Prince Edward Island
CANADA

Department of Education
English Programs

Atlantic Canada Science Curriculum

Science

Grade 5

CURRICULUM

Acknowledgements

The departments of education of New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island gratefully acknowledge the contributions of the following groups and individuals toward the development of this grade 5 science curriculum guide.

- The Regional Elementary Science Curriculum Committee; current and past representatives include the following:

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- The Provincial Curriculum Working Group, comprising teachers and other educators in Prince Edward Island, which served as lead province in drafting and revising the document.
- The teachers and other educators and stakeholders across Atlantic Canada who contributed to the development of the grade 5 science curriculum guide.

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Foreword

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

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

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

Introduction

Background

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

Aim

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

Scientific literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become life-long learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment.

SuggestedTeaching Sequence for grade 5 Science

The grade 5 science curriculum consists of four units: one Life Science ***(Meeting Basic Needs and Maintaining a Healthy Body)***, two Physical Science (***Properties and Changes in Materials*** and ***Forces and Simple Machines***), and one Earth Science ***(Weather)***. The following teaching sequence is suggested; however, teachers are encouraged to identify opportunities to integrate science with other curricula throughout the year.

Meeting Basic Needs and Maintaining a Healthy Body

In this unit, students explore the organ systems that make up the human body, what is required to keep the body healthy, and what can be done to help when a part of our body does not function properly. Many opportunities exist for teachers to integrate these concepts with the Health curriculum.

Properties and Changes in Materials

Students will explore the three states of matter and common changes of state such as melting, freezing, condensing, and evaporating. They will also identify the properties that make different materials useful in everyday products and examine the environmental impact of their use.

Forces and Simple Machines

In this unit, students will investigate the effect of forces acting on different structures and mechanical systems and will design and evaluate solutions to open-minded problems involving simple machines.

Weather

Children have already been exposed to weather phenomena for many years and will have developed some ideas about temperature, clouds, the water cycle, air, winds and climate. This unit will enable students to develop a deeper understanding of the major climatic factors and patterns associated with weather.

Program Design and Components

Learning and Teaching Science

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

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

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

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

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

Writing in Science

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

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

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

The Three Processes of Scientific Literacy

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

Inquiry

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

Problem Solving

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

Decision Making

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

Meeting the Needs of All Learners

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

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

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

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

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

Assessment and Evaluation

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

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

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

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

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

Inquiry

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

Problem Solving

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

Decision Making

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

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

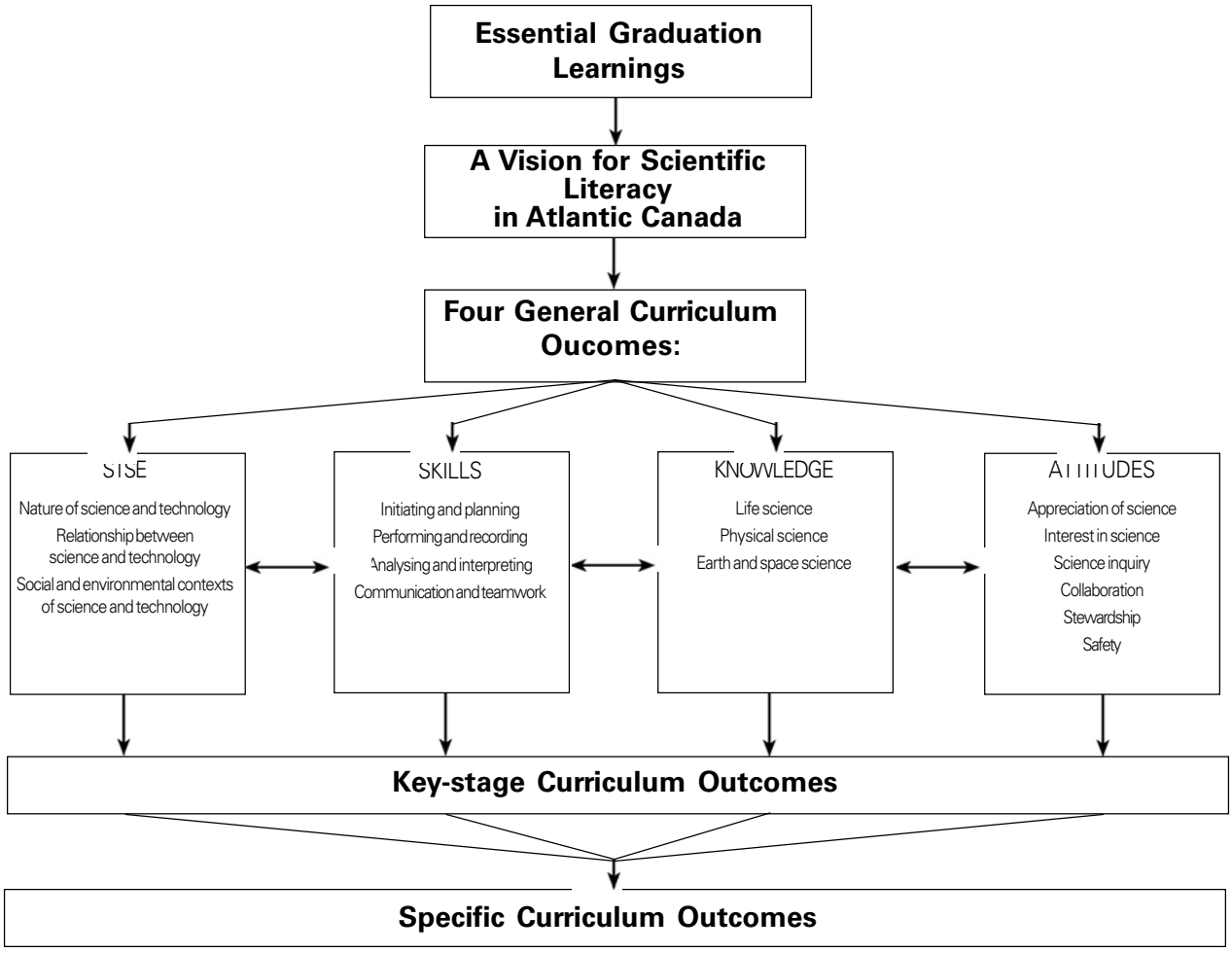
Curriculum Outcomes Framework

Overview

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

Outcomes Framework

FIGURE 1



Essential Graduation Learnings

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

Aesthetic Expression

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

Citizenship

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

Communication

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

Personal Development

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

Problem Solving

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

Technological Competence

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

General Curriculum Outcomes

The general curriculum outcomes form the basis of the outcomes framework. They also identify the key components of scientific literacy. Four general curriculum outcomes have been identified to delineate the four critical aspects of students' scientific literacy. They reflect the wholeness and interconnectedness of learning and should be considered interrelated and mutually supportive.

Science, Technology, Society, and the Environment

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

Skills

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

Knowledge

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

Attitudes

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

Key-Stage Curriculum Outcomes

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

Specific Curriculum Outcomes

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

Attitude Outcomes

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

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

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

Curriculum Guide Organization

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

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

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

Unit Organization

Each unit begins with a three-page synopsis. On the first page, a general introduction to the topic is provided. This is followed by sections that specify the *focus* (inquiry, problem solving, and/or decision making) and possible contexts for the unit. Finally, a *curriculum links* paragraph specifies how this unit relates to science concepts and skills addressed in other grades so teachers will understand how the unit fits with the students' progress through the complete science program.

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

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

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

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

The Four-Column Spread

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

The Digestive and Excretory Systems

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to	
• propose questions to investigate about how our body works and what its components are (204-1)	Students could brainstorm a list of questions about the components of their bodies and their functions. The students could discuss the following: "What do my lungs do, and how do they work?"; "What happens to food after I eat it?"; "How do our bodies work?". The point of this activity is to get students thinking about how their bodies perform all the major functions, and to provide a focus for the rest of the unit.
• describe the structure and function of the major organs of the digestive system (302-5a)	Students should investigate the role of the digestive system in providing food for the body's functions. Major organs include teeth, tongue, esophagus, stomach, small intestine, and large intestine.
• carry out procedures to investigate how simulated saliva can start the digestion process, by breaking down substances like starch into simple sugars, and record observations using sentences or charts (205-1, 205-7)	Students should explore the initial part of the digestive process by investigating the effect of simulated saliva (amylase) on starch. This can be explored by using the iodine test for starch: in the presence of starch, iodine turns a dark blue colour. Students can mix a soda cracker with water in a paper cup, add a drop of iodine solution, and show that starch is present by the dark colour. Then they can add their simulated saliva (a solution of amylase, available from science catalogues or health stores) to the mix, and watch the dark colour disappear as the simulated saliva breaks down the starch into simple sugars. During classroom discussion, students can propose explanations about the role of teeth in the digestive process, and phrase the explanations in the form of a testable question. Students may claim that chewing things speeds up digestion. A testable question could be, "Will smaller pieces of food digest faster than larger pieces?". This could be tested by repeating the simulated saliva experiment using a whole cracker in one paper cup, and a crunched up cracker in another paper cup to simulate the result of teeth action. Students can time how long it takes for the blue iodine colour to fade.
• describe the structure and function of the major organs of the excretory system (302-5b) • describe examples of the products/technologies that have been developed in response a need for the disposal, control, and containment of excrement (107-8)	Students should investigate the role of the excretory system in ridding the body of harmful wastes and body products. Major organs include kidneys, bladder, ureters and urethra, as well as the skin and lungs. Waste materials from the blood are collected in the kidneys, and are then sent to the bladder through the ureters, and expelled through the urethra. The lungs can also be considered part of the excretory system, since gasses not needed by the body are expelled through them. The skin also plays a role, as many chemicals are eliminated through sweat. Students can relate increased activity to sweat using their experiences in gym classes. Students should brainstorm and then research products/technologies that have been developed in response to the need for the disposal, control, and containment of excrement or other body wastes (e.g., diapers, toilet paper, flush toilets, deodorants.)

The Digestive and Excretory Systems

Tasks for Instruction and/or Assessment

Performance

- Complete the chart below using your observations from the experiment. Why do you think there were differences in the times it took for the iodine to change colour? (205-1, 205-7)

Starting to Digest!

Treatment	Observations	Time taken for colour change
whole soda cracker in water		
whole soda cracker with water and amylase		
crushed soda cracker in water		
crushed soda cracker with water and amylase		

Journal

- My kidneys are so important to me because... (302-5b)

Paper and Pencil

- Label or draw a diagram (teeth, tongue, esophagus, stomach, small intestine, and large intestine) and use it to illustrate your answer. (302-5a)
- Label or draw a diagram (i.e., kidneys, bladder, ureters and urethra) and use it to illustrate your answer. (302-5b)

Interview

- Why do we need to eat? (302-5a)
- Identify different products and technologies can you think of that help to reduce or remove the substances released by the excretory system? (107-8)

Resources

Science and Technology 5

Teachers Resource: The Human Body

Launch: All About Me, p.8

2. The Digestive System, p. 13

10. The Excretory System, p. 44

Column One: Outcomes

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

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

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

Column Two: Elaborations—Atlantic Science Curriculum

The second column may include elaborations of outcomes listed in column one, and describes learning environments and experiences that will support students' learning. The strategies in this column are intended to provide a holistic approach to instruction. In some cases, they address a single outcome; in other cases, they address a group of outcomes.

Column Three: Tasks for Instruction and/or Assessment

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

Column Four: Resources/ Notes

This column provides correlations of outcomes to authorized resources.

Life Science: Meeting Basic Needs and Maintaining a Healthy Body

Introduction

Students will understand the body has organs and systems that function together to help humans and other animals meet their basic needs. Students should have the opportunity to explore major internal organs through the use of models and simulations, and know where they are located in the body. It is important for students to recognize that many factors may affect a healthy body.

Focus and Context

This unit could be integrated with the health/family living program, but it should extend beyond what is normally done to a more inquiry-oriented approach. For example, students should investigate first hand the factors that can increase heart rate, build models of organs and systems to see how they function, and experiment to see the function saliva plays in digestion. It is not enough for students to simply be able to draw or label diagrams of the various systems—they need to be involved in investigating the factors that affect them. Integrating with health/family living will facilitate a decision-making focus, and should be set in a context of making choices that lead toward living an active, healthy lifestyle. Students at this age will soon have to make many important decisions about smoking, drugs, and alcohol. This unit will provide them with opportunities to see how their body systems work together, and how these systems can be adversely affected when the wrong choices are made.

Science Curriculum Links

Students have already investigated the *Needs and Characteristics of Living Things*, as well as rowth and life cycles in by the end of grade 3. In this unit, they start to look at human body systems. This will lead to a more in-depth treatment of *Cells, Tissues, Organs, and Systems* in grade 8.

pan-Canadian Science Learning Outcomes

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

STSE

Students will be expected to

Nature of Science and Technology

104-2 demonstrate and describe processes for investigating scientific questions and solving technological problems

Relationships Between Science and Technology

106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications

Social and Environmental Contexts of Science and Technology

107-8 describe examples of technologies that have been developed to improve their living conditions

107-12 provide examples of Canadians who have contributed to science and technology

Skills

Students will be expected to

Initiating and Planning

204-1 propose questions to investigate and practical problems to solve

204-2 rephrase questions in a testable form

Performing and Recording

205-1 carry out procedures to explore a given problem and to ensure a fair test of a proposed idea, controlling major variables

Analysing and interpreting

206-2 compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs

206-3 identify and suggest explanations for patterns and discrepancies in data

Knowledge

Students will be expected to

302-5a describe the structure and function of the major organs (teeth, tongue, oesophagus, stomach, small intestine, and large intestine) of the digestive system

302-5b describe the structure and function of the major organs (kidneys, bladder, ureters and urethra, as well as the skin and lungs) of the excretory system

302-5c describe the structure and function of the major organs (nose, trachea, lungs, diaphragm) of the respiratory system

302-5d describe the structure and function of the major organs (heart, blood vessels (arteries, veins, capillaries), and blood) of the circulatory system

302-5e describe the structure and function of the major organs (brain, spinal cord, and nerves) of the nervous system

302-6 demonstrate how the skeletal, muscular, and nervous systems work together to produce movement

PEI/APEF Specific Curriculum Outcomes

The Digestive and Excretory Systems

Students will be expected to

- propose questions to investigate about how our body works and what its components are (204-1)
- describe the structure and function of the major organs of the digestive system (302-5a)
- carry out procedures to investigate how saliva can start the digestion process, by breaking down substances like starch into simple sugars, and record observations using sentences or charts (205-1, 206-2)
- describe the structure and function of the major organs of the excretory system (302-5b)
- describe examples of the products/technologies that have been developed in response to a need for the disposal, control, and containment of excrement (107-8)

The Respiratory and Circulation Systems

Students will be expected to

- describe the structure and function of the major organs of the respiratory system (302-5c)
- describe the structure and function of the major organs of the circulatory system (302-5d)
- propose questions about the factors that affect breathing and heartbeat rate and rephrase these questions in a testable form (204-1, 204-2)
- carry out procedures, making sure to control variables, to investigate the factors affecting breathing and heartbeat rate, and compile and display data from these investigations in a graph (205-1, 206-2)
- demonstrate and describe the scientific processes used to investigate the factors that affect breathing and heartbeat rate (104-2)

The Skeletal, Muscular, and Nervous Systems

Students will be expected to

- describe the structure and function of the major organs of the nervous system (302-5e)
- demonstrate how the skeletal, muscular, and nervous systems work together to produce movement (302-6)
- provide examples of Canadians who have contributed to science and technology related to body organs, systems, and health issues (107-12)
- carry out porcedures to explore response time, and identify and suggest explanations for patterns and discrepancies in the data collected (205-1, 206-3)
- describe various medical technologies, such as exercise machines and artifical limbs, that have arisen from the study of how our body moves (106-4)

The Digestive and Excretory Systems

Outcomes

Students will be expected to

- propose questions to investigate about how our body works and what its components are (204-1)
- describe the structure and function of the major organs of the digestive system (302-5a)
- carry out procedures to investigate how simulated saliva can start the digestion process, by breaking down substances like starch into simple sugars, and record observations using sentences or charts (205-1, 206-2)
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Elaboration–Strategies for Learning and Teaching

Students could brainstorm a list of questions about the components of their bodies and their functions. The students could discuss the following: "What do my lungs do, and how do they work?"; "What happens to food after I eat it?"; "How do our bodies work?". The point of this activity is to get students thinking about how their bodies perform all the major functions, and to provide a focus for the rest of the unit.

Students should investigate the role of the digestive system in providing food for the body's functions. Major organs include teeth, tongue, esophagus, stomach, small intestine, and large intestine.

Students should explore the initial part of the digestive process by investigating the effect of simulated saliva (amylase) on starch. This can be explored by using the iodine test for starch: in the presence of starch, iodine turns a dark blue colour. Students can mix a soda cracker with water in a paper cup, add a drop of iodine solution, and show that starch is present by the dark colour. Then they can add their simulated saliva (a solution of amylase, available from science catalogues or health stores) to the mix, and watch the dark colour disappear as the simulated saliva breaks down the starch into simple sugars.

During classroom discussion, students can propose explanations about the role of teeth in the digestive process, and phrase the explanations in the form of a testable question. Students may claim that chewing things speeds up digestion. A testable question could be, "Will smaller pieces of food digest faster than larger pieces?". This could be tested by repeating the simulated saliva experiment using a whole cracker in one paper cup, and a crunched up cracker in another paper cup to simulate the result of teeth action. Students can time how long it takes for the blue iodine colour to fade.

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The Digestive and Excretory Systems

Tasks for Instruction and/or Assessment

Performance

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crushed soda cracker with water and amylase		

Journal

- My kidneys are so important to me because... (302-5b)

Paper and Pencil

- Label or draw a diagram (teeth, tongue, esophagus, stomach, small intestine, and large intestine) and use it to illustrate your answer. (302-5a)
- Label or draw a diagram (i.e., kidneys, bladder, ureters and urethra) and use it to illustrate your answer. (302-5b)

Interview

- Why do we need to eat? (302-5a)
- Identify different products and technologies can you think of that help to reduce or remove the substances released by the excretory system? (107-8)

Resources

Science and Technology 5

Teachers Resource: The Human Body

Launch: All About Me, p.8

2. The Digestive System, p. 13

10. The Excretory System, p. 44

The Respiratory and Circulatory Systems

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to • describe the structure and function of the major organs of the respiratory system (302-5c) • describe the structure and function of the major organs of the circulatory system (302-5d)	Students should investigate the structures and functions of the major parts of the respiratory system (nose, trachea, lungs and diaphragm) and the circulatory system (heart, arteries, veins, capillaries and blood). Students can use a variety of sources (print, electronic, computer software) to learn more about the major organs of these systems.
• propose questions about the factors that affect breathing and heartbeat rate and rephrase these questions in a testable form(204-1, 204-2)	The circulatory and respiratory systems should be investigated using pulse and breathing rates. Students should pose questions about factors they want to investigate, and design experiments around these questions. An investigation could include determining how exercise affects breathing and pulse rates. Such an experience provides an excellent opportunity to control variables, and compile and display results. **Caution: Teachers should be aware of any physical problems, such as asthma, that students might have, and ensure that the investigations that they undertake will not overtax them.** Connections can be made to the excretory system studied earlier. Students may note that as the amount of activity increases, so too may the amount of perspiration. Stop watches can be used to measure breathing and pulse rates.
• carry out procedures, making sure to control variables, to investigate the factors affecting breathing and heartbeat rate, and compile and display data from these investigations in a graph (205-1, 206-2)	Students could measure their lung capacity by blowing into a plastic tube that leads into an inverted jar filled with water. This jar should be partially submerged in a pan of water to keep the water in the jar. The air that they blow out will displace the water in the jar, and they can measure how much water is displaced. Alternatively, they may want to compare the circumference of balloons that they can blow up in one breath. However, some balloons may be more flexible than others, or become more flexible over time. Another way could be to see how far they can blow a light object across a table. Students may be able to think of other ways to test lung capacity; they may have access to a spirometer through the local heart and lung association or from a local high school lab.
• demonstrate and describe the scientific processes used to investigate the factors that affect breathing and heartbeat rate (104-2)	Students should be aware of the scientific processes they use when they conduct investigations. They have just completed a fair test in which they investigated and carried out procedures in which some variables were controlled and others measured. Students should be able to describe what constitutes a fair test, and recognize if a test is fair. They should ensure that all variables are controlled except the one being tested. Students have had previous experience with the concept of variables. This may be an opportunity for teachers to review the concept.

The Respiratory and Circulatory Systems

Tasks for Instruction and/or Assessment

Performance

- With a partner, take your pulse for 15 seconds and count the number of times you breathe in two minutes. Record the numbers in the chart. Then do some gentle exercise (e.g., running on the spot, skipping, push-ups). Take your pulse and count the number of times you breathe in two minutes. Draw a bar graph illustrating your results. (204-1, 204-2, 205-1, 206-2)

Journal

Trial	Pulse (before)	Pulse (after)	Breathing Rate (before)	Breathing Rate (after)
Person 1 Trial 1				
Person 1 Trial 2				
Person 2 Trial 1				
: etc. :				

- Imagine you are in a capsule in the circulatory system. Describe the parts through which you would move during your voyage. (302-5d)

Interview

- Identify a variable that needs to be controlled during exercise when conducting a fair test for heartrate. (104-2)
- Could we breathe without a diaphragm? Explain. (302-5c)

Presentation

- Construct a working model of the respiratory system using household materials. (302-5c)

Resources

Science and Technology 5

Teachers Resource: The Human Body

3. The Respiratory System, p. 16
4. The Circulatory System, p. 20

The Skeletal, Muscular, and Nervous Systems

Outcomes	Elaboration–Strategies for Learning and Teaching
Students will be expected to • describe the structure and function of the major organs of the nervous system (302-5e) • demonstrate how the skeletal, muscular, and nervous systems work together to produce movement (302-6)	Students should investigate the structure and function of the major organs of the nervous system (brain, spinal cord, and nerves) by accessing a variety of sources (print, electronic, computer software) to learn about the major organs of the nervous system. Students could construct the skeletal system with attached muscles. These models should illustrate how muscles are necessary to move the bones, and the nervous system is the command centre for any movement. Teachers may want to use chicken wings, legs, and thighs to illustrate whole muscles, tendons, ligaments, and bones. Pull away the muscle tissue to observe the bone structure. Students could compare and contrast the bones of the chicken wing to the human arm and hand bones. The teacher may wish to get x-rays from local hospitals to demonstrate components of the skeletal system. **Caution: Chicken parts must be cooked and dried at home by the teacher.**
• carry out procedures to explore response time, and identify and suggest explanations for patterns and discrepancies in the data collected (205-1, 206-3)	Students could conduct an activity that tests for response time. One student could drop a long object such as a pencil or metre stick, and then measure the point at which a second student, whose arm is stationary, catches the object. Collect, analyse, and graph the response time data. The further down the ruler or pencil is caught, the slower the reaction time. These activities provide excellent opportunities to show how results from a single student can vary (the student will not be able to catch it in the exact same place every time due to variations in alertness and response time), and this will highlight the need for repeating tests and averaging results. Math outcomes related to determining the mean can be addressed in this context.
• describe various medical technologies, such as exercise machines and artificial limbs, that have arisen from the study of how our body moves (106-4)	Students could conduct research on the variety of artificial limbs that have been developed over the years, noting improvements. Students may also research the wide variety of exercise machines that have been developed to increase strength and endurance. This will encourage positive attitudes about the role and contribution of science and technology in the world. Research information may be collected from rehabilitation centres, prosthetic centres, or health product companies.
• provide examples of Canadians who have contributed to science and technology related to body organs, systems and health issues (107-12)	Students can write a report on a local or regional scientist, inventor, or medical practitioner. Notable Canadians include: Wilfred Bigelow, who invented the cardiac pacemaker; Banting and Best, co-discoveres of insulin; Ray Chu-Jeng Chiu, pioneer of a surgical technique for failing hearts; D. Harold Copp, discoverer of an effective treatment of osteoporosis (a bone disease); Phil Gold, developer of the first blood test for certain types of cancer; and Maude Abbott, developer of a classification for heart diseases. Students could also learn about researchers at local universities.

The Skeletal, Muscular, and Nervous Systems

Tasks for Instruction and/or Assessment

Performance

- Develop an experiment to test response time or muscular activity during physical exertion. Compare and analyse the results of your experiment and express the results in graph form.(205-1, 206-3)

Paper and Pencil

- Choose one of the Canadians studied in this unit. Write a paragraph about how he/she has helped us to keep healthy or contributed to our understanding of organs and/or systems. (107-12)
- Write a lyric or poem about the interconnection of the skeletal system. (302-6)
- Produce a report on how various technologies have arisen from the study of how our body moves. (106-4)

Interview

- Why do people sometimes become paralysed due to an injury? (302-5e)

Presentation

- Build a model of an arm to show how the skeletal, muscular and nervous system work together. Prepare an oral presentation using jot notes to explain how all the systems work together to produce movement. After completing your presentation and showing your model and notes to the teacher for evaluation, take the model home, and do your presentation for a family member or neighbour. Ask him/her to write a brief evaluation of your presentation. (302-5e, 302-6)

Resources

Science and Technology 5

Teachers Resource: The Human Body

5. The Nervous System, p. 24
6. Muscles and Bone:
   Making Us Move, p. 28
11. The Bionic Body, p. 47

Physical Science: Properties and Changes in Materials

Introduction

Materials in the world around us have properties that have led to their being used in specific ways. By studying materials used in various applications, students come to understand properties such as solubility, hardness and buoyancy. They learn the significance of these properties to particular uses and how substances can be changed through reactions to display new properties.

Focus and Context

The focus in this unit should be inquiry and investigation. Students should be encouraged to explore a wide range of physical and chemical changes, to investigate how to separate mixtures, and to look closely at the composition of the objects around them. One possible context for this unit is household chemistry. Many physical and chemical changes occur as people eat, bake, clean, and repair or renovate the house. Students should relate what they do in this unit to household events, and inquire about changes that may be occurring, and/or where materials originated.

Science Curriculum Links

Students are introduced to materials and their properties in the grades 1–3 science curriculum. In grade 1, students explore outcomes related to materials in the unit *Materials, Objects, and Our Senses*. In the grade 2, unit *Liquids and Solids* students explore buoyancy, as well as physical and chemical changes. In grade 3, students use their knowledge gained from earlier units to build structures.

In this unit, the concepts of physical and chemical changes are studied in greater depth. The will support the achievement of outcomes related to *Mixtures and Solutions* in grade 7, *Fluids* in grade 8, and *Atoms and Elements* in grade 9.

pan-Canadian Science Learning Outcomes

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

STSE

Students will be expected to

Nature of Science and Technology

104-5 describe how results of similar and repeated investigations may vary and suggest possible explanations for variations

104-7 demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results

Relationships Between Science and Technology

Social and Environmental Contexts of Science and Technology

107-8 describe examples of technologies that have been developed to improve their living conditions

Skills

Students will be expected to

Initiating and Planning

204-5 identify and control major variables in their investigations

204-7 plan a set of steps to solve a practical problem and carry out a fair test of a science-related idea

Performing and Recording

205-3 follow a given set of procedures

205-5 make observations and collect information that is relevant to a given question or problem

205-8 identify and use a variety of sources and technologies to gather pertinent information

Analysing and Interpreting

206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying

206-2 compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs

Communication and Teamwork

207-3 work with team members to develop and carry out a plan

Knowledge

Students will be expected to

300-10 identify properties such as texture, hardness, colour, buoyancy, and solubility that allow materials to be distinguished from one another

300-9 group materials as solids, liquids, or gases, based on their properties

301-9 identify changes that can be made to an object without changing the properties of the material making up the object

301-10 identify and describe some changes to materials that are reversible and some that are not

301-12 describe examples of interactions between materials that result in the production of a gas

301-11 describe changes that occur in the properties of materials when they interact with each other

300-12 identify the source of the materials found in an object and describe the changes to the natural materials required to make the object

300-11 relate the mass of a whole object to the sum of the mass of its parts

PEI/APEF Specific Curriculum Outcomes

Physical Science: Properties and Changes in Materials

Students will be expected to

- identify properties that allow materials to be distinguished from one another (104-7, 300-10)
- classify materials as solids, liquids, or gases, and illustrate this classification in a chart that shows their properties (206-1, 300-9)

Physical Changes

Students will be expected to

- observe and identify physical changes, that can be made to an object, that changes the form or size of the material in the object without producing any new materials (301-9, 205-5)
- identify and describe some physical changes that are reversible and some that are not (301-10)

Chemical Changes

Students will be expected to

- describe chemical changes, that occur when materials interact with each other to form totally new materials including those that result in the production of a gas (301-12, 301-11)
- indentify and describe some chemical changes to materials that are reversible and some that are not (301-10)
- work with team members to develop and carry out a plan to systematically distinguish a material based on its chemical properties (204-7, 207-3, 204-5)
- compile and display data to present the results of chemical tests used to distinguish materials from each other (206-2)

Sources / Masses of Materials in Objects

Students will be expected to

- follow a given set of procedures to relate the mass of a whole object to the sum of the mass of its parts, and suggest possible explanations for variations in the results (104-5, 205-3, 300-11)
- describe examples of manufactured materials that have been developed to improve their living conditions (107-8)
- identify the source of the materials found in an object, and use a variety of sources and technologies to gather information to describe the changes to the natural materials required to make the object (205-8, 300-12)

Properties of Materials

Outcomes

Students will be expected to

- identify properties that allow materials to be distinguished from one another (104-7, 300-10)

- classify materials as solids, liquids, or gases, and illustrate the classification in a chart showing the properties of each matieral (206-1, 300-9)

Elaborations–Strategies for Learning and Teaching

The focus in this section is to determine and describe the properties of different materials.

Students should investigate a wide variety of materials and describe their distinguishing characteristics. Properties of solids that students could explore include colour, hardness, ability to pour, buoyancy, odour, solubility and magnetism. Liquids could include colour, odour, viscosity, solubility in water, buoyancy and surface tension. Solid substances could include powdered or granular solids such as salt, sugar, baking soda, as well as solid objects such as pencils, cups or coins. Liquids could include water, vegetable oil, liquid soaps, molasses or vinegar. Gases can be illustrated using balloons, jars, or bubbles filled with air, or producing gases through reactions caused by mixtures of vinegar and baking soda. **Caution: Any experiments in which gases are produced should be done in containers that are open to air. Producing a gas in a closed gas jar, for example, could cause the jar to break open.**

Before conducting their investigations, students could brainstorm properties of solids, liquids, and gases and classify materials using their distinguishing properties:

- classify solids as substances with a definite shape and volume
- classify liquids as substances with a definite volume but no definite shape
- classify gases as having no definite shape or volume

Teachers can help students with such classifications by demonstrating properties of substances e.g., swirling liquids to show that they don't keep the same shape and leading discussions by asking questions such as, "Can you compress a liquid or solid?"

Properties of Materials

Tasks for Instruction and/or Assessment

Performance

- Explore the distinguishing characteristics or properties of solids or liquids. Record your observations in the table. (A similar table can be constructed for liquids.) (104-7, 300-10)

Properties of Solids

	Colour	Structure (appearance when magnified)	etc.
salt			
sugar			
sand			
toothpick			

- Test the substances listed below for solubility. Chart your results. (104-7, 300-10)

  Substances: salt, sugar, baking soda, pepper, baking powder.

Interview

- How can you tell if something is a liquid? What are some of the properties it wil have. Compare the properties of a liquid to the properties of a solid. (206-1, 300-9)

Presentation

- Produce a video or a collage of pictures illustrating the properties of solids, liquids, and gases. (206-1, 300-9)

Resources

Science and Technology 5

Teachers Resource: Changes in Matter

1. Observing Changes, p. 10
2. What's the State? p. 14
3. Changes of State, p. 18
4. Keep it Hot - Keep it Cold, p. 21
6. The Unknown Powder, p. 30
7. Using Chemical Changes, p. 35

Design Project:
Who Stole the Statue? p. 51

Physical Changes

Outcomes

Students will be expected to

- observe and identify physical changes, that can be made to an object, that change the form or size of the material in the object without producing any new materials (301-9, 205-5)

- identify and describe some physical changes that are reversible and some which are not (301-10)

Elaborations–Strategies for Learning and Teaching

Students should investigate physical changes in this part of the unit; that is, changes that affect the look, feel, strength, and texture of an object, but do not actually change the object into a different material. Cutting wood is an example of a physical change, while burning wood is a chemical change.

Teachers and students should understand that in some cases a physical change is obvious, while in others, it is not. Shaping putty, breaking a piece of wood, folding paper, sharpening a pencil are clearly physical changes since it is evident that no new materials are formed. However, changes such as phase changes (e.g., boiling or freezing water), or dissolving materials in water are not obvious physical changes, because in these cases, the change yields materials having very different properties.

Students should explore physical changes to a variety of materials and investigate changing properties. For example, students may explore materials to answer the questions "Does the shape of an object (plasticine, aluminum foil) affect buoyancy?", "Does the temperature of the materials affects its malleability?"

Some physical changes are reversible (e.g., boiling water) and some are not (e.g., sanding wood into sawdust, grinding wheat into flour). Do not use reversibility as a distinguishing feature of physical changes as some chemical changes are reversible (e.g., litmus paper can change from pink to blue and back to pink).

Physical Changes

Tasks for Instruction and/or Assessment

Performance

- Investigate three physical changes of various materials. Demonstrate and record any changes. (301-9, 205-5, 301-10)
- In groups, design an experiment to measure how temperature affects the flow rate of water, molasses, corn syrup, or milk on a sloped surface. Identify and control variables. Share the results with your classmates. Create a graph of the class results, and draw conclusions. **Caution: Do not exceed 20° C when heating liquids and use a hot water bath to increase temperature of the substance.** (301-9, 205-5)

Journal

- Some physical changes can be reversed. Some physical change can not easily be reversed. For example ... (301-10)

Paper and Pencil

Note: This assessment should be done after the section on "Chemical Change".

- Write "physical" or "chemical" beside each change and give a reason for your answer. (301-9, 205-5)
  - crumpling up paper
  - pouring water on the floor
  - lighting a match
  - mixing vinegar and baking soda
  - boiling water
  - melting a crayon to make a candle

Resources

Science and Technology 5

Teachers Resource: Changes in Matter

1. Observing Changes, p. 10
2. What's the State? p. 14
3. Changes of State, p. 18
4. Keep it Hot - Keep it Cold, p. 21
5. Changes: Reversible or Non-Reversible, p. 25
6. The Unknown Powder, p. 30
7. Using Chemical Changes, p. 35
8. The Case of the Extra Mass, p. 39
9. A Canadian Favourite, p. 44

Chemical Changes

Outcomes

Students will be expected to

- describe chemical changes, that occur when materials interact with each other to form totally new materials including those that result in the production of a gas (301-12, 301-11)
- identify and describe some chemical changes to materials that are reversible and some which are not (301-10)
- work with team members to develop and carry out a plan to systematically distinguish a material based on its chemical properties (204-7, 207-3, 204-5)
- compile and display data that represents the results of chemical tests used to distinguish one material from another (206-2)

Elaborations–Strategies for Learning and Teaching

Note: Reversibility does not distinguish physical change from chemical change. When different chemcials are mixed in a solution new substances may be formed. However, the addition of more chemicals, application of heat, or stirring may cause the original chemcials to re-form (i.e., to reverse). In other cases, the chemical mixture causes a reaction in which the new substances are strongly bonded and the reaction cannot be reversed.

Students should explore chemical changes of different materials. Many chemical reactions can be demonstrated with household chemicals (e.g., vinegar and baking soda; yogurt and baking soda; an apple turning brown after it is peeled; milk and vinegar). While these examples are not reversible, it is more important for students to focus on the fact that new substances are formed.

Indicators are chemicals that easily undergo reversible chemical reactions, and in the process, change colours. Students could explore reactions by using blue litmus paper which will turn pink when it reacts with chemicals such as vinegar, lemon juice, or other acids. It will reverse to blue when it reacts with chemicals such as baking soda, baking powder, or an anti-acid tablet (Eno™) dissolved in water. Students can make natural indicators out of substances such as raspberries, blueberries, rhubarb, red cabbage, cherry juice, beet juice, strong tea, and carrot juice. Simply mix one of these substances in hot water until it becomes coloured, the more colour, the better. (The teacher may want to prepare some of these using boiling water). Students could experiment to try to change these indicators from one colour to another using acids and bases.

Many chemical reactions in the body are reversible. For example, oxygen attaches to blood in the lungs, and then is released as the blood travels to other parts of the body. In contrast, a person will suffocate if he/she breathes in enough carbon monoxide, because it attaches to the blood in a virtually non-reversible chemical reaction. The blood is then unable to bond with oxygen.

Students should develop a plan to distinguish one material from another based on chemical properties. They should produce a table showing how household substances react when combined. (some substances such as baking powder, baking soda, and chalk will react with vinegar.)

Students should then be given unmarked samples of baking powder, salt, and baking soda. Students can determine from their reactions any chemical changes. **Caution: Students should be cautioned not to taste any of the chemicals.**

Chemical Changes

Tasks for Instruction and/or Assessment

Performance

- Explore chemical changes that take place for X, Y and Z with approved chemicals. Complete the table using your observations. (301-12, 301-11, 301-10)

	X	Y	Z
vinegar			
corn oil			
club soda			

- Perform the same tests on substances unknown to students. Ask them to identify the substances. (204-7, 207-3, 204-5, 206-2)

Resources

Science and Technology 5

Teachers Resource: Changes in Matter

5. Changes: Reversible or Non-Reversible, p. 25
6. The Unknown Powder, p. 30
8. The Case of the Extra Mass, p. 39
9. A Canadian Favourite, p. 44
10. A Sticky Test, p. 47

Design Project:
Who Stole the Statue? p. 51

Sources/Masses of Materials in Objects

Outcomes	Elaborations–Strategies for Learning and Teaching
Students will be expected to • follow a given set of procedures to relate the mass of a whole object to the sum of the mass of its parts, and suggest possible explanations for variations in the results (104-5, 205-3, 300-11)	Students should use a balance to determine the mass of an object. Through further investigations, students should recognize the total mass of an object equals the sum of its parts. The sum of the parts should come relatively close to the mass of the total object, but may vary slightly due to errors balancing the scale or taking accurate readings. An example might be a pencil case containing various pens, pencils and erasers, or they could cut a piece of material, such as cardboard or fabric, into pieces and compare mass. Teachers might pose questions such as, "What happens when we burn a piece of paper? What happens to its chemcial and physical characteristics? Can we measure changes in mass?" Accuracy is important in completing this activity. Students should take care to measure as accurately as possible. The mass of an object can neither be created nor destroyed, but it can be transformed into smaller components, with different chemical and physical properties. This represents the law of the *Conversation of Mass*.
• describe examples of manufactured materials that have been developed to improve human living conditions (107-8)	Students will investigate a variety of manufactured materials produced to improve living conditions. Students should focus on the composition of these manufactured materials and how the materials have been processed. Students should do research on some common materials. These could include nylon, synthetic rubber, latex, Gortex™, and household barrier wrap. Care must be taken that students do not get into the technical details of manufacturing to the extent that they are simply writing words from an encyclopedia. It is enough to determine the raw material from which the object is made, and to have a general understanding of the processing involved. Students can examine various ores that contain some common metals, to determine if the metal is present in its pure, elemental form (e.g., gold). In most cases, the metal in the ore is a compound, and must undergo chemical reactions to turn it into a pure metal.
• identify the source of the materials found in an object, and use a variety of methods and technologies to gather information to describe the changes required of the natural materials to create the object (205-8, 300-12)	Students may want to try to process some raw material themselves. They may, for example, want to make their own paper. People from the community may be invited to show how wool from a sheep is spun. Students may take field trips to sawmills, oil refineries, or a manufacturing company. Video or other electronic media could be used to illustrate these processes and products where direct access is not possible.

Sources/Masses of Materials in Objects

Tasks for Instruction and/or Assessment

Performance

- Mass each of the objects listed and complete the table below. (104-5, 205-3, 300-11)

Object	Estimated Mass (g)	Measured Mass (g)
4 pencils		
block of 10 Lego ™ pieces		
bag of marbles		
an apple		
etc.		

Journal

- Why are materials important? What did you learn about materials, and their physical and chemical changes? (205-8, 300-12)

Paper and Pencil

- Indicate whether the objects listed below are natural or manufactured. If they are manufactured, identify the source of the materials in the object as either rock/mineral, petroleum, and/or wood/plant. (107-8, 205-8, 300-12)
  - paper; glass, nylon tent, orange, car tires, bricks, cotton shirt, boulder, chair

Presentation

- Research a product to detemine from which raw materials it is made, and how the raw materials are processed to make the final product. (205-8, 300-12)
- Make a display of materials and the raw materials from which they are made. (205-8, 300-12)

Portfolio

- Here is a sample of the paper I made. I started with ... (describe materials and process involved in making the paper). (105-8, 300-12)

Resources

Science and Technology 5

Teachers Resource: Changes in Matter

4. Keep it Hot - Keep it Cold, p. 21
7. Using Chemical Changes, p. 35
8. The Case of the Extra Mass, p. 39
9. A Canadian Favourite, p. 44

Physical Science: Forces and Simple Machines

Introduction

The study of motion and the forces which cause motion helps students to begin to develop a more sophisticated understanding of forces. As they manipulate simple machines, students are able to move from qualitative to simple quantitative descriptions of forces acting on objects. Through investigations they also explore the effects of friction on the movement of objects. Students investigate the ability of simple machines to accomplish tasks with less effort, and compare and improve the ability of these machines to function. Simple machines are used in many aspects of life, and students should become familiar with their design and their advantages.

Focus and Context

The principle focus in this unit is problem solving. Students should have many opportunities for hands-on exploration, to determine how various simple machines reduce effort. They should then be given open-ended challenges in which they can use simple machines, singly or in combinations, to design solutions. Assessment should focus on the students' abilities to design creative solutions, not the one "right" answer. Inquiry also plays a role in this unit, especially in the beginning as students explore the effect of forces on motion.

There are various contexts through which this unit could be addressed. Relating the outcomes to simple machines at home (e.g., nails, screws, wrench, wheelbarrow) would make the unit relevant and useful. Another interesting context would be to relate the outcomes to the human body, and how biotechnology is developing machines to enhance or replace limbs. In both of these contexts, students can define problems to solve, and then design solutions involving simple machines.

Science Curriculum Links

Students have investigated factors affecting motion and magnetism in grade 3. In this unit, a broader investigation of forces is undertaken, involving the application of forces to the use of machines. The concept of force as it relates to fluids is addressed in grade 8. Motion is dealt with on a more quantitative level in grade 10, and the relationships between force, motion and work are studied in high school physics.

pan-Canadian Science Learning Outcomes

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

STSE

Students will be expected to

Nature of Science and Technology

104-7 demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results

105-5 identify examples of scientific knowledge that have developed as a result of the gradual accumulation of evidence

Relationships Between Science and Technology

106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications

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

107-8 describe examples of technologies that have been developed to improve their living conditions

Skills

Students will be expected to

Initiating and Planning

204-1 propose questions to investigate and practical problems to solve

204-3 state a prediction and a hypothesis based on an observed pattern of events

204-5 identify and control major variables in their investigations

204-7 plan a set of steps to solve a practical problem and to carry out a fair test of a science-related idea

Performing and Recording

205-2 select and use tools in manipulating materials and in building models

205-5 make observations and collect information that is relevant to a given question or problem

205-6 estimate measurements

205-8 identify and use a variety of sources and technologies to gather pertinent information

Analysing and Interpreting

206-6 suggest improvements to a design or constructed object

206-9 identify new questions or problems that arise from what was learned

Communication and Teamwork

207-1 communicate questions, ideas, and intentions, and listen to others while conducting investigations

Knowledge

Students will be expected to

303-12 investigate different kinds of forces used to move objects or hold them in place

303-13 observe and describe how various forces, such as magnetic, mechanical, wind, and gravitational, can act directly or from a distance to cause objects to move

303-14 demonstrate and describe the effect of increasing and decreasing the amount of force applied to an object

303-15 investigate and compare the effect of friction on the movement of an object over a variety of surfaces

303-16 demonstrate the use of rollers, wheels, and axles in moving objects

303-17 compare the force needed to lift a load manually with that required to lift it using a simple machine

303-18 differentiate between the position of the fulcrum, the load, and the effort force when using a lever to accomplish a particular task

303-19 design the most efficient lever to accomplish a given task

303-20 compare the force needed to lift a load using a single pulley system with that

PEI/APEF Specific Curriculum Outcomes

Forces and their Effects

Students will be expected to

- observe, investigate, and desribe how forces can act directly or from a distance to cause objects to move or hold then in place (303-12, 303-13)
- describe forces as contact or non-contact forces (104-7)
- demonstrate and describe the effect of increasing and decreasing the amount of force applied to an object (303-14)
- make observations in order to describe force qualitatively and quantitatively (205-5)
- estimate the force needed to lift or pull a given load in standard or nonstandard units (205-6)

Friction

Students will be expected to

- propose questions to investigate, identify variable to control, and plan a set of steps to identify factors that affect friction (204-1, 204-5, 204-7)
- investigate and compare the effect of friction on the movement of objects over a variety of surfaces (303-15)
- demonstrate the use of rollers, wheels, and axles in moving objects (303-16)
- describe how the understanding of the concept of friction has led to the development of products that reduce and enhance friction (106-4, 107-1)

Simple Machines: An Introduction

Students will be expected to

- use simple machines to reduce effort or increase the distance an object moves (205-2)
- compare the force needed to lift or move a load manually with the effort required to lift it using a simple machine (303-17)
- identify the problem of the large amount of effort needed to lift or move heavy objects small distances, or smaller objects long distances, that arises from the study of forces (206-9)

Simple Machines: Levers

Students will be expected to

- differentiate between the position of the fulcrum, the load, and the effort force when using a lever to accomplish a particular task (303-18)
- design the most efficient lever to accomplish a given task (303-19)

Simple Machines: Pulleys, Systems of Machines

Students will be expected to

- compare the force needed to lift a load using a pulley system with that needed to lift it using a multiple pulley system, and predict the effect of adding another pulley on load-lifting capacity (303-20, 204-3)
- design a system of machines to solve a task (204-7)
- describe examples of how simple machines have improved living conditions (107-8)
- communicate questions, ideas, and intentions, listen to other, and suggest improvements to the systems of machines designed by students in the class (207-1, 206-6)
- identify examples of sources such as books, software and the Internet, of machines that have been used in the past, and have developed over time (205-8, 105-5)

Forces and their Effects

Outcomes

Students will be expected to

- observe, investigate and describe how forces can act directly or from a distance to cause objects to move or remain in place (303-12, 303-13)
- describe forces as contact or non-contact (104-7)
- demonstrate and describe the effect of increasing and decreasing the amount of force applied to an object (303-14)

Elaborations–Strategies for Learning and Teaching

Teachers can engage students in a **K**now-**W**ant to Learn-**L**earned (K-W-L) activity about forces to begin this unit. This will allow teachers to determine students' conceptions about forces. It will also provide some direction for the choice of investigations throughout the unit.

A force is a push or a pull. In this introductory section, opportunities should exist for students to experience several types of contact (e.g., mechanical, wind) and non-contact (e.g., magnetic, gravitational) forces. Students could be encouraged to explore these forces through a series of open-ended activities. For example:

- How many ways could you make a paper clip move from one place to another?
- Can you make a book move 0.5 m without touching it?

Alternatively, teachers could create several activity centres featuring different types of forces and structured learning experiences. One centre could feature magnets, another could have students exploring the effect of mechanical forces, and another could feature fans for exploring the force of wind.

As students investigate the various types of forces, encourage them to determine how they can increase or decrease the amount of force being exerted, and to observe what happens. In follow-up discussions, ask students to examine their findings. In most cases, changing the amount of force changes the speed at which an objects moves, but in some instances, it may have no effect on the motion of an object. For example, students may push on a wall, but the wall will not move.

Students should be able to identify some of the forces acting on objects as contact or non-contact. For example, if a student is lifting a paper clip in the air with a magnet, the forces of gravity and magnetism should be identified. A common misconception of students is that if there is no motion, there is no force. Teachers can explore students' conceptions of force by asking them to identify the forces acting on a book that is resting on a table. If they have a hard time conceptualizing the force of the table on the book (which is equal but opposite to the force of gravity pulling the book downwards), then ask them to hold out their hands, and place the book on them. They will feel the force of the book on their hand, and feel their hands straining to hold the book in this upward position.

Forces and their Effects

Tasks for Instruction and/or Assessment

Performance

- Move a paper clip 0.5 m along your desk four separate times using four different forces. Describe the ways in which you moved the clip. Identify whether they were contract or non-contact forces. (303-12, 303-13, 104-7)
- Demonstrate how could you get a staple out of an upright jar without tipping it? (303-13)

Interview

- Is wind a contact or non-contact force? Explain. (104-7)
- What force keeps a book on a desk? (303-13)

Paper and Pencil

- Draw a labelled diagram to illustrate the forces acting upon:
  a) a book resting on a desk
  b) a sail boat (303-12, 303-13)

Resources

Science and Technology 5

Teachers Resource: Forces on Structure

Launch: All Kinds of Force, p. 7

1. Force, p. 9
3. Friction, p. 15
4. Bridge Builders, p. 19
5. Push and Pull, p. 23
6. Everyone Needs an Egg Protector, p. 26
8. Gears and Force, p. 34
11. Computer Parts, p. 44

Design Project:

Design a Pet Shelter, p. 49

Forces and their Effects (continued)

Outcomes

Students will be expected to

- make observations in order to describe force qualitatively and quantitatively (205-4, 205-5)
- estimate the force needed to lift or pull a given load in standard or nonstandard units (205-6)

Elaborations–Strategies for Learning and Teaching

Once students are comfortable with the concept of a force, and how to increase or decrease the amount of a force using terms such as "more" and "less", they can measure forces quantitatively using tools such as a spring scale or elastic bands. Students may construct their own instruments for measuring force. For example, they might use elastic bands or slinkies™ to measure how far they stretch (from the force of gravity as well as an applied force).

If available, students can use force sensors connected to computer interface equipment to measure and graph the force acting on an object as it is lifted in the air or pulled up a ramp.

Students may be introduced to the Newton as the unit of force by illustrating how a spring scale shows the degree of force being applied. It is not important that students know the definition of a Newton, but simply that it is a standard unit that indicates the amount of force being applied: The greater the force, the greater the number of Newtons. Using spring scales, students can note the number of Newtons it takes to lift or pull various objects. Note: A Newton is the force (weight) of one medium size apple. The formal definition (not intended for the student) of a Newton is the force exerted on a 1kg mass to move it 1 meter/sec^2.

The above investigations can be followed by activities which involve estimating the force required to lift various objects or answering questions, such as: "Does the angle of a ramp affect the amount of force required to pull/push an object up it? Does it take more force to open a door when pushing closer to the hinge or closer to the doorknob?; Does it take more force to move an object faster?" Students could estimate the amount of force using standard (i.e., Newton) or nonstandard (e.g., the length an elastic band or the amount the Slinky™ stretches) units. These activities help students appreciate the importance of accuracy, and working collaboratively with others during investigations.

Forces and their Effects (continued)

Tasks for Instruction and/or Assessment

Performance

- Record the force used to lift the objects listed below. If you are using a spring scale, record the force in Newtons. If you are using an elastic band or spring, measure its length in centimeters as an indication of the amount of force: (205-4, 205-5)
  Objects: science book, pencil case, exercise book, scissors, ...

Paper and Pencil

- Estimate how far the elastic band would stretch if it were used to lift an orange? (205-6)
- Using a spring scale and a wagon, the student is to measure the force required to move the wagon (empty). The student then repeats the experiment and adds various weights to the wagon and records the results. (205-4)

Resources

Science and Technology 5

Teachers Resource: Forces on Structure

1. Force, p. 9
2. Using the Spring Scale to Measure Force, p. 12
3. Friction, p. 15
4. Bridge Builders, p. 19
5. Push and Pull, p. 23
7. Using Machines to Lift Loads, p. 30
8. Gears and Force, p. 34
9. Design a Mechanical System, p. 38
11. Computer Parts, p. 44

Friction

Outcomes	Elaborations–Strategies for Learning and Teaching
Students will be expected to	During classroom activities in which students identify the forces acting on various objects in different situations (e.g., moving, stationary), highlight a situation in which an object was pulled along the floor, and the force was measured. Pose a question such as, "Why do they think it took so much force to move the object? How could they reduce this amount of force?" Introduce the term "friction" into the discussion. Can students describe friction? Do they know how to increase or decrease friction?
• propose questions to investigate, identify variables to control, and plan steps to identify factors that affect friction (204-1, 204-5, 204-7)	
• investigate and compare the effect of friction on the movement of objects over a variety of surfaces (303-15)	During these activities, teachers can encourage students to propose questions to investigate about the factors that affect friction. For example, if students suggest that heavier objects will experience more friction, ask them to rephrase their proposal into a testable question. For example: "Do heavier objects experience more friction than lighter ones?". Students should work in groups to plan steps to answer the questions they propose. These types of activities can be used to further develop the notion of a fair test and the skill of controlling variables. Factors that students may test are mass, amount of surface that is in contact (e.g., is there more friction between a 1 kg wooden cube and a surface, or a 1 kg rectangular-shaped wooden block and the same surface?), the speed at which the object is pulled and the type of surface over which it moves. The only factors that should have an effect on friction are mass and the type of surface.
• demonstrate the use of rollers, wheels, and axles in moving objects (303-16)	Using students' definition of friction and their knowledge of the factors that affect friction, they can suggest ways of reducing friction. Science Olympics activities, for example, challenge students to raise a standard object up an inclined plane with a minimum amount of force by reducing the friction involved. This can be an excellent vehicle for increasing students' understanding of friction and the factors which affect it. Students should be exposed to the use of lubricants, rollers, wheels and axles as possible mechanisms for friction reduction. For example, they can measure the force needed to pull a book up a ramp, and then measure the forces when it is rolled up with drinking straws underneath it.
• describe how the understanding of the concept of friction has led to the development of products that reduce and enhance friction (106-4, 107-1)	As a follow-up, students may spend some time investigating and determining instances when friction is beneficial or necessary or when it is harmful or unncessary. Many types of writing activities, including fictional pieces about what would happen if there were no friction, can be used to help students clarify and broaden their thinking about the topic. For example, students could write an essay titled "Friction: It Can Slow You Down and Speed You Up", in which they include examples of how friction can help or hinder various efforts.

Friction

Tasks for Instruction and/or Assessment

Performance

- Plan an experiment to investigate factors that affect friction. Carry out the investigation, make a chart for your results, and describe the procedure you used. (204-7, 303-15)
- Pull a block across different surfaces, and record the force required in each instance. Examples of surfaces might include carpet, tiled floor, grass, or a soapy board. (303-15)
- Pull a block using various rolling objects; record the force needed in a chart. Examples to investigate might include blocks with no wheels or rollers, blocks resting on pencils or straws, or blocks resting on a skateboard. (106-4, 107-1)

Paper and Pencil

- If you were pulling a toy, predict which surface would produce the least amount of friction: carpet, ice, gravel, or a wooden floor. (303-15)
- Draw a picture illustrating how friction helps in your life. (107-1)

Interview

- Why does a toy car slow down and then eventually stop after you push it? (303-15)
- Could you walk if there was no friction? Explain. (303-15)
- Imagine that your hands are covered in frictionless gloves. What would happen? (303-15)

Journal

- Invent a machine that uses friction in a new way. Explain how it works and the benefits it produces. (106-4, 107-1)

Resources

Science and Technology 5

Teachers Resource: Forces on Structure

3. Friction, p. 15
9. Design a Mechanical System, p. 38

Simple Machines: An Introduction

Outcomes	Elaborations–Strategies for Learning and Teaching
Students will be expected to • use simple machines to reduce effort or increase the distance an object moves (205-2)	Simple machines can be used to reduce the effort required to move an object, or increase the amount of distance something moves. Students could rotate through centres that highlight the use of simple machines such as scissors, a bottle opener, a can opener, an egg beater, tongs, a hammer, clothes line pulley, screwdriver, or a monkey wrench. The centres should include common household or school devices that are simple machines, and provide opportunities for students to interact with and use the machines as they learn more about them.
• compare the force needed to lift or move a load manually with the effort required to lift it using a simple machine (303-17)	As students explore simple machines, emphasis should be given to developing the concepts of "load" and "effort", and the distances over which these forces are applied. The *load* is the amount of force it would take to move an object without the aid of a simple machine, while the *effort* is the amount of force it takes with the aid of a simple machine. Students can determine both the load and the effort using spring scales or instruments they have been devised to measure force. For example, students could measure the force needed to lift an object 0.5 m straight up, and then measure the force needed to slide it up to a 2.0 m inclined plane to the same height. They should note that even though it was easier to slide up the ramp, they had to pull it for a longer distance. In cases in which a machine reduces the effort required to lift an object (force advantage), the effort force will always have to be applied over a longer period. In cases where a machine increases the effort required to lift an object, the effort force will have to be applied over a shorter period, but the object will be lifted a greater distance (distance advantage).
• identify problems that consider large amount of effort needed to lift or move heavy objects, using the knowledge they gained through the study of forces (206-9)	Students should now have a good understanding about how much force it takes to move objects, and how much they can lift unaided. Until now they have been using spring scales or constructed force sensors to determine force required to move things small distances. In classroom discussion, ask students how they would move something really heavy, or move something a long distance. For example, how could they lift a heavy box? Better yet, how could they lift it to the tenth floor of a building? Students will have seen heavy machinery, such as cranes and tractors, and may suggest using these to lift objects. Students should be encouraged to bring in household machines such as wrenches, hammers, or screwdrivers, or pictures or drawings of more complicated systems of machines for a classroom display.

Simple Machines: An Introduction

Tasks for Instruction and/or Assessment

Performance

- Take a copy of the table below with you to the various centres around the room. Using a simple machine, determine if the force needed to move or lift the object is less than, equal to, or greater than the weight of the object. Record your findings on the table beside the appropriate activity centre. (104-7, 205-2, 303-7)
  The machine overcomes the effect of gravity on the object, which is the weight of the mass (load).

Simple Machines Can Make My Life Easier

Activity Centre #	Simple Machine	Required Force
1	No Machine	
2	Pulley	
3	Wheel and Axle	
4	Ramp	
5	Lever	
6	etc.	

- Compare your findings. Which simple machine required the least force to move the mass? Which required the most? Do you see any advantage to using a simple machine to move the mass?

Journal

- Things that I would find very hard to lift or move by myself include ... Things I use to help me move these objects are ... (206-9)

Resources

Science and Technology 5

Teachers Resource: Forces on Structure

7. Using Machines to Lift Loads, p. 30
8. Gears and Force, p. 34
9. Design a Mechanical System, p. 38

Design Project:
Design a Pet Shelter, p. 49

Simple Machines–Levers

Outcomes

Students will be expected to

- differentiate between the position of the fulcrum, the load, and the effort when using a lever to accomplish a particular task (303-18)

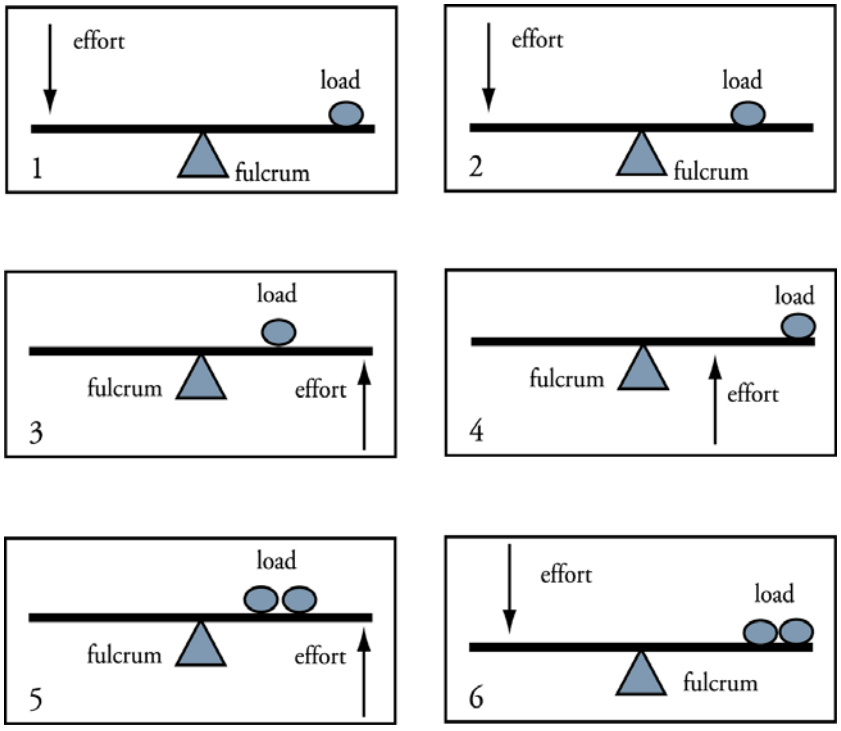
- design the most efficient lever to accomplish a given task (303-19)

Elaborations–Strategies for Learning and Teaching

Students should be encouraged to investigate the advantages and disadvantages of changing the position of the fulcrum in a lever. Students should become familiar with the common terms associated with levers (i.e., load, fulcrum, and effort). A variety of household levers (e.g., wrenches, nut crackers, wheelbarrows) can be displayed in class. While students should not be required to memorize the characteristics of a first (e.g., teeter totter) second (e.g., BBQ tongs) or third class lever (e.g., BBQ tongs) they should explore the differences that occur depending on where the fulcrum is placed. Attention should be paid to the amount of effort needed to lift objects, and the distance that the objects are lifted. Students can experiment with the effort required to lift an object (see examples below) when it is closer or further away from the fulcrum (1 and 2). They can also try to lift the object up from the same side of the fulcrum and vary whether they are between the object and the fulcrum (4), or the object is between the lifting student and the fulcrum (3). They may also try liftng two objects (5 and 6).

A teeter totter-like lever can be used for this exercise.

Students can be given a variety of tasks. Depending on whether the task requires a force advantage (e.g., lifting an extremely heavy object) or distance advantage (e.g., lifting something over a long distance), students can vary the position of the fulcrum to design a lever appropriate to the task.



Simple Machines–Levers

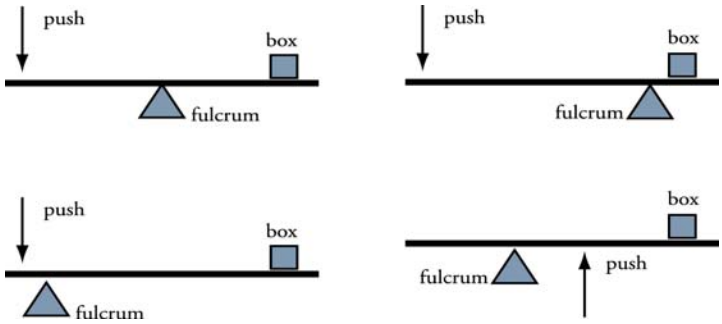
Tasks for Instruction and/or Assessment

Performance

- Design levers to (i) lift a book a distance of 0.5 m using the least amount of force possible; (ii) project a marshmallow at a target; or (iii) crack a nut. (303-19)

Paper and Pencil

- Describe through writing which picture shows the easiest way to lift a heavy box? Which show the hardest way? Which shows the box being lifted the greatest distance? (303-18, 303-19)



Interview

- Show the fulcrum, the load and the effort when you use a this hammer to remove a nail from a board. (303-19)

Resources

Science and Technology 5

Teachers Resource: Forces on Structure

7. Using Machines to Lift Loads, p. 30
9. Design a Mechanical System, p. 38

Simple Machines–Pulleys, Systems of Machines

Outcomes

Students will be expected to

- compare the force needed to lift a load using a single pulley system with that needed to lift it using a multiple pulley system, and predict the effect of adding another pulley on load-lifting capacity (303-20, 204-3)
- design a system of machines to solve a task (204-7)
- communicate questions, ideas, and intentions; listen to others; and suggest improvements to the systems of machines designed by students in the class (207-1, 206-6)
- describe examples of how simple machines have improved living conditions (107-8)
- identify examples of machines that have been used in the past, and have developed over time, using information sources such as books, software packages, and the Internet (205-8, 105-5)

Elaborations–Strategies for Learning and Teaching

Students can further their understanding of simple machines through investigations involving the use of pulleys. They can explore various ways of lifting objects using pulleys, and compare, using a spring scale or their own measuring instruments, the differences which occur when two or more pulleys are used in various combinations. Students should note the distance the effort or force is applied. This is very easily done with pulleys by simply measuring the length of the rope used to lift the object in the air. Students will find that while the object may only be lifted to a height of 0.5 m, it may take rope 2-4 times longer to lift it depending on the pulley combinations used. They should record their observations in a chart. The focus of the analysis should be qualitative, that is, the easier it becomes to lift objects, the longer the rope needed to be used.

Once students are familiar with the various simple machines, they can be given a task to explore a variety of them. They can be encouraged to use two or more simple machines in combination. Students can work in groups to try out various combinations of machines. Following investigations, students can demonstrate their designs and discuss the various strategies applied and the simple machines used. They can test their designs to see which group has best designed a system that matches the assigned task.

Students could dismantle discarded, mechanical-based machines of various types (e.g., bathroom scales, fishing reel, clocks), label the parts and observe the simple machines at work inside. **Caution: Do not use electrical appliances**.

Encourage students to look around their home and community to find example of machines, such as wheelbarrows and conveyor belts that facilitate the carrying and transportation of products, or pulleys, which are used in a clothesline or in lifting the platforms used by window cleaners. Students can analyze the pictures they have collected of tractors, cranes, bicycles, scooters, skateboards, and other machinery to identify the simple machines in each of them.

Students can research how simple machines have been used in the past. Examples such as the Egyptian pyramids, Britain's Stonehenge, the First Nation totem poles and inukshuks can intrigue students.

During field trips, students could be challenged to identify applications of simple machines.

Simple Machines–Pulleys, Systems of Machines

Tasks for Instruction and/or Assessment

Informal/Formal Observation

- Assess a student's group participation during classroom activities. (201-1, 206-6)

Performance

- Complete the table shown below as you carry out your investigations involving pulleys. What do you notice about the force required as the number of pulleys increases? What do you notice about the length of rope? (303-20, 204-3)

Pulleys

# of pulleys	force to lift weight 1 metre	length of rope used to lift the object 1 metre
none		
1		
2		
3		

- From the simple machines you have used, select two or more to use together as a system of machines, Use this system to raise a book one metre. Test your solution to see how much force it took, and see if you can improve it in any way. (Criteria for assessment: the use of different machines, creativity, how much did they reduce effort, space required for system) (204-7)

Journal

- Two problems our group had today while designing our system of machines were ... We tried to solve these problems by ... (204-7)

Presentation

- Write and ferform a play or skit, or complete a research paper on simple machines. When the research paper is presented orally, posters or web pages may be used in the presentation. The play, skit or research paper should show how simple machines are used today, and how they ahve been used in the past. (107-8, 205-8, 105-5)

Portfolio

- Select a piece of your best work from this unit to include in your portfolio. Complete a portfolio assessment rubric to indicate why you selected the certain piece.

Resources

Science and Technology 5

Teachers Resource: Forces on Structure

7. Using Machines to Lift Loads, p. 30
9. Design a Mechanical System, p. 38
10. Different Mechanisms for Difference Jobs, p. 42
11. Computer Parts, p. 44

Design Project:

Design a Pet Shelter, p. 49

Earth and Space Science: Weather

Introduction

Weather is an important aspect of daily life. Students should be provided with opportunities to realize that daily weather conditions are not the result of random occurrences, but rather are part of larger systems and patterns that can be predicted on both a short-term and seasonal basis. An important part of the study of weather is understanding the characteristics of air, its movement, and its ability to hold water. Students consider various aspects of weather such as temperature, wind speed, precipitation, and cloud formation, beginning to recognize the role these factors play in weather systems.

Focus and Context

The focus in this unit should be inquiry. Data collection and predicting are processes to be developed. An appropriate context for this unit is the development and use of a school weather station. Students will have many opportunities to collect a wide variety of data on the weather using instruments they may have constructed. They will also interact with a variety of people and use a wide variety of sources to determine techniques, instruments, and indicators for predicting the weather.

Science Curriculum Links

Students have been introduced to weather in grade 1 in a unit called *Daily and Seasonal Changes*. This topic was expanded upon in grade 2 with the unit *Air and Water in the Environment*.

In this unit, students do a further study of the factors that impact weather. The topic is studied in greater detail in grade 10 in a unit called *Weather Dynamics*.

pan-Canadian Science Learning Outcomes

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

STSE

Students will be expected to

Nature of Science and Technology

104-4 compare the results of their investigations to those of others and recognize that results may vary

104-7 demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results

105-1 identify examples of scientific questions and technological problems that are currently being studied

105-2 identify examples of scientific questions and technological problems addressed in the past

Relationships Between Science and Technology

106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications

Social and Environmental Contexts of Science and Technology

107-2 describe and compare tools, techniques, and materials used by different people in their community and region to meet their needs

107-5 provide examples of how science and technology have been used to solve problems in their community and region

107-10 identify women and men in their community who work in science- and technology-related areas

107-14 identify scientific discoveries and technological innovations of people from different cultures

108-1 identify positive and negative effects of familiar technologies

Skills

Students will be expected to

Initiating and Planning

204-3 state a prediction and a hypothesis based on an observed pattern of events

204-8 identify appropriate tools, instruments, and materials to complete their investigations

Performing and Recording

205-4 select and use tools for measuring

205-6 estimate measurements

205-7 record observations using a single word, notes in point form, sentences, and simple diagrams and charts

205-10 construct and use devices for a specific purpose

205-8 identify and use a variety of sources and technologies to gather pertinent information

Analysing and Interpreting

206-1 classify according to several attributes and create a chart or diagram that shows the method of classifying

206-2 compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs

206-3 identify and suggest explanations for patterns and discrepancies in data

206-5 draw a conclusion, based on evidence gathered through research and observation, that answers an initial question

Communicating and Teamwork

207-4 ask others for advice or opinions

Knowledge

Students will be expected to

300-13 describe weather in terms of temperature, wind speed and direction, precipitation, and cloud cover

302-11 describe the key features of a variety of weather systems

303-21 relate the transfer of energy from the sun to weather conditions

300-14 describe situations demonstrating that air takes up space, has weight, and expands when heated

302-10 identify patterns in indoor and outdoor air movement

301-13 relate the constant circulation of water on Earth to the processes of evaporation, condensation, and precipitation

301-14 describe and predict patterns of change in local weather conditions

PEI/APEF Specific Curriculum Outcomes

Measuring and Describing Weather

Students will be expected to

- identify and use weather-related folklore to predict weather (105-2)
- identify and/or construct, and use instruments for measuring weather information (204-8, 205-4, 205-10)
- use appropriate terminology in naming weather instruments and collecting weather data (104-7)
- record observations using measuring instruments in order to describe weather in terms of temperature, wind speed, wind direction, precipitation, and cloud cover (205-7, 300-13)
- classify clouds as stratus, cumulus, cirrus, or "other", compare results with others, and recognize that results may vary (104-4, 206-1)
- use a variety of sources to gather information to describe the key features of a variety of weather systems (205-8, 302-11)
- estimate weather measurements for various times of the day, week, or for weather systems (205-6)
- identify weather-related technological innovations and products that have been developed by various cultures in response to weather conditions (107-14)

Sun's Energy Reaching the Earth

Students will be expected to

- relate the transfer of energy from the sun to weather conditions (303-21)
- identify and use appropriate tools, measuring instruments and materials to measure the temperature of soil and water after exposing them to light and draw conclusions (204-8, 205-4, 206-5)

Properties of Air

Students will be expected to

- describe situations demonstrating that air takes up space, has mass, and expands when heated (300-14)
- draw a conclusion, based on evidence gathered through research and observation, about the patterns of air and/or water flow that result when two air or water masses of different temperature meet (206-5)

Movement of Air and Water

Students will be expected to

- identify patterns in indoor and outdoor air movement (302-10)
- relate the constant circulation of water on Earth to the processes of evaporation, condensation, and precipitation (301-13)

Predicting the Weather

Students will be expected to

- compile and display weather data collected over a period of time in table and/or graph format, and identify and suggest explanations for patterns or discrepancies in the data (206-2, 206-3)
- ask different people in the community and region for advice on how to predict weather, and compare the tools and techniques they use to make predictions (107-2, 107-10, 207-4)
- provide examples of ways that weather forecasts are used by various people in their community (107-5)
- describe and predict patterns of change in local weather conditions (204-3, 301-14)

Environmental Issues

Students will be expected to

- identify examples of weather phenomena that are currently being studied (105-1)
- identify positive and negative effects of technologies that affect weather and the environment (108-1)
- describe how studies of the depletion of the ozone layer, global warming and the increase in acid rain have led to new inventions and stricter regulations on emissions from cars, factories, and other polluting technologies (106-4)

Measuring and Describing Weather

Outcomes	Elaborations–Strategies for Learning and Teaching
Students will be expected to	*Note: Many of the activities suggested in this section will also address outcomes for describing and predicting weather patterns, which occur later on in this unit.*
• identify and use weather-related folklore to predict weather (105-2)	Introduce students to this unit with weather sayings, folklore and indicators that people use to predict weather. Students can monitor such sayings to see how well they work. For example, "Seagulls on land, bad day at hand", "Red sky in mornings, sailor take warning".
• identify, construct, and use instruments for measuring weather information (204-8, 205-4, 205-10)	Students should construct and/or collect instruments for measuring weather information such as temperature, wind speed, wind direction, precipitation, humidity, and air pressure. Air and water thermometers, barometers, and other meteorological instruments could be constructed by students, and then used throughout this unit to collect data on the local weather.
• use appropriate terminology to name weather instruments when collecting weather data (104-7)	Students could develop an illustrated glossary of terms related to the study of weather, such as the names of weather instruments, weather systems, and words that describe aspects of weather, such as "humidity" and "windchill factor".
• record observations using instruments to describe weather in terms of temperature, wind speed, wind direction, precipitation, and cloud cover (205-7, 300-13)	Students could record their observations and measurements in charts or tables, to describe the weather, and note patterns for predicting weather later in the unit.
• classify clouds as stratus, cumulus, cirrus, or "other", compare results with others, and recognize that results may vary (104-4, 206-1)	Students should spend time observing clouds. Classifying clouds can be a challenge, as cloud formations can change quickly. Students could look at pictures of clouds to identify and develop concepts about stratus, cumulus, or cirrus. Some clouds do not fit any of the common classifications. However, observing, classifying and researching what types of clouds are associated with various weather systems is an important part of predicting weather systems. Some students may wish to do some research on cloud types to extend their classification scheme and classify clouds based on how high they are in the sky, (e.g., nimbostratus or cumulonimbus).

. . . continued

Measuring and Describing Weather

Tasks for Instruction and/or Assessment

Performance

- Use the weather instruments to help you make observations over a one-week period. Record these in the chart. (205-7, 300-13, 104-4, 206-1)

Weather Observations

Weather Instrument	Day 1	Day 2	Day 3	. . . .
Barometer				
Wind Vane				
Anemometer				
Precipitation				
Thermometer				
Cloud Type				
etc.				

Journal

- Some weather sayings that predict the weather that I have heard are.... I have found that these (work/don't work/sometimes work).... (105-2, 107-2, 207-4, 107-10)

Paper and Pencil

- Print the letter of each instrument on the line in front of the description of the instrument. (This item can be combined with pictures of the instruments) (204-8, 205-4, 205-10, 104-7)

  a) wind vane ____ Shows the direction of the wind

  b) thermometer ____ Tells the air pressure, high or low

  c) rain gauge ____ Tells the speed of the wind

  d) anemometer ____ Provides a measure of rainfall

  e) barometer ____ Tells the temperature

. . . continued

Resources

Science and Technology 5

Teachers Resource: Weather

Launch: What's the Weather? p. 8

1. Investigating Temperature, p. 11
2. Designing Weather Instruments, p. 14
3. Making More Weather Instruments, p. 18
4. Clouds, Clouds, Clouds p. 22
5. Setting up a Weather Station, p. 25
8. Adapting to Weather, p. 35
10. Predicting the Unpredictable, p. 43

Design Project:

A Weather Broadcast, p. 47

Measuring and Describing Weather (continued)

Outcomes	Elaborations–Strategies for Learning and Teaching
Students will be expected to • use a variety of sources to gather information to describe the key features of a variety of weather systems (205-8, 302-11)	Examples of weather systems include hurricanes, tornadoes, snow storms, and thunderstorms. Most students will be able to watch the weather channel on television. These channels have informative and interesting video clips that answer questions, explain how various instruments work, and show the key features of weather systems. There are also many informative sites on the Internet.
• estimate weather measurements for various times of the day, week, or for weather systems (205-6)	Students can use the information they have gathered from the variety of sources to estimate wind speed, amounts and types of precipitation, and when various weather systems are forecast or occur both locally and globally. Students could be encouraged to estimate temperature and wind speed to assist in selecting appropriate outside clothing. Students could be encouraged to estimate the wind speed of a storm, or estimate the amount of precipitation after a rain or snowstorm.
• identify weather-related technological innovations and products that have been developed by various cultures in response to weather conditions (107-14)	Students should be encouraged to investigate the role and contributions of science and technology to the development of weather-related products. Students can use a variety of electronic media (e.g., television, Internet), as well as print resources, to identify weather-related products such as storm doors, weather proof clothing, Sou'wester hats, snow fences, dams and dikes in flood zones, hurricane shutters, snowshoes and sloped roofs. Teachers may wish to have individuals or pairs of students conduct research, and then display their findings as part of a classroom "Weather Exhibit".

Measuring and Describing Weather (continued)

Tasks for Instruction and/or Assessment

Performance

- Ask students to first estimate temperature and wind speed and then record the actual temperature and wind speed. Compare predicted to actual results. (104-4, 205-6, 205-7)

Paper and Pencil

- Think about the various items humans have invented to help them deal with different kinds of weather. What is one item that you would like to see someone invent (e.g., glasses that don't fog up when you come in on a cold day).
- Use a variety of sources to find out about weather events such as hurricanes, tornadoes, snow storms, thunderstorms, and heat waves. Record information such as amount of precipitation, wind speed, cloud type, temperature. (205-8, 302-11)

Interview

- What do you think the wind speed would be in the middle of a winter blizzard? Explain. (205-6)
- What do you think our average day-time temperature is in February? Explain. (205-6)
- A hurricane is due to hit land on Wednesday. What do you think the wind speed range will be? Explain. (205-6)

Presentation

- Use magazines, books, or electronic resources to find products that have been developed by various cultures to help them cope with extreme weather. These products could include special clothing, roofing materials, shapes and structures of buildings, or special forms of transportation. Cut out or draw pictures to support your research. (107-14)

Resources

Science and Technology 5

Teachers Resource: Weather

1. Investigating Temperature, p. 11
3. Making More Weather Instruments, p. 18
4. Clouds, Clouds, Clouds, p. 22
8. Adapting to Weather, p. 35
9. What is Climate? p, 39

Design Project:

A Weather Broadcast, p. 47

Sun's Energy Reaching the Earth

Outcomes

Students will be expected to

Elaborations–Strategies for Learning and Teaching

Students have been involved in measuring and describing weather and various weather systems. In this section they will be introduced to some of the causes of weather phenomena, namely precipitation and winds. Two processes related to weather and air/water movement that students should investigate are the water cycle and temperature-induced winds or *convections*. Using these two processes, students will be able to understand how the sun plays such an important role in determining the weather.

- relate the transfer of energy from the sun to weather conditions (303-21)

Students should explain how solar energy provides energy to evaporate water, and warm the Earth's lands and oceans. The sun plays an important role in the water cycle and in determining weather conditions. It is the energy from the sun that warms the water and land. Students will discover that when more heat is given to water, evaporation takes place faster. This will result in more water vapour in the air. Conversely, as the moist air cools, condensation occurs, and water fall as various forms of precipitation.

- identify and use appropriate tools, and materials to measure the temperature of soil and water after exposing them to light and draw conclusions about the temperature readings (204-8, 205-4, 206-5)

Students should investigate the temperature change of soil and water when exposed to a lamp for equal periods of time. They should investigate the temperature change after the lamp is removed, and draw conclusions based on their observations. They should note that water will take longer to heat up and cool down.

As the temperature of the water and the land rises, so does the temperature of the air above it. Because land and bodies of water do not warm up at the same rate, there will be temperature differences over land and water. These differences, which cause wind convections, will be explored in the next section.

Sun's Energy Reaching the Earth

Tasks for Instruction and/or Assessment

Performance

- With a partner, plan an experiment to determine whether water or soil heats up more quickly. Record your results in a chart, and graph your results using a line graph. (204-8, 205-4, 206-5)

Paper and Pencil

- Draw a diagram to show how the following concepts are related: energy, sun, water, land, evaporation, condensation, precipitation (the water cycle). (303-21)

Interview

- On a hot summer day, which would you expect to be cooler, the water in a lake or the beach rocks or sand on the shoreline? Which do you think would cooler first thing in the morning, before the sun comes up? Explain your answer. (204-8, 205-4, 206-5)

Resources

Science and Technology 5

Teachers Resource: Weather

6. The Water Cycle, p. 29
7. Air Masses and Fronts, p. 32
9. What is Climate? p. 39

Properties of Air

Outcomes

Students will be expected to

- describe situations which demonstrate air takes up space, has weight, and expands when heated (300-14)

- draw a conclusion, based on evidence gathered through research and observation, about the patterns of air and/or water flow that result when two air or water masses of different temperature meet (206-5)

Elaborations–Strategies for Learning and Teaching

Moving air or wind is a noticeable part of most weather systems. Students can do many activities to demonstrate the properties of air. Blowing up balloons, lifting up boxes by blowing into plastic bags that have been placed under its corners, and trying to fill up a bottle with water by submersing it in a large tub of water (the air bubbles have to escape before it can fill up) all demonstrate that air takes up space.

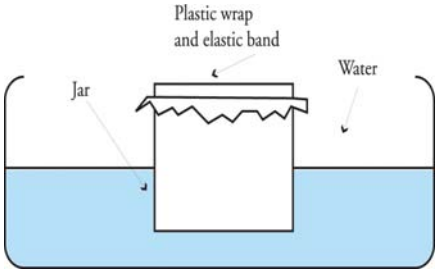
Students can find the mass of uninflated balloons or air mattresses, and then find the mass again when they are full of air to demonstrate that air has mass. Changes in the mass of air can also be illustrated by examining differences in air pressure at various heights above the surface of the Earth. This can be modelled by stacking paper in progressively larger piles to show how the mass increases. Similarly, air has a greater pressure closer to sea level because of all of the air "stacked" on top of it.

An example of a way to demonstrate that air expands when heated and contracts when cooled is to submerse a tube or bottle in water until it is partly filled with water, and the rest is air. Invert the bottle or tube so that it is upside down, with the opening sitting in the water, and the water level in the tube or bottle showing above it. Mark the side of the bottle to show the water level. (This also indicates how much space the air is taking up.) Use a hair dryer to warm the air in the bottle, or take the apparatus outside to cool the air in the bottle, and note the change in the space that the air takes up. Another activity is to blow up a small balloon, and completely submerse it water of room temperature. Mark the water level with the balloon submersed. Then, using an identical amount of warm water, submerse the balloon again, wait a few minutes, and mark the water level with the balloon submersed. It should take up more space when it is warm because the volume of air has increased. This can also be done with cold water. An alternative activity involves placing the balloon under a lamp or in the refrigerator to note changes in the size of the balloon.

Properties of Air

Tasks for Instruction and/or Assessment

Performance



- Put some plastic wrap over a jar, and secure it with an elastic band. Put the jar in a pan that has hot water in it. After three minutes, record your observations of the plastic wrap. Repeat with the pan filled with ice-cold water. What happens to air as it heats up? What happens as it cools? (300-14) (206-5)

Paper and Pencil

- Why is the air pressure greater at sea level than at the top of a mountain? Draw a diagram to support your explanation. (300-14)

Interview

- What could you do to show me that air takes up space? (300-14)

Resources

Science and Technology 5

Teachers Resource: Weather

7. Air Masses and Fronts, p. 32

Movement of Air and Water

Outcomes

Students will be expected to

- identify patterns in indoor and outdoor air movement (302-10)

- relate the constant circulation of water on Earth to the processes of evaporation, condensation, and precipitation (301-13)

Elaborations–Strategies for Learning and Teaching

Patterns of indoor air movement are far more subtle than outdoor patterns of movement. Students can investigate patterns of indoor air movement by putting their hands about 0.5 meters above a raditator, and noting how the warm air rises. They may try to detect the direction of the moving air by clapping a chalk eraser over it, or letting small feathers from a down pillow drift over the heater. **Caution: adding extra chalk dust and feathers in the classroom may irritate asthmatic students**. They will also note moving air with fans or open windows.

Outdoor air movement is much more pronounced. Students can easily feel the wind, and can use a wind vane to measure its direction at various times of the day, and an anemometer to measure its speed. Satellite images can show the pattern of air movement on a more global level by showing cloud movement.

As air and water are considered fluids and behave similarly; investigations regarding air flow patterns can more easily be shown by experimenting with water. Students can investigate patterns by heating up one side of a large beaker or aquarium with heat lamps or a heat source. Alternatively, they might put a bag of ice on one side of the aquarium, and float a bowl of hot water on the other side. As the water is warming on one side, a drop of food colouring can be added to show how the water is moving. Students will see that the warm water moves up and over on top of the cold water, and the cold water moves down and across to replace the warm water. The same circular pattern, called a convection, applies to air: warm air rises, and cool air sinks and moves over to replace the warm air.

These convections can illustrate how winds occur. The bigger the difference in the temperatures between two air or water masses, the stronger the convections or winds. Students can now revisit the effect of the sun on weather conditions and propose explanations for "sea breezes" (land heats up more quickly than water). During the daytime, the air over land will rise while the cool air over water will move in to replace it. In the night-time, this situation reverses as the land cools down quickly once the sun disappears, while the water cools down much more slowly.

Students will have explored phase changes in the unit *Properties and Changes of Materials*. Students can investigate the water cycle by making clouds in a jar, distilling water, exploring the evaporation of water from a glass, or letting water vapour condense on a window or glass. This can be related to the bodies of water on Earth and to the moisture in the atmosphere. Rivers, lakes and oceans are a water source for rain, snow, and other forms of precipitation. As water evaporates from them into the air, clouds form. Precipitation from these clouds completes the water cycle.

Movement of Air and Water

Tasks for Instruction and/or Assessment

Performance

- How often does the wind change direction and speed? Keep track of the wind for a week by completing the table below. (302-10)

Tracking the Wind

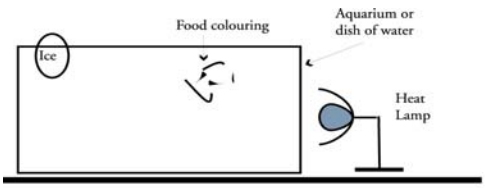
Time	Day 1				Day 2
	Before School	Recess	Lunch	After School	Before School
Wind Direction					
Wind Speed					

Journal

- One day it can be sunny, and the next day the air is full of clouds, and it is raining. Where does the water come from? Where do clouds come from? (301-13)
- Places in which I can feel moving air when I am inside are: (describe pattern, if any). (302-10)
- When I am outside, I feel moving air whenever I feel the wind. Over a one week period, ... (describe results of their observations, draw conclusions about patterns of outdoor air movement). (302-10)

Paper and Pencil

- From your observations, draw arrows to show the pattern of food colouring movement. Write a conclusion about the direction at water movement of different temperatures. Describe evidence that air behaves the same way over the land and the ocean? (206-5)



- Draw arrows to show the direction of the wind in the middle of a hot summer day over the land and the ocean . Explain your arrows. (206-5)

Resources

Science and Technology 5

Teachers Resource: Weather

5. Setting up a Weather Station, p. 25
6. The Water Cycle, p. 29
7. Air Masses and Fronts, p. 32
8. Adapting to Weather, p. 35
9. What is Climate? p. 39

Design Project:

A Weather Broadcast, p. 47

Predicting the Weather

Outcomes

Students will be expected to

- compile and display weather data collected over a period of time in table and/or graph format, and identify and suggest explanations for patterns or discrepancies in the data (206-2, 206-3)

- ask different people in the community and region for advice on how to predict weather, and compare the tools and techniques they use to make predictions (107-2, 107-10, 207-4)

- provide examples of ways that weather forecasts are used by various people in their community (107-5)

- describe and predict patterns of change in local weather conditions (204-3, 301-14)

Elaborations–Strategies for Learning and Teaching

Students will have collected weather data throughout this unit and explored some of the theory underlying the causes of wind and precipitation. They should now begin to analyze the data, looking for patterns. They should also examine how weather forecasts are made and how they have developed over the years.

Students should interview family members, neighbours, students from other schools (via e-mail) farmers, fishers, weather reporters or meteorologists, to find ways of forecasting the weather. There are many sites on the Internet that explain how weather is predicted by various groups, and some sites allow questions to be asked directly to a meteorologist.

From their interviews students should gain the sense that there is a range of indicators that can be used in predicting weather. To illustrate the degree of uncertainty in weather forecasting, students may wish to record forecasts, both short and long term, and then compare the forecasts to the actual weather as it occurs. These activities encourage students to show an interest in the activities of individuals working in scientific and technological fields. This activity might be related to the work students have done on weather predicting using folklore.

Students could interview people in their neighbourhood or community to see how they use weather forecasts in their daily lives. Farmers, fisherpersons, skiers, school board personnel responsible for school closures, and people involved in transportation are examples of people with whom they could talk.

Students can then make weather forecasts based on indicators and sayings they have collected and compiled. Since they have only collected weather data for a limited period of time, they will only be able to identify a few patterns. They will find that they can make short term forecasts to a fair degree of accuracy using the indicators and sayings, but their ability to make long-range forecasts will be limited. These may improve if they include satellite images available on the Internet in their analysis.

Predicting the Weather

Tasks for Instruction and/or Assessment

Performance

- In the top row of the chart below, record different ways you have learned to predict the weather based on information you gained from talking to people in the community. Complete the table for a week, and write a description of your results. (107-2, 107-10, 204-3, 207-4, 301-14)

Predicting the Weather

Predictor or Indicators		Weather forecast	Sunset/ Sunrise	Cows/ Spiders	....
Monday	Predicted				
	Actual				
Tuesday	Predicted				
	Actual				
:	Predicted				
:	Actual				

Paper and Pencil

- Describe some of the tools a meteorologist uses to predict weather. (107-2, 107-10, 207-4)
- Name three groups of people or professions in your community who use weather forecasts. Explain why it is important to have accurate weather forecasts. (107-5)

Presentation

- Create a poster that displays graphs of the various weather measurements you have collected over the course of the unit. Write a paragraph that describes what you found, and suggest explanations for any patterns or unusual points that you see. Some sample focus questions include: Did the temperature steadily increase or decrease? Could you predict the temperature accurately if you knew the temperature the day before? Are weather conditions connected to the air pressure, as measured by a barometer? (204-3, 206-2, 206-3, 301-14)

Resources

Science and Technology 5

Teachers Resource: Weather

Launch: What's the Weather? p. 8

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10. Predicting the Unpredictable, p. 43

Design Project:

A Weather Broadcast, p. 47

Environmental Issues

Outcomes

Students will be expected to

- identify examples of weather phenomena that are currently being studied (105-1)

- identify positive and negative effects of technologies that affect weather and the environment (108-1)

- describe how studies of the depletion of the ozone layer, global warming and the increase in acid rain have led to new inventions and stricter regulations on emissions from cars, factories, and other polluting technologies (106-4)

Elaborations–Strategies for Learning and Teaching

Examples of weather phenomena that can be studied are the effects thought to be caused by the Green House Effect or Global Warming, acid rain, and El Niño/La Niña. In this section of the unit, students should gain awareness of some current weather and climate related issues. Students will be introduced to the causes and the effects of global warming, depletion of the ozone, and acid rain. Other weather/environmental issues such as volcanic emissions, and deforestation can also be addressed. The depth of treatment for the causes would be limited to identifying the types of activities that contribute to these problems (e.g., refining ores, burning fossil fuels) but would not deal with actual chemical reactions. Students should, however, become familiar with some of the terminology surrounding these issues. For example, they should be aware that "ozone" is a gas in the "upper atmosphere", and that ozone blocks some of the sun's harmful "ultaviolet rays". Students will also explore the effects of other phenomena, such as sun dogs, rainbows, and lunar halos, using information gathered from a variety of sources. Students may wish to simulate some of these effects using models. For example, they may wish to demonstrate the effects of acid rain on plant growth. The greenhouse effect can be simulated by comparing the temperatures in two identical jars, one of which is covered in plastic wrap while the other is left open.

Students should investigate the positive and negative effect of the technologies that contribute to air pollution. These can include greeenhouse gases, ozone-depleting gases, and/or acidic chemicals. For example, the chemicals that cause ozone depletion in the upper atmosphere were developed as cheap, stable, non-toxic alternatives to air conditioning chemicals used previously. Acid rain is caused, in large part, by automobile exhaust, and many members of society are dependant on cars. Students should realize that because of these positive benefits, finding solutions to problems caused by them will not not easy.

They could find out what local, provincial and federal governments, and well as international organizations, are doing to find solutions.

This part of the unit fosters a realization that the applications of science and technology can have both intended and unintended effects.

Environmental Issues

Tasks for Instruction and/or Assessment

Presentation

- Create a presentation involving a cartoon, brochure, poster, report, or web page on a current weather-related environmental topic from the list below. Give a description of the environmental issue. Suggest inventions or innovations that have been developed to deal with the problem. (105-1, 106-4, 108-1)
  - acid rain
  - global warming
  - the ozone hole
  - El Niño or La Niña
  - volcanic emissions
  - others

Portfolio

- Select a piece of your best work from this unit for your portfolio. Complete a portfolio self-assessment rubric to assist you with the selection process.

Resources

Science and Technology 5

Teachers Resource: Weather

9. What is Climate? p. 39

Elementary Science Safety

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

The Safe Classroom

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

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

Non-Hazardous Chemicals

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

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

Dangerous Household Chemicals

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

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

Disposing of Chemicals

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

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

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

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

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

Plant and Animal Care in the Classroom

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

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

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

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

Attitude Outcome Statements

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

Appreciation of Science	Interest in Science	Scientific Inquiry
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 curiousity 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 trail 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	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 • open-mindedly consider nontraditional approaches to science • seek additional information before making a decision • base conclusions on evidence rather than preconceived ideas or hunches • report and record what is observed, not what they think ought to be or what they believe the teacher expects • willingly consider changing actions and opinions when presented with new information or evidence • record accurately what has been seen or measured when collecting evidence • take the time to repeat a measurement or observation for greater precision • ask questions about what would happen in an experiment if one variable were changed

Attitude Outcome Statements

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

Collaboration	Stewardship	Safety in Science
418 work collaboratively while exploring and investigating *Evident when students, for example,* • complete group activities or projects • willingly participate in cooperative problem solving • stay with members of the group during the entire work period • willingly contribute to the group activity or project • willingly work with others, regardless of their age, their gender or their physical or cultural characteristics • willingly consider other people's views of the world	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 effect and consequences of their actions • demonstrate willingness to change behaviour to protect the environment • repect 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	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