

# Atlantic Canada Science Curriculum

*New Brunswick* **New**  *Nouveau*  
*Department of Education* **Brunswick**  
*Educational Programs & Services Branch*

## Science 5

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# CURRICULUM

**2002**

Additional copies of this document (*Science Grade 5*) may be  
obtained from the Instructional Resources Branch.

**Title Code (843230)**

# 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.

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# Introduction

## Background

The curriculum framework described in the *Foundation for the Atlantic Canada Science Curriculum* was planned and developed collaboratively by regional committees. The process for developing the specific science curriculum for Atlantic Canada (entry to grade ten) involved regional consultation with the stakeholders in the education system in each Atlantic province. The Atlantic Canada science curriculum (entry to grade ten) 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 help students develop scientific literacy, an evolving combination of science-related knowledge, skills and attitudes. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment. Scientific inquiry, problem-solving and decision making support students to become life-long learners and to maintain a sense of wonder about the world around them.





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# 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 whole class, small 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.

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## Writing in Science

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

Learning experiences in science should 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.

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## The Three Processes of Scientific Literacy

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

### *Inquiry*

Scientific inquiry involves posing questions and developing explanations for phenomena. While there is general agreement 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 practise the process of theory development in science and understand 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.

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## 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 address students' various learning styles.

As well, teachers must 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.

It is important that teachers articulate high expectations for all students and ensure 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.

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.

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## Assessment and Evaluation

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

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

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

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

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



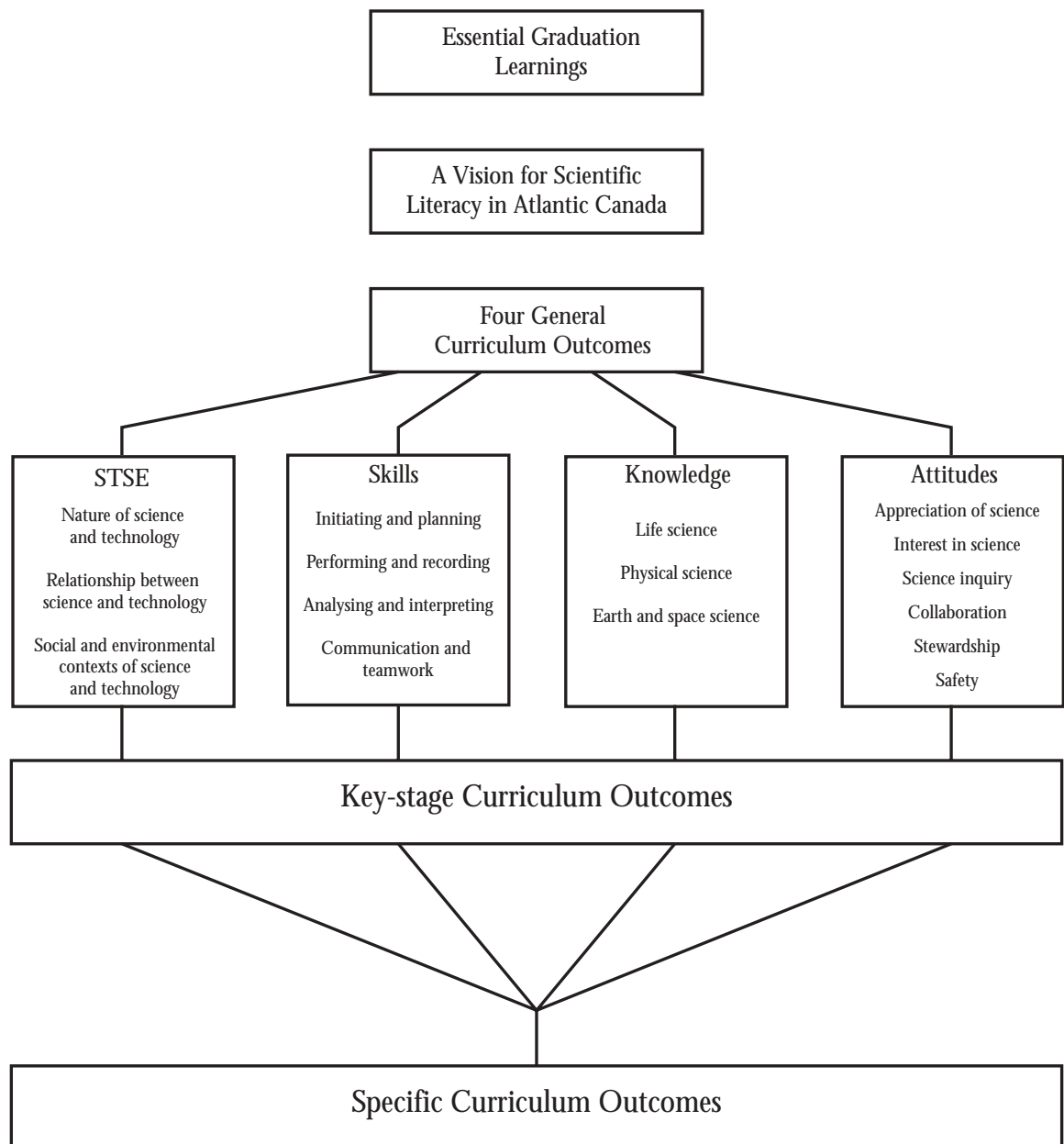
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# Curriculum Outcomes Framework

## Overview

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

## Outcomes Framework



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## Essential Graduation Learnings

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

### *Aesthetic Expression*

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

### *Citizenship*

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

### *Communication*

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

### *Personal Development*

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

### *Problem Solving*

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

### *Technological Competence*

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



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## 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 2, 5, 8, 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.

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## 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.

By the end of grade 5 (key stage), students will be expected to:

- appreciate the role and contribution of science and technology in their understanding of the world (409)
- realize that the application of science and technology can have both intended and unintended effects (410)
- recognize that women and men of any cultural background can contribute equally to science (411)
- show interest and curiosity about objects and events within different environments (412)
- willingly observe, question, explore and investigate (413)
- show interest in activities of individuals working in scientific and technological fields (414)
- consider their own observations and ideas as well as others during investigations and before drawing conclusions (415)
- appreciate the importance of accuracy and honesty (416)
- demonstrate perseverance and a desire to understand (417)
- work collaboratively while exploring and investigating (418)
- be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment (419)

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## Curriculum Guide Organization

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

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

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

## Unit Organization

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

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

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

These code numbers appear in brackets after each specific curriculum outcome (SCO). The outcomes have been expressed in a context in order to clarify their intent.

## The Four-Column Spread

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

*Two Page, Four Column Spread*

### Page One

### Page Two

Topic			
Outcomes	Elaborations—Strategies for Learning and Teaching	Tasks for Instruction and/or Assessment	Resources/Notes
Students will be expected to <ul style="list-style-type: none"> <li>• Specific curriculum outcome based on the Pan-Canadian outcomes (outcome number)</li> <li>• Specific curriculum outcome based on the Pan-Canadian outcomes (outcome number)</li> </ul>	elaboration of outcome and strategies for learning and teaching  elaboration of outcome and strategies for learning and teaching	Type of Assessment Tasks:  <i>Informal/Formal Observation</i>  <i>Performance</i>  <i>Journal</i>  <i>Interview</i>  <i>Paper and Pencil</i>  <i>Presentation</i>  <i>Portfolio</i>	Provincial responsibility  Resources suggested for use in N.B.

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*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 defines what students are expected to know 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. Italics is used in this column for commentary directed to the teacher

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 task identifies the outcome(s) addressed being assessed; the outcome number is in brackets after the task.

*Column Four: Resources/  
Notes*

This column is a provincial responsibility.



**Unit 1**  
**Life Science:**  
**Meeting Basic Needs and**  
**Maintaining a Healthy Body**

# Unit Overview

## 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 learn where they are located in the body. It is important for students to recognize many factors may affect a healthy body. The body has its own defences against germs, but students should understand they must meet their own bodies' requirements for basic needs such as nutrition and exercise.

## Focus and Context

This unit could be integrated with the health/personal development curriculum, but it should extend beyond what is normally covered to a more inquiry-oriented approach. For example, students should investigate first hand the factors that can increase heartbeat rate, build models of organs and systems to see how they function, and experiment to determine the function saliva plays in digestion. It is not enough for students to simply be able to draw or label diagrams of the various body systems; they need to be involved in investigating the factors that affect them. Integrating learning experiences with the health curriculum will facilitate a decision-making focus. Activities should be set in a context of making choices that lead toward living an active, healthy lifestyle. Students at this age will soon be faced with 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 wrong choices are made.

## Science Curriculum Links

Students have already investigated the *Needs and Characteristics of Living Things*, as well as growth and life cycles 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.



# Curriculum Outcomes

STSE	Skills	Knowledge
<p>Students will be expected to</p> <p><b>Nature of Science and Technology</b></p> <p><b>104-2</b> demonstrate and describe processes for investigating scientific questions and solving technological problems</p> <p><b>105-2</b> identify examples of scientific questions and technological problems addressed in the past</p> <p><b>Relationships Between Science and Technology</b></p> <p><b>106-2</b> describe examples of tools and techniques that have contributed to scientific discoveries</p> <p><b>106-4</b> describe instances in which scientific ideas and discoveries have led to new inventions and applications</p> <p><b>Social and Environmental Contexts of Science and Technology</b></p> <p><b>107-2</b> describe and compare tools, techniques, and materials used by different people in their community and region to meet their needs</p> <p><b>107-5</b> provide examples of how science and technology have been used to solve problems in their community and region</p> <p><b>107-8</b> describe examples of technologies that have been developed to improve their living conditions</p> <p><b>107-12</b> provide examples of Canadians who have contributed to science and technology</p> <p><b>107-14</b> identify scientific discoveries and technological innovations of people from different cultures</p>	<p>Students will be expected to</p> <p><b>Initiating and Planning</b></p> <p><b>204-1</b> propose questions to investigate and practical problems to solve</p> <p><b>204-2</b> rephrase questions in a testable form</p> <p><b>Performing and Recording</b></p> <p><b>205-1</b> carry out procedures to explore a given problem and to ensure a fair test of a proposed idea by controlling major variables</p> <p><b>205-2</b> select and use tools to manipulate materials and build models</p> <p><b>205-7</b> record observations using a single word, notes in point form, sentences, simple diagrams and charts</p> <p><b>Analysing and interpreting</b></p> <p><b>206-2</b> compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs</p> <p><b>206-3</b> identify and suggest explanations for patterns and discrepancies in data</p> <p><b>206-4</b> evaluate the usefulness of different information sources in answering a given question</p> <p><b>Communication and teamwork</b></p> <p><b>207-5</b> identify problems as they arise and work cooperatively with others to find solutions</p>	<p>Students will be expected to</p> <p><b>301-8</b> relate bodily changes, such as acne on the skin and the growth of body hair, to growth and development</p> <p><b>302-4</b> describe the role played by body systems in helping humans and other animals to grow and reproduce and meet their basic needs</p> <p><b>302-5a</b> describe the structure and function of the major organs (i.e., teeth, tongue, oesophagus, stomach, small intestine, and large intestine) of the digestive system</p> <p><b>302-5b</b> describe the structure and function of the major organs (i.e., kidneys, bladder, ureters and urethra, as well as the skin and lungs) of the excretory system</p> <p><b>302-5c</b> describe the structure and function of the major organs (i.e., nose, trachea, lungs, diaphragm) of the respiratory system</p> <p><b>302-5d</b> describe the structure and function of the major organs (i.e., heart, blood vessels (arteries, veins, capillaries), and blood) of the circulatory system</p> <p><b>302-5e</b> describe the structure and function of the major organs (i.e., brain, spinal cord, and nerves) of the nervous system</p> <p><b>302-6</b> demonstrate how the skeletal, muscular, and nervous systems work together to produce movement</p> <p><b>302-8</b> describe the body's defences, such as tears, saliva, skin, certain blood cells, and stomach secretions, against infections</p> <p><b>302-7</b> describe the role of the skin</p> <p><b>302-9</b> describe nutritional and other requirements for maintaining a healthy body</p>

## Growth and Development

### Outcomes

Students will be expected to

- propose questions to investigate how our body functions and the contribution of its components (204-1)
- relate bodily changes, such as acne on the skin and growth of body hair, to growth and development (301-8)
- describe how body systems help humans and other animals to grow and reproduce and to meet their basic needs (302-4)

### Elaboration–Strategies for Learning and Teaching

*This unit may be integrated with curriculum units from health/personal development at the elementary level. Video or other media could be used to support and illustrate growth and development outcomes.*

Students could brainstorm a list of questions about the components of their bodies and their functions. The students could discuss the following: “Why do we need to eat?”, “How does food give us energy?”, “What do my lungs do, and how do they work?”, “What happens to food after I eat?”, “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. In keeping with the decision-making focus in this unit, questions should be raised about how substances like tobacco, alcohol, and drugs affect growth, development and their actual bodies. Teachers should be prepared for questions and concerns from parents who use tobacco/alcohol.

Students could, individually or in groups, make a list of body changes that occur as one grows older. When the list is completed, initiate a discussion about when these changes occur. Some changes that take place during puberty are gradual (e.g., increases in height and weight) while other changes have a fairly sudden onset (e.g., acne, hair growth, etc.)

Videos or other media can be used to illustrate growth and development.

Students should investigate the structures and functions of the major parts of the reproductive system. Students can use a variety of sources (e.g., print, electronic, computer software) to learn about the major organs of the reproductive system.

## Growth and Development

### Tasks for Instruction and/or Assessment

#### *Performance*

- Create a chart that will help track changes in growth (height). Collect data on the height of classmates and plot a graph indicating changes in height over a period of time. Note differences in gender and other bodily changes. (301-8)

#### *Journal*

- I wonder how my body grows. The things I wonder about most are ... (204-1) **Note: Confidentiality should be maintained between the student and the teacher.**

#### *Paper and Pencil*

- Research bodily changes from birth to puberty. A chart similar to the example below could be used to organize the data. (301-8)

### Body Changes

Change	Onset	Time Span
get taller	birth	varies, up until around age 17
cut baby teeth	around 6 months of age	varies, short time span (around 3 years)
etc.		

#### *Presentation*

- Make a poster that includes pictures or drawings of people at various ages. Include a variety of pictures of life stages (e.g., infant, child, adolescent, young adult, middle, and senior adults). Include descriptions of changes that occur for each stage. (301-8)

### Resources

#### Teacher's Guide

pp. 12, 70, 106

#### Student Resource

Lessons 1, 10, 15

#### **Videos:**

*The Human Body*

703600, VH

*Who Am I, Anyway?*

704678, VH

*Sex and Babies*

704676, VH

*Body Symphony: The Inside Story of*

*Your Whole Body*

700343, VH

*Skin and Bone*

704668, VH

*Human Growth*

706043, VH

## The Digestive and Excretory Systems

### Outcomes

Students will be expected to

- 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, 205-7)
- 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 the need for the disposal, control, and containment of excrement (107-8)

### Elaboration–Strategies for Learning and Teaching

Students should investigate the role of the digestive system in providing energy for the body's functions. The major organs of the digestive system include teeth, tongue, esophagus, stomach, small intestine, and large intestine. Modeling/simulating as much of the digestive and excretory processes as possible will make the unit interesting, relevant and motivating. Components and processes of these systems can be investigated using software or print/electronic resources.

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. **Caution: Iodine is poisonous.** 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. They can then 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. **Caution: Due to possible spread of germs causing disease, do not use real saliva. Amylase should be used instead of real saliva.**



During classroom discussions, students can propose explanations about the role of teeth in the digestive process, and phrase the explanations in the form of 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.

Students should investigate the role of the excretory system in ridding the body of harmful wastes and body products. Major organs of the excretory system include kidneys, bladder, ureters and urethra, as well as the skin and lungs. The excretory system deals with getting rid of harmful or useless materials from the body. 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 gases 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 (e.g., diapers, toilet paper, flush toilets, deodorants.) in response to the need for the disposal, control, and containment of excrement or body gas.

## 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 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 (kidneys, bladder, ureters and urethra, as well as the skin and lungs) and use it to illustrate your answer. (302-5b)

### *Interview*

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

## Resources

### Teacher's Guide

pp. 32, 38, 65

### Student Resource

Lessons 4, 5, 9

### **Videos:**

*Come and See About Nutrition and Exercise*

705270, VH

*Down, Down, Down: The Inside Story of Digestion*

700338, VH

*You Are What You Eat*

704670, VH

*Bursting with Energy*

704672, VH

*Skin and Bone*

704668, VH

## The Respiratory and Circulatory Systems

### Outcomes

- 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 certain to control variables, when investigating the factors affecting breathing and heartbeat rate; 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)

### Elaboration–Strategies for Learning and Teaching

Students should investigate the structures and functions of the major parts of the respiratory system. The major organs include nose, trachea, lungs, and diaphragm. Students can use a variety of sources (e.g., print, electronic, computer software) to learn about the major organs of the respiratory system.

Students should investigate the structures and functions of the major parts of the circulatory system. The major organs include heart, blood vessels, (arteries, veins, capillaries) and blood. Students can use a variety of sources (e.g., print, electronic, computer software) to learn about the major organs of the circulatory system.

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 of their students, like asthma, and ensure activities completed during the investigations 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.

Equipment such as stop watches, spirometers and computer interface sensors can be used to accurately measure breathing and pulse rates.

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 to measure lung capacity is 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.

Students should be aware of the scientific processes they use when they do investigations. Students have just completed a fair test in which they investigated and carried out procedures in which 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 must remember to ensure that all variables are controlled except the one being tested. Students have had previous experiences 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 a time of 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. Draw a bar graph illustrating your results. (204-1, 204-2, 205-1, 206-2)

#### *Journal*

Trial	Pulse (before)	Pulse (after)	Breathing (before)	Breathing (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*

- During exercise, identify a variable that needs to be controlled to get a fair test for heartbeat rate. (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

#### Teacher's Guide

pp. 45, 53, 60

#### Student Resource

Lessons 6, 7, 8

#### **Videos:**

*Lubba Dubba: The Inside Story of Your Heart and Blood*

700336, VH

*The Breath of Life: The Inside Story of Respiration*

700337, VH

*Going With the Flow*

704671, VH

*My Body, My Buddy: Healthy Fun*

800171, VH

*CPR Theatre*

706245, VH

*A Healthy Heart*

705707, VH

*The Lungs*

705472, VH

*The Heart*

705471, VH

## The Skeletal, Muscular, and Nervous Systems

### Outcomes

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)
- carry out procedures to explore a person's 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 artificial limbs, that have originated from the study of how our body moves (106-4)

### Elaboration–Strategies for Learning and Teaching

Students should investigate the structure and function of the major organs of the nervous system. The major organs include the brain, spinal cord, and nerves. Students can use a variety of sources (e.g., 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 the 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.**



Students could do 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. Such an activity provides an excellent opportunity 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. This will highlight the need for repeating tests and averaging results. Math outcomes related to determining the mean can be addressed in this context.

Students could do 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 of the world. Research information may be collected from rehabilitation centres, prosthetic centres, or health product companies.



## 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 result in graph form. (205-1, 206-3)

#### *Paper and Pencil*

- Write a lyric or poem on the interconnection of the skeletal system. (302-6)
- Produce a report on how various technologies have originated 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

#### Teacher's Guide

pp. 76, 83, 90

#### Student Resource

Lessons 11, 12, 13

#### **Videos:**

*Team That Hustles: Inside Story of Your Bones and Muscles*

700339, VH

*Small Parts: Inside Story of Your Brain and Nervous System*

700340, VH

*Muscles Make Motion*

704669, VH

*It Makes Sense To Me*

704673, VH

## Body Systems

### Outcomes

Students will be expected to

- select and use tools to build models of organs or body systems (205-2)
- identify problems and work cooperatively with other students to refine their design of a model of an organ or system (207-5)
- provide examples of Canadians who have contributed to science and technology related to body organs, body systems and health issues (107-12)

### Elaboration–Strategies for Learning and Teaching

Students should make and/or use models of the various body systems or organs. This would help in the identification of various organs, and/or illustrate the function of the organs. Students could make models and label the various parts. The model would not necessarily be a working model. They could illustrate, using tubes of various diameters, how the diameter of the tube (vein) affects the rate of water (blood) flow. They could also make models using bicycle pumps or syringes to show how water could flow through the various chambers. These last two models may not necessarily look like a heart, but would illustrate how parts of the circulatory system work.

Another possibility is a model of the respiratory system using a clear plastic bottle and balloons. Students can simulate the effect of the diaphragm by squeezing the bottle and noting the effect on the balloon. Teachers could demonstrate a model of the digestive system by simulating stomach acid using dilute solutions of hydrochloric acid. A clear bottle containing this solution could be displayed, and food could be added to see how it is affected. Intestines could be simulated visually using panty hose. Models can show how muscles and bones move together. Teachers may want to set up displays or demonstrations using grocery store specimens of organs, such as beef or chicken hearts, or the skeletal system of a chicken.

Students can write a report on a local or regional scientist, inventor, or medical practitioner (male/female, variety of ethnic backgrounds) working in the medical field. Past notable Canadians include: Wilfred Bigelow, who invented the cardiac pacemaker; Banting and Best, co-discoverers 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 include researchers at local universities.

## Body Systems

### Tasks for Instruction and/or Assessment

#### *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 body organs and/or body systems. (107-12)

#### *Interview*

- Describe how the respiratory and circulatory systems work together to get oxygen through your body. (302-4)
- Describe how the digestive and excretory systems work together to make certain the body uses the food you eat and the waste is processed properly. (302-4)

#### *Presentation*

- Create a model of one of the organs in the body systems studied in this unit. The model can be made to look like the actual organ or show how the organ works. You could work in pairs. (205-2)

#### *Informal/Formal Observation*

- During the model design activity, observe the performance of students working in groups and their ability to problem solve to improve the model. (207-5)

### Resources

#### Teacher's Guide

pp. 38, 45, 53, 70, 76

#### Student Resource

Lessons 5, 6, 7, 10, 11

## Maintaining a Healthy Body

### Outcomes

Students will be expected to

- describe the body's defences against infections (302-8)
- describe the role of the skin (302-7)
- describe nutritional and other requirements for maintaining a healthy body (302-9)
- evaluate the usefulness of different information sources in answering question about health and diet (206-4)
- describe examples of health and fitness programs within their community and region (107-5)
- describe and compare the techniques used by different people in their community and region, to address their health requirements (107-2)

### Elaboration–Strategies for Learning and Teaching

*This section can also be integrated with the health/personal development curriculum outcomes.*

Students should discuss and investigate the body's natural defence mechanisms (e.g., such as tears, saliva, skin, certain blood cells, and stomach secretions) against diseases and illnesses. Students may not be aware of how many germs they come in contact with in the course of a day. Students should research the various ways that germs can be spread. In exploring how their own body can defend itself against bacteria, viruses, and germs, it is valuable to contrast this information with people whose immune system is not effective. This will highlight how we can take for granted when our immune system is working well.

Students could explore the *Canada Food Guide* for maintaining a healthy body.

Students could explore, through discussions, how lifestyle plays a role in healthy living. Students could focus on how “life style” advertising affects their choices related to nutrition, fitness, and other health care products. Students should choose an ad, magazine or tabloid article, and discuss its merit. This will lead to important discussions about the meaning of a healthy lifestyle, and appropriate role models.

Field trips or speakers from health and fitness programs could be arranged for students.

Students should explore through field trips, research, or guest speakers, techniques used by people in their community to address health requirements. This could include in-school resources such as the health and physical education teacher.

## Maintaining a Healthy Body

### Tasks for Instruction and/or Assessment

#### *Journal*

- Which things do I eat that are truly nutritional? (302-9)

#### *Paper and Pencil*

- Write a report about a health and/or fitness program in your community or region. Describe what the program involves, and the audience it tries to help. (107-5)

#### *Interview*

- What strategies are used by people in your community to meet our health requirements. (107-2)

#### *Presentation*

- Research one of the following topics to find out how it affects the growth and development of your body: tobacco, alcohol, steroids, marijuana, tanning salons, junk food. (302-9, 206-4)

### Resources

#### Teacher's Guide

pp. 17, 23, 70, 76, 99

#### Student Resource

Lessons 2, 3, 10, 11, 14

#### **Videos:**

*Come See What the Doctor Sees*  
705266, VH

*Come See How We Fight Infection*  
705268, VH

*Come See About Nutrition and Exercise*  
705270, VH

*Good Food For Good Health*  
705011, VH

*Goofy Over Health*  
705008, VH

*The Human Body*  
703600, VH

*My Body, My Buddy: Healthy Habits*  
800170, VH

*Eardrum-Hum: Exploring the Health of Hearing*  
706316, VH

*Stressbusters*  
706520, VH

*Nutrition: Keep Your Balance*  
706358, VH

*Clean Kids*  
705928, VH

*Feeling Good With Good Hygiene*  
705897, VH

*What's Hygiene?*  
705929, VH

## Maintaining a Health Body (continued)

### Outcomes

Students will be expected to

- describe examples of medical techniques developed by other cultures, past and present, that have contributed to knowledge of maintaining a healthy body (105-2, 107-14, 106-2)

### Elaboration–Strategies for Learning and Teaching

Students should investigate medical techniques that have been developed by other cultures, both past and present. Topics might include acupuncture (Chinese), sweat lodges (First Nations), chiropractics (various cultures), saunas, whirlpools, and herbal remedies. Students can find out where the technique was developed and how it works to prevent or cure illnesses. Students could also choose a culture and research its traditional medical techniques and practices.

Medicinal practice has developed over the years. Students may have no idea from where various drugs or medical techniques come. They can research medicine, doctors, natural herbs and remedies, and show how in some cases, today's drugs and medical techniques have developed from ancient remedies. A possible choice for a class study is the impact clear cutting the rainforests has on destroying some exotic plant and animal species that have pharmaceutical importance. The following is an example of a past medical belief that is no longer in use: Doctors used to grind up precious gemstones for their patients to ingest. If, or when, a patient died, it was thought that the gemstone had some flaw, or they had not ingested enough of it.

Have the class take part in a fitness session such as yoga, Tai Chi, or Chi Quong.

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## Maintaining a Healthy Body (continued)

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### Tasks for Instruction and/or Assessment

#### *Presentation*

- Create a skit, video, song, or lyric on the importance of the body systems working in harmony to maintain a healthy body. (302-4)

#### *Portfolio*

- Select pieces of work from this unit for your portfolio. Use the portfolio self-assessment rubric to assess your work.

#### *Interview*

- Interview a health care professional about changes in health care in various cultures. (105-2)

#### *Journal*

- I am interested in a cultural technique to improve my body's resistance to disease. Here are my reasons for this choice ...

### Resources

Teacher's Guide  
Lesson 7, Page 57

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**Unit 2**  
**Physical Science:**  
**Properties and Changes in Materials**

# Unit Overview

## Introduction

Materials in the world around us have properties that have led to them 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 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 types of changes that may be occurring, and/or where materials originated.

## Science Curriculum Links

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

In this unit, the concepts of physical and chemical changes are studied in greater depth. This learning 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.

# Curriculum Outcomes

STSE	Skills	Knowledge
<p>Students will be expected to</p> <p><b>Nature of Science and Technology</b></p> <p><b>104-5</b> describe how the results of similar or repeated investigations may vary and suggest possible explanations for the variations</p> <p><b>104-7</b> demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results</p> <p><b>Relationships Between Science and Technology</b></p> <p><b>Social and Environmental Contexts of Science and Technology</b></p> <p><b>107-8</b> describe examples of technologies that have been developed to improve living conditions</p>	<p>Students will be expected to</p> <p><b>Initiating and Planning</b></p> <p><b>204-5</b> identify and control major variables in investigations</p> <p><b>204-7</b> plan steps to solve a practical problem and carry out a fair test of a science-related idea</p> <p><b>Performing and Recording</b></p> <p><b>205-3</b> follow a given set of procedures</p> <p><b>205-5</b> make observations and collect information that is relevant to a given question or problem</p> <p><b>205-8</b> identify and use a variety of sources and technologies to gather pertinent information</p> <p><b>Analysing and Interpreting</b></p> <p><b>206-1</b> classify according to several attributes and create a chart or diagram that shows the method of classification</p> <p><b>206-2</b> compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs</p> <p><b>Communication and Teamwork</b></p> <p><b>207-3</b> work with team members to develop and carry out a plan</p>	<p>Students will be expected to</p> <p><b>300-10</b> identify properties such as texture, hardness, colour, buoyancy, and solubility that allow materials to be distinguished from one another</p> <p><b>300-9</b> group materials as solids, liquids, or gases, based on their properties</p> <p><b>301-9</b> identify changes that can be made to an object without changing the properties of the material of which it is made</p> <p><b>301-10</b> identify and describe changes to materials that are reversible and some which are not</p> <p><b>301-12</b> describe examples of interactions between materials that result in the production of a gas</p> <p><b>301-11</b> describe changes that occur in the properties of materials when materials interact with each other</p> <p><b>300-12</b> identify the source of materials found in an object and describe the changes to the natural materials required to make the object</p> <p><b>300-11</b> relate the mass of a whole object to the sum of the mass of its parts</p>

## 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 material (206-1, 300-9)

### Elaborations–Strategies for Learning and Teaching

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

Students should investigate a wide variety of materials (e.g., solids, liquids, and gases) and describe their distinguishing characteristics. Properties of solids students could explore include (e.g., colour, hardness, ability to pour, buoyancy, odour, solubility, magnetism) and liquids could include (e.g., colour, odour, viscosity, solubility in water, buoyancy, surface tension). Solid substances could include powder 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 investigated using balloons, jars, or by bubbles filled with air, or producing gases through reactions caused by mixtures such as vinegar and baking soda. **Caution: Any experiments in which gases are produced should be completed in containers that are open to air. Producing gas in a closed jar could cause the jar to break open.**



Before completing investigations, students could brainstorm properties of solids, liquids, and gases. Students should classify materials using their distinguishing properties. For example,

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

Teachers can help students with such classifications by demonstrating properties of substances (e.g., swirl liquids to show they do not 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

	Solid	Solid	Solid
Property	salt	sugar	etc.
colour	white		
Structure (appearance when magnified)	tiny crystals (Students may include a sketch)		
etc.			

- 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 determine if something is a liquid? What are some of the properties it will 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

#### Teacher's Guide

pp. 12, 18, 26, 33, 50

#### Student Resource

Lessons 1, 2, 3, 4, 5, 6

#### **Videos:**

*Observing the Properties of Matter*  
706552, VH

*All About Properties of Matter*  
706259, VH

*All About Solids, Liquids & Gases*  
706261, VH

*Solids, Liquids and Gases*  
703504

## Physical Changes

### Outcomes

Students will be expected to

- observe and identify physical changes that affect 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 which affect the look, feel, strength, 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 in some cases a physical change is obvious, while in others, it is not readily apparent. Shaping putty, breaking a piece of wood, folding paper, sharpening a pencil are clear examples of physical changes as 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 different properties.

Students should explore physical changes to a variety of materials and such changes impact other properties of the materials. For example, students may investigate materials to answer questions such as “Does the shape of an object (e.g., plasticine, aluminum foil) affect buoyancy?”, “Does the temperature of a material affect its malleability?”

Some physical changes are reversible (e.g., boiling water, melting ice, cutting paper, bending metal) and some are not (e.g, sanding wood into sawdust, grinding wheat into flour, mixing sand and molasses). Do not use reversibility as a distinguishing feature of physical changes, as some chemical changes are also 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 the given 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.** (301-9, 205-5)



#### *Journal*

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

#### *Paper and Pencil*

- *Note: This assessment can be done after the section on “Chemical Changes”.* Write “physical” or “chemical” beside each change listed below and explain. (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

#### Teacher’s Guide

pp. 18, 41, 50, 63, 78

#### Student Resource

Lessons 2, 5, 6, 8, 10

#### **Videos:**

*Properties of Matter*  
706276, VH

## 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 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 chemicals 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 chemicals 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 done with household chemicals (e.g., vinegar and baking soda, yogurt and baking soda, an apple turning brown after it is peeled, milk and vinegar). These example reactions are not reversible.

While it looks as though these chemical changes are not reversible, do not encourage this thought. Some chemical reactions reverse quite easily, while others virtually never reverse. Instead, students should 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. This 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 table (Eno™) dissolved in water, or other bases (alkalis). 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.

Connections may be made to the Grade 5 unit on *Body Systems*. 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 unable to bond with oxygen.

Students should develop a plan to distinguish one material from another based on chemical properties. Students should produce a table showing how household substances react when combined. (Some substances such as baking powder, baking soda, flour and chalk will each react with vinegar. Students should then be given unmarked samples of baking powder, salt, flour and baking soda. Students can identify the substances from their reactions during chemical changes.

**Caution: Students should be cautioned not to taste any of the chemicals. Do not experiment with heavy duty cleansers.**





## 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) *The teacher chooses X, Y and Z.*

	X	Y	Z
vinegar			
corn oil			
club soda			

- Then have students perform the same tests on substances unknown to them. Ask students to identify the substances. Note: Leave some of the tests blank, and let students decide which tests to perform. (204-7, 207-3, 204-5, 206-2) *A similar table may be used.*

### Resources

#### Teacher's Guide

pp. 78, 85

#### Student Resource

Lessons 10, 11

#### **Videos:**

*Properties of Matter*  
706276, VH

*Periodic Table*  
706279, VH

*Elements, Compounds and Mixtures*  
706268, VH

*Atoms/Motions*  
705901, VH

*Chemical Reactions/Phases of Matter*  
704851, VH

## Sources/Masses of Materials in Objects

### Outcomes

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 human living conditions (107-8)
- 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)

### Elaborations–Strategies for Learning and Teaching

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. Examples of experiments could include a banana in a bottle or a pencil case containing various pens, pencils and erasers. Alternatively, students could cut a piece of material, such as cardboard or fabric, into pieces.

Teachers might pose questions such as, “What happens when we burn a piece of paper? What happens to its chemical 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 conservation of mass.

Students will investigate a variety of manufactured materials produced to improve living conditions. Students should focus on the composition of 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 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). If they find this to be the case, the separation of the metal from the rock is largely a physical one. In most cases, the metal in the ore is a compound, and must undergo chemical reactions to produce the pure metal.

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.

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 determine 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.

#### *Portfolio*

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

### Resources

#### Teacher's Guide

pp. 26, 33, 41, 63, 72

#### Student Resource

Lessons 3, 4, 5, 8, 9

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**Unit 3**  
**Physical Science:**  
**Forces and Simple Machines**

# Unit Overview

## Introduction

The study of motion and the forces which cause motion helps students 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 designs and their advantages.

## Focus and Context

The principal 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 involving the reduction of effort 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 contexts, students can define problems to solve, and 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 *Fluids* 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.

# Curriculum Outcomes

STSE	Skills	Knowledge
<p>Students will be expected to</p> <p><b>Nature of Science and Technology</b></p> <p><b>104-7</b> demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results</p> <p><b>105-5</b> identify examples of scientific knowledge that have developed as a result of the gradual accumulation of evidence</p> <p><b>Relationships Between Science and Technology</b></p> <p><b>106-4</b> describe instances in which scientific ideas and discoveries have led to new inventions and applications</p> <p><b>Social and Environmental Contexts of Science and Technology</b></p> <p><b>107-1</b> describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs</p> <p><b>107-8</b> describe examples of technologies that have been developed to improve their living conditions</p>	<p>Students will be expected to</p> <p><b>Initiating and Planning</b></p> <p><b>204-1</b> propose questions to investigate and practical problems to solve</p> <p><b>204-3</b> state a prediction and a hypothesis based on an observed pattern of events</p> <p><b>204-5</b> identify and control major variables in their investigations</p> <p><b>204-7</b> plan steps to solve a practical problem and to carry out a fair test of a science-related idea</p> <p><b>Performing and Recording</b></p> <p><b>205-2</b> select and use tools to manipulate materials and build models</p> <p><b>205-4</b> select and use tools for measuring</p> <p><b>205-5</b> make observations and collect information relevant to a given question or problem</p> <p><b>205-6</b> estimate measurements</p> <p><b>205-8</b> identify and use a variety of sources and technologies to gather pertinent information</p> <p><b>Analysing and Interpreting</b></p> <p><b>206-6</b> suggest improvements to a design or constructed object</p> <p><b>206-9</b> identify new questions or problems that arise from learning new information</p> <p><b>Communication and Teamwork</b></p> <p><b>207-1</b> communicate questions, ideas, and intentions, and listen to others while conducting investigations</p>	<p>Students will be expected to</p> <p><b>303-12</b> investigate different kinds of forces used to move objects or hold them in place</p> <p><b>303-13</b> observe and describe how various forces, such as magnetic, mechanical, wind induced, and gravitational, can act directly or from a distance to cause objects to move</p> <p><b>303-14</b> demonstrate and describe the effect of increasing and decreasing the amount of force applied to an object</p> <p><b>303-15</b> investigate and compare the effect of friction on the movement of an object over a variety of surfaces</p> <p><b>303-16</b> demonstrate the use of rollers, wheels, and axles in moving objects</p> <p><b>303-17</b> compare the force needed to lift a load manually with that required to lift it using a simple machine</p> <p><b>303-18</b> differentiate between the position of the fulcrum, the load, and the effort force when using a lever to accomplish a particular task</p> <p><b>303-19</b> design the most efficient lever to accomplish a given task</p> <p><b>303-20</b> compare the force needed to lift a load using a single pulley system with that needed to lift it using a multiple pulley system</p>

## 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 **Know-Want to learn-Learned (K-W-L)** activity about forces to begin this unit. This will allow teachers to determine students' conceptions about forces. It will also provide 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. Students would rotate through each of the centres. One centre could feature magnets, another could have students exploring the effect of mechanical forces, 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 explain their findings. In most cases, changing the amount of force changes the speed at which an object moves, but in some instances, however, 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 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 non-contact forces of gravity and magnetism should be identified. A common misconception of students is if there is no motion, to presume 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 difficulty conceptualizing the force of the table on the book, which is equal but opposite to the force of gravity pulling the book downwards, engage them in the following activity. Ask them to hold out their hands and then place book on their hands. They will feel the force of the book on their hands, and feel their hands straining to hold the book in this upward position.



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## Forces and their Effects

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### 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 contact or non-contact forces. (303-12, 303-13, 104-7)
- Demonstrate how you could 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

### Resources

#### Teacher's Guide

pp. 16, 24, 36, 94

#### Student Resource

Lessons 2, 3, 5, 15

#### **Videos:**

##### Teacher Use:

*Force*

700226, VH

*Gravity and Friction*

700227, VH

*Simple Machines*

700229, VH

##### Class Use:

*Forces*

702088

*Forces We See and Use Everyday*

704967, VH

## Forces and their Effects (continued)

### Outcomes

Students will be expected to

- describe forces both qualitatively and quantitatively using their observations (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 to measure how far they stretch, or Slinkies™ to measure how far they stretch due the force of gravity as well as an applied force. **Caution: possible injuries due to breakage of elastic bands.**



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 unit, but simply that it is a standard unit indicating 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, 1 kilogram is approximately equal to 10 Newtons)

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 stretches, the amount the Slinky™ stretches) units. These activities help students appreciate the importance of accuracy, and working collaboratively with others during investigations.

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## Forces and their Effects (continued)

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### Tasks for Instruction and/or Assessment

#### *Performance*

- Record the force used to lift the objects described 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 centimetres as an indication of the amount of force. (205-4, 205-5)  
Objects – science book, pencil case, exercise book, scissors, etc.

#### *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 by adding various weights to the wagon and recording the results. (205-4)

### Resources

Teacher's Guide  
pp. 48, 55, 80

Student Resource  
Lessons 7, 8, 12

**Video:**  
*Forces*  
706270, VH

## Friction

### Outcomes

Students will be expected to

- propose questions to investigate related to friction, identify variables to control when exploring the questions, and plan steps to determine 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 understanding of the concept of friction has led to the development of products that reduce and enhance friction (106-4, 107-1)

### Elaborations–Strategies for Learning and Teaching

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 questions 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” to the discussion. Can students describe friction? Do they know how to increase or decrease friction?

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. Such a statement might be rephrased as, “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 an object is pulled, and the type of surface over which an object is being pulled. Students should try to maintain a constant speed when pulling an object during a test. The only factors that should have an effect on friction are mass and the type of surface.

Using the 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 investigation 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 reducing friction, as well as increasing surface smoothness. 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 beneath it.

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 unnecessary. 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, blocks resting on a skateboard, or a block resting on a ball. (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.
- 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.

### Resources

#### Teacher's Guide

pp. 42, 7, 55, 75

#### Student Resource

Lessons 6, 7, 8, 11

#### **Videos:**

*Friction - Getting a Grip*  
704827, VH

*Friction/Simple Machines*  
705967, VH

*Friction*  
706271, VH

## Simple Machines: An Introduction

### Outcomes

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 problems that consider the amount of effort needed to lift or move heavy objects, using the knowledge they gained through the study of forces (206-9)

### Elaborations—Strategies for Learning and Teaching

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, a clothes line pulley, pliers, 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 to learn more about them.

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. During experiments students can determine both load and effort using spring scales or instruments they have devised to measure force. This is achieved by measuring the force needed without the machine (load), and then measuring the force required to move the object with the effort applied to a machine. For example, students could measure the force needed to lift an object 0.5 m upwards in a straight direction, and then measure the force needed to slide the same object up a 2.0 m inclined plane to the same height. They should note that even though it was easier to slide the object 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 larger distance (e.g., using low gear on a bicycle). In cases in which a machine increases the effort required to lift an object, the effort will have to be applied over a shorter distance, but the object will be lifted a greater distance (distance advantage) (e.g., using tongs).

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 students have been using spring scales or constructed force sensors to determine the force required to lift smaller objects or 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 can 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. They may also suggest pulleys or other simple machines of which they are aware. Students should be encouraged to bring in household machines such as wrenches, hammers, screwdrivers, or pictures or drawings of more complicated systems of machines to set up a classroom display. As the students explore simple machines, the more complicated pictures can be analysed to try to identify the simple machines that they are made from, and how the machines are connected.

## 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 could use to help me move these objects are ... (206-9)

### Resources

#### Teacher's Guide

pp. 55, 67, 80

#### Student Resource

Lessons 8, 10, 12

#### **Videos:**

*Friction/Simple Machines*  
705967, VH

*Simple Machines*  
706277, VH

## Simple Machines–Levers

### Outcomes

Students will be expected to

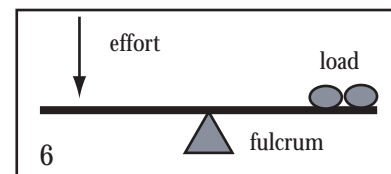
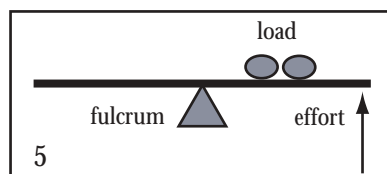
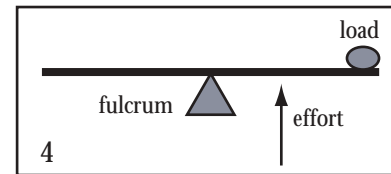
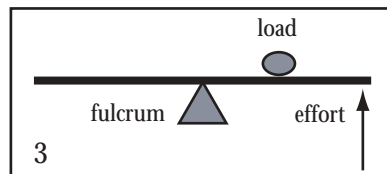
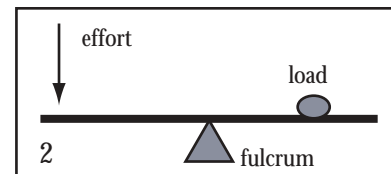
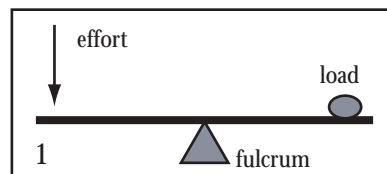
- differentiate between the position of the fulcrum, the load, and the effort when using a lever to accomplish a particular task (303-18)
- design the most efficient lever to accomplish a given task (303-19)

### 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 the classroom. While students should not be required to memorize the characteristics of a first (e.g., teeter totter), second (e.g., wheelbarrow), and third class lever (e.g., barbeque tongs), they should explore the differences that occur depending on the relative positions of the effort, load and fulcrum. Attention should be paid to the amount of effort needed to lift objects, and the distance the objects are lifted. Students can experiment with the effort required to lift an object 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 lifting 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 a 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

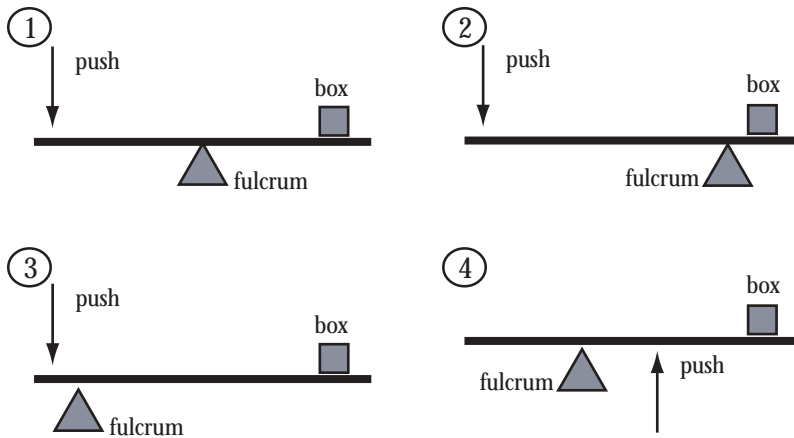
### Tasks for Instruction and/or Assessment

#### *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*

- Explain through writing which picture shows the easiest way to lift a heavy box? Which shows 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 hammer to remove a nail from a board. (303-19)

### Resources

#### Teacher's Guide

p. 60

#### Student Resource

p. 34

## 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 the 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 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 various simple machines, they can be given a task to explore with 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 to match 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 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 often 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 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?

**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 perform 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 have 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 peice.

### Resources

#### Teacher's Guide

pp. 55, 75, 80, 94

#### Student Resource

Lessons 8, 11, 12, 15

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**Unit 4**  
**Earth and Space Science:**  
**Weather**

# Unit Overview

## 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 also 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 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*.

# Curriculum Outcomes

STSE	Skills	Knowledge
<p>Students will be expected to</p> <p><b>Nature of Science and Technology</b></p> <p><b>104-4</b> compare the results of their investigations to those of others and recognize that results may vary</p> <p><b>104-7</b> demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results</p> <p><b>105-1</b> identify examples of scientific questions and technological problems currently being studied</p> <p><b>105-2</b> identify examples of scientific questions and technological problems addressed in the past</p> <p><b>Relationships Between Science and Technology</b></p> <p><b>106-4</b> describe instances in which scientific ideas and discoveries have led to new inventions and applications</p> <p><b>Social and Environmental Contexts of Science and Technology</b></p> <p><b>107-2</b> describe and compare tools, techniques, and materials used by different people in their community and region to meet their needs</p> <p><b>107-5</b> provide examples of how science and technology have been used to solve problems in their community and region</p> <p><b>107-10</b> identify women and men in their community who work in science- and technology-related areas</p> <p><b>107-14</b> identify scientific discoveries and technological innovations of people from different cultures</p> <p><b>108-1</b> identify positive and negative effects of familiar technologies</p>	<p>Students will be expected to</p> <p><b>Initiating and Planning</b></p> <p><b>204-3</b> make a prediction and state a hypothesis based on an observed pattern of events</p> <p><b>204-8</b> identify appropriate tools, instruments, and materials to complete their investigations</p> <p><b>Performing and Recording</b></p> <p><b>205-4</b> select and use tools for measuring</p> <p><b>205-6</b> estimate measurements</p> <p><b>205-7</b> record observations using single words, notes in point form, sentences, simple diagrams and charts</p> <p><b>205-10</b> construct and use devices for a specific purpose</p> <p><b>205-8</b> identify and use a variety of sources and technologies to gather pertinent information</p> <p><b>Analysing and Interpreting</b></p> <p><b>206-1</b> classify according to several attributes and create a chart or diagram that shows the method of classification</p> <p><b>206-2</b> compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs</p> <p><b>206-3</b> identify and suggest explanations for patterns and discrepancies in data</p> <p><b>206-5</b> gather evidence through research and observation to answer a question and use the resulting information to draw a conclusion</p> <p><b>Communicating and Teamwork</b></p> <p><b>207-4</b> ask others for advice or opinions</p>	<p>Students will be expected to</p> <p><b>300-13</b> describe weather in terms of temperature, wind speed and direction, precipitation, and cloud cover</p> <p><b>302-11</b> describe the key features of a variety of weather systems</p> <p><b>303-21</b> relate the transfer of energy from the sun to weather conditions</p> <p><b>300-14</b> describe situations that demonstrate air takes up space, has weight, and expands when heated</p> <p><b>302-10</b> identify patterns in indoor and outdoor air movement</p> <p><b>301-13</b> relate the constant circulation of water on Earth to the processes of evaporation, condensation, and precipitation</p> <p><b>301-14</b> describe and predict patterns of change in local weather conditions</p>

## Measuring and Describing Weather

### Outcomes

Students will be expected to

- identify and use weather-related folklore to predict weather (105-2)
- identify, construct, and use instruments to measure weather information (204-8, 205-4, 205-10)
- use appropriate terminology to name weather instruments when collecting weather data (104-7)
- record observations using instruments 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 results may vary (104-4, 206-1)

### Elaborations–Strategies for Learning and Teaching

*Note: Many of the activities done in this section also address outcomes related to describing and predicting weather patterns, which occur later in the unit.*

Introduce students to this unit with sayings and folklore indicators (e.g., if the cows are lying down, then it is going to rain) people used to predict weather in the past. Students can monitor such sayings to see how well they work.

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.

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 weather, like “humidity” and “windchill factor”.

Students could record their observations and measurements in charts or tables, to describe the weather, and to note patterns for predicting weather later in the unit.

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 characteristics 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 research on cloud types extending their classification scheme to include clouds based on how high they are in the sky, (e.g., nimbostratus, cumulonimbus).

. . . continued



## Measuring and Describing Weather

### Tasks for Instruction and/or Assessment

#### *Performance*

- Use weather instruments to help you make observations. Record these in the chart shown below for one week. (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 sayings to predict the weather that I have heard are.... I have found that these (work/do not 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

#### Teacher's Guide

pp. 28, 53, 61

#### Student Resource

Lessons 4, 8, 9

#### **Videos:**

*Weather: A First Look*  
705934, VH

*Meteorology*  
706388, VH

*Clouds, Weather & Life*  
706556, VH

*Let's Explore Weather*  
704223, VH

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## Measuring and Describing Weather (continued)

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### Outcomes

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)
- estimate weather measurements for various times of the day, week, or for specific 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)

### Elaborations–Strategies for Learning and Teaching

Some examples of weather systems include hurricanes, tornadoes, sleet storms, and thunderstorms. Most students will be able to watch the weather channel on television. These channels have related to weather 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.

Students can use 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 to 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.

Students should be encouraged to investigate the role and contributions of science and technology in 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, igloos, snowshoes and sloped roofs. Teachers may wish to have individuals or pairs of students do research, and then display their findings as part of a classroom “Weather Exhibit”.

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## Measuring and Describing Weather (continued)

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### 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. Have students 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 you would like to see someone invent (e.g., glasses that do not fog up when you come in on a cold day)?
- Use a variety of sources to learn about weather events such as hurricanes, tornadoes, sleet storms, thunderstorms, and heat waves, making certain to include indicators such as ranges of precipitation, wind speed, cloud type and 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, special forms of transportation. Cut out or draw pictures for a classroom collage on weather to support your research on products used to cope with weather. (107-14)

### Resources

#### Teacher's Guide

pp. 47, 53, 61

#### Student Resource

Lessons 7, 8, 9

## Sun's Energy Reaching the Earth

### Outcomes

Students will be expected to

- relate the transfer of energy from the sun to weather conditions (303-21)
- identify and use appropriate tools and/or materials to measure the temperature of soil and water which have been exposed to light and draw conclusions about the temperature readings (204-8, 205-4, 206-5)

### 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 an important role in determining the weather.

Students should explain how solar energy provides energy to evaporate water, and energy to 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 results in more water vapour in the air. Conversely, as moist air cools, condensation occurs, and water falls as various forms of precipitation.

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, (i.e., there is more energy gained/lost per degree temperature change).

As the temperature of the water and the land rises, so does the temperature of the air above them. 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.

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## Sun's Energy Reaching the Earth

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### 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 the 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, and 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 and sand on the shoreline? Which of these do you think would be cooler first thing in the morning, before the sun comes up? Explain your answer. (204-8, 205-4, 206-5)

### Resources

#### Teacher's Guide

pp. 22, 28, 35, 73

#### Student Resource

Lessons 3, 4, 5, 11

#### **Videos:**

*Climate & Seasons*  
706385, VH

## 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 a box by blowing into a plastic bag that has been placed under its corners, and trying to fill a bottle with water by submersing it in a large tub of water (Note: the air bubbles have to escape before the bottle can fill) 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 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.

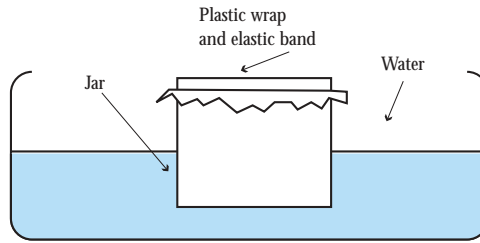
An example of how to demonstrate that air expands when heated or contracts when cooled is to submerge a tube or bottle in water until it is partly filled with water, and the rest is air. Invert the bottle or tube so that it is upside down, with the opening sitting in the water, and the water level in 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. Note the change in the space that the air takes up. Another way to illustrate how air expands and contracts is to blow up a small balloon, and completely submerge it in water of room temperature. Mark the water level with the balloon submersed. Then, using an identical amount of warm water, submerge 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 in which case the water level drops because the volume of the balloon decreases. An alternative activity involves placing the balloon under a lamp and in the refrigerator, changes in size of the balloon should be easily seen.

## Properties of Air

### Tasks for Instruction and/or Assessment

#### *Performance*

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



#### *Paper and Pencil*

- Why is 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 that air takes up space? (300-14)

### Resources

#### Teacher's Guide

pp. 14, 35, 42, 47

#### Student Resource

Lessons 2, 5, 6, 7

#### **Videos:**

*Wind*

706390, VH

*Clouds*

706386, VH

*Air Pressure: How Heavy Is Air?*

704205, VH

*Let's Explore Air*

704222, VH

## 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 metres above a radiator, and noting how the warm air rises. They may try to detect the direction of the moving air by clapping a chalk eraser over the radiator, 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 may also explore moving air using 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 be shown more easily 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 how 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, holds in air: warm air rises, and cool air sinks and moves over to displace the warm air.

These convections illustrate how winds occur. The bigger the difference in the temperature between two air or water masses, the stronger the convections or winds. Students can now revisit the effect of the sun on weather conditions as they are now in a position to propose explanations for “sea breezes” - land heats up more quickly than water. During the daytime, the air over land will warm up more than the air over water. The warm air over the 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 quickly once the sun disappears, while the water cools much more slowly.

Students will have explored phase changes in the unit on *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

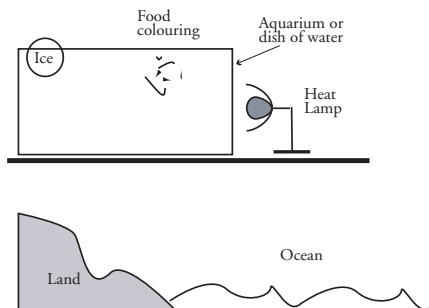
Time	Day 1				Day 2
	Before School	Recess	Lunch	After School	Before School
Wind Direction					
Wind Speed					

#### *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? I think I know, it comes from ... (301-13)
- Places in which I can feel moving air when I am inside are: ... It moves (Describe the 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, and draw conclusions about patterns of outdoor air movement). (302-10)

#### *Paper and Pencil*

- From your observations, draw arrows to show the pattern of the movement of the food colouring. Write a conclusion about the direction of water movement caused by different temperatures. Describe evidence that air behaves the same way over the land and 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

#### Teacher's Guide

pp. 28, 35, 47, 73

#### Student Resource

Lessons 4, 5, 7, 11

#### **Videos:**

*Earth Science: Learning About Earth's Weather*

706307, VH

*Climate and Seasons*

706385, VH

*Clouds*

706386, VH

*Rain and Snow*

706389, VH

## 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 or suggest explanations for patterns or discrepancies in the data (206-2, 206-3)
- ask various people in the community and region for advice on how to predict weather; 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 can continue to collect weather data but should begin to analyze the data, looking for patterns. They should now look at 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 learn 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 and research, students should gain the sense there is a range of indicators that can be used to predict 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, fishers, 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 be able to see only some patterns and be able to explain some of these based on the theory investigated in the last section. The usefulness of this data for making predictions will be limited. They will find they can make short-term forecasts with a fair degree of accuracy using the indicators and sayings, but their ability to make long-range forecasts will be limited. They may improve predictions if they include satellite images which are 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 fill in 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				
etc.	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 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

#### Teacher's Guide

pp. 53, 61, 73

#### Student Resource

Lessons 8, 9, 11

#### **Videos:**

##### *Clouds*

706386, VH

##### *Meteorology*

706388, VH

##### *Where Storms Begin*

706013, VH

## 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 layer, 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 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 “ultraviolet rays”. Students will also explore the effects of these phenomena, such as sun dogs, rainbows, and lunar halos, using information gained from a variety of sources (e.g., videos, television documentaries, newspaper and magazine articles, and news reports). Students may wish to try to simulate some of these effects using models. For example, students may wish to simulate 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 and one which is left open.

Students should investigate the positive and negative effects of technologies that contribute to air pollution. These can include greenhouse 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 dependent on cars. Students should realize that because of the positive benefits of some inventions, finding solutions to the problems caused by them will not be easy.

Finally, students should explore solutions or products that have been developed to reduce the effect of air pollution or other environmental problems. They could learn 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.

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## Environmental Issues

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### 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 to include in your portfolio. Complete a portfolio rubric to assist with the selection process.

### Resources

#### Teacher's Guide

pp. 42, 67

#### Student Resource

Lessons 6, 10

#### **Videos:**

*Earth Science: Learning About the Earth's Weather*

706307, VH

*Earth's Seasons/Climates*

705964, VH

*Weather: How Do Clouds Float?*

704206, VH