container for collecting soil
- glass jar with lid
- water
- paper
- writing and colouring tools
- strips of cardstock
- construction glue

Procedure

Go outside and collect a small sample of soil from around the schoolyard. Spoon some soil into a glass jar and fill the jar with water. Place the lid on tightly. Let the jar settle (over a day would work well for observation). Record and draw what you observed in your journal. Draw what you see in a jar other than your own. Are they similar?

Teacher Note: Rocks and sand from the soil sample will fall to the bottom, with water in the middle and humus on the top. Connect this for the students by explaining that soil is made of three layers. The first layer, the one that they see, is called topsoil, and it is made up of roots, humus (dead, decayed material), and fine grains of eroded and weathered rock. The second layer is subsoil, and it is made of few roots, little humus, and larger grains of eroded and weathered rock. The bottom layer has no roots and no humus; it has many large rocks with bedrock (solid rock) underneath.

As a supplement, students can collect some materials from the outside and represent the layers on hard cardstock strip of paper, gluing the material in order. They can collect any items that might decompose to make humus (leaves, grass), fine grains, roots, pebbles, and larger thin rock, using construction glue to adhere to the strips.

You will need to use literacy time before this activity to explore cross-sections as features of information text. A cross-section reveals hidden parts of a subject and shows how these parts are connected. They are most often labelled and sometimes use arrows to provide explanations. After having the opportunity to find and look at examples of cross-sections, students will draw layers of soil as a cross-section (as if a segment of landscape were cut in half revealing what is inside). As an extension, students can use arrows to draw a rock cycle on how each layer was formed. Later, discuss everyone's thoughts about what a rock cycle might look like. At the end of this unit of study, a rock cycle could be drawn as a class, with discussion (and possibly debate) on the link between soil, weathering, erosion, and rocks and minerals.

Activity 78: Fossils—Records of the Earth's History

Outcome

Students will be expected to

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

Assessment

- Students are able describe how records of the Earth's history are preserved in rocks by simulating a fossil formation.

Questions

- What can fossils tell us about the Earth's past? How is this useful?
- What kinds of fossils are rare? What kinds are more common?
- How much of a chance do animal remains, insects, leaves, or footprints have of becoming fossilized? What happens to them?

Materials

- aluminum cake pan
- container for mixing
- object for stirring
- mud, plaster of Paris
- sand
- water
- petroleum jelly
- any object that can be fossilized (shells, leaves, parts of tree trunks, bones, toy that represents a natural object with a face that will leave an imprint)

Procedure

Pour a layer of sand about 2.5 cm thick in the bottom of an aluminum cake pan. Coat the objects to be fossilized with the petroleum jelly and lay the objects on the sand. Mix equal amounts of plaster of Paris and sand; add enough water so the mixture is moist and just thin enough to pour. Spread the mixture evenly over the sand about 5 cm thick. Leave the pan in a warm place to dry. When the mixture hardens (perhaps leave it a day or so), turn the pan over to dump out the hardened material and carefully clean the sand away to observe the fossils. You may wish to have students carry out this activity individually, in groups of four or five, or do a few examples as a whole-class demonstration.

Once this activity is completed as an introduction to fossils, give students the opportunity to find out more about the different ways in which fossils are formed and what formations are most rare and most common. Students can be provided with a variety of non-fiction texts on fossils, access to the Internet, samples of fossils, and/or pictures.

Provide an opportunity for students to examine potential fossils in the making—in muddy areas around the school or a shoreline. What are the chances that what they see as potential fossils will actually fossilize? What will likely occur so this does not happen?

What do we know about the natural history of plants and animals from a thousand years ago? What is it about our present time that might be useful for people to know about us a thousand years from now?

Use this opportunity of focus on fossils to once again examine the student's favourite rocks. Does any rock have an imprint?

Activity 79: A Research Project and Presentation

Outcome

Students will be expected to

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

Assessment

- Students are able to choose one natural phenomenon such as a tidal wave, flood, hurricane, mudslide, volcano, avalanche, tornado, or forest fire, and research the sudden and significant changes it has on the landscape and its effect on living things.
- Students are able to demonstrate what they learned through the research and presentation of their classmates on other natural phenomena that they did not research themselves by writing a little of what they learned in their science journals.

Questions

- How does your chosen natural phenomenon cause sudden and significant change to the landscape?
- Where around the world does this phenomenon tend to occur most frequently?
- Have you ever experienced one of these natural phenomena?

Materials

- variety of information texts on natural phenomena
- access to Internet
- newspaper and archives

Procedure

Natural phenomena such as tidal waves, tsunamis, hurricanes, tornadoes, volcanoes, floods, and avalanches are of natural interest to humans because of the sudden, significant, and often unexpected changes they make to the landscape and lives of living things. Media give incredible coverage to these events, which captures the attention of children and adults worldwide. Many parts of Nova Scotia have experienced one or more of these natural phenomena, as have other parts of Canada. Provide students with the opportunity to choose one example of a natural phenomenon and explore either at home or at school, independently or in pairs, the sudden and significant changes this phenomenon makes both to the landscape and to the lives of humans, plants, and animals. What are some of the positive aspects to the natural phenomenon you have chosen? What are some of the negative aspects? Students should share their research and findings in some form with classmates. Oral presentations, poster displays, or PowerPoint presentations are some ideas. Have students record what they have learned from the research of others, either on index cards to pass into the teacher or in their science journals.

Appendix I: Print Resources

Authorized Learning Resources

The following resources to support teaching and learning in science are currently available through the Nova Scotia School Book Bureau. The NSSBB number is given in parenthesis. For more details, visit the website at <https://w3apps.EDnet.ns.ca/nssbb>.

Ahmed and the Nest of Sand: A Piping Plover's Story (13067)

Beneath the Waves (13829)

Earth at Risk (13716)

Endangered or Extinct! (The News Library Pack) (13567)

Forest Giants (13699)

From Rocks to Sand: The Story of a Beach (12699)

Grassland Safari (13827)

The Hatchling's Journey (13891)

Healthy Habitats, Teacher's Guide, Pan-Canadian Science Place (16600)

Inquisitive Green Level (13802)

Light Up Your Life, Teacher's Guide, Pan-Canadian Science Place (16601)

Living in Two Worlds (13691)

The Living Rainforest (13560)

Mainsails, Grade 4 (16689)

National Geographic Reading Expeditions (13497–13502)

National Geographic: Reading Expeditions, Language, Literacy, and Vocabulary!: Physical Science, Complete Kit (17034)

National Geographic: Windows on Literacy, Fluent Plus (13610)

National Geographic: Windows on Literacy, Fluent Plus, Science Classroom Set (13646)

The News II Library Pack (13568)

On the Wild Side (13839)

Pan-Canadian Science Place, Complete Grade 4 Unit (16587)

Power Magazine Introductory Package, Grade 4 (16687)

Rock Climbing (13708)

Rock Hunters (13693)

Rockhound, Teacher's Guide, Pan-Canadian Science Place (16603)

Rocklands (13844)

Sci-Tech Connections 4 (17025)

Shifting Sands (13841)

Show Me! Teaching Information and Visual Texts (13152,13153)

Sounds Good, Teacher's Guide, Pan-Canadian Science Place (16602)

Switch It On! (13838)

Waterbirds (13692)

What Do I Eat? (big book) (13342)

What's Living at Your Place? (13552)

Wild Planet (13845)

Other Print Resources

This section contains resources that are currently *not listed* on the *Authorized Learning Resource* list that teachers may wish to access to support their science curriculum for grade 4.Where possible, an ISBN number is included to aid in locating a title. Many of the titles are trade books available through Canadian publishers and educational distributors and can more than likely be found in publishers' catalogues. They can be found as part of classroom sets of individual titles or guided reading packs. Many of these titles would be ideal for use during independent reading time in English language arts or as short read-aloud experiences by the teacher.

Ahearn, Janet Reed. (2004). *Life on the Tallest Mountains*. Austin, TX: Steck-Vaughn. ISBN: 0-7398-7636-8

Bauer, David. (2004). *Glaciers—Rivers of Ice*. Austin, TX: Steck-Vaughn. ISBN: 0-7398-7665-1

Blevins, Wiley. (2005). *Rocks and Minerals*. Bloomington, MN: Red Brick Learning. ISBN: 0-7368-3962-3

Daniel, Susanna, and Chelsea Donaldson. (2005). *Light and Shade*. Don Mills, ON: Pearson Education Canada. ISBN:0-13-127419-8

Carney, Margaret. (2005). *Bird Watching*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-121227-3

Fuerst, Jeffrey. (2005). *Seeing Is Not Believing*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-127415-5

Ganeri, Anita. (2005). *A Year in Antarctica*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-1274090

Goodfellow, Gib. (2005). *Exploring Canada's Coasts*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-123432-3

Gannett, Barbara. (2005). *It's All in the Soil*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-123432-3

Hammonds, Heather. (2002). *Fossil Hunting*. Toronto, ON: Nelson Thomson Learning. ISBN: 0-17-010452-4

Haydon, Julie. (2002). *Shaping the Earth*. Toronto, ON: Nelson Thomson Learning. ISBN: 0-17-010423-0

Kleinhenz, Sydnie Meltzer. (2005). *Coral Reefs*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-127417-1

McCormick, Rosie. (2002). *Linking Art to the World around Us: Arty Facts, Plants, and Art Activities*. New York: Crabtree Publishing Company. ISBN: 0-7787-1138-2 (Other titles in this series by various authors include *Structures, Materials and Art Activities*, *Planet Earth*, *Animals*, *Insects and Bugs*, *Oceans*, *Weather and Machines*, and *Transportation*.)

Meyers, Susan. (2002). *From Earth to Art*. Barrington, IL: Rigby. ISBN: 0-7578-2011-5

Michaels, Eric. (2005). *Fossils*. Bloomington, MN: Red Brick Learning. ISBN: 0-7368-3960-7

Oxlade, Chris. (2002). *Rocks*. Chicago, IL: Heinemann. ISBN: 140340086-5

Ring, Susan. (2004). *Fantastic Fossils*. Austin, TX: Steck-Vaughn. ISBN: 0-7398-7667-8

Rose, Emma. (2005). *Animal Habitats*. Bloomington, MN: Red Brick Learning. ISBN: 0-7368-3950-X

Rubin, Alan. (2004). *Take Note*. Austin, TX: Steck-Vaughn. ISBN: 0-7398-7674-0

Sinclair, Joanne. (2005). *Island Life*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-127402-3

Stewart, Sharon. (2005). *It's a Mammal!* Don Mills, ON: Pearson Education Canada. ISBN: 0-13-120911-6

Stewart, Sharon. (2005). *Save Our Earth*. Don Mills, ON: Pearson Education Canada. ISBN: 0-13-121234-6

Stradling, Jan. (2000). *Earth Materials*. Denver, CO: Shortland Publications. ISBN: 0-7699-1230-3

Stradling, Jan. (2000). *Lights On*. Denver, CO: Shortland Publications. ISBN: 0-7699-1221-4

Stradling, Jan. (2000). *Sounds All Around*. Denver, CO: Shortland Publications. ISBN: 0-7699-1228-1

Stradling, Jan. (2000). *Forces of Nature*. Denver, CO: Shortland Publications. ISBN: 0-7699-1232-X

Appendix J: Pan-Canadian Outcomes Chart

The following outcomes are from *Common Framework of Science Learning Outcomes K to 12* that were used as guidelines for this science document. Column one outcomes have been developed from these pan-Canadian outcomes.

Life Science: Habitats

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
Nature of Science and Technology	**Initiating and Planning**	**300-1** compare the external features and behavioural patterns of animals that help them thrive in different kinds of places
104-6 demonstrate that specific terminology is used in science and technology contexts	**204-1** propose questions to investigate and practical problems to solve	**300-2** compare the structural features of plants that enable them to thrive in different kinds of places
105-1 identify examples of scientific questions and technological problems that are currently being studied	**204-3** state a prediction and a hypothesis based on an observed pattern of events	**301-1** predict how the removal of a plant or animal population affects the rest of the community
Relationships between Science and Technology	**204-6** identify various methods for finding answers to given questions and solutions to given problems and select one that is appropriate	**301-2** relate habitat loss to the endangerment or extinction of plants and animals
106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications	**Performing and Recording**	**302-1** identify a variety of local and regional habitats and their associated populations of plants and animals
Social and Environmental Contexts of Science and Technology	**205-5** make observations and collect information that is relevant to a given question or problem	**302-2** describe how a variety of animals are able to meet their basic needs in their habitat
108-1 identify positive and negative effects of familiar technologies	**205-10** construct and use devices for a specific purpose	**302-3** classify organisms according to their role in a food chain
108-3 describe how personal actions help conserve natural resources and care for living things and their habitats	**Analysing and Interpreting**	
108-6 identify their own and their family's impact on natural resources	**206-1** classify according to several attributes and create a chart or diagram that shows the method of classifying	
	206-6 suggest improvements to a design or constructed object	

Physical Science: Light

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

Physical Science: Sound

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
Nature of Science and Technology	**Performing and Recording**	**300-3** describe how the human ear is designed to detect vibrations
104-1 demonstrate processes for investigating scientific questions and solving technological problems	**205-2** select and use tools in manipulating materials and in building models	**300-4** compare the range of sounds heard by humans to that heard by other animals
104-6 demonstrate that specific terminology is used in science and technology contexts	**205-8** identify and use a variety of sources and technologies to gather pertinent information	**301-3** demonstrate and describe how the pitch and loudness of sounds can be modified
105-1 identify examples of scientific questions and technological problems that are currently being studied	**Analysing and Interpreting**	**303-9** identify objects by the sounds they make
Relationships between Science and Technology	**206-7** evaluate personally constructed devices with respect to safety, reliability, function, efficient use of materials, and appearance	**303-10** relate vibrations to sound production
106-1 describe examples of tools and techniques that extend our senses and enhance our ability to gather data and information about the world		**303-11** compare how vibrations travel differently through a variety of solids and liquids and through air
Social and Environmental Contexts of Science and Technology		
107-1 describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs		
107-12 provide examples of Canadians who have contributed to science and technology		
108-1 identify positive and negative effects of familiar technologies		

Earth and Space Science: Rocks, Minerals, and Erosion

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
Nature of Science and Technology	**Initiating and Planning**	**300-5** compare different rocks and minerals from their local area with those from other places
104-4 compare the results of their investigations to those of others and recognize that results may vary	**204-1** propose questions to investigate and practical problems to solve	**300-6** describe rocks and minerals according to physical properties such as colour, texture, lustre, hardness, crystal shape (minerals)
Social and Environmental Contexts of Science and Technology	**204-8** identify appropriate tools, instruments, and materials to complete their investigations	**300-7** identify and describe rocks that contain records of Earth's history
108-3 describe how personal actions help conserve natural resources and care for living things and their habitats	**Performing and Recording**	**300-8** relate the characteristics of rocks and minerals to their uses
108-6 identify their own and their family's impact on natural resources	**205-5** make observations and collect information that is relevant to a given question or problem	**301-4** describe ways in which soil is formed from rocks
	205-7 record observations using a single word, notes in point form, sentences, and simple diagrams and charts	**301-5** describe effects of wind, water, and ice on the landscape
	Analysing and Interpreting	**301-6** demonstrate a variety of methods of weathering and erosion
	206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying	**301-7** describe natural phenomena that cause rapid and significant changes to the landscape
	Communication and Teamwork	
	207-2 communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawings, and oral language	