# Science 5

*Guide*

NOVA SCOTIA
NOUVELLE-ÉCOSSE

2008

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Science 5


Prepared by the Department of Education and Early Childhood Development

This is the most recent version of the current curriculum materials as used by teachers in Nova Scotia.

Atlantic Canada
Science Curriculum

NOVA SCOTIA
Education
English Program Services

CURRICULUM

# Science
## Grade 5

# Atlantic Canada Science Curriculum:
# Grade 5

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Prepared by the Department of Education



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# Foreword

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

Science 5 includes the following units:

- Earth and Space Science: Weather
- Physical Science: Forces and Simple Machines
- Life Science: Meeting Basic Needs and Maintaining a Healthy Body
- Physical Science: Properties of and Changes in Materials

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

# Acknowledgments

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

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# Introduction

## Background

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

## Aim

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

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

# Program Design and Components

## Learning and Teaching Science

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

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

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

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

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

## The Science Lesson—Links to the World

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

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

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

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

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

## Writing in Science

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

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

Students 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 communication in science.

# The Three Processes of Scientific Literacy

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

## Inquiry

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

## Problem Solving

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

## Decision Making

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

## Meeting the Needs of All Learners

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

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

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

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

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

## Assessment and Evaluation

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

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

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

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

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

## Instructional Time

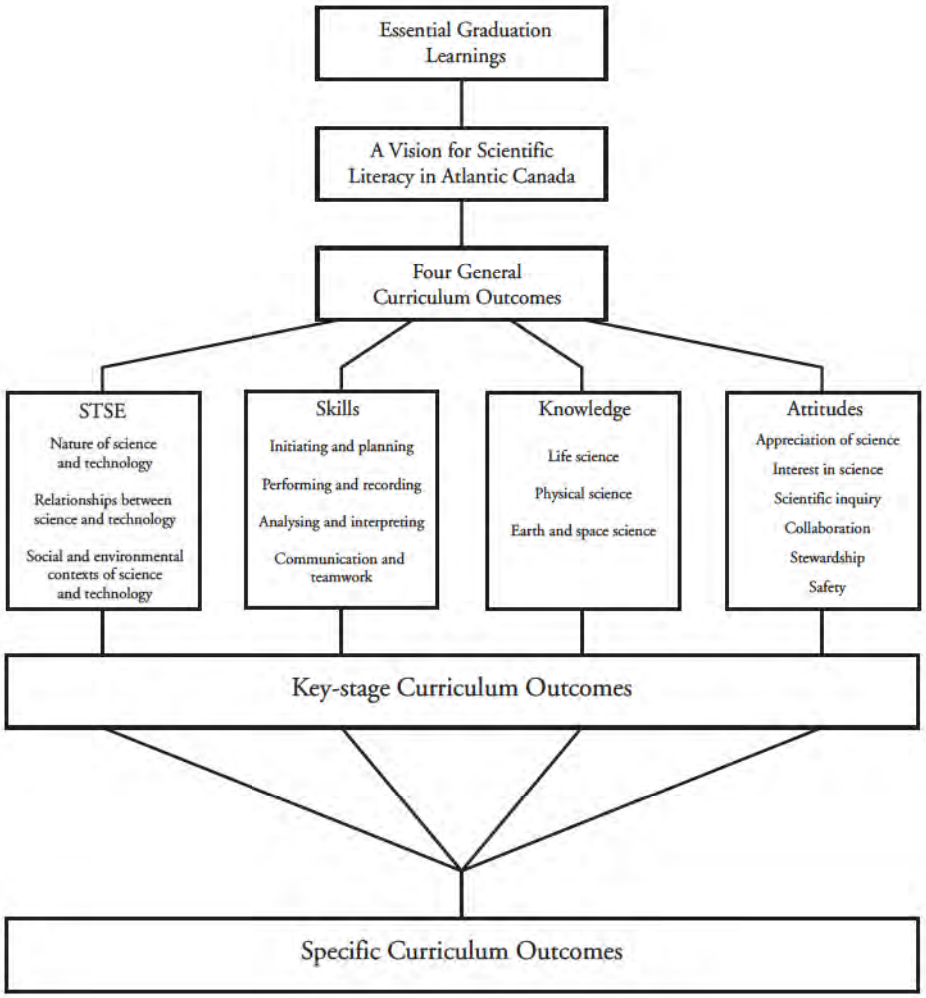
It is expected that a minimum of 110 minutes per week will be the allotment of instructional time for Science 5 curriculum. In addition, there are many opportunities to address science curriculum outcomes in the context of other subject areas in the elementary program, such as health education, language arts, mathematics, music, social studies, and visual arts.

# Curriculum Outcomes Framework

## Overview

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

### Outcomes Framework



## Essential Graduation Learnings

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

### Aesthetic Expression

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

### Citizenship

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

### Communication

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

### Personal Development

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

### Problem Solving

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

### Technological Competence

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

## General Curriculum Outcomes

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

### Science, Technology, Society, and the Environment (STSE)

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

### Skills

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

### Knowledge

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

### Attitudes

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

## Key-Stage Curriculum Outcomes

Key-stage curriculum outcomes are statements that identify what students are expected to know, be able to do, and value by the end of grades 3, 6, 9, and 12 as a result of their cumulative learning experiences in science. The key-stage curriculum outcomes are from the pan-Canadian *Common Framework of Science Learning Outcomes K to12*.

## Specific Curriculum Outcomes

This curriculum guide outlines specific curriculum outcomes for Science 5 and provides suggestions for learning, teaching, assessment, and resources to support students' achievement of these outcomes. Teachers should consult *Foundation for the Atlantic Canada Science Curriculum* for descriptions of the essential graduation learnings, vision for scientific literacy, general curriculum outcomes, and key-stage curriculum outcomes.

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

Specific curriculum outcomes are organized in four units. Each unit is organized by topic. Science 5 units and topics follow.

**Earth and Space Science: Weather**

- Measuring and Describing Weather
- Sun's Energy Reaching the Earth
- Properties of Air
- Movement of Air and Water
- Environmental Issues

**Physical Science: Forces and Simple Machines**

- Forces and Their Effects
- Friction
- Simple Machines: An Introduction
- Simple Machines: Levers
- Simple Machines: Pulleys, Systems of Machines

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

- Growth and Development
- The Systems: Digestive, Excretory, Respiratory, and Circulatory
- Skeletal, Muscular, and Nervous Systems
- Body Systems
- Maintaining a Healthy Body

**Physical Science: Properties of and Changes in Materials**

- Properties of Materials
- Physical Changes
- Chemical Changes
- Sources/Masses of Materials in Objects

This page and the following three pages outline specific curriculum outcomes—grouped by units and topics—for Science 5.

## Earth and Space Science: Weather

*Students will be expected to*

**Measuring and Describing Weather**

- identify and use weather-related folklore to predict weather (105-2)
- using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)
- identify, classify, and compare clouds (104-4, 206-1)
- using a variety of sources, gather information to describe the key features of weather systems and identify weather-related technological innovations and products that have been developed by cultures in response to weather conditions (107-14, 205-8, 302-11)

**Sun's Energy Reaching the Earth**

- relate the transfer of energy from the sun to weather and discuss the sun's impact on soil and water (206-5, 303-21)

**Properties of Air**

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

**Movement of Air and Water**

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

**Environmental Issues**

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

## Physical Science: Forces and Simple Machines

*Students will be expected to*

**Forces and Their Effects**

- observe, investigate, and describe how forces can act directly (contact) or from a distance (non-contact) to move or hold objects in place (303-12, 303-13)
- demonstrate and describe the effect of increasing and decreasing the amount of force applied to an object (303-14)
- perform experiments to describe the force needed to lift or pull a given load in standard and non-standard units (205-4, 205-5, 205-6)

**Friction**

- investigate and compare the effect of friction on the movement of objects over a variety of surfaces (204-1, 204-5, 303-15)
- demonstrate the use of rollers, wheels, and axles in moving objects (303-16)

**Simple Machines: An Introduction**

- use simple machines to identify the effort and load required to move objects (205-2, 206-9, 303-17)

**Simple Machines: Levers**

- design a lever for a particular task and differentiate between the positions of the fulcrum, the load, and the effort (303-18, 303-19)

**Simple Machines: Pulleys, Systems of Machines**

- compare and record the force needed to lift and load an object by using a single pulley system with that needed to lift it by using a multiple pulley system and predict the effect of adding another pulley or load-lifting capacity (303-20, 204-3)
- design a system of machines to solve a task (204-7)
- describe examples of how simple machines have improved living conditions and identify machines that have been used in the past and that have developed over time (105-5, 107-8, 205-8)

## Life Science: Meeting Basic Needs and Maintaining a Healthy Body

*Students will be expected to*

**Growth and Development**

- propose questions to investigate how our body works, and what its components are, and relate bodily changes to growth and development (204-1, 301-8)
- describe the role played by body systems in helping humans and other animals to grow and reproduce and to meet their basic needs (302-4)

**The Systems: Digestive, Excretory, Respiratory, and Circulatory**

- describe the structure and function of the major organs of the digestive, excretory, respiratory, and circulatory systems (302-5)
- propose questions and carry out procedures to investigate the factors affecting breathing and heartbeat rate, and compile and display data from these investigations in a graph (205-1, 206-2)

**Skeletal, Muscular, and Nervous Systems**

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

**Body Systems**

- select and use tools in building models of organs or body systems (205-2)

**Maintaining a Healthy Body**

- describe the body's defences against infections and describe the role of the skin (302-7, 302-8)
- describe nutritional and other requirements for maintaining a healthy body and evaluate the usefulness of different information sources in answering questions about health and diet (206-4, 302-9)
- describe examples of medical techniques and technologies developed by Canadians and other cultures that have contributed to the knowledge of body organisms, systems, and health issues (106-2, 106-4, 107-12, 107-14)

## Physical Science: Properties of and Changes in Materials

*Students will be expected to*

### Properties of Materials

- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)

### Physical Changes

- observe and identify changes in an object's appearance, state, and/or reversibility and classify it as a physical change or not (301-9, 205-5, 301-10)

### Chemical Changes

- describe and give examples of the interactions among materials, including gases, and discuss their properties (301-11, 301-12)
- work with team members to develop and carry out a plan to distinguish a material based on its chemical properties and display the results of the data (204-7, 207-3, 206-2, 204-5)

### Sources/Masses of Materials in Objects

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

## Attitudes Outcomes

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

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

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

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

## Key-Stage Curriculum Outcomes: Attitudes

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

| Appreciation of Science | Interest in Science | Scientific Inquiry |
|---|---|---|
| **409** appreciate the role and contribution of science and technology in their understanding of the world<br><br>**410** realize that the applications of science and technology can have both intended and unintended effects<br><br>**411** recognize that women and men of any cultural background can contribute equally to science<br><br>*Evident when students, for example,*<br>• recognize that scientific ideas help explain how and why things happen<br>• recognize that science cannot answer all questions<br>• use science inquiry and problem-solving strategies when given a question to answer or a problem to solve<br>• plan their actions to take into account or limit possible negative and unintended effects<br>• are sensitive to the impact their behaviour has on others and the environment when taking part in activities<br>• show respect for people working in science, regardless of their gender, their physical and cultural characteristics, or their views of the world<br>• encourage their peers to pursue science-related activities and interests | **412** show interest and curiosity about objects and events within different environments<br><br>**413** willingly observe, question, explore, and investigate<br><br>**414** show interest in the activities of individuals working in scientific and technological fields<br><br>*Evident when students, for example,*<br>• attempt to answer their own questions through trial and careful observation<br>• express enjoyment in sharing and discussing with classmates science-related information gathered from books; magazines; newspapers; videos; digital discs; the Internet; or personal discussions with family members, teachers, classmates, and experts<br>• ask questions about what scientists in specific fields do<br>• express enjoyment from reading science books and magazines<br>• willingly express their personal way of viewing the world<br>• demonstrate confidence in their ability to do science<br>• pursue a science-related hobby<br>• involve themselves as amateur scientists in exploration and scientific inquiry, arriving at their own conclusions rather than those of others<br>• ask to use additional science equipment to observe objects in more detail<br>• express the desire to find answers by exploring and conducting simple experiments | **415** consider their own observations and ideas as well as those of others during investigations and before drawing conclusions<br><br>**416** appreciate the importance of accuracy and honesty<br><br>**417** demonstrate perseverance and a desire to understand<br><br>*Evident when students, for example,*<br>• ask questions to ensure they understand<br>• respond positively to the questions posed by other students<br>• listen attentively to the ideas of other students and consider trying out suggestions other than their own<br>• listen to, recognize, and consider differing opinions<br>• open-mindedly consider non-traditional approaches to science<br>• seek additional information before making a decision<br>• base conclusions on evidence rather than preconceived ideas or hunches<br>• report and record what is observed, not what they think ought to be or what they believe the teacher expects<br>• willingly consider changing actions and opinions when presented with new information or evidence<br>• record accurately what has been seen or measured when collecting evidence<br>• take the time to repeat a measurement or observation for greater precision<br>• ask questions about what would happen in an experiment if one variable were changed<br>• complete tasks undertaken or all steps of an investigation<br>• express the desire to find answers by conducting simple experiments |

## Key-Stage Curriculum Outcomes: Attitudes

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

| Collaboration | Stewardship | Safety |
|---|---|---|
| **418** work collaboratively while exploring and investigating<br>*Evident when students, for example,*<br>• complete group activities or projects<br>• willingly participate in co-operative problem solving<br>• stay with members of the group during the entire work period<br>• willingly contribute to the group activity or project<br>• willingly work with others, regardless of their age, their gender, or their physical or cultural characteristics<br>• willingly consider other people's views of the world | **419** be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment<br>*Evident when students, for example,*<br>• choose to have a positive effect on other people and the world around them<br>• frequently and thoughtfully review the effects and consequences of their actions<br>• demonstrate a willingness to change their behaviour to protect the environment<br>• respect alternative views of the world<br>• consider cause-and-effect relationships that exist in environmental issues<br>• recognize that responding to our wants and needs may negatively affect the environment<br>• choose to contribute to the sustainability of their community through individual positive actions<br>• look beyond the immediate effects of an activity and identify its effects on others and the environment<br>• willingly suggest how we can protect the environment | **420** show concern for their safety and that of others in planning and carrying out activities and in choosing and using materials<br>**421** become aware of potential dangers<br>*Evident when students, for example,*<br>• look for labels on materials and seek help to interpret them<br>• ensure that all steps of a procedure or all instructions given are followed<br>• repeatedly use safe techniques when transporting materials<br>• seek counsel of the teacher before disposing of any materials<br>• willingly wear proper safety attire, when necessary<br>• recognize their responsibility for problems caused by inadequate attention to safety procedures<br>• stay at their own work area during an activity, to minimize distractions and accidents<br>• immediately advise the teacher of spills, breaks, or unusual occurrences<br>• share in cleaning duties after an activity<br>• seek assistance immediately for any first-aid concerns like cuts, burns, and unusual reactions<br>• keep the work station uncluttered, with only appropriate materials present |

## Curriculum Guide Organization

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

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

Some units or certain aspects of units may also be combined or integrated. This is one way of assisting students as they attempt to make connections across topics in science or between science and the real world. In some cases, a unit may require an extended time frame to collect data such as weather patterns and plant growth. These cases may warrant starting the activity early and overlapping it with the existing unit or continuing throughout the year. 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, an introductory paragraph provides a unit overview. This is 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 section 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 *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:

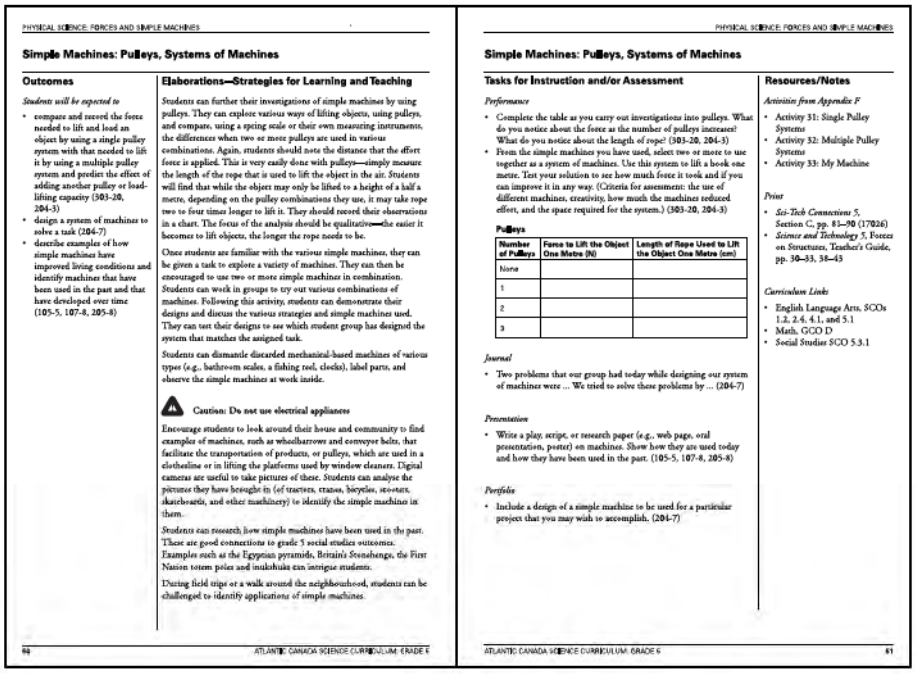
- 100s—STSE outcomes
- 200s—Skills outcomes
- 300s—Knowledge outcomes
- 400s—Attitudes outcomes (See pages 17–19.)

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

## The Four-Column Spread

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

## Two-Page, Four-Column Spread



PHYSICAL SCIENCE: FORCES AND SIMPLE MACHINES

**Simple Machines: Pulleys, Systems of Machines**

**Outcomes**

*Students will be expected to*

- compare and record the force needed to lift and load an object by using a single pulley system with that needed to lift it by using a multiple pulley system and predict the effect of adding another pulley or load-lifting capacity (303-20, 204-3)
- design a system of machines to solve a task (204-7)
- describe examples of how simple machines have improved living conditions and identify machines that have been used in the past and that have developed over time (105-5, 107-8, 205-8)

**Elaborations—Strategies for Learning and Teaching**

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

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

Students can dismantle discarded mechanical-based machines of various types (e.g., bathroom scales, a fishing reel, clocks), label parts, and observe the simple machines at work inside.

**Caution: Do not use electrical appliances**

Encourage students to look around their house and community to find examples of machines, such as wheelbarrows and conveyor belts, that facilitate the transportation of products, or pulleys, which are used in a clothesline or in lifting the platforms used by window cleaners. Digital cameras are useful to take pictures of these. Students can analyse the pictures they have brought in (of tractors, cranes, bicycles, see-saws, skateboards, and other machinery) to identify the simple machines in them.

Students can research how simple machines have been used in the past. These are good connections to grade 5 social studies outcomes. Examples such as the Egyptian pyramids, Britain's Stonehenge, the First Nation totem poles and inuksuks can intrigue students.

During field trips or a walk around the neighbourhood, students can be challenged to identify applications of simple machines.

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PHYSICAL SCIENCE: FORCES AND SIMPLE MACHINES

**Simple Machines: Pulleys, Systems of Machines**

**Tasks for Instruction and/or Assessment**

*Performance*

- Complete the table as you carry out investigations into pulleys. What do you notice about the force as the number of pulleys increases? What do you notice about the length of rope? (303-20, 204-3)
- From the simple machines you have used, select two or more to use together as a system of machines. Use this system to lift a book one metre. Test your solution to see how much force it took and if you can improve it in any way. (Criteria for assessment: the use of different machines, creativity, how much the machines reduced effort, and the space required for the system.) (303-20, 204-3)

**Pulleys**

| Number of Pulleys | Force to Lift the Object One Metre (N) | Length of Rope Used to Lift the Object One Metre (cm) |
|---|---|---|
| None | | |
| 1 | | |
| 2 | | |
| 3 | | |

*Journal*

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

*Presentation*

- Write a play, script, or research paper (e.g., web page, oral presentation, poster) on machines. Show how they are used today and how they have been used in the past. (105-5, 107-8, 205-8)

*Portfolio*

- Include a design of a simple machine to be used for a particular project that you may wish to accomplish. (204-7)

**Resources/Notes**

*Activities from Appendix F*

- Activity 31: Single Pulley Systems
- Activity 32: Multiple Pulley Systems
- Activity 33: My Machine

*Print*

- *Sci-Tech Connections* 5, Section C, pp. 81–90 (17026)
- *Science and Technology* 5, Forces on Structures, Teacher's Guide, pp. 30–33, 38–43

*Curriculum Links*

- English Language Arts, SCOs 1.2, 2.4, 4.1, and 5.1
- Math, GCO D
- Social Studies SCO 5.3.1

ATLANTIC CANADA SCIENCE CURRICULUM: GRADE 5 65

### *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 STSE, skills, and knowledge outcomes indicated by the outcome number(s) that appear(s) in parentheses after the outcome. Some STSE and skills outcomes have been written in a context that shows how these outcomes should be addressed.

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

In grade 5, the STSE and knowledge outcomes are combined.

*Column Two: Elaborations—Strategies for Learning and Teaching*

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

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

*Column Three: Tasks for Instruction and/or Assessment*

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

*Column Four: Resources/Notes*

This column identifies activities to support student achievement in meeting specific curriculum outcomes (found in Appendices E–H of this guide); print resources available through the Nova Scotia School Book Bureau (order numbers are listed beside the titles); videos available through the Education Media Library and the Learning Resources and Technology website (call numbers are listed beside the titles); and in links to other curriculum areas, where applicable. This column also provides an opportunity for teachers to make notes about other useful resources.

# Specific Curriculum Outcomes

# Earth and Space Science: Weather

## Introduction

Weather is an important aspect of daily life. Students should be provided with opportunities to understand that daily weather conditions are not the result of random occurrences but 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 aspects play in weather systems.

## Focus and Context

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

## Science Curriculum Links

Students have previously explored Daily and Seasonal Changes as an introduction to weather in Science 1. This topic was expanded upon in Science 2 with the unit Air and Water in the Environment.

In this unit on weather, students will study the factors that affect weather. This topic will be studied further in the Science 10 unit Weather Dynamics.

## Curriculum Outcomes

The following outcomes have been developed from the pan-Canadian outcomes in *Common Framework of Science Learning Outcomes K to 12*. See Appendix J for the original outcomes from which these were derived.

| STSE | Skills | Knowledge |
|---|---|---|
| *Students will be expected to* | *Students will be expected to* | *Students will be expected to* |
| **105-2** identify and use weather-related folklore to predict weather<br><br>**105-1** identify examples of weather phenomena that are currently being studied<br><br>**106-4** describe how studies of the depletion of the ozone layer, global warming, and the increase in acid rain have led to new innovations and stricter regulations on emissions from cars, factories, and other polluting technologies | **104-4, 206-1** identify, classify, and compare clouds<br><br>**104-7, 204-8, 205-4, 205-10, 205-7, 300-13** using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation<br><br>**206-5, 303-21** relate the transfer of energy from the sun to weather and discuss the sun's impact on soil and water | **107-14, 205-8, 302-11** using a variety of sources, gather information to describe the key features of weather systems and identify weather-related technological innovations and products that have been developed by cultures in response to weather conditions<br><br>**300-14** describe situations demonstrating that air takes up space, has mass, and expands when heated<br><br>**301-13** relate the constant circulation of water on Earth to processes of evaporation, condensation, and precipitation |

## Measuring and Describing Weather

### Outcomes

*Students will be expected to*

- identify and use weather-related folklore to predict weather (105-2)
- using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)
- identify, classify, and compare clouds (104-4, 206-1)

### Elaborations—Strategies for Learning and Teaching

Introduce students to this unit with weather sayings, folklore, and indicators on how people have predicted weather in the past (e.g., if cows are lying down, then it is going to rain). Through students' own observation, they can discuss the validity of the sayings.

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 can develop an illustrated glossary of terms related to the study of weather, such as the names of weather instruments, weather systems, and terms that describe weather, like **humidity** and **windchill factor**.

Students can start to tabulate their observations and measurements in charts or tables, for use in describing the weather and for noting patterns and predicting weather later on in the unit. As a link to mathematics in grade 5, students should be encouraged to collect, display, and analyse weather data.

Students should spend time observing clouds. Classifying clouds can be a challenge, as cloud formations can change quickly. Students can look at pictures of clouds to identify and develop concepts about stratus, cumulus, or cirrus. Some clouds do not fit any of the common classifications. However, observing, classifying and researching which types of clouds are associated with the various weather systems is an important part of predicting weather. Some students may wish to do research on cloud types to extend their classification scheme to classify clouds based on how high they are in the sky, such as classifying clouds as "nimbostratus" or "cumulonimbus."

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

## Measuring and Describing Weather

### Tasks for Instruction and/or Assessment

*Informal/formal Observation*

- Have students keep a chart of their predictions and actual measurements of various aspects of weather for a duration of time. (104-7, 204-8, 205-4, 205-10, 205-7, 300-13, 104-4, 206-1)

*Performance*

- Use the weather instruments to help you make observations. Record these on a chart. (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)
- Challenge students to estimate temperature and wind speed. Take the actual temperature and wind speed. Compare predicted to actual results. (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)

*Journal*

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

*Paper and Pencil*

- Print the letter of each instrument on the line in front of the description of the instrument. (This exercise can be combined with pictures of the instruments.)

  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

  (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)
- Illustrate and describe various cloud formations you have observed. (104-4, 206-1)

### Resources/Notes

*Activities from Appendix E*

- Activity 1: Weather Folklore
- Activity 2: Recording the Data
- Activity 3: My Rain Gauge
- Activity 4: My Anemometer
- Activity 5: My Barometer
- Activity 6: My Hygrometer
- Activity 7: Classifying Clouds

*Print*

- *Make Your Own Weather Station* (13165)
- *Sci-Tech Connections 5*, Unit 5C, pp. 11–52 (17026)
- *Science and Technology 5*, Weather, Teacher's Guide, pp. 11–28
- *Show Me! Grades 3–4*, pp. 72–75 (13152)
- *Weather Encyclopedia* (Weather, Stages 3–9) (13165)

*Videos*

- *Clouds, Weather and Life* (23522)
- *Telling the Weather* (23167)

*Curriculum Links*

- English Language Arts: SCO 5.1
- Math: SCOs F2, F7, G1, and G2

## Measuring and Describing Weather *(continued)*

### Outcome

*Students will be expected to*

- using a variety of sources, gather information to describe the key features of weather systems and identify weather-related technological innovations and products that have been developed by cultures in response to weather conditions (107-14, 205-8, 302-11)

### Elaborations—Strategies for Learning and Teaching

Most students will be able to watch The Weather Channel on television. This channel has extremely 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 the information they have gathered from the variety of sources to estimate things like wind speed, amounts and types of precipitation, and when various weather systems are forecast or occur both locally and globally. Students can be encouraged to estimate temperature and wind speed to assist in selecting appropriate outside clothing. Students can be encouraged to estimate the wind speed of a storm or estimate the amount of precipitation after a rainstorm or snowstorm.

Students should be encouraged to investigate the role and contributions of science and technology in the development of products. Students can use a variety of electronic media (e.g., television, the Internet), as well as print resources, to identify weather-related products such as storm doors, weatherproof 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. The students can make models, as a connection to visual arts, and share their findings and new understandings with the class.

As a social studies connection to ancient societies, students can explore how various seasonal weather systems contributed innovations in response to weather systems.

## Measuring and Describing Weather *(continued)*

### Tasks for Instruction and/or Assessment

*Performance*

- Use a range of materials to construct a model of a home built in response to weather systems around the world and engage in, respond to, and evaluate presentations to share their new discoveries. (107-14, 205-8, 302-11)

*Paper and Pencil*

- Think about the many items humans have invented to help them deal with different kinds of weather. What is one item that you would like to see someone invent (such as glasses that don't fog up when you come in on a cold day)? (107-14, 205-8, 302-11)
- Use a variety of sources to find out about weather events such as hurricanes, tornadoes, sleet storms, thunderstorms, and heat waves, using indicators such as ranges of precipitation, wind speed, cloud type, and temperature. (107-14, 205-8, 302-11)

*Presentation*

- Look in 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 be special clothing, roofing materials, shapes and structures of buildings, or special forms of transportation. Cut out or draw pictures for a classroom collage on weather and present to other classes and, if possible, a grade 1 class (to complement Science 1 teaching and learning in Daily and Seasonal Changes). (107-14, 205-8, 302-11)

### Resources/Notes

*Activities from Appendix E*

- Activity 8: Technology Innovations and Products
- Activity 9: Tools of the Trade
- Activity 10: Weather Predictions

*Print*

- *Homes Everywhere*, Big Book (13581)
- *Sci-Tech Connections 5*, Unit 5C, pp. 11–52 (17026)
- *Science and Technology 5*, Weather, Teacher's Guide, pp. 39–48
- *Show Me! Grades 3–4*, pp. 84–87 (13152)

*Videos*

- *Atmosphere: On the Air* (21424)
- *Precipitation and Prevailing Winds* (23511)

*Curriculum Links*

- English Language Arts, SCOs 1.2, 2.4, 4.1, and 5.1
- Social Studies
- Visual Arts, GCO 1

## Sun's Energy Reaching the Earth

### Outcome

*Students will be expected to*

- relate the transfer of energy from the sun to weather and discuss the sun's impact on soil and water (206-5, 303-21)

### Elaborations—Strategies for Learning and Teaching

Students have been involved in measuring and describing weather and various weather systems, and, 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 can play such a crucial role in determining the weather.

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

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

As the temperature of the water and the land rises, so does the air above it. Because land and oceans 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 further explored in the next section.

## Sun's Energy Reaching the Earth

### Tasks for Instruction and/or Assessment

*Performance*

- With a partner, plan an experiment to see which heats up more quickly, water or soil. Record your results on a chart, and graph your results by using a line graph. (206-5, 303-21)

*Interview*

- On a hot summer day, would you expect the water in a lake or the beach rocks or sand on the shoreline to be coolest? Which of them do you think would be coolest first thing in the morning, before the sun comes up? What makes you think this? (206-5, 303-21)

*Paper and Pencil*

- Draw a diagram to show how the following are related: energy, sun, water, land, evaporation, condensation, and precipitation (the water cycle). (206-5, 303-21)

### Resources/Notes

*Activities from Appendix E*

- Activity 11: Temperature Change of Soil
- Activity 12: Temperature Change of Water
- Activity 13: The Sun's Energy

*Print*

- *Sci-Tech Connections 5*, Unit 5C, p. 33 (17026)

*Video*

- *The Air Around Us* (23516)

# Properties of Air

## Outcome

*Students will be expected to*

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

## 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 boxes by blowing into plastic bags that have been placed under their corners, and trying to fill up a bottle with water by submersing it in a large tub of water (the air bubbles have to escape before it can fill up) will all demonstrate that air takes up space.

Students can find the mass of uninflated balloons or air mattresses and then mass them when they are full of air. This will demonstrate and give evidence that air has mass. The mass of the air is also evident by differences in air pressure at different 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 greater pressure closer to sea level because of all the air "stacked" on top of it.

An example of a way to demonstrate that air expands when heated or contracts when cooled is to submerse a tube or bottle in water until it is partly filled with water and the rest is air. Invert the bottle or tube so that it is upside down, with the opening sitting in the water and the water level in the tube or bottle showing above it. Mark the side of the bottle to show the water level (which indicates also how much space the air is taking up above it). Then use a hair dryer to warm the air in the bottle, or take the apparatus outside to cool the air in the bottle, and note the change in the space that the air takes up.

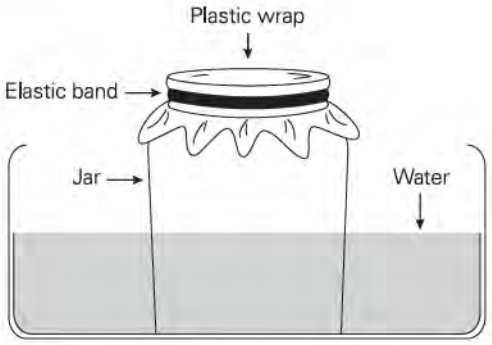
Another way is to blow up a small balloon and completely submerse it in room-temperature water. Mark the water level with the balloon submersed. Then, using an identical amount of warm water, submerse the balloon again, wait a few minutes, and mark the water level with the balloon submersed. It should take up more space when it is warm. This can also be done with cold water.

## Properties of Air

### Tasks for Instruction and/or Assessment

*Performance*

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




*Interview*

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

*Paper and Pencil*

- How is the air pressure different at sea level compared to at the top of a mountain? Draw a diagram to show your reasoning. (300-14)

### Resources/Notes

*Activity from Appendix E*

- Activity 14: Effects of Temperature on Air

*Print*

- *Sci-Tech Connections 5*, Unit 5C, p. 25 (17026)
- *Science and Technology 5*, Weather, Teacher's Guide, pp. 32–34

## Movement of Air and Water

### Outcome

*Students will be expected to*

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

### Elaborations—Strategies for Learning and Teaching

Patterns of indoor air movement are far more subtle than patterns of outdoor air movement. Students can investigate patterns of indoor air movement by putting their hands about a half a metre above a radiator and noting the rising warmed air. Students may try to detect the direction of the moving air by clapping a chalk eraser over it or letting small feathers from a down pillow drift over the heater.

⚠ **Caution: Extra chalk dust and feathers in the classroom may irritate asthmatic students.**

Students can also observe moving air with fans or open windows. Outdoor air movement is much more pronounced. Students can easily feel the wind and can use a wind vane (weather vane) to measure its direction at various times of the day or an anemometer to measure its speed. Satellite images can show the pattern of air movement on a global level.

To illustrate air-pattern movements, teachers can use the fact that both air and water are considered fluids and behave similarly. Investigations regarding airflow patterns can more easily be shown by experimenting with water. Students can investigate these patterns by heating up one side of a large beaker or aquarium with a heat lamp or another heat source. As the water is warming on one side, a drop of food colouring can be added to show how the water is moving. Students will see that the warm water moves up and over on top of the cold water and that the cold water moves down and across to replace the warm air. The same circular pattern, called a convection, holds in air—warm air rises, and cool air will sink and move over to displace the warm air.

These convections can illustrate how winds occur. The bigger the difference in temperatures between two air or water masses, the stronger the convections or winds. Students can revisit the effect of the sun on weather conditions as they can now 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, so the warm air over the land will rise up, while the cool air over water will move in to replace it. In the nighttime, this situation reverses as the land quickly cools down once the sun disappears, while the water cools down much more slowly.

Students will explore phase changes in the Physical Science: Properties of and Changes in Materials unit. See Physical Changes on page 74 of this unit for information on the water cycle.

## Movement of Air and Water

### Tasks for Instruction and/or Assessment

*Performance*

- In a group of four to five people, dramatize the water cycle. (301-13)
- Put a bag of ice on one side of an aquarium, and float a bowl of hot water on the other side. Explain what happens to the water. (301-13)

*Journal*

- One day it could 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)

*Paper and Pencil*

- Using a flow chart, illustrate the water cycle. (301-13)
- What systems are connected with weather? What do you think is the meaning of "systems" when we talk about weather? How are daily weather occurrences part of larger systems and patterns that can be predicted on a short-term and seasonal basis? (301-13)

*Portfolio*

- Include three reports and/or activities that indicate your understanding of how systems and weather are related. (301-13)

### Resources/Notes

*Activity from Appendix E*

- Activity 15: The Water Cycle

*Print*

- *Sci-Tech Connections 5*, Unit 5C, p. 53 (17026)
- *Science and Technology 5*, Weather, Teacher's Guide, pp. 29–31

## Environmental Issues

### Outcomes

*Students will be expected to*

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

### Elaborations—Strategies for Learning and Teaching

Weather phenomena that can be studied are thought to be caused by the greenhouse effect, or global warming; acid rain; and El Niño/La Niña. In this part of the unit, students should gain an awareness of some current weather and climate-related issues. Students will be introduced to the causes and the effects of global warming, depletion of the ozone, and acid rain. Other weather/environmental issues can also be addressed, such as deforestation and volcanic emissions. The depth of treatment for the causes would be limited to identifying the types of activities that contribute to these problems (e.g., refining ores, burning fossil fuels) but would not deal with actual chemical reactions. Students should, however, familiarize themselves 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, gathering information from a variety of sources, such as videos, television documentaries, newspaper and magazine articles, and news reports.

Students may wish to try to simulate some of these effects by using models. 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 while the other is left open.

Students should investigate the positive and negative effects of the 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, and non-toxic alternatives to air-conditioning chemicals in use previously. Acid rain is caused, in large part, by automobile exhaust, and many members of society are dependent on their cars. Students should realize that because of these positive benefits, finding solutions to these problems will not be easy.

Finally, students should explore solutions or products that have been developed to reduce the effects of these problems. They could find out what local, provincial, and federal governments, and well as international organizations, are doing to find solutions.

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

## Environmental Issues

### Tasks for Instruction and/or Assessment

*Presentation*

- Create a presentation (e.g., script, brochure, poster, report, 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 because of the problem. (105-1, 106-4)
  - acid rain
  - global warming
  - the ozone hole
  - El Niño or La Niña
  - volcanic emissions
  - others

### Resources/Notes

*Activity from Appendix E*

- Activity 16: Changes in Weather

*Print*

- *El Niño* (Weather, Stages 3–9) (13165)
- *Extreme Weather* (Power Magazine Introductory Package, Grade 5) (16688)
- *Weather Works* (The News II Library Pack) (13568)

*Videos*

- *Air: Climate* (Transit: Across Canada Series) (23340)
- *Air: Pollution and Solutions* (V2447)
- *Cyclone!* (21636)
- *Greenhouse Warming* (21340)
- *Hurricane: Earth's Greatest Storm* (22251)
- *Why Are Hurricanes Seasonal?* (Inquiring Minds Series) (22938)

*Curriculum Links*

- English Language Arts, SCOs 1.2, 2.4, 4.1, and 5.1
- Social Studies

# Physical Science: Forces and Simple Machines

## Introduction

The study of motion and the forces causing motion help students begin to build 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. The effects of friction on the movement of objects are also explored. Students investigate the ability of simple machines to accomplish tasks with less effort and compare and improve the ability of these machines to function. Simple machines are used in many aspects of life, and students should become familiar with their design and advantages.

## Focus and Context

The principle focus in this unit is on problem solving. Teachers should allow many opportunities for hands-on exploration (finding how various simple machines reduce effort) and then should provide open-ended challenges in which students can use simple machines, singly or in combinations, to design solutions. Assessment should focus on the students' ability to design creative solutions, not the "right" one. Inquiry will also play a role in this unit, especially in the beginning as students explore the effect of forces on motion.

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

## Science Curriculum Links

Students were introduced to motion in Science 2 and invisible forces in Science 3. In this unit, a broader investigation of forces is explored, with the application of forces to the use of machines. The concept of force as it relates to fluids is addressed in Science 8. Motion will be explored in Science 10, and the relationships between force, motion, and work are studied in high-school physics.

## Curriculum Outcomes

The following outcomes have been developed from the pan-Canadian outcomes in *Common Framework of Science Learning Outcomes K to 12*. See Appendix J for the original outcomes from which these were derived.

| STSE | Skills | Knowledge |
|---|---|---|
| *Students will be expected to* | *Students will be expected to* | *Students will be expected to* |
| **105-5, 107-8, 205-8** describe examples of how simple machines have improved living conditions and identify machines that have been used in the past and that have developed over time | **205-4, 205-5, 205-6** perform experiments to describe the force needed to lift or pull a given load in standard and non-standard units<br><br>**204-7** design a system of machines to solve a task<br><br>**204-1, 204-5, 303-15** investigate and compare the effect of friction on the movement of objects over a variety of surfaces<br><br>**205-2, 206-9, 303-17** use simple machines to identify the effort and load required to move objects | **303-12, 303-13** observe, investigate, and describe how forces can act directly (contact) or from a distance (non-contact) to move or hold objects in place<br><br>**303-14** demonstrate and describe the effect of increasing and decreasing the amount of force applied to an object<br><br>**303-16** demonstrate the use of rollers, wheels, and axles in moving objects<br><br>**303-18, 303-19** design a lever for a particular task and differentiate between the positions of the fulcrum, the load, and the effort<br><br>**303-20, 204-3** compare and record the force needed to lift and load an object by using a single pulley system with that needed to lift it by using a multiple pulley system and predict the effect of adding another pulley or load-lifting capacity |

## Forces and Their Effects

### Outcomes

*Students will be expected to*

- observe, investigate, and describe how forces can act directly (contact) or from a distance (non-contact) to move or hold objects in place (303-12, 303-13)
- 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

To launch this unit, teachers can engage students in a Know-Want to learn-Learned (K-W-L) activity (or other similar graphic organizer) on forces. This will allow teachers to find out the students' current understanding of forces. It will provide some direction for investigations throughout the unit.

A force is a push or a pull. Opportunities should exist for students to experience several types of contact (e.g., mechanical, wind) and non-contact (e.g., magnetic, gravitational) forces. Students can be encouraged to explore these forces through a series of open-ended operative questions: How many ways can you make a paper clip move from one place to another? Can you make a book move half a metre without touching it?

Alternatively, teachers could develop learning centres featuring different types of forces in which students rotate through a series of more structured experiences. (For example, one centre could use magnets for exploration, another could have students exploring the effects of mechanical forces, and another could use fans to explore the force of wind).

As students are investigating the various types of forces, encourage them to find out how they can increase or decrease the amount of force that is being exerted and to note what happens. In classroom discussion afterwards, ask students what they discovered. In most cases, changing the amount of force changes the speed at which an object moves; but in some instances, it may have no effect on the motion of an object. For example, students may push on a wall, but the wall will not move.

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

## Forces and Their Effects

### Tasks for Instruction and/or Assessment

*Informal/Formal Observation*

- Perform tasks that give evidence of contact and non-contact forces. (303-12, 303-13)

*Performance*

- Move a paper clip half a metre along your desk four times, using four different forces. Describe the ways you moved the clip. Identify whether they were contact or non-contact forces. (303-12, 303-13)
- Without tipping a jar, how could you get a staple out of it? (303-12, 303-13)

*Interview*

- Is wind a contact or non-contact force? What makes you think this? (303-12, 303-13)
- What force keeps a book on a desk? (303-12, 303-13)

*Paper and Pencil*

- Describe what happens when you increase or decrease the amount of force applied to an object. (303-14)

### Resources/Notes

*Activities from Appendix F*

- Activity 17: What Do I Know?
- Activity 18: To Move an Object or Not
- Activity 19: Contact/Non-contact
- Activity 20: Force and Movement
- Activity 21: More or Less

*Print*

- *Sci-Tech Connections 5*, Section C, pp. 54–59 (17026)
- *Science and Technology 5*, Forces on Structures, Teacher's Guide, pp. 9–11, 23–29

*Videos*

- *Force* (Forceful Follies Series) (V7487)

## Forces and Their Effects *(continued)*

### Outcome

*Students will be expected to*

- perform experiments to describe the force needed to lift or pull a given load in standard and non-standard units (205-4, 205-5, 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, using elastic bands (measuring how far they stretch) or Slinkies (to measure how far they stretch from the force of gravity as well as an applied force).

**Caution: Possible injury due to breakage of elastic bands.**

If possible, 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 should be introduced to the newton, N, as a unit of force. Using a spring scale that shows the force measured in newtons, students should record their results of experiments in data tables. It is not important that they know the definition of a newton, but simply that it is a standard unit that indicates the amount of force being applied and that 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. A newton is different from a gram. A newton measures force and a gram measures mass.

This can be followed by exercises that involve estimating the force required to lift various objects or answering certain 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? or Does it take more force to move an object faster? Students can estimate the amount of force by using standard (e.g., newton) or non-standard (e.g., the length of the elastic band, the amount the Slinky stretches) units. These activities encourage attitudes related to appreciating the importance of accuracy and working collaboratively with others in investigations.

## Forces and Their Effects *(continued)*

### Tasks for Instruction and/or Assessment

*Performance*

- Estimate and record the force used to lift the objects. 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. Possible ideas include a science book, a pencil case, an exercise book, or scissors. (205-4, 205-5, 205-6)

*Paper and Pencil*

- Lift several objects with an elastic band. Record the force used. Estimate how far the elastic band would be stretched if it were used to lift an orange. (205-4, 205-5, 205-6)
- Using a spring scale and a wagon, measure the force required to move the wagon (empty). Repeat the experiment, adding objects of varying mass to the wagon, and record the results. (205-4, 205-5, 205-6)

### Resources/Notes

*Activity from Appendix F*

- Activity 22: Standard and Non-standard Units

*Print*

- *Sci-Tech Connections 5*, Section C, p. 73 (17026)
- *Science and Technology 5*, Forces on Structures, Teacher's Guide, pp. 12–14

*Video*

- *Force and Newton's Laws* (Motion, Energy and Force Series) (23110)

*Curriculum Link*

- Math, SCO D8

# Friction

## Outcomes

*Students will be expected to*

- investigate and compare the effect of friction on the movement of objects over a variety of surfaces (204-1, 204-5, 303-15)
- demonstrate the use of rollers, wheels, and axles in moving objects (303-16)

## Elaborations—Strategies for Learning and Teaching

During classroom activities in which students identify the forces acting on various objects in different situations (moving and stationary), highlight a situation in which an object was pulled (not lifted) along the floor and the force was measured. What contributed to the degree of force needed to move the object? How could one reduce this amount of force? Introduce the term **friction** after discussing the resistance to moving. Can the students describe friction? Do they know how to increase or decrease friction?

During these learning experiences, teachers can encourage students to propose questions to investigate factors that affect friction. For example, if students suggest that heavier objects will experience more friction, then ask them to phrase their proposal into an operational (testable) question: "Do heavier objects experience more friction than lighter ones?" They should then work in groups to plan the steps to answer the questions that they propose. These types of activities can be used to further develop the notion of a fair test and the concept of controlling variables. Discussion about variables should simply distinguish between independent and dependent (manipulated). Factors that they test could be mass, the amount of surface that is in contact (e.g., is there more friction between a one-kilogram wooden cube and a surface or a one-kilogram rectangular-shaped wooden block and the same surface?), the speed at which the object is pulled (they should try to maintain a constant speed in their tests), and the type of surface. The only factors that should have an effect are mass and the type of surface.

Using their definition of friction and knowledge of the factors that affect friction, students can suggest ways of reducing friction. Challenge students to move a standard object up an inclined plane with a minimum amount of force by reducing the friction involved. This can be an excellent vehicle for increasing students' understanding of friction and the factors that affect it. Students should be exposed to the use of lubricants, surface smoothness, rollers, and wheels and axles as possible mechanisms for friction reduction. They can measure the force needed to pull a book up a ramp and then measure the force needed when it is rolled up the ramp with drinking straws underneath it. Lubricants, such as oil, could be discussed but *not* used by students. (For example, Vaseline and vegetable oil would change the surface).

Following this, students may spend some time investigating and determining instances when friction is beneficial or necessary or when friction is harmful or unnecessary.

## Friction

### Tasks for Instruction and/or Assessment

*Performance*

- Plan an experiment that investigates factors that affect friction. Carry out the investigation and make a chart for your results. Report your findings. (204-1, 204-5, 303-15)
- Pull a block across different surfaces and, in a chart, record the force needed. Explain what happens to the object with regard to friction. Examples of surfaces include carpet, a tiled floor, grass, or a soapy board. (204-1, 204-5, 303-15)
- Pull a block, using various rolling objects, and, in a chart, record the force needed. Examples are blocks with no wheels or rollers, blocks resting on pencils or straws, blocks resting on a skateboard, or a block resting on a ball. (303-16)

*Interview*

- Imagine that your hands are covered in frictionless gloves. What might happen? (204-1, 204-5, 303-15)

*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? (204-1, 204-5, 303-15)

### Resources/Notes

*Activities from Appendix F*

- Activity 23: Friction
- Activity 24: Various Surfaces and Friction
- Activity 25: Rollers, Wheels, and Axles
- Activity 26: Pinwheel—Wheel and Axle

*Print*

- *Science and Technology 5*, Forces on Structures, Teacher's Guide, pp. 15–18

*Video*

- *Gravity and Friction* (Forceful Follies Series) (V7488)

## Simple Machines: An Introduction

### Outcome

*Students will be expected to*

- use simple machines to identify the effort and load required to move objects (205-2, 206-9, 303-17)

### Elaborations—Strategies for Learning and Teaching

Simple machines can be used to reduce effort force or increase the amount of distance something moves. Students can rotate through centres that highlight simple machines such as scissors, a bottle opener, a can opener, an egg beater, tongs, a hammer, a clothesline pulley, pliers, a screwdriver, or a monkey wrench. These centres should include common household or school devices that are simple machines and should provide opportunities for students to interact and use these machines as they learn more about them.

As students explore these machines, the emphasis should be on developing the concepts of "load" and "effort" and the distances that 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, and the effort is the amount of force it would take with the aid of a simple machine. Through experimentation, students can determine both the load and the effort using spring scales (or the instruments they have devised to measure force), by measuring the force needed without the machine (load) and then measuring the force required to move the object with the machine (effort). For example, students can measure the force needed to lift an object a half a metre straight up, and then measure the force needed to slide it up a two-metre inclined plane to the same height. They could 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. In cases in which a machine increases the effort required to lift an object, the effort force will have to be applied over a shorter distance, but the object will be lifted a greater distance (distance advantage).

Students should now have a good understanding with an explanation of how much force it takes to move objects and of how much they can lift unaided. Until now, they have been using spring scales, constructed force sensors on smaller objects, or moved things small distances. In classroom discussion, ask students how they would move something heavy or move something a long distance. For example, how would they lift a heavy box? 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 or may suggest pulleys or other simple machines that they may be aware of. Bring in household machines, such as wrenches, hammers, or screwdrivers, or pictures or drawings of more complicated systems of machines, so that a classroom display can be set up. As the students explore simple machines, these more complicated pictures can be analysed to try to identify the simple machines that they are made from and how the machines are connected. Lego Dacta sets, available through the Nova Scotia School Book Bureau, can also be used.

## Simple Machines: An Introduction

### Tasks for Instruction and/or Assessment

*Performance*

- Using a simple machine, predict and then determine if the force needed to move or lift the object is less than, equal to, or greater than the mass of the object. Record your findings.

**Simple Machines Can Make My Life Easier**

| Activity Centre | Simple Machine | Prediction | Required Force |
|---|---|---|---|
| 1 | No machine | | |
| 2 | Pulley | | |
| 3 | Wheel and axle | | |
| 4 | Ramp | | |
| 5 | Lever | | |
| 6 | | | |

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? (205-2, 206-9, 303-17)

*Journal*

- Things I would find very hard to lift or move by myself are ... Things I would use to help me move these objects are ... (205-2, 206-9, 303-17)

### Resources/Notes

*Activities from Appendix F*

- Activity 27: Inclined Planes
- Activity 28: Moving an Object

*Print*

- *Galimoto* (17038)
- *Sci-Tech Connections 5*, Section C, pp. 54–67 (17026)
- *Science and Technology 5*, Forces on Structures, Teacher's Guide, pp. 30–33

*Videos*

- *Simple Machines* (Forceful Follies Series) (V7490)
- *Simple Machines: A First Look* (23372)
- *Simple Machines and Motion* (Science Essentials Series) (22647)

# Simple Machines: Levers

## Outcome

*Students will be expected to*

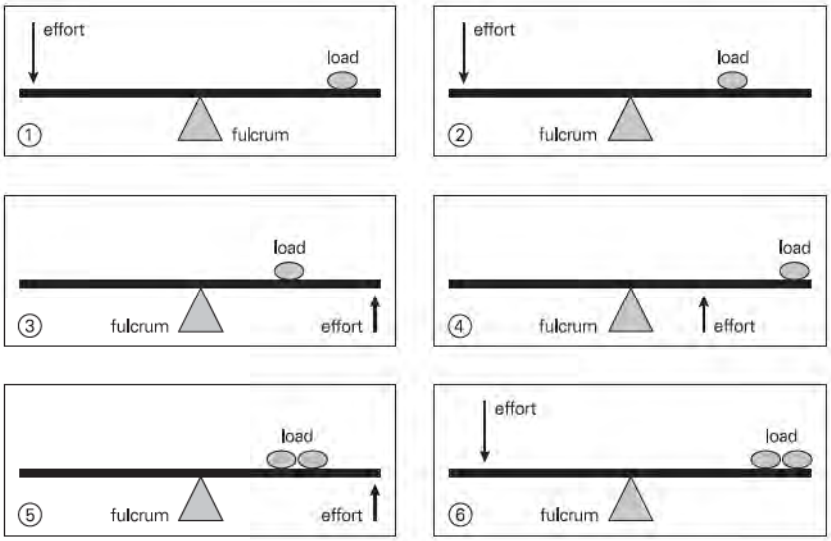
- design a lever for a particular task and differentiate between the positions of the fulcrum, the load, and the effort (303-18, 303-19)

## 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 used in levers (**load**, **fulcrum**, and **effort**). A variety of household levers (e.g., wrenches, nutcrackers, wheelbarrows) can be displayed in class. While students should not be required to memorize or be tested on the characteristics of a first-, second-, and third-class lever, they should explore the differences that occur depending on where the fulcrum is placed. Attention should be paid to the amount of effort needed to lift objects and the distance that the objects are lifted. Students can experiment with the effort required to lift an object when it is closer or farther 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 whether the object is between them and the fulcrum (3). They may also try lifting two objects (5 and 6). The types of levers may be named after all the samples have been tried. Classifying which objects work the same way will lead to the various lever types.

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

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



## Simple Machines: Levers

### Tasks for Instruction and/or Assessment

*Performance*

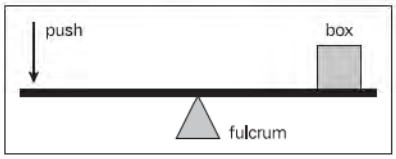
- Design levers to (a) lift a book a distance of a half a metre, using the least amount of force possible; (b) project a marshmallow at a target; or (c) crack a nut. (303-18, 303-19)

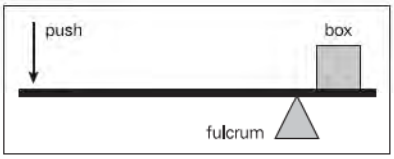
*Interview*

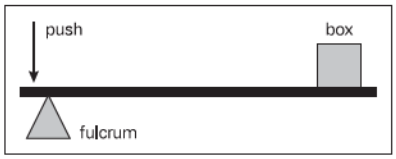
- Show me the fulcrum, the load, and the effort when you use a hammer to remove a nail from a board. (303-18, 303-19)

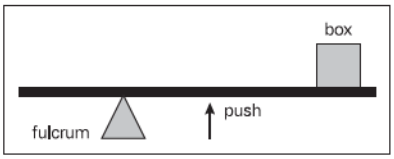
*Paper and Pencil*

- Describe in words 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)




### Resources/Notes

*Activities from Appendix F*

- Activity 29: Levers
- Activity 30: Levers All Around Us

*Print*

- *Sci-Tech Connections 5*, Section C, pp. 77–79 (17026)
- *Science and Technology 5*, Forces on Structures, Teacher's Guide, pp. 30–33

## Simple Machines: Pulleys, Systems of Machines

### Outcomes

*Students will be expected to*

- compare and record the force needed to lift and load an object by using a single pulley system with that needed to lift it by using a multiple pulley system and predict the effect of adding another pulley or load-lifting capacity (303-20, 204-3)
- design a system of machines to solve a task (204-7)
- describe examples of how simple machines have improved living conditions and identify machines that have been used in the past and that have developed over time (105-5, 107-8, 205-8)

### Elaborations—Strategies for Learning and Teaching

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

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

Students can dismantle discarded mechanical-based machines of various types (e.g., bathroom scales, a fishing reel, clocks), label parts, and observe the simple machines at work inside.

**Caution: Do not use electrical appliances.**

Encourage students to look around their house and community to find examples of machines, such as wheelbarrows and conveyor belts, that facilitate the transportation of products, or pulleys, which are used in a clothesline or in lifting the platforms used by window cleaners. Digital cameras are useful to take pictures of these. Students can analyse the pictures they have brought in (of tractors, cranes, bicycles, scooters, skateboards, and other machinery) to identify the simple machines in them.

Students can research how simple machines have been used in the past. These are good connections to grade 5 social studies outcomes. Examples such as the Egyptian pyramids, Britain's Stonehenge, the First Nation totem poles and inukshuks can intrigue students.

During field trips or a walk around the neighbourhood, students can be challenged to identify applications of simple machines.

## Simple Machines: Pulleys, Systems of Machines

### Tasks for Instruction and/or Assessment

*Performance*

- Complete the table as you carry out investigations into pulleys. What do you notice about the force as the number of pulleys increases? What do you notice about the length of rope? (303-20, 204-3)
- From the simple machines you have used, select two or more to use together as a system of machines. Use this system to lift a book one metre. Test your solution to see how much force it took and if you can improve it in any way. (Criteria for assessment: the use of different machines, creativity, how much the machines reduced effort, and the space required for the system.) (303-20, 204-3)

**Pulleys**

| Number of Pulleys | Force to Lift the Object One Metre (N) | Length of Rope Used to Lift the Object One Metre (cm) |
|---|---|---|
| None | | |
| 1 | | |
| 2 | | |
| 3 | | |

*Journal*

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

*Presentation*

- Write a play, script, or research paper (e.g., web page, oral presentation, poster) on machines. Show how they are used today and how they have been used in the past. (105-5, 107-8, 205-8)

*Portfolio*

- Include a design of a simple machine to be used for a particular project that you may wish to accomplish. (204-7)

### Resources/Notes

*Activities from Appendix F*

- Activity 31: Single Pulley Systems
- Activity 32: Multiple Pulley Systems
- Activity 33: My Machine

*Print*

- *Sci-Tech Connections 5*, Section C, pp. 81–90 (17026)
- *Science and Technology 5*, Forces on Structures, Teacher's Guide, pp. 30–33, 38–43

*Curriculum Links*

- English Language Arts, SCOs 1.2, 2.4, 4.1, and 5.1
- Math, GCO D
- Social Studies SCO 5.3.1

# Life Science: Meeting Basic Needs and Maintaining a Healthy Body

## Introduction

Students can explore and explain that 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 that many factors can affect a healthy body. The body has its own defences against germs, but students should evaluate and elaborate on the idea that they are responsible for meeting their bodies' requirements of basic needs such as nutrition and exercise.

## Focus and Context

This unit could be integrated with the health education curriculum, but it should extend to a more inquiry-based 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 see the function that saliva plays in digestion. It is not enough for students to simply be able to draw or label diagrams of the various systems—they need to actively construct and investigate the factors that affect them. Addressing grade 5 health education outcomes within this unit of study will facilitate a decision-making focus and should be set in the context of making choices that lead toward living an active, healthy lifestyle. Students at this age will soon have to make important decisions about smoking, drugs, and alcohol. This unit will provide them with opportunities to see how their body systems work together and how these systems can be adversely affected when the wrong choices are made.

## Science Curriculum Links

Students have explored the needs and characteristics of living things in Science 1, as well as growth and life cycles in Science 2. 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 Science 8.

## Curriculum Outcomes

The following outcomes have been developed from the pan-Canadian outcomes in *Common Framework of Science Learning Outcomes K to 12*. See Appendix J for the original outcomes from which these were derived.

| STSE | Skills | Knowledge |
|---|---|---|
| *Students will be expected to* | *Students will be expected to* | *Students will be expected to* |
| **106-2, 106-4, 107-12, 107-14** describe examples of medical techniques and technologies developed by Canadians and other cultures that have contributed to the knowledge of body organisms, systems, and health issues | **204-1, 301-8** propose questions to investigate how our body works and what its components are, and relate bodily changes to growth and development<br><br>**205-1, 206-2** propose questions and carry out procedures to investigate the factors affecting breathing and heartbeat rate, and compile and display data from these investigations in a graph<br><br>**205-2** select and use tools in building models of organs or body systems<br><br>**206-4, 302-9** describe nutritional and other requirements for maintaining a healthy body and evaluate the usefulness of different information sources in answering questions about health and diet | **302-4** describe the role played by body systems in helping humans and other animals to grow and reproduce and to meet their basic needs<br><br>**302-5** describe the structure and function of the major organs of the digestive, excretory, respiratory, and circulatory systems<br><br>**302-6** demonstrate how the skeletal, muscular, and nervous systems work together to produce movement<br><br>**302-7, 302-8** describe the body's defences against infections and describe the role of the skin |

## Growth and Development

### Outcomes

*Students will be expected to*

- propose questions to investigate how our body works and what its components are, and relate bodily changes to growth and development (204-1, 301-8)
- describe the role played by body systems in helping humans and other animals to grow and reproduce and to meet their basic needs (302-4)

### Elaborations—Strategies for Learning and Teaching

This unit may be integrated with the health education curriculum.

Students can brainstorm a list of questions about the functions and components of their bodies. Questions on bodily changes such as acne on the skin and the growth of body hair are appropriate here. The students can focus their discussions on the following: How does food give us energy? What do my lungs do, and how do they work? What happens to food after I eat it? and How do our bodies work? This will get them thinking about how their bodies perform all the major functions and will 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 and development of our bodies. Teachers should be prepared for questions and concerns about parents who use tobacco/alcohol. Students have had experiences with the life cycles of animals and plants. Teachers could connect the life cycle with growth and development, the reproductive system, and bodily changes.

Students can, individually or in groups, make a list of bodily changes that occur as they grow older. When the list has been 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 will have a fairly sudden onset (e.g., acne, hair growth).

Videos or other media can also 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, software) to learn about the major organs of the reproductive system.

Talking about systems and the connections that systems have is important to clarify learnings and understandings about the body.

## 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. (204-1, 301-8)

*Journal*

- I wonder how my body grows. The things I wonder about most are ... **Teacher Note:** Confidentiality should be maintained between the student and the teacher. (204-1, 301-8)

*Paper and Pencil*

- Research bodily changes from birth to puberty. A chart similar to the example below could be used to organize the data. (204-1, 301-8)

**Body Changes**

| Change | Onset | Time Span |
|---|---|---|
| Get taller | Birth | Varies, up until around age 17 |
| Cut baby teeth | Around six months of age | Varies, short time span (around three years) |
| | | |

*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 adult, and senior adult). Include descriptions of changes that occur at each stage. (204-1, 301-8)
- Develop a skit, video, song, or lyrics on the importance of all the bodily systems working in harmony to maintain a healthy body. (302-4)

### Resources/Notes

*Activity from Appendix G*

- Activity 34: Questions Generated about a Healthy Body

*Print*

- *Health Education Curriculum: Grades 4–6,* pp. 100–103 (Nova Scotia Department of Education, 2003)
- *Science and Technology 5,* Teacher's Guide, p. 8
- *The Human Machine* (National Geographic Reading Expeditions) (13500)

*Curriculum Link*

- Health Education, SCOs A1.2, A2.2, and A3.1

## The Systems: Digestive, Excretory, Respiratory, and Circulatory

### Outcome

*Students will be expected to*

- describe the structure and function of the major organs of the digestive, excretory, respiratory, and circulatory systems (302-5)

### Elaborations—Strategies for Learning and Teaching

Students should investigate the role of the digestive system in providing nourishment for the body's functions. Major organs include the teeth, tongue, esophagus, stomach, small intestine, and large intestine. Modelling/simulating as much of the digestive and excretory processes as possible will make learning interesting, relevant, and motivating. Components and processes of these systems can be investigated by 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.

Students can mix a soda cracker with water in a paper cup, add a drop of iodine solution, and show that starch is present by the dark colour. Then they can add their simulated saliva (a solution of amylase, available from science catalogues or health food stores) to the mix and watch the dark colour disappear as the simulated saliva breaks down the starch into simple sugars mimicking the process carried out by the teeth, tongue, esophagus, stomach, small intestine, and large intestine.

**Caution: Due to the possible spread of germs causing disease, do not use real saliva. Amylase should be used instead of real saliva.**

In classroom discussion, students can propose explanations about the role of teeth in the digestive process and phrase these explanations in the form of a testable question. Students may claim that chewing up 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 by 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 then time how long it takes for the blue-iodine colour to fade.

## The Systems: Digestive, Excretory, Respiratory, and Circulatory

### Tasks for Instruction and/or Assessment

*Performance*

- Complete the chart below for your observations. What may have contributed to the differences in the times required for the iodine to change colour? (302-5)

**Starting to Digest!**

| Treatment | Observations | Time Required for the 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 | | |

*Interview*

- How does eating contribute to meeting basic needs and maintaining a healthy body? (302-5)

*Paper and Pencil*

- Orally, or through a written task, explain the course of digestion. (302-5)
- Label or draw a diagram about the digestive system that includes the teeth, tongue, esophagus, stomach, small intestine, and large intestine. (302-5)

### Resources/Notes

*Activities from Appendix G*

- Activity 35: The Course of Digestion
- Activity 36: Disappearing Act

*Print*

- *Body Systems Edition* (The News Library Pack) (13567)
- *Health Education Curriculum: Grades 4–6,* pp. 32–35 (Nova Scotia Department of Education, 2003)
- *Science and Technology 5,* Teacher's Guide, pp. 13–15, 44–46

*Video*

- *The Human Body* (Bill Nye, The Science Guy) (21648)

## The Systems: Digestive, Excretory, Respiratory, and Circulatory *(continued)*

### Outcome

*Students will be expected to*

- describe the structure and function of the major organs of the digestive, excretory, respiratory, and circulatory systems (302-5)

### Elaborations—Strategies for Learning and Teaching

Students should investigate the role of the excretory system in ridding the body of harmful wastes and body products. Major organs include the 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 by using their experiences in physical education.

Students should brainstorm and then research products/technologies that have been developed in response to the need for the disposal, control, and containment of excrement or body gases (e.g., diapers, toilet paper, flush toilets, deodorants).

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

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

Students can be divided into groups for each system. Using craft materials, recycled objects, and consumables, students can make a model on a traced body shape (on brown or tracing paper) of each system. Label the parts. These can then be compared and overlapped. Discussion about each system and how they interact with others facilitates understanding how the body works.

## The Systems: Digestive, Excretory, Respiratory, and Circulatory *(continued)*

### Tasks for Instruction and/or Assessment

*Journal*

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

*Interview*

- Could we breathe without a diaphragm? What role does the diaphragm play in the respiratory system? (302-5)

*Paper and Pencil*

- Write a play about how one system works. Have each body part talk to explain its role in the process. Have students do a public performance of the play, with paper costumes, to show how the system works. (302-5)

*Presentation*

- Construct a working model of the respiratory system by using various craft, recycled, and consumable objects. (302-5)

### Resources/Notes

*Print*

- *Health Education Curriculum: Grades 4–6,* pp. 96–99 (Nova Scotia Department of Education, 2003)
- *Sci-Tech Connections 5,* Unit 5A, pp. 38–42 (17026)
- *Show Me! Grades 5–6,* pp. 80–83 (13153)

*Curriculum Links*

- Health Education, SCOs A1.1, A2.1, B4.3, B4.4, B7.1, and B7.2
- Math, SCOs D8, F1, F2, and F7
- Physical Education, Active Living

## The Systems: Digestive, Excretory, Respiratory, and Circulatory *(continued)*

### Outcome

*Students will be expected to*

- propose questions and carry out procedures to investigate the factors affecting breathing and heartbeat rate, and compile and display data from these investigations in a graph (205-1, 206-2)

### Elaborations—Strategies for Learning and Teaching

The circulatory and respiratory systems should be investigated by 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 seeing how exercise affects breathing and pulse rates. These experiments provide excellent opportunities to control variables and to compile and display results.

**Caution: Teachers should be aware of any physical problems, like asthma, that students might have and ensure that the investigations that students undertake will not overtax them.**

Connections can be made to the excretory system studied earlier. Students may note that as the amount of activity increases, so will their rate of perspiration.

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

Students can measure their lung capacity by blowing into a plastic tube that leads into an inverted jar filled with water. This jar should be partially submersed in a pan of water to keep the water held 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 get more flexible over time. Another way could be to see how far they can blow a light object across a table. Students may be able to think of other ways to test lung capacity; they may have access to a spirometer through the local Heart and Lung Association or from a local high-school lab.

Students should be aware of the scientific processes they use when they do investigations: They have just completed a fair test in which they investigated and carried out procedures in which some variables were controlled and others were tested. Students will have experienced describing what constitutes a fair test and should be able to recognize if a test is fair or not. They should ensure that all variables are controlled except the one being tested. Students have had experience with the concept of variables. This may be an opportunity for teachers to introduce the term **variables**.

## The Systems: Digestive, Excretory, Respiratory, and Circulatory *(continued)*

### Tasks for Instruction and/or Assessment

*Performance*

- With a partner, take your pulse for 15 seconds and count the number of times you breathe for two minutes. Record these numbers in the chart. Then do some gentle exercise (e.g., running on the spot, skipping, push-ups) (**Teacher Note:** Substitute other procedures related to other factors the students may want to test.) and take your pulse and count the number of times you breathe. Draw a bar graph illustrating your results. (205-1, 206-2)

**Pulse-Rate Times**

| Trial | Pulse (before) | Pulse (after) | Breathing (before) | Breathing (after) |
|---|---|---|---|---|
| Person 1 Trial 1 | | | | |
| Person 1 Trial 2 | | | | |
| Person 2 Trial 1 | | | | |
| Person 2 Trial 2 | | | | |

### Resources/Notes

*Activity from Appendix G*

- Activity 37: Comparing Lung Capacity

*Print*

- *Science and Technology 5*, Teacher's Guide, pp. 16–23
- *Shaping Up* (Power Magazine, Introductory Package, Grade 5) (16688)

*Video*

- *Fitness and Sport* (20951)

## Skeletal, Muscular, and Nervous Systems

### Outcome

*Students will be expected to*

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

### Elaborations—Strategies for Learning and Teaching

Students should investigate the structure and function of the major parts 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, software) to learn about the major organs of the nervous system.

Students can construct a skeletal system with attached muscles. These models should illustrate how the muscles are necessary to move the bones and that the nervous system is the command centre for any movement. Teachers may wish to use a model of a human skeleton or posters illustrating the skeleton and muscles. The teacher may wish to use X rays from local hospitals.

Students can participate in any 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 that the ruler or pencil is caught, the slower the reaction time. These activities provide excellent opportunities to show how results from a single student can vary (the student will not be able to catch the object in the exact same place every time due to variations in alertness and response time), and this will highlight the need for repeating tests and averaging results. Math outcomes related to determining the mean can be addressed in this context.

## Skeletal, Muscular, and Nervous Systems

### Tasks for Instruction and/or Assessment

*Interview*

- What is meant by paralysis? (302-6)
- What injury can cause paralysis and how? (302-6)

*Paper and Pencil*

- Write lyrics or a poem on the interconnection of the skeletal system. (302-6)

*Presentation*

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

### Resources/Notes

*Activity from Appendix G*

- Activity 38: Response Time

*Print*

- *Bones Edition* (The News Library Pack) (13567)
- *Health Education Curriculum: Grades 4–6,* pp. 36–39 (Nova Scotia Department of Education, 2003)
- *Sci-Tech Connections 5,* Unit 5A, pp. 17–33 (17026)
- *Science and Technology 5,* Teacher's Guide, pp. 24–31
- *Understanding the Brain* (National Geographic Reading Expeditions) (13500)

*Curriculum Links*

- Math, SCOs F6 and F7
- Physical Education

## Body Systems

### Outcome

*Students will be expected to*

- select and use tools in building models of organs or body systems (205-2)

### Elaborations—Strategies for Learning and Teaching

Students should make and/or use models of the various systems or organs and help with the identification of various organs and/or show the function of those organs. The model does not necessarily have to be a working model. Students can illustrate, using tubes of various diameters, how the diameter of a 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.

Students can construct models of the respiratory system by 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 digestive-system models that include simulating stomach acid by 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 made out of pantyhose. Models can show how muscles and bones move together. Allow students to design and create their own models by using various examples in groups or independently. This will provide an opportunity to link visual arts through science.

## Body Systems

### Tasks for Instruction and/or Assessment

*Presentation*

- Create a model of one of the organs in the 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)

### Resources/Notes

*Activity from Appendix G*

- Activity 39: Building Body Systems

*Curriculum Link*

- Visual Arts, SCOs 1.1.1, 1.2.1, 1.3.1, and 2.1.1

## Maintaining a Healthy Body

### Outcomes

*Students will be expected to*

- describe the body's defences against infections and describe the role of the skin (302-7, 302-8)
- describe nutritional and other requirements for maintaining a healthy body and evaluate the usefulness of different information sources in answering questions about health and diet (206-4, 302-9)

### Elaborations—Strategies for Learning and Teaching

This section can be integrated with health education outcomes.

Students should discuss and investigate the body's natural defence mechanisms against disease and illness (such as tears, saliva, skin, certain blood cells, and stomach secretions). 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 informative for students to contrast themselves with people whose immune systems are compromised. This will highlight how we can take this process for granted when it is working well.

Students can explore, through dicussions, how lifestyle plays a role in healthy living. Students can focus on how "lifestyle" advertising affects their choices of nutrition, fitness, and 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. Students can explore *Canada's Food Guide* for maintaining a healthy body.

Field trips or speakers from health and fitness agencies could be arranged for students. Students should explore, through field trips, research, or guest speakers, techniques used by people in their community to address their health requirements. This could include in-school resources, such as the health and physical education teacher or school public health nurse, as well as outside professionals such as naturopaths, chiropractors, traditional Chinese medicine doctors, acupuncture doctors, nutritionists, or dermatologists.

## Maintaining a Healthy Body

### Tasks for Instruction and/or Assessment

*Journal*

- Some sources of information that I look to for information about health are ... (206-4, 302-9)

*Interview*

- What programs are available in your community to promote health and fitness? (206-4, 302-9)

*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, or junk food. (302-7, 302-8)

### Resources/Notes

*Activity from Appendix G*

- Activity 40: The Role of the Skin

*Print*

- *Eat to Win Edition* (The News Library Pack) (13567)
- *Fighting Disease* (National Geographic Reading Expeditions) (13500)
- *Making Healthy Choices* (National Geographic Reading Expeditions) (13500)
- *Science and Technology 5*, Teacher's Guide, pp. 32–43
- *Show Me! Grades 3–4*, pp. 68–71 (13152)
- *Eating Well with Canada's Food Guide*

*Videos*

- *Cells and Systems* (20954)
- *Immune System* (21944)
- *Microbeasts and Disease* (20935)
- *Why Does Getting Sick Always Give You the Same Symptoms?* (Inquiring Minds Series) (22934)

*Curriculum Links*

- Health Education, SCOs B1.1, B1.2, and B1.3
- Physical Education, Active Living

## Maintaining a Healthy Body *(continued)*

### Outcome

*Students will be expected to*

- describe examples of medical techniques and technologies developed by Canadians and other cultures that have contributed to the knowledge of body organisms, systems, and health issues (106-2, 106-4, 107-12, 107-14)

### Elaborations—Strategies for Learning and Teaching

Students should investigate medical techniques that have been developed by other cultures, past and present—acupuncture (Chinese), chiropractic (various cultures), saunas, whirlpools, and herbal remedies—and find out where the techniques were developed and how they work to prevent or cure illnesses. Students can also choose a culture and research its traditional medical techniques and practices. Have the class take part in a fitness session such as yoga, tai chi, or qigong.

Medicinal practice has developed over the years. Students may have no idea where various drugs or medical techniques come from. They can research medicine, doctors, and 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 class study is the effect that clear-cutting the rainforests has had on destroying some exotic plant and animal species that have pharmaceutical importance.

Students can do research on the variety of artificial limbs that have been developed over the years, noting the improvements. Students may also research the wide variety of exercise machines that have been developed to increase strength and endurance. This will encourage positive attitudes about the role and contribution of science and technology in their understanding of the world. Research information may be collected from rehabilitation centres, prosthetic centres, or companies.

Students can write a report on a local or regional scientist, inventor, or medical practitioner (a male or female chosen from a variety of ethnic backgrounds) working in the medical field. Past notable Canadians are 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 for osteoporosis (a bone disease); Phil Gold, developer of the first blood test for certain types of cancer; and Maude Abbott, developer of a classification system for heart diseases. A researcher at a local university could also be chosen.

Teaching and learning experiences addressing this outcome can link nicely with an exploration of societies, both ancient and modern, within the social studies curriculum for grade 5.

## Maintaining a Healthy Body *(continued)*

### Tasks for Instruction and/or Assessment

*Journal*

- I am interested in learning more about various medical and cultural techniques because ... (106-2, 106-4, 107-12, 107-14)

*Interview*

- Interview a health-care professional about changes in health care in various cultures and over time. (106-2, 106-4, 107-12, 107-14)

*Paper and Pencil*

- Produce a report on how various technologies have arisen from the study of how our body moves. (106-2, 106-4, 107-12, 107-14)
- Choose one of the Canadians studied in this unit. Write a paragraph about how he or she has helped us to keep healthy or contributed to our understanding of organs and/or systems. (106-2, 106-4, 107-12, 107-14)

### Resources/Notes

*Activity from Appendix G*

- Activity 41: Culture and Maintaining Good Health

*Print*

- *Science and Technology 5*, Teacher's Guide, pp. 47–49

*Curriculum Link*

- Social Studies, Units 1–4

# Physical Science: Properties of and Changes in Materials

## Introduction

Materials around us have properties that are important to their use. By studying materials used in various applications, students become aware of 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 of this unit will be on inquiry and investigation. Students should be encouraged to explore a wide range of physical and chemical changes, to investigate how to separate mixtures, and to look closely at the composition of the objects around them. One possible context for this unit is household chemistry. Many physical and chemical changes occur as we eat, bake, clean, and repair or renovate the house. Students should relate what they will learn and experience as part of this unit to household events and inquire about the types of changes that occur and/or where household materials originated.

## Science Curriculum Links

Students were introduced to materials and their properties throughout grades 1–3 science. Science 1 addresses outcomes related to materials in the unit Materials, Objects, and Our Senses. The Liquids and Solids unit in Science 2 explores buoyancy as well as physical and chemical changes. In Science 3, students use their knowledge from earlier units to build structures and investigate invisible forces.

In this unit, the concepts of physical and chemical changes are explored further and in greater depth. This will lead to a study of Mixtures and Solutions in Science 7, Fluids in Science 8, and Atoms and Elements in Science 9.

## Curriculum Outcomes

The following outcomes have been developed from the pan-Canadian outcomes in *Common Framework of Science Learning Outcomes K to 12*. See Appendix J for the original outcomes from which these were derived.

| STSE/Knowledge | Skills | Knowledge |
|---|---|---|
| *Students will be expected to* | *Students will be expected to* | *Students will be expected to* |
| **107-8, 205-8, 300-12** use a variety of sources and technologies to identify and describe the source of the materials found in an object, changes to the natural materials required to make the object, and how manufactured materials have been developed to improve living conditions | **204-7, 207-3, 206-2, 204-5** work with team members to develop and carry out a plan to distinguish a material based on its chemical properties and display the results of the data<br><br>**206-1, 300-9** classify materials as solids, liquids, or gases and illustrate this classification in a property chart<br><br>**104-5, 205-3, 300-11** follow a given set of procedures to relate the mass of a whole object to the sum of the masses of its parts and suggest possible explanations for variations in the results | **301-9, 205-5, 301-10** observe and identify changes in an object's appearance, state, and/or reversibility and classify it as a physical change or not<br><br>**301-11, 301-12** describe and give examples of the interactions among materials, including gases, and discuss their properties |

## Properties of Materials

### Outcome

*Students will be expected to*

- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)

### Elaborations—Strategies for Learning and Teaching

Students should investigate a wide variety of materials (solids, liquids, and gases) and describe their distinguishing characteristics. Properties that students can explore are those of solids (e.g., colour, hardness, ability to pour, buoyancy, odour, solubility, magnetism) and liquids (e.g., colour, odour, viscosity, solubility in water, buoyancy, surface tension). Solid substances could include powdered or granular solids such as salt, sugar, and baking soda as well as solid objects such as pencils, cups, or coins. Liquids could include water, vegetable oil, liquid soaps, molasses, or vinegar. Gases can be illustrated by using balloons, jars, or bubbles filled with air or by producing gases with reactions such as mixing vinegar and baking soda.

**Caution: Any experiments in which gases are produced should be done in containers that are open to air. Producing a gas in a closed glass jar, for example, could cause the jar to break open.**

Students can brainstorm properties of solids, liquids, and gases and classify materials according to their distinguishing properties. They should:

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

Teachers can help students by demonstrating some properties of substances (e.g., swirling liquids to show that they don't keep the same shape) and lead the discussion by asking questions such as, "Can you compress a liquid or a solid?" that may lead to further investigations.

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

**Properties of Solids**

| Property | Salt | Sugar |
|---|---|---|
| Colour | White | |
| Appearance when magnified | Tiny crystals (a sketch may be included) | |
| | | |

- Test the following substances' solubility in water: salt, sugar, baking soda, pepper, and baking powder. Chart your results. (206-1, 300-9)

*Interview*

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

*Presentation*

- Write a poem illustrating the properties of solids, liquids, and/or gases. (206-1, 300-9)

### Resources/Notes

*Activities from Appendix H*

- Activity 42: Solids, Liquids, or Gases
- Activity 43: Solids
- Activity 44: Liquids
- Activity 45: Gases
- Activity 50: Known Substances
- Activity 51: Unknown Substances

*Print*

- *Sci-Tech Connections 5*, Section B, pp. 11–30 (17026)
- *Science and Technology 5*, Changes in Matter, Teacher's Guide, pp. 10–20

*Videos*

- *Chemical Reactions: Phases of Matter* (Bill Nye, The Science Guy) (23117)
- *Learning about Liquids, Solids, and Gases* (22261)

*Curriculum Link*

- Math, SCO D6

## Physical Changes

### Outcome

*Students will be expected to*

- observe and identify changes in an object's appearance, state, and/or reversibility and classify it as a physical change or not (301-9, 205-5, 301-10)

### Elaborations—Strategies for Learning and Teaching

In this part of the unit, students should investigate physical changes—changes that affect the look, feel, strength, and texture of an object but do not actually change the object into a totally different material. (For example, cutting wood is a physical change while burning wood is a chemical change).

Teachers and students should understand that in some cases a physical change is obvious while in others it is not. For example, shaping putty, breaking a piece of wood, folding paper, and sharpening a pencil are clearly physical changes, since it is evident that no new materials have been formed, but changes such as phase changes (boiling or freezing water, for example) or dissolving materials in water are obviously not physical changes, since, in these cases, they have yielded materials that have very different properties.

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.

Students should explore physical changes to a variety of materials and investigate changing properties. Students may explore materials to answer the questions Does the shape of an object (e.g., modelling clay, aluminum foil) affect its buoyancy? Does the temperature of a material affect its malleability?

Some physical changes are reversible (boiling water, for example) and some are not (sanding wood into sawdust). Do not use reversibility as a distinguishing feature of physical changes, since there are also many chemical changes that are reversible (e.g., litmus paper can change from pink to blue and back to pink again) and since some reversible changes may be chemical rather than physical (e.g., paper changing colour).

## Physical Changes

### Tasks for Instruction and/or Assessment

*Performance*

- Investigate the physical changes of various materials. Use a table to 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. Identify and control variables. Share your results with your classmates. Draw a graph of the class results, and make conclusions. (301-9, 205-5, 301-10)

**Caution: Do not exceed 20°C when heating a material.**

*Journal*

- Some physical changes can be reversed. Some physical changes cannot not easily be reversed. For example ... (301-9, 205-5, 301-10)

### Resources/Notes

*Activities from Appendix H*

- Activity 46: Physical Changes
- Activity 47: Reversible Physical Changes
- Activity 50: Known Substances
- Activity 51: Unknown Substances

*Print*

- *Science and Technology 5*, Changes in Matter, Teacher's Guide, pp. 25–29

*Video*

- *Changes in Matter* (V2445)

# Chemical Changes

## Outcomes

*Students will be expected to*

- describe and give examples of the interactions among materials, including gases, and discuss their properties (301-11, 301-12)
- work with team members to develop and carry out a plan to distinguish a material based on its chemical properties and display the results of the data (204-7, 207-3, 206-2, 204-5)

## Elaborations—Strategies for Learning and Teaching

Students should explore chemical changes of different materials. Many chemical reactions can be done using household chemicals (e.g., vinegar and baking soda, yogurt and baking soda, an apple turning brown after it is peeled, milk and vinegar).

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 have been formed.

Indicators are chemicals that easily undergo reversible chemical reactions and, in the process, change colour. Students can explore reactions by using blue litmus paper, which will turn pink when it reacts with chemicals such as vinegar, lemon juice, or other acids and then blue when it reacts with chemicals such as baking soda, baking powder, or an antacid tablet dissolved in water or another base. 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 by using boiling water. Students can experiment to try to change these indicators from one colour to another by using acids and bases.

Students should develop a plan to distinguish one material from another based on its chemical properties. Students should create a table showing how household substances react when combined. Some substances that may react with vinegar include baking powder, baking soda, and chalk.

Students should then be given unmarked samples of baking powder, salt, and baking soda and asked to determine, from their reactions, any chemical changes.

⚠ **Caution: Students should be cautioned not to taste any of the chemicals.**

Connection to the grade 5 Life Science: Meeting Basic Needs and Maintaining a Healthy Body unit: 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 or she breathes in enough carbon monoxide, since it attaches to the blood in a virtually non-reversible chemical reaction—making the blood unable to bond with oxygen.

## Chemical Changes

### Tasks for Instruction and/or Assessment

*Performance*

- Students should explore the chemical changes that take place with approved chemicals and complete a table with their observations. (301-11, 301-12)
- Having completed a table with their observations, students should perform the same tests on an unknown substance and try to identify which substance it is. **Teacher Note:** Leave some of the tests blank and let the students decide which tests to do. (204-7, 207-3, 206-2, 204-5)

*Paper and Pencil*

- Write "chemical" or "not chemical" beside each of the following changes and provide evidence. (204-7, 207-3, 206-2, 204-5)
  - crumpling up paper
  - pouring water on the floor
  - lighting a match
  - mixing vinegar and baking soda
  - boiling water

### Resources/Notes

*Activities from Appendix H*

- Activity 48: Playdough
- Activity 49: Chemical Changes
- Activity 50: Known Substances
- Activity 51: Unknown Substances

*Print*

- *Science and Technology 5*, Changes in Matter, Teacher's Guide, pp. 25–34

*Video*

- *Solid, Liquid, Gas* (23063)

## 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 masses of its parts and suggest possible explanations for variations in the results (104-5, 205-3, 300-11)
- use a variety of sources and technologies to identify and describe the source of the materials found in an object, changes to the natural materials required to make the object, and how manufactured materials have been developed to improve living conditions (107-8, 205-8, 300-12)

### Elaborations—Strategies for Learning and Teaching

Students should use a balance scale to determine the mass of an object. Students should determine that the total mass of an object equals the sum of the masses of its parts. Examples could be a banana in a bottle or a pencil case with various pens, pencils, and erasers in it. Alternatively, a piece of a material, like cardboard or fabric, might be cut into pieces. The sum of the masses of the pieces should come relatively close to the mass of the total object but may vary slightly due to errors balancing the scale or taking inaccurate readings. Teachers might pose the questions What happens when we burn a piece of paper? What happens to its chemical and physical characteristics? and Can we measure changes in mass? Accuracy is very important in doing this activity. Students should take care to measure as accurately as they can. 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 (the law of the conservation of mass).

Students will investigate a variety of manufactured materials produced to improve living conditions. Students should focus on what these manufactured materials are made of (composition) and how they have been processed.

Students should do research on materials in daily life. These could include nylon, synthetic rubber, latex, Gore-Tex, and household barrier wrap.

**Caution: Be aware of any allergies to latex!**

Care must be taken that students do not get into the technical details of manufacturing to the extent that they are simply writing words from an encyclopedia. It is enough to determine the raw material from which an object has been made, and then to have a general understanding of the processing involved. Students can look at various ores that contain common metals and understand that if the metal is present in its pure, elemental form (gold, for example), the separation of the metal from the rock is largely a physical one. In most cases, the metal is in the ore as a compound and must undergo chemical reactions to turn it into a pure metal.

Students may want to try to process some raw materials themselves. They may, for example, want to make their own paper. People from the community could be invited to show how wool from a sheep is spun. Students can take field trips to sawmills, oil refineries, or any manufacturing company. Videos or other electronic media can 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*

- Weigh each of the objects listed, and complete a table of the results. (104-5, 205-3, 300-11)

*Journal*

- How are these materials important? What did you learn about materials and their physical and chemical changes? (107-8, 205-8, 300-12)

*Paper and Pencil*

- Indicate whether the following objects are natural or manufactured: paper, glass, a nylon tent, an orange, car tires, bricks, a cotton shirt, a boulder, and a chair. 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)

*Presentation*

- Research a product to find out which raw materials it was made from and how the raw materials were processed to make the final product. (107-8, 205-8, 300-12)
- Make a display of materials and what they are made of. (107-8, 205-8, 300-12)

### Resources/Notes

*Activities from Appendix H*

- Activity 52: Mass of Objects
- Activity 53: Mass of the Parts of Objects
- Activity 54: What Are Materials Made Of?

*Print*

- *Science and Technology 5*, Changes in Matter, Teacher's Guide, pp. 35–46

*Video*

- *Properties of Matter* (23333)

*Curriculum Link*

- Math, GCO D

# Appendices

# Appendix A: Equipment Lists

## School Materials

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

| | Weather | Forces and Simple Machines | Basic Needs and Healthy Body | Properties and Changes |
|---|---|---|---|---|
| **Supply List** | | | | |
| anemometer | X | | | |
| balances | | | | X |
| balls, (Ping-Pong) | X | | | |
| barometer | X | | | |
| bowls, plastic | | | X | X |
| cake pan, shallow | X | | | |
| cars or toys with wheels | | X | | |
| computers (with Internet access) | X | X | X | X |
| dowels | | X | | X |
| elastic bands | X | X | | |
| fans | | X | | |
| *Farmer's Almanac* | X | | | |
| feathers | | X | | |
| garbage bags | | | | X |
| gauze | X | | | |
| hooks (U, to screw in wood) | | X | | |
| hygrometer | X | | | |
| index cards | | | X | |
| kettle | X | | | X |
| knife, butter | | | | X |
| lamp(s) | X | | | |
| LCD projector | | | X | |

| | Weather | Forces and Simple Machines | Basic Needs and Healthy Body | Properties and Changes |
|---|---|---|---|---|
| magnets | | X | | |
| magnifiers, hand-held | | | | X |
| masses | | | | X |
| measuring cups | | | | X |
| measuring tapes | | | X | |
| metre sticks | | | X | |
| microscopes | | | | X |
| newton scales | | X | | |
| paper clips | | X | | |
| pulley, triple (optional) | | X | | |
| pulleys, single and double | | X | | |
| rain gauge | X | | | |
| ramps (from Science Primary and Science 2) | | X | | |
| ropes, thick and thin | | X | X | |
| sand | | X | | X |
| sandpaper | | X | | |
| screws | | X | | |
| string, heavy-duty | | X | | |
| string, thin | X | | | |
| syringes, plastic | | | | X |
| tape, clear | X | X | | |
| thermometers | X | | | |
| thread | X | | | X |
| toy vehicles with moving wheels | | X | | |
| wedge (to act as a fulcrum) | | X | | |
| wooden blocks (from Science Primary and Science 2) | | X | | X |

## Classroom Supplies

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

| | Weather | Forces and Simple Machines | Basic Needs and Healthy Body | Properties and Changes |
|---|---|---|---|---|
| **Supply List** | | | | |
| books and magazines | X | X | X | X |
| chart paper | | | X | |
| coloured pencils | X | X | | |
| crayons | X | X | | |
| desks | | X | | |
| glue | X | X | | |
| graph paper | | | X | |
| hole punch | X | | | |
| markers | X | | X | |
| metric rulers | X | X | | |
| modelling clay | | | X | X |
| pencils | X | X | | X |
| pictures of cloud formations | X | | | |
| protractors | X | X | | |
| push-pins | X | | | |
| scissors | X | X | | |
| **Consumables** | | | | |
| aluminum foil | | X | | X |
| baking powder | | | | X |
| baking soda | | | | X |
| balloons | X | | X | X |
| candles (votive) | | | | X |
| corn syrup | | | | X |
| cups (small, clear, and flexible) | X | | | X |
| diapers | | | | X |

| | Weather | Forces and Simple Machines | Basic Needs and Healthy Body | Properties and Changes |
|---|---|---|---|---|
| flour | | | | X |
| food colouring | | | | X |
| grass seed | X | | | |
| gum | | X | | |
| ice cubes | X | | | |
| jelly powder | | | | X |
| laundry detergent (with enzymes) | | | X | |
| matches | | | | X |
| molasses | | | | X |
| paper | X | X | | X |
| plaster of Paris | | | X | X |
| plastic spoons | | | | X |
| plastic wrap | X | | | |
| pop | | | | X |
| salt | | | | X |
| soap (bars, liquid, unscented) | | | | X |
| spools (thread) | | X | | X |
| straws | X | X | | |
| sugar | | | | X |
| tomatoes | | | X | |
| toothpicks | | | X | X |
| vinegar | | | | X |
| water | X | | X | X |

# Recyclables and Collectibles

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

| | Weather | Forces and Simple Machines | Basic Needs and Healthy Body | Properties and Changes |
|---|---|---|---|---|
| **Supply List** | | | | |
| aluminum plates (tart-size) | | | | X |
| board, 1" × 2" or 2" × 2" | | X | | |
| bricks | | X | | |
| cardboard | | | | X |
| cereal boxes | X | | | |
| cloth | | X | | |
| containers (plastic) | | | | X |
| cotton cloth | | | X | |
| jars | X | | | X |
| milk cartons, 1 L | X | | | |
| milk cartons, 2 L | X | X | | |
| newspaper | X | | X | |
| paper-towel rolls | | | X | |
| pill bottles (transparent) | | | | X |
| plastic lids | | | | X |
| plastic tubs, 1 L | X | | | |
| pop bottles (plastic 500 mL) | | | | X |
| pop bottles (plastic 750 mL) | X | | | |
| shoelaces | X | | | |
| soil | X | | | |
| wood (1" x 3" strapping, 1 m in length) | | | | X |
| wood (pieces or splints) | | | | X |

# Appendix B: Video Resources

## Education Media Library

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

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

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

| Title | Description |
|---|---|
| **Earth and Space Science: Weather** | |
| *Air: Climate*<br>(Transit: Across Canada Series)<br>(23340)<br>20 min., 2000 | When it comes to weather and climate, Canada has it all. This program takes students on a tour of the regions and seasons, illustrating extreme weather and climate. |
| *Air: Pollution and Solutions*<br>(V2447)<br>15 min., 2000 | The air is one of our greatest natural resources. It is oxygen gas that helps our bodies to work and grow. Atmosphere, as part of the weather, is a factor that contributes to human survival. This program takes a look at global warming and pollution. |
| *Atmosphere: On the Air*<br>(21424)<br>23 min., 1993 | Students observe wind, clouds, and precipitation to see how the atmosphere acts as a shield to protect us. This video discusses what can be done to keep the atmosphere healthy. |
| *Clouds, Weather and Life*<br>(23522)<br>25 min., 1999 | This video is for use as an introduction to hydrology, or the water cycle, and cloud identification. The program explains five scientific concepts of weather: the hydrologic cycle; life is dependent upon this cycle; the sun is the causative agent that powers the formation of clouds and the water cycle; the three states of water (gas, liquid, and solid); and weather is changeable in time and place. Includes a brief teachers' guide. |
| *Cyclone!*<br>(21636)<br>60 min., 1995 | National Geographic chronicles some of the world's most shocking storms—twisters, typhoons, and hurricanes. |
| *Greenhouse Warming*<br>(21340)<br>16 min., 1991 | This video looks at what is meant by global warming, at what contributes to global warming, and how it can be controlled and minimized. |
| *Hurricane: Earth's Greatest Storm*<br>(22251)<br>20 min., 1991 | Witness the incredible energy unleashed by one of nature's most dramatic weather systems, the hurricane. |
| *Precipitation and Prevailing Winds*<br>(23511)<br>15 min., 1998 | Water and ice cover three quarters of the Earth's surface, and water is continually being recycled. This program looks at the formation of clouds and winds and the cause of precipitation. |
| *Telling the Weather*<br>(23167)<br>25 min., 1996 | This National Geographic video introduces students to basic weather facts including the causes and effects of cold and warm fronts, the three types of clouds, the formation of a tornado, and the origin of lightning. |

| Title | Description |
|---|---|
| *The Air Around Us*<br>(23516)<br>20 min., 1996 | This program describes and defines atmosphere, climate, the role of the sun, the composition of the air, the greenhouse effect, and the effects of human activity. |
| *Why Are Hurricanes Seasonal?*<br>(Inquiring Minds Series)<br>(22938)<br>6 min., 1996 | This short program explores why hurricanes strike only in late summer or early fall, what a hurricane is, why it is the most destructive natural force on Earth, and even how to make a hurricane in the kitchen. |
| **Physical Science: Forces and Simple Machines** | |
| *Discovering Simple Machines: Compound Machines*<br>(V2508)<br>13 min., 2001 | This video shows how six simple machines can be found in very complicated machines and equipment. |
| *Force* (V7487)<br>*Gravity and Friction* (V7488)<br>*Pressure* (V7489)<br>*Simple Machines* (V7490)<br>(Forceful Follies Series)<br>15 min. each, 1979 | This is a series of separate films in which amusing skits are used to illustrate the principles of physics. |
| *Force and Newton's Laws*<br>(Motion, Energy and Force Series)<br>(23110)<br>20 min., 2000 | Live-action footage illustrates the principle of force and the application of Newton's Three Laws of Motion. |
| *Physical Science 2*<br>(Bill Nye, The Science Guy)<br>(21651)<br>36 min., 1994 | Bill Nye provides demonstrations of various physical-science principles. Experiments include sections on simple machines and gravity. |
| *Simple Machines*<br>(Motion, Energy and Force Series)<br>(23112)<br>20 min., 2000 | Students will learn how we use simple machines every day and how to calculate work and power. |
| *Simple Machines and Motion*<br>(Science Essentials Series)<br>(22647)<br>28 min., 1990 | This program contains four segments—What makes things move? What is an inclined plane? What is a lever? and What is a pulley? |

| Title | Description |
|---|---|
| *Simple Machines: A First Look*<br>(23372)<br>17 min., 2001 | All machines are based on six different kinds of simple machines: lever, wedge, inclined plane, screw, wheel and axle, and pulley. The program shows students performing a wide variety of experiments with simple machines. |
| **Life Science: Meeting Basic Needs and Maintaining a Healthy Body** | |
| *Cells and Systems*<br>(20954)<br>20 min., 1989 | The blood system transports oxygen and other vital materials to cells in the human body. This program describes how cells can be both useful and harmful to humans. |
| *Fitness and Sport*<br>(20951)<br>20 min., 1986 | This program takes a look at the relationship among fitness, sport, and health and how different kinds of activity affect the body. Heart rate, temperature, blood pressure, and breathing rates are examined. |
| *Immune System*<br>(21944)<br>20 min., 1989 | This animated video shows the body's natural defence system working together to identify and destroy any invader that is not part of the human body. It also explores recommendations for good health. |
| *Microbeasts and Disease*<br>(20935)<br>20 min., 1986 | This program tells the story of Jenner and his work with the smallpox vaccination and then explores how some microscopic organisms multiply and make us ill. |
| *Skeleton Exhibit Video*<br>(V1742)<br>4 min., 1995 | This program is a series of three-mimed vignettes designed to demonstrate the function of the skeleton. |
| *The Human Body*<br>(Bill Nye, The Science Guy)<br>(21648)<br>36 min., 1994 | This program explores fascinating facts about the human body, taking a look at cells, blood and circulation, and digestion. |
| *Why Does Getting Sick Always Give You the Same Symptoms?*<br>(Inquiring Minds Series)<br>(22934)<br>8 min., 1996 | This short film explores how a cold or flu virus works and its effect on your body. |

| Title | Description |
|---|---|
| **Physical Science: Properties of and Changes in Materials** | |
| *Changes in Matter*<br>(V2445)<br>18 min., 1999 | This program examines the various changes in matter. Through everyday examples, students will see how they are affected by the changes in matter and will understand that matter is changing all around them. |
| *Chemical Reactions: Phases of Matter*<br>(Bill Nye, The Science Guy)<br>(23117)<br>50 min., 1998 | This program has two segments of 25 minutes each in which Bill Nye demonstrates that matter exists in three phases: solids, liquids, and gases. |
| *Learning about Liquids, Solids, and Gases*<br>(22261)<br>11 min., 1975 | This program establishes the similarities and differences among the three forms of matter. |
| *Physical Science 1*<br>(Bill Nye, The Science Guy)<br>(21650)<br>36 min., 1994 | Bill Nye uses experiments to demonstrate basic physical-science principles, one segment looking at the phases of matter. |
| *Properties of Matter*<br>(23333)<br>20 min., 2003 | Students will learn that our entire world is made of matter, including things that we don't see. Students also identify that matter has mass, takes up space, and exists in different states. |
| *Solid, Liquid, Gas*<br>(23063)<br>15 min., 1986 | This National Geographic video introduces students to the three forms of matter and illustrates basic concepts about their properties as children experiment with everyday materials. |

# Appendix C: Performance Assessment

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

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

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

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

## Performance Assessment Rubric

| **Name:** | **Date:** |
|---|---|
| **Activity:** | |

**Problem Comprehension**

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

**Co-operative Learning**

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

**Problem Solving**

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

**Equipment Use**

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

**Communication of Results**

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

# Appendix D: Journals and Logbooks

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

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

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

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

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

## Journal Comment Rubric

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

## Journal Scoring Rubric

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

# Appendices E–H

## Introduction

In the following four appendices (E–H), you will find activities you may wish to use or modify to support student achievement of specific curriculum outcomes for Science 5. These activities are referenced under column four, Resources/Notes, in each unit on the two-page spreads and are meant to add to other hands-on learning experiences that you may provide to address curriculum outcomes.

You may also find well-written, easy-to-follow activities and curriculum links to science in the print resources in, or available to, schools through the Nova Scotia School Book Bureau. (See Appendix I.)

# Appendix E: Activities for Earth and Space Science: Weather

## Activity 1: Weather Folklore

### Outcome

*Students will be expected to*

- identify and use weather-related folklore to predict weather (105-2)

### Assessment

- Students are able to do research to gain an understanding of the types of folklore related to weather.
- Students show an understanding of the term **weather folklore**.
- Students are able to give presentations to their peers on the types of local and international folklore related to weather folklore.

### Questions

- What does the term **weather folklore** mean?
- How does weather folklore impact how/when farmers plant their crops?

### Materials

- books on weather folklore
- computers with Internet access
- *Farmer's Almanac*

### Procedure

Discuss with the students what they think the term **weather folklore** means. From their input, develop a working definition of the term. Discuss with the students any weather folklore they may have heard of from their parents and/or their grandparents or other relatives. Have students use the Internet to do research as it relates to this topic. Prior to starting this activity, suitable websites should be found by the teachers. Using a search engine, type in "weather folklore" and review the sites. This activity can be introduced in a science class and continued as part of the language arts program.

**Teacher Note:** If you type "weather folklore" under "search" in Internet Explorer, it will list several good websites for students to view. The individual sites can be bookmarked prior to students accessing them or the sites can be saved as a text file so that students may have access to them. The initial part of this activity can be done in two half-hour sessions in a computer lab. The actual write-ups and illustrations can be done over a period of time (e.g., when time is left in a science class after making one of the weather instruments).

# Activity 2: Recording the Data

## Outcome

*Students will be expected to*

- using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)

## Assessment

- Students are able to record, on a consistent basis, various weather patterns and data by using their weather instruments.
- Students are able to analyse their data to gain an understanding of the information they have collected.

## Questions

- How do we use weather data in our daily lives?
- How do scientists use weather data?
- What type of weather data do we most commonly use?

## Materials

- Activity 2: Recording the Data, My Investigations

## Procedure

The activity sheet on the next page has been designed for students to use when recording the data they collect from the various weather instruments they construct. This activity sheet can be used as either a black-line master or a guide to have students make their own data record in their science journals/scribblers. After the data have been collected over a period of time, patterns and events that took place or were cancelled should be discussed.

## Activity 2: Recording the Data, My Investigations

| Type of Day (sunny, cloudy, etc.) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | | | | | | | | | | | | |
| Air Pressure | | | | | | | | | | | | |
| Wind Speed | | | | | | | | | | | | |
| Humidity | | | | | | | | | | | | |
| Amount of Rain | | | | | | | | | | | | |
| Time of Day | | | | | | | | | | | | |
| Date | | | | | | | | | | | | |

# Activity 3: My Rain Gauge

## Outcome

*Students will be expected to*

- using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)

## Assessment

- Students are able to make a rain gauge and record the amount of rain over a given period.
- Students are able to measure the amount of rain over a given period.

## Questions

- What is a rain gauge and what does it do?
- How does measuring the amount of rain help scientists and farmers?

## Materials

- clear jar
- metric ruler (with millimetres)

## Procedure

This is the first of several learning experiences designed to help students understand the use of various weather instruments. A daily weather chart is provided in Activity 2: Recording the Data. Students should be able to fill in each section as they construct and use their weather instruments. These activities should be done with students working in groups.

On a day when it is going to rain, have students place a clear jar outside in an open area and put a metric ruler in it. After the rain has ended, have the students measure, in millimetres, the amount of rain in the jar. Have them record their findings. Students should do this activity over a period of time and calculate the average rainfall. This could be compared to the local weather forecast results.

Class discussions could take place on the importance of precipitation and what the results are when there is too much or too little precipitation.

# Activity 4: My Anemometer

## Outcome

*Students will be expected to*

- using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)

## Assessment

- Students are able to construct and use an anemometer to measure wind speed.
- Students are able to explain the importance of knowing the wind speed as it relates to weather.

## Questions

- What is an anemometer?
- What is an anemometer used for?
- How does knowing the wind speed help scientists understand weather patterns?

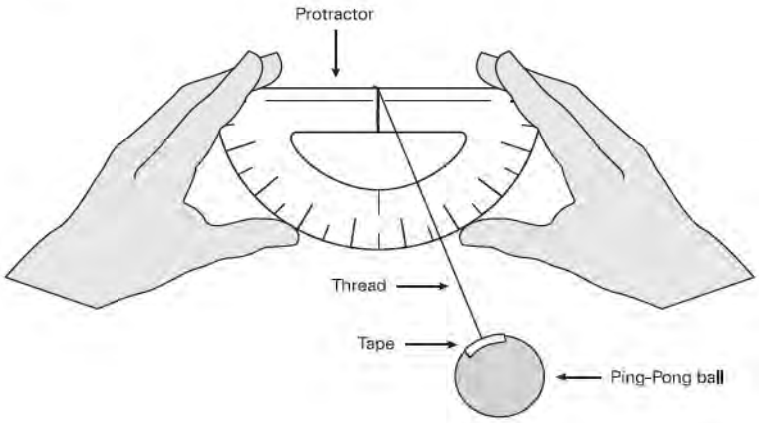
## Materials

- Ping-Pong ball
- protractor
- scissors
- tape
- thread

## Procedure

An anemometer is used to measure the speed of the wind. There are several different devices that students can construct to measure wind speed. The following is an example of one.

Cut 30 centimetres of strong thread and attach one end to a protractor as indicated below. Attach a Ping-Pong ball to the other end of the thread.



Your anemometer is now ready to use. Take it outdoors in an open area where the wind is blowing. Point the flat edge of the protractor into the wind, holding it away from your body.

Look at the number of degrees that the thread is blowing at on the protractor. Create a wind-speed table. Using this table, determine the speed of the wind.

# Activity 5: My Barometer

## Outcome

*Students will be expected to*

- using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)

## Assessment

- Students are able to construct and use a barometer to measure air pressure.
- Students are able to explain the importance of knowing the air pressure as it relates to weather.

## Questions

- What is a barometer?
- What is a barometer used for?
- How does knowing the air pressure help scientists understand weather patterns?

## Materials

- balloons or plastic wrap
- box (cereal, shoe) or milk carton
- elastic bands
- glass jar (wide mouth) or coffee can
- metric ruler
- paper
- scissors
- straws
- tape

## Procedure

Materials should be collected prior to beginning this learning experience.

Have the students stretch a cut balloon or plastic wrap over the mouth of the jar or coffee can and put an elastic band over its mouth to hold the balloon or plastic wrap in place. Have students cut one end of a straw into a point and tape or glue the uncut end to the middle of the balloon or plastic wrap. Have students glue a piece of plain white paper to the front of the box and tape a ruler to the middle of it.

Have the students take their barometers outdoors and observe what happens to the straw in relation to the ruler. A change should take place over time.

Students should record their findings and check the local weather forecast to see if the two are the same.

**Teacher Note:** Barometers are used to track air pressure. When the straw is straight, the air pressure is normal. When the straw rises, the air pressure is increasing or high (which means there will be fair weather). When the straw moves down, the pressure is dropping (which means stormy weather is on the way). Students should record their findings on the daily weather chart, Activity 2: Recording the Data, My Investigations.

# Activity 6: My Hygrometer

## Outcomes

*Students will be expected to*

- using correct names of weather instruments, construct and use instruments to record temperature, wind speed, wind direction, and precipitation (104-7, 204-8, 205-4, 205-10, 205-7, 300-13)

## Assessment

- Students are able to explain and demonstrate the use of a hygrometer to measure the humidity in the air.
- Students are able to explain how scientists use their understanding of humidity to benefit society.
- Students are able to explain the importance of understanding humidity and its impact on their daily lives (e.g., moisture in the home).

## Questions

- What is a hygrometer?
- What does a hygrometer do?
- Where are hygrometers used?
- How do we use an understanding of humidity in our daily lives?

## Materials

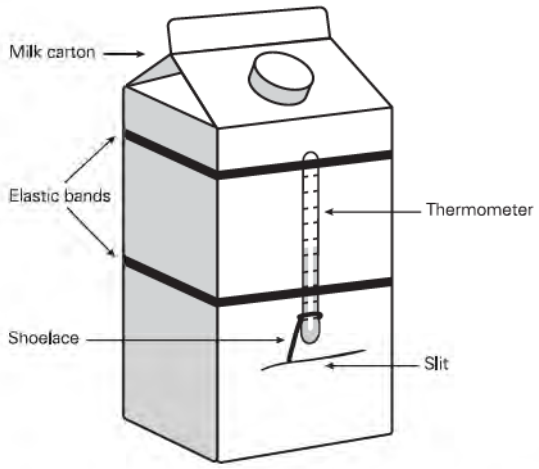
- clear tape
- elastic bands
- 1 L milk cartons
- scissors
- shoelaces or gauze
- thermometers (two per hygrometer)
- water

## Procedure

Each group of students will need a milk carton, a shoelace or gauze, two thermometers, and elastic bands.

Have the students cut a three–four-centimetre horizontal slit in the milk carton five centimetres from the bottom.

Students should then tie one end of the shoelace around the bottom of a thermometer and push the other end through the slit in the milk carton.




Students should secure the thermometers against the milk carton, using two elastic bands. (The thermometers should be on any two sides of the milk carton.)

Students should then pour water into the milk carton until it reaches the bottom of the slit.

Have the students take their hygrometer outdoors and take the temperature of the air, using the thermometer that is not attached to the shoelace (dry bulb). They should then take the temperature of the thermometer with the shoelace or gauze attached to it (wet bulb).

**Teacher Note:** To determine the relative humidity, students should subtract the reading of the wet bulb from that of the dry bulb and record their answer. Using a relative-humidity chart, they should be able to find the relative humidity. Students should check the local weather forecast to see how accurate their hygrometer is. Measurements should be recorded over a period of time. Discussions could take place regarding the impact of humidity on people and their homes.

Students should research a relative-humidity chart. This chart should indicate the temperature in Celsius and the relative humidity in percent. To determine the relative humidity, students must find the difference between the wet and dry thermometers and locate it on the chart. This will be the relative humidity.

# Activity 7: Classifying Clouds

## Outcome

*Students will be expected to*

- identify, classify, and compare clouds (104-4, 206-1)

## Assessment

- Students are able to distinguish between the various cloud formations indicated in the outcome.
- Students are able to explain how various cloud formations help in predicting the type of weather associated with them.

## Questions

- What does a stratus cloud formation look like?
- What does a cumulus cloud formation look like?
- What does a cirrus cloud formation look like?
- How do the various cloud formations help to indicate impending weather?

## Materials

- Activity 7: Classifying Clouds, My Investigations (optional)
- books on clouds
- computers with Internet access
- pictures of stratus, cumulus, and cirrus cloud formations

## Procedure

Discuss with students what they know about clouds. Using the Internet, look up "types of clouds" and bookmark appropriate sites for students to use. Have students research the various types of clouds and chart them over a given period of time. Have students predict the type of weather that will occur with the various cloud formations.

## Activity 7: Classifying Clouds, My Investigations

| Date | Time of Day | Type of Clouds and Illustration |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

# Activity 8: Technology Innovations and Products

## Outcome

*Students will be expected to*

- using a variety of sources, gather information to describe the key features of weather systems and identify weather-related technological innovations and products that have been developed by cultures in response to weather conditions (107-14, 205-8, 302-11)

## Assessment

- Students are able to carry out research to discover the types of devices that have been produced to protect inhabitants of our world from various weather systems.
- Students are able to present their findings in a form that is informative to the rest of the class.
- Students are able to show how science and technology work together to develop weather-related devices.

## Questions

- What innovations have been developed to protect homes from various types of weather conditions?
- What types of clothing have been developed to protect us from various weather conditions?
- How have various innovations helped us to cope with the various weather conditions where we live?

## Materials

- books
- computers with Internet access
- pictures and advertisements from magazines

## Procedure

Have students, in groups, discuss each of the questions. Have them write down their ideas. Have each group share their ideas with the class. Record their responses on the board or chart paper. Have students divide a page in their science journal into three equal sections and write one question in each section. Then have the students choose one of the discussion responses for each question, write it down, and illustrate it.

# Activity 9: Tools of the Trade

## Outcome

*Students will be expected to*

- using a variety of sources, gather information to describe the key features of weather systems and identify weather-related technological innovations and products that have been developed by cultures in response to weather conditions (107-14, 205-8, 302-11)

## Assessment

- Students are able to show an understanding of the tools and techniques used for weather forecasts.
- Students are able to show an understanding of the use of satellite images and weather maps in predicting weather patterns.

## Questions

- How are satellite images used in analysing and predicting weather patterns?
- How are weather maps used?
- How did your weather instruments' reliability compare to that of the actual instruments used to measure various weather conditions?

## Materials

- computers with Internet access
- various weather instruments such as a barometer, hygrometer, and thermometer

## Procedure

If possible, arrange a field trip to a local weather station and/or have a meteorologist visit the classroom. Prior to students looking at radar images on the computer, the teacher should investigate appropriate sites for students to view. Weather maps could be obtained from Environment Canada and analysed by the students. Actual weather instruments could be purchased for use within the school.

# Activity 10: Weather Predictions

## Outcome

*Students will be expected to*

- using a variety of sources, gather information to describe the key features of weather systems and identify weather-related technological innovations and products that have been developed by cultures in response to weather conditions (107-14, 205-8, 302-11)

## Assessment

- Students are able to use the data they have collected over a period of time to graph various weather conditions (e.g., temperature, humidity, wind speed).
- Students are able to use the software program Microsoft Excel to design graphs showing various weather conditions over a period of time.
- Through the analysis of data, students are able to begin to predict weather conditions.

## Questions

- What type of graph(s) could be used to plot temperature, humidity, and wind speed over a period of time?
- How would analysing data on weather conditions help to predict weather patterns?

## Materials

- access to computers with Microsoft Excel
- weather data (collected from previous activities)

## Procedure

Students have been collecting data by using the weather instruments they constructed. These data should now be analysed, and discussions should take place regarding how scientists predict weather conditions. Students should develop graphs in order to begin to predict weather patterns. Discussions should take place regarding the type of graphs that should be used. Microsoft Excel could be used, or students can make their own graphs without using computer software.

Have students design a weather forecast and present it to the class.

# Activity 11: Temperature Change of Soil

## Outcome

*Students will be expected to*

- relate the transfer of energy from the sun to weather and discuss the sun's impact on soil and water (206-5, 303-21)

## Assessment

- Students are able to observe, through touch and by using appropriate measuring instruments, what happens to the temperature of soil when it is exposed to heat or the sun over a period of time.
- Students are able to chart their results to show the change in temperature.
- Students are able to compare and record the temperature of soil in different locations (e.g., shade, direct sun, under a lamp).

## Questions

- How would you measure the temperature of the soil?
- What instrument(s) would you use?
- How does the energy from the sun impact the temperature of the soil?
- What happens to the temperature of the soil when a lamp is shone over it for a period of time?

## Materials

- Activity 11: Temperature Change of Soil, My Investigations (optional)
- containers to hold soil
- lamps
- soil
- thermometers

## Procedure

In this activity, students can either go outside at different times of the day or have soil samples inside, using artificial sunlight (a lamp or light bulb). Students should be careful when using the thermometers (possible breakage of the glass). Have students measure the temperature of soil at various locations and note the time of day and the type of weather condition (e.g., cloudy, sunny, hot). Discussions should take place on how the temperature of the soil impacts the climate. Discussions might also be on the relationship of the temperature of soil and when farmers plant their crops.

## Activity 11: Temperature Change of Soil, My Investigations

### Comparing Air and Soil Temperatures

| Date | Time of Day | Location of the Soil | Air Temperature | Soil Temperature |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
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| | | | | |

Illustration of taking the temperature of the soil:

What impact did the air temperature have on the temperature of the soil?

Was the soil temperature different in different areas? If so, what might be the reason for this?

# Activity 12: Temperature Change of Water

## Outcome

*Students will be expected to*

- relate the transfer of energy from the sun to weather and discuss the sun's impact on soil and water (206-5, 303-21)

## Assessment

- Students are able to observe, through touch and by using appropriate measuring instruments, what happens to the temperature of water when it is exposed to heat or the sun over a period of time.
- Students are able to chart their results to show the change in temperature.
- Students are able to compare and record the temperature of water in different locations (e.g., shade, direct sun, under a lamp).

## Questions

- How would you measure the temperature of the water?
- What instrument(s) would you use?
- How does the energy from the sun impact the temperature of the water?
- What happens to the temperature of the water when a lamp is shone over it for a period of time?

## Materials

- Activity 12: Temperature Change of Water, My Investigations (optional)
- containers to hold water
- lamps
- thermometers
- water

## Procedure

In this activity, students can either go outside at different times of the day or have water samples inside, using artificial sunlight (a lamp or light bulb). Students should be careful when using the thermometers (possible breakage of the glass). Have students measure the temperature of water at various locations and note the time of day and the type of weather condition (e.g., cloudy, sunny, hot). Discussions should take place on how the temperature of the water impacts the climate.

If you are in an area where soil or water is not easily accessible, outdoor samples could be put in one-litre plastic containers and left in various areas for students to measure the temperature.

## Activity 12: Temperature Change of Water, My Investigations

### Comparing Air and Water Temperatures

| Date | Time of Day | Location of the Water Sample | Air Temperature | Water Temperature |
|---|---|---|---|---|
| | | | | |
| | | | | |
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Illustration of taking the temperature of the water:

What impact did the air temperature and sun have on the temperature of the water?

Was the water temperature different in different areas? If so, what might be the reason for this?

## Temperature of Soil and Water

### Soil

| Location | Soil Temperature | Air Temperature |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

### Water

| Location | Water Temperature | Air Temperature |
|---|---|---|
| | | |
| | | |
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# Activity 13: The Sun's Energy

## Outcome

*Students will be expected to*

- relate the transfer of energy from the sun to weather and discuss the sun's impact on soil and water (206-5, 303-21)

## Assessment

- Students are able to explain how the sun's energy has an impact on weather conditions.
- Students are able to relate the sun's energy to their daily activities and the type of clothing they wear.

## Questions

- What role does the sun play in determining various weather conditions?
- How does the sun impact how we dress when we are going outside?
- How does the sun help to warm or cool the land/atmosphere around us?

## Materials

- None

## Procedure

In this activity, students will rely on their prior knowledge and experiences in discussing the sun's energy and its impact on the land and society. Students can produce scenes or demonstrate their discussions through illustrations and/or writing.

# Activity 14: Effects of Temperature on Air

## Outcome

*Students will be expected to*

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

## Assessment

- Students are able to observe what happens to air when it is cooled and heated.
- Students are able to relate their observations of what happens to weather conditions when cold and warm air meet.

## Questions

- What happened to the air when it was heated?
- What happened to the air when it was cooled?
- How does the warming and cooling of air have an impact on weather conditions?

## Materials

- balloons
- ice cubes
- 1 L plastic tubs
- pop bottles
- warm and cold water

## Procedure

This can be either a teacher-directed activity or a student-based one. Discuss with students what they think will happen when the air in a balloon is heated and cooled. Place the balloon over the neck of the bottle. Place the bottle in warm water. Have the students observe and record what happens. The balloon and bottle could also be put on a sunny window ledge and observed over a period of time. Have the students place the bottle and balloon in cold water and record their observations. Discuss with students the cooling and warming of air as it relates to weather conditions.

# Activity 15: The Water Cycle

## Outcome

*Students will be expected to*

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

## Assessment

- Students are able to, through experiments and observations, show an understanding of the water cycle.
- Students are able to record the results of their experiments in making a water cycle.
- Students are able to relate the knowledge they gained from their experiments to that of the water cycle of the Earth.

## Questions

- What do we mean by the term **water cycle**?
- How is the Earth able to keep the water supply replenished?
- How does the temperature of the air and water impact the water cycle?

## Materials

- Activity 15: The Water Cycle, My Investigations
- elastic bands
- grass seed
- ice cubes
- kettle
- plastic wrap
- pop bottles or clear plastic cups
- shallow cake pan
- soil

## Procedure

In this activity, students can be given a variety of ways to produce condensation in their own environment. From these experiments, discussions should take place on the bigger picture of the Earth's water cycle.

Several weeks prior to this activity, have students plant grass seed in a cut-off two-litre clear pop bottle or in a clear plastic cup. Have them water the grass and cover the bottle or cup with plastic wrap. They can use an elastic band to hold the plastic wrap on the bottle or cup. Have the students put the container in a window that receives direct sunlight. Students should record their observations over several days. Water droplets should form on the plastic wrap and fall back down on the grass.

Put warm water in the bottom of a cut-off two-litre clear pop bottle or a clear plastic cup (about half full). Cover the container with plastic wrap and hold the plastic wrap held in place with an elastic band. Place the container on a window ledge that receives direct sunlight. Students should record their observations.

Put a shallow cake pan between two chairs, so the chairs hold the cake pan up. Put ice cubes in the cake pan. Place a kettle under the pan. As the water heats up in the kettle, have students observe what happens. Condensation will form on the bottom of the pan, and it will start to "rain."

Discussions should take place on how these experiments relate to the Earth's water cycle.

## Activity 15: The Water Cycle, My Investigations

Diagram of the container before it was placed in the window:

Diagram of the container after it had been placed in the window:

### The Water Cycle

| Day | Observations |
|---|---|
| | |
| | |
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| | |
| | |

# Activity 16: Changes in Weather

## Outcomes

*Students will be expected to*

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

## Assessment

- Students are able to show an understanding of weather conditions that have had an impact on their lives and those of others.
- Students are able to discuss and show an understanding of, through research and presentations, how pollution and man-made products have had an impact on weather conditions.
- Students are able to develop strategies to help reduce the amount of airborne pollutants.

## Questions

- What is meant by the term **pollution**?
- What are greenhouse gases?
- How has the depletion of the ozone layer affected our lives and those of others?
- How are governments and scientists working to develop better air quality?

## Materials

- books
- computers with Internet access
- newspapers

## Procedure

Students can be given a variety of topics to choose from to do research on either in groups or individually. Materials should be made available for students to use and in language that they will understand. Students should be given the option as to how they want to make their presentations to the class. Newscasts, weather reports, scenes, and PowerPoint presentations are a few examples. Suggested topics could be tsunamis, tornadoes, floods, acid rain, greenhouse gases, global warming, the importance of the ozone layer, and policies and legislation that are in place to curb pollution. Students should be given the opportunity to do their research in school, either as part of the science class or integrated into the language arts program.

# Appendix F: Activities for Physical Science: Forces and Simple Machines

## Activity 17: What Do I Know?

### Launching the Unit

The purpose of this activity is to have students articulate any prior knowledge they have about forces and simple machines and what they would like to learn about them.

### Outcomes

*Students will be expected to*

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

### Assessment

- Students will fill in a chart to explain what they know and want to learn about forces and simple machines.

### Questions

- What do you know about forces and simple machines?
- What would you like to learn about these topics?

### Materials

- Activity 17: What Do I Know?, My Investigations
- thick rope

### Procedure

This learning experience is designed to be an introduction to the unit on forces and simple machines.

**Part 1:** Discuss with the class that they are going to begin a new unit called Forces and Simple Machines. Have students fill in columns one and two of the chart (Activity 17). As a class, make a class chart for display throughout the unit. Indicate to the students that they will fill in the third column after they have completed the unit.

**Part 2:** Divide the students into two groups. Using a "tug-of-war" rope, have one group try to pull the other group past a centre line. If you are able to have two different surfaces, this would be ideal (e.g., one half of the group on a hardwood floor and the other half on tile or terrazzo flooring, or one group on asphalt and the other group on grass). Have them switch surfaces. Discuss, as a class, what they observed. Words such as **force**, **friction**, **push**, and **pull** may be used by the students. Begin a word wall for words that students will use in this unit.

## Activity 17: What Do I Know?, My Investigations

| What I Know | What I Want to Learn | What I Learned |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# Activity 18: To Move an Object or Not

## Outcome

*Students will be expected to*

- observe, investigate, and describe how forces can act directly (contact) or from a distance (non-contact) to move or hold objects in place (303-12, 303-13)

## Assessment

- Students will demonstrate how forces hold or move an object.
- Students are able to record and explain the results of their observations.

## Questions

- What types of forces do we use to move objects?
- How do the forces cause an object to move or not move?
- How were you able to stop a force from moving an object?

## Materials

- a variety of items to move and items to move them, such as magnets, paper clips, books, paper, pencils, and fans
- Activity 18: To Move an Object or Not, My Investigations

## Procedure

In this learning experience, students will explore forces and how they are able to move objects. Give students, in groups, a variety of materials and ask them to find ways to move them. For example, a paper clip can be moved by using a magnet, by blowing on it, by pushing it, or by lifting it up. Have the students fill in the activity sheet or design a method to record their results. Discuss with the students what they found out. Have students design ways in which forces on an object will not allow it to move. (For example, paper will move when a fan is put by it, but if you put a book over it, it won't move.) Discuss the results as a class.

## Activity 18: To Move an Object or Not, My Investigations

| Object | Description of the Types of Forces Used to Move the Object | Ways in Which the Object Was Not Able to Be Moved by a Force |
|---|---|---|
| | | |
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# Activity 19: Contact/Non-Contact

## Outcome

*Students will be expected to*

- observe, investigate, and describe how forces can act directly (contact) or from a distance (non-contact) to move or hold objects in place (303-12, 303-13)

## Assessment

- Students are able to explain and demonstrate the difference between contact and non-contact as it relates to forces.

## Questions

- What does the term **contact** mean as it relates to forces?
- What does the term **non-contact** mean as it relates to forces?
- How are contact and non-contact forces used in the world around us?

## Materials

- a variety of items to move and items to move them, such as magnets, paper clips, books, paper, pencils, and fans
- Activity 19: Contact/Non-Contact, My Investigations

## Procedure

In this learning experience, students should look at the ways objects were moved in Activity 18: To Move an Object or Not. Have students use the activity sheet to decide whether the force was a contact force or a non-contact force. Discussions on the meaning of these terms should take place prior to the activity and then after the activity has been completed. Students should record a working definition/understanding of each term. Contact forces: wind, mechanical; non-contact forces: magnetism, gravity.

## Activity 19: Contact/Non-Contact, My Investigations

| Object | Description of the Types of Forces Used to Move the Object | Ways in Which the Object Was Not Able to Be Moved by a Force | Contact or Non-contact |
|---|---|---|---|
| | | | |
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# Activity 20: Force and Movement

## Outcome

*Students will be expected to*

- observe, investigate, and describe how forces can act directly (contact) or from a distance (non-contact) to move or hold objects in place (303-12, 303-13)

## Assessment

- Students are able to understand the term **force**.
- Students are able to demonstrate that when force is applied to an object, the object does not necessarily have to move.

## Questions

- When pushing on a wall, are you exerting a force?
- Does an object need to move in order for you to say force was applied to it?

## Materials

- books
- desks
- paper
- walls

## Procedure

This learning experience will give students the opportunity to discuss what the term **force** means. Students will be able to demonstrate force as a push or pull on an object. Have students discuss what they think the term **force** means. Put their ideas on the board. Have students push down on the top of their desk and ask them if they are applying force to it. Now have students lift a piece of paper or a book and ask them if force was required to move it. Finally, have students pull their desk toward them and ask them if force was needed to pull their desk. From these experiments, develop a working definition of force (e.g., force = a push or pull). An object does not have to move in order for us to show that force was applied to it.

# Activity 21: More or Less

## Outcome

*Students will be expected to*

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

## Assessment

- Students will demonstrate and describe the difference between more and less.
- Students will be able to demonstrate the effect of increasing or decreasing the amount of force.

## Questions

- What do the terms **more** and **less** mean as they relate to force?
- How are you able to increase the amount of force applied to an object?
- How are you able to decrease the amount of force applied to an object?
- What happens to an object when more force is applied to it?

## Materials

- elastic bands
- toy vehicles with moving wheels

## Procedure

**Part 1:** Give students an elastic band. Have them demonstrate how they can make the elastic band longer or shorter. After they have experimented with the elastic band, discuss, as a class, what happens when more force is applied to stretch the elastic. Have the students discuss what happens when less force is added to the elastic band (in relation to how far it will stretch). Have them record their results.

**Part 2:** Give each group of students a toy vehicle with moving wheels. Have them apply various amounts of force to see what effect the force has on the distance the toy vehicle (with moving wheels) travels. Have them record their observations. This would be a good opportunity to review a fair test. Discuss with the students if the distance the toy vehicle travels with one student is the same as that with another. If both students say they used the same force, are they able to measure the exact amount of force? Does this make it a fair test?

# Activity 22: Standard and Non-Standard Units

## Outcome

*Students will be expected to*

- perform experiments to describe the force needed to lift or pull a given load in standard and non-standard units (205-4, 205-5, 205-6)

## Assessment

- Students are able to predict and estimate the amount of force required to lift or pull an object.
- Students are able to use non-standard units to estimate the amount of force required to move an object.
- Students are able to use standard units to estimate the amount of force required to move an object.

## Questions

- How would you estimate the amount of force needed to move an object by using an elastic band?
- How would using a standard unit provide a more accurate measurement in finding the amount of force needed to move an object?

## Materials

- Activity 22: Standard and Non-Standard Units, My Investigations
- elastic bands
- newton scales
- various objects to lift and/or move

## Procedure

This learning experience is designed to help students take a closer look at forces and estimate how much force it takes to move an object. Students have gained an understanding of the terms **more** and **less** from Activity 21: More or Less. Students should be given a variety of objects and asked to estimate how much force it would take to move them. For example, the students can attach an elastic band to a stone/book/geometric solid. Have them estimate how far the elastic band will stretch before the object moves. Have them record their estimation on the activity sheet. The term **newton** could be introduced as the unit to measure force. By using newton scales, students can estimate how many newtons it would take to move an object (up, sideways, forward, backward). Have students share their estimations with the class. Then have them find the actual amount of force used to move the object. Have them record their results.

## Activity 22: Standard and Non-Standard Units

| Object | Estimated Stretch of the Elastic Band | Actual Distance the Elastic Band Stretched | Force, in Newtons, Required to Move/Lift the Object |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

How accurate was your measurement when using the elastic band?

How accurate was your measurement when using the newton scale to measure the force?

# Activity 23: Friction

## Outcome

*Students will be expected to*

- investigate and compare the effect of friction on the movement of objects over a variety of surfaces (204-1, 204-5, 303-15)

## Assessment

- Students are able to demonstrate what friction is.
- Students are able to demonstrate and explain how friction is important in their daily lives.

## Questions

- What is friction?
- How does friction help us, as individuals, to be safe?
- How is friction harmful to us as individuals?

## Materials

- None

## Procedure

In this learning experience, students will look at friction as it relates to them. Have students rub their hands together (at first slowly, then faster). Have them describe how this feels. Have students slide their chair in and out from under their desk while they are sitting on it. Then have them move the chair when they aren't sitting on it. Have them describe the difference. Have students slide their feet on the floor. Then ask them to describe the difference between sliding their feet on tile, compared to carpet, compared to ice. From these experiences, discuss the term **friction** with students and what effect it had on the above. From these discussions, describe how friction helps with personal safety. Develop a working definition of the term **friction**.

# Activity 24: Various Surfaces and Friction

## Outcome

*Students will be expected to*

- investigate and compare the effect of friction on the movement of objects over a variety of surfaces (204-1, 204-5, 303-15)

## Assessment

- Students are able to demonstrate and explain how various surfaces affect the amount of friction.
- Students are able to design a fair test to assess surfaces and their impact on the amount of friction.

## Questions

- What types of surfaces cause the most friction?
- What types of surfaces reduce the amount of friction?
- What would be a fair test?

## Materials

- Activity 24: Various Surfaces and Friction, My Investigations
- aluminum foil
- cloth
- elastic bands and/or newton spring scales
- floor tile
- objects to be moved
- sand
- toy vehicles with moving wheels

## Procedure

Students should be given the opportunity to discuss which surfaces might cause the most friction. Have them record their hypotheses. Give students the opportunity to try various surfaces, using a variety of objects. Have them record their results. After students have tried a variety of surfaces and objects, review what would be a fair test. Have students design a fair test. Have them try their fair test and record their results. (For example, for all surfaces the length of the surface is the same, the distance the object travels is the same, the unit used to measure the force is the same, and the object they use to test the amount of friction is the same.

Have students discuss which surface caused the most friction. Have them discuss the need to have various types of surfaces to reduce or increase the amount of friction.

**Teacher Note:** To conserve the quantity of materials required, stations could be set up, with each station having a different surface. Students can rotate from station to station.

## Activity 24: Various Surfaces and Friction, My Investigations

| Surface | Object | Force Needed to Move the Object (Measured with a Newton scale) or a Length of an Elastic Band) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Which type of surface produced the most friction?

Which type of surface produced the least amount of friction?

Describe your fair test.

# Activity 25: Rollers, Wheels, and Axles

## Outcome

*Students will be expected to*

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

## Assessment

- Students are able to explain the difference between wheels and rollers.
- Students are able to demonstrate how wheels and rollers reduce friction.
- Students are able to explain how wheels and rollers can make moving an object easier.

## Questions

- What is the difference between wheels and rollers?
- How do wheels and rollers reduce friction?
- How do wheels and rollers reduce the amount of effort needed to move an object?

## Materials

- Activity 25: Rollers, Wheels, and Axles, My Investigations
- dowels
- newton scales or elastic bands
- objects to be moved (e.g., bricks, books)
- straws or pencils (to act as rollers)
- wheels or toy vehicles with moving wheels

## Procedure

Have students give examples of where rollers and wheels are used. Have them explain the difference between the two. Develop working definitions for each.

Have students pull an object without using wheels or rollers. Have them record the amount of force needed to move the object. Put the object on wheels. Have students record the amount of force needed to move the object. Now do the same with rollers. As a class, discuss the results of these experiments. Discuss how wheels and rollers reduce friction and the amount of effort required to move an object.

## Activity 25: Rollers, Wheels, and Axles, My Investigations

| Object | Force Needed to Move the Object Without Wheels or Rollers | Force Needed to Move the Object Using Wheels | Force Needed to Move the Object Using Rollers |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

How did using wheels or rollers reduce the amount of force needed to move the object?

What impact did the mass of the object have on the amount of force needed to move the object?

Illustration of an object being moved with wheels. Illustration of an object being moved with rollers.

# Activity 26: Pinwheel—Wheel and Axle

## Outcome

*Students will be expected to*

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

## Assessment

- Students are able to make a wheel and axle to move an object.

## Questions

- How does a pinwheel act like a wheel and axle?
- What problems did you encounter when you tried to lift the object?
- How did you solve the problems that arose?

## Materials

- Activity 26: Pinwheel—Wheel and Axle, My Investigations
- gum
- pencil
- scissors
- string
- tape
- 2 L milk carton

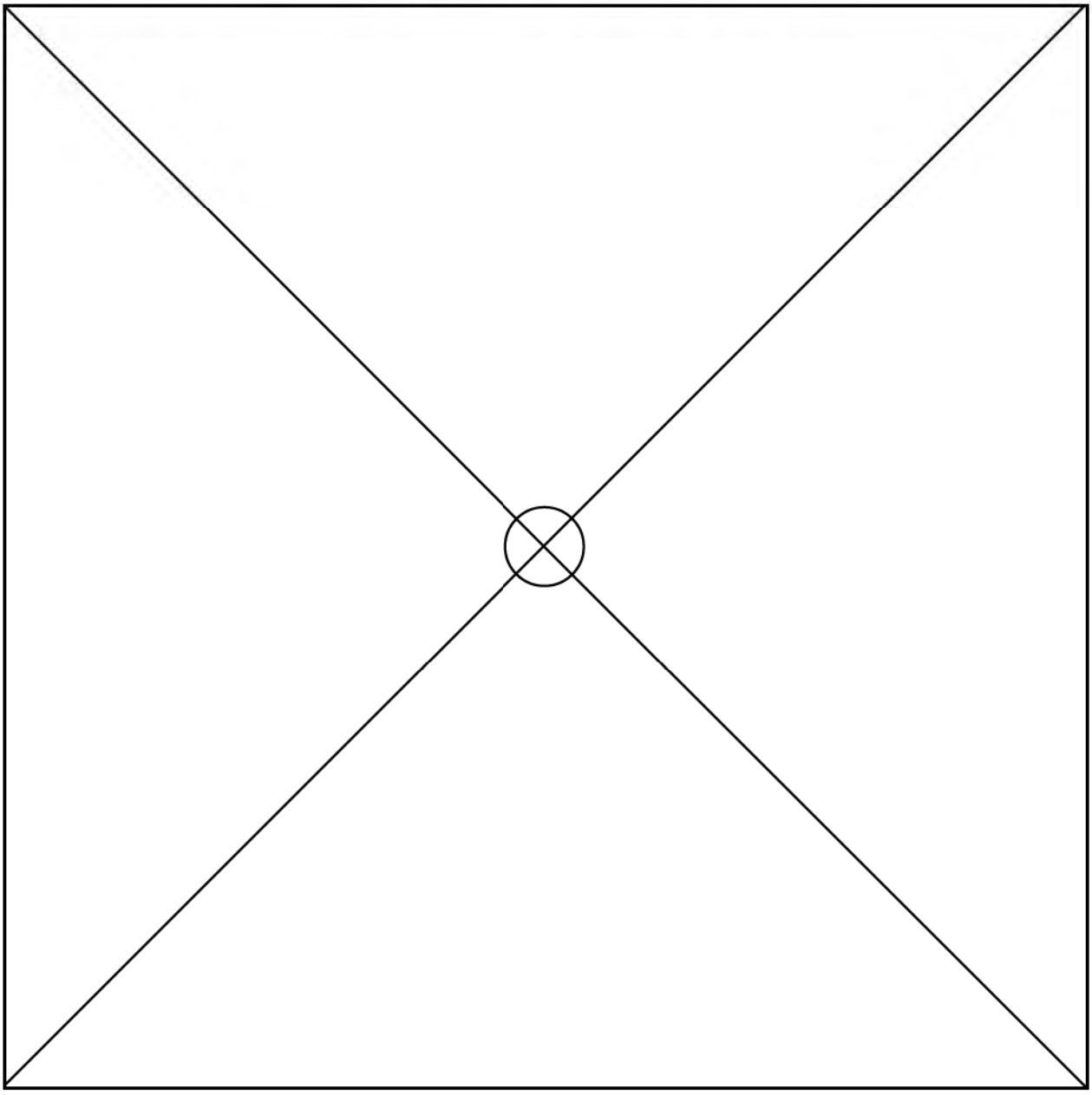
## Procedure

**Note:** Teachers may wish to model this procedure.

Cut the top off the milk carton. Cut two slits on opposite sides of the carton (cut down a few centimetres). Tape the string to one side of the pencil. Tape the gum to the other end of the string. Cut and tape the pinwheel together. Put a hole in the centre of the pinwheel with a hole punch. Fit the pinwheel on the end of the pencil that has not been taped. Place the pencil with the pinwheel on one end and the string that has the gum attached on the other end into the slots cut in the milk carton. Blow on the pinwheel and see if it lifts the gum. Students can have races to see who can lift their gum to the top first.

Have students write down their observations and difficulties they encountered or changes they had to make in order to make their pinwheel axle work.

## Activity 26: Pinwheel—Wheel and Axle, My Investigations



# Activity 27: Inclined Planes

## Outcome

*Students will be expected to*

- use simple machines to identify the effort and load required to move objects (205-2, 206-9, 303-17)

## Assessment

- Students are able to demonstrate and explain how an inclined plane will/can reduce the amount of force needed to move an object.
- Students are able to illustrate and describe a variety of inclined planes.

## Questions

- What is an inclined plane?
- Where do we find inclined planes?
- How does an inclined plane reduce the amount of force needed to lift an object?
- What are some of the different types of inclined planes?

## Materials

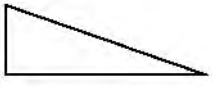
- ramps and blocks (available from your science storage organization)
- items to be moved (e.g., toy vehicle with moving wheels, books)
- newton scales and/or elastic bands
- pictures and/or various types of inclined planes (e.g., ramps, screws, stairs)
- Activity 27: Inclined Planes, My Investigations

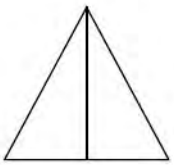
## Procedure

Discuss with students their ideas of what an inclined plane is. Record their ideas on the board. Have students measure the amount of force required to lift an object without an inclined plane. Then have them move the object by placing it on an inclined plane and measure the force needed to move it. Discuss their results. Have students use a variety of heights of the inclined plane to see whether the slope has an impact on the amount of force required to move the object. Discuss their results. Have examples of various inclined planes and discuss where they are used and how they reduce the amount of effort needed.

**Screw:** a simple machine that is an inclined plane wound around a central core.

**Wedges:** a single wedge consists of one inclined plane; a double wedge consists of two inclined planes back to back (chisel, doorstop, and knife)





## Activity 27: Inclined Planes, My Investigations

### Inclined Planes: Height and Force

| Object | Height of Ramp (in cm) | Estimated Force Needed to Move the Object (in Newtons) | Actual Force Needed to Move the Object (in Newtons) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

### Inclined Planes: Height and Distance

| Object | Height of Ramp (in cm) | Estimated Distance the Object Will Travel (in cm) | Actual Distance the Object Will Travel (in cm) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

How did the height of the ramp affect the amount of force needed to move the object?

How did the height of the ramp affect the distance the object travelled after going down the ramp?

Illustration of one of your tests.

# Activity 28: Moving an Object

## Outcome

*Students will be expected to*

- use simple machines to identify the effort and load required to move objects (205-2, 206-9, 303-17)

## Assessment

- Students are able to show an understanding of the difficulties that can arise when lifting objects.
- Students are able to demonstrate an understanding of the challenges in moving objects over a distance.
- Students are able to give examples of how these challenges can be overcome.

## Questions

- What problems might one encounter when trying to lift heavy objects?
- What challenges might one encounter when trying to move objects over a distance?
- What are some of the ways in which these challenges can be overcome?

## Materials

- Activity 28: Moving an Object, My Investigations

## Procedure

Discussions from this learning experience will help build on the concepts students will learn when looking at the outcomes for levers, pulleys, and wheels and axles.

Pose a problem for the students that might arise in a real-life situation when an object is being lifted. For example, movers are asked to move a piano to a house and it is to go on the second floor. How would they get it there? Do the same for an object that has to be moved a distance but that does not have to be lifted. Discuss the students' results. Have students work in groups to think of objects that have to be moved and how they can be moved. From these examples, ask students what types of simple machines can be used and how the machines can help reduce the load and force required to move the object.

## Activity 28: Moving an Object, My Investigations

| Object | Ways in Which the Object Can Be Moved |
|---|---|
| | |
| | |
| | |

Choose one of the above objects and describe how the load and the effort could be reduced to move it.

# Activity 29: Levers

## Outcomes

*Students will be expected to*

- design a lever for a particular task and differentiate between the positions of the fulcrum, the load, and the effort (303-18, 303-19)

## Assessment

- Students are able to distinguish between load and effort.
- Students are able to illustrate and explain how the location of the fulcrum impacts the force required to lift an object.
- Students are able to explain what the term **fulcrum** means.

## Question

- What is the load when using a lever?
- How is the load different from the effort?
- Where would you place the fulcrum to have the least amount of effort when lifting/moving an object?

## Materials

- Activity 29: Levers, My Investigations
- items to be lifted
- newton scales
- wedge (to act as a fulcrum)
- wood (such as 1" × 3" strapping, 100 cm long (optional))

## Procedure

Discuss with students the term **lever**. Put their ideas and drawings of what they think a lever is on the board. From these discussions, develop an understanding of what a lever is and the function of the fulcrum. With students working in groups, give them a piece of wood, an item to act as a fulcrum, and items to lift (e.g., books, a brick, a rock).

Pose the questions Where would you place the fulcrum to require the least amount of effort to lift an object? and Where would you place the fulcrum to require an increased amount of effort to lift an object? Have students illustrate and explain their results. As a class, discuss their findings and have students record the results in their science journals.

## Activity 29: Levers, My Investigations

| Location of the fulcrum that requires the least amount of effort to lift/move an object. | Location of the fulcrum that requires the most amount of effort to lift/move an object. |
|---|---|
| Illustration | Illustration |
| Explanation | Explanation |

| Other ways to move/lift an object by using a lever. | |
|---|---|
| Illustration | Explanation |

# Activity 30: Levers All Around Us

## Outcome

*Students will be expected to*

- design a lever for a particular task and differentiate between the positions of the fulcrum, the load, and the effort (303-18, 303-19)

## Assessment

- Students are able to demonstrate and/or explain where levers are used in their daily lives.

## Questions

- How do we use levers in our daily lives?
- Where do we use levers in the world around us?

## Materials

- Activity 30: Levers All Around Us, My investigations
- examples of levers
- pictures of different machines that are levers or can be used as a lever (e.g., screwdriver, crowbar, can opener, handle of a lawn mower, pick)

## Procedure

In this learning experience, students will be able to use the knowledge they gained in Activity 29: Levers to show how they use levers in the world around them. Have students discuss, in groups, where there are levers in their house. Have them illustrate and explain how a lever is used and how it reduces effort. If possible, bring examples of levers to the class.

## Activity 30: Levers All Around Us: My Investigations

| Illustration and Name of the Machine | Where It Is Used | How It Is Used as a Lever |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

How do levers make our lives easier?

# Activity 31: Single Pulley Systems

## Outcome

*Students will be expected to*

- compare and record the force needed to lift and load an object by using a single pulley system with that needed to lift it by using a multiple pulley system and predict the effect of adding another pulley or load-lifting capacity (303-20, 204-3)

## Assessment

- Students are able to design, illustrate, and use a single pulley system to move/lift an object.
- Students are able to see how the use of a single pulley system reduces the force required to lift an object (in comparison to lifting it manually).

## Questions

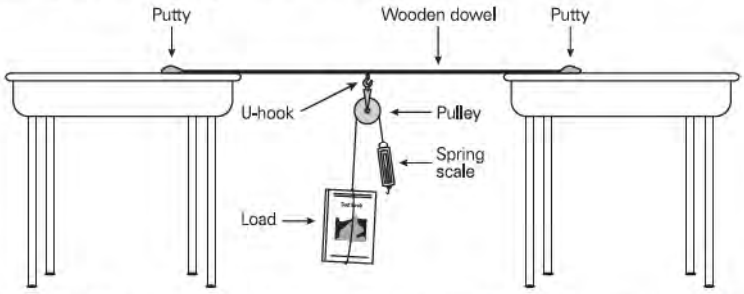
- What is a pulley?
- How does a single pulley system reduce the amount of force needed to lift an object?

## Materials

- a means to mount the pulley (1" × 2" or 2" × 2" board with a U-hook placed between two desks)
- Activity 31: Single Pulley Systems, My Investigations
- newton scales
- objects to be lifted
- single pulleys
- strong string or rope

## Procedure

**Part 1:** Discuss with students where they might have seen pulleys used. From these discussions, explain that they are going to see if using a single pulley to lift a load reduces the amount of force required compared to lifting the load without a pulley.




**Part 2:** Have students design a single movable pulley system and compare the amount of force it takes to lift an object to that of a single fixed pulley and lifting the object manually. Have them illustrate and record their results. Have them put together their pulley system. If they use a book as a load, string can be tied around it in order for it to be lifted.

## Activity 31: Single Pulley Systems, My Investigations

Illustration and explanation of the results when lifting a load with a single pulley:

Illustration and explanation of the results when lifting a load without a single pulley:

How does a pulley reduce the amount of effort/force required to lift a load?

# Activity 32: Multiple Pulley Systems

## Outcome

*Students will be expected to*

- compare and record the force needed to lift and load an object by using a single pulley system with that needed to lift it by using a multiple pulley system and predict the effect of adding another pulley or load-lifting capacity (303-20, 204-3)

## Assessment

- Students are able to build, illustrate, and explain how a multiple pulley system works.
- Students are able to recognize that a multiple pulley system decreases the amount of effort required to lift an object.
- Students are able to demonstrate that a multiple pulley system lessens the load and, therefore, reduces the effort required to lift an object (as compared to lifting it manually).

## Questions

- How is the mass of an object distributed in several places by using a multiple pulley system?
- How does this reduce the amount of effort/force required to lift an object?
- If you had to lift an object, which would you use—a single pulley system or a multiple pulley system?
- Where are pulleys used in the world around us?

## Materials

- a means to mount the pulley (1" × 2" or 2" × 2" board with a U-hook placed between two desks)
- additional pulleys
- newton scales
- objects to be lifted
- single pulleys
- strong string or rope

## Procedure

**Part 1:** Review what students learned in Activity 31: Single Pulley Systems. Explain to students that they are going to make a pulley system in which there is a fixed pulley and a movable pulley. Have them build the pulley system and compare the amount of force it takes to lift an object to that of using a single pulley system and lifting the object manually. Have them illustrate their system and record and discuss their results.

**Part 2:** Double-grooved pulleys. As a teacher demonstration, a double-grooved movable pulley system could be made. Have students compare the amount of force it takes to lift the objects to that of using the other pulley systems. Discuss, as a class, where it might be used.

# Activity 33: My Machine

## Outcome

*Students will be expected to*

- design a system of machines to solve a task (204-7)

## Assessment

- Students are able to design a machine by using two or more simple machines.
- Students are able to assess and analyse other students' machines and make constructive suggestions/observations regarding the machines and their uses.
- Students are able to show the step-by-step process they followed to make their machines.

## Questions

- What task is your machine going to be able to carry out?
- What materials will you need to make your machine?
- What problems did you encounter? How did you solve them?

## Materials

- Activity 33: My Machine, My Investigations
- materials will vary depending on the student's design
- sewing spools may be used as pulleys

## Procedure

This learning experience can be done in class or at home. However, to do a true assessment of students and their problem-solving skills, and to take into account those students who may not have materials at home, this project should be done at school. Students can work in groups or individually. Review with students the simple machines they have learned about. Have them discuss the type of task they want their machine to do. From these discussions, have them draw a diagram of the machine they want to build and make a list of the materials they will need to build it. As the children are building their machine, have them record problems they had and how they solved them. When the machines have been completed, have students demonstrate to the class the task they accomplish.

## Activity 33: My Machine, My Investigations A

Name of my machine: _____

Diagram of the machine I am going to build, with the parts and materials labelled:

Materials I will need to build my machine:

_____

_____

_____

_____

Problem(s) that were encountered:

How the problem(s) were resolved:

The task the machine was designed to do:

Simple machines that are part of my machine:

Design changes:

## Activity 33: My Machine, My Investigations B

Student: _____

Machine: _____

Student's Partner: _____

| Stayed on task | Developed a machine to make ... | List of materials needed | Illustration of machine | Came prepared with materials | Machine was produced | Problems that arose were discussed | Model was redesigned to accommodate the problems encountered | Presentation of the project to the class | Ability to answer questions from the class |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

Final assessment: _____

Student: _____

Machine: _____

Student's Partner: _____

| Stayed on task | Developed a machine to make ... | List of materials needed | Illustration of machine | Came prepared with materials | Machine was produced | Problems that arose were discussed | Model was redesigned to accommodate the problems encountered | Presentation of the project to the class | Ability to answer questions from the class |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

Final assessment: _____

# Appendix G: Activities for Life Science: Meeting Basic Needs and Maintaining a Healthy Body

## Activity 34: Questions Generated about a Healthy Body

### Outcome

*Students will be expected to*

- propose questions to investigate how our body works and what its components are, and relate bodily changes to growth and development (204-1, 301-8)

### Assessment

- Students are able to generate and share questions they have about the functions and components of the human body.
- Students are able to suggest lifestyle choices that can affect the growth, development, and health of the human body.

### Questions

- What do you know about how the body works and what its components are?
- What do you want to know about how the body works and what its components are?
- What does a baby need to maintain a healthy body?
- What does a child need to maintain a healthy body?
- What does a teenager need to maintain a healthy body?
- What does an adult need to maintain a healthy body?

### Materials

- chart paper
- markers

### Procedure

To begin this unit of study, it is important for teachers to gain an understanding of students' prior knowledge of body systems and what is required for the maintenance of a healthy body as well as to provide students with the opportunity to propose questions to further investigate the science of the human body and how the body systems work together.

As part of the grade 4 health education curriculum, students were expected to demonstrate a knowledge of the digestive, excretory, skeletal, muscular, and nervous systems and their related organs—specifically exploring how the digestive and excretory systems process food and how the skeletal, muscular, and nervous systems work together to produce movement.

In this unit, Meeting Basic Needs and Maintaining a Healthy Body, students will further their understanding of the systems that make up the human body and the responsibility of humans to meet its basic needs of nutrition, rest, and exercise.

Provide students, in small groups, with chart paper and two different colours of markers. Ask one group member to record the group's ideas and understandings of the systems and organs that make up the human body or have the group decide how they will share the work. This may include taking jot notes of the group's ideas and designing a web, a diagram, or a flow chart of what they know about how the body works and its components. Students must use one colour of marker to represent these ideas. Ask students to then use another colour of marker and record actions that humans need to take to promote and maintain the health of these systems. Have each group share their ideas with the class. Post these chart papers around the room so, as the unit unfolds, understandings or misunderstandings can be referred to and discussed. Encourage students to think in terms of what humans need to maintain a healthy body throughout its life stages (i.e., baby, child, teenager, and adult). Do they think the needs remain the same?

Ask students to think about what they want to know about how the human body works and/or what is needed to maintain the health of our body systems. Students can record their questions on sticky notes to be revisited throughout the unit, or in science journals. At the end of the unit, reflect, as a class, on whether the students' questions were answered through hands-on learning experiences, media, guest speakers, field trips, information texts, or research through the Internet.

# Activity 35: The Course of Digestion

## Outcome

*Students will be expected to*

- describe the structure and function of the major organs of the digestive, excretory, respiratory, and circulatory systems (302-5)

## Assessment

- Students are able to describe the path that food takes through the body.
- Students are able to orally describe the process of digestion, using a model, beginning with the role saliva plays in digestion and how the digestive system's major organs (teeth, tongue, esophagus, stomach, small intestine, and large intestine) contribute to the process of digestion.

## Questions

- Which area of the digestive system do you think measures the longest in distance?
- Which area do you think measures the shortest?

## Materials

- index cards
- marker
- measuring tapes
- metre sticks
- thick rope

## Procedure

Hand out a six-metre piece of rope to small groups of students. Ask the students to estimate the distance of each area of the digestive system that contains major organs—the mouth (teeth and tongue), esophagus, stomach, small intestine, and large intestine—if the areas were stretched out in a straight line. Once each group has marked their estimates for each area on index cards, ask them to share their estimates, using oral language to describe how a favourite healthy food item of their choice travels through the digestive system and the distance it travels in centimetres or metres. Students should use measuring tapes to mark their estimates accurately. Once each group has shared their estimates, give the class the approximate distance of the course of digestion: 8 centimetres for the mouth, 25 centimetres for the esophagus, 6 centimetres for the stomach, 4 metres for the small intestine, and 1.2 metres for the large intestine. Ask the groups to share how close or not close their estimates were to the actual measurements and to discuss their thinking. Have the groups turn over their index cards and, with their markers, record the actual measurements.

As an extension, ask students to ponder how long, measured in time, they think it takes for food to travel throughout each area of the digestive system. Students can make estimates in their science journals or scribblers. This is information that students come across as they read non-fiction texts during independent or shared reading time.

**Teacher Note:** This learning experience should take place after an exploration of the process of digestion and the role of saliva, lungs, and skin in this process. Having explored the process of digestion prior to this learning experience, students will then be able to articulate their understanding of it orally and to link it within a real-life experience to measurement concepts in math.

# Activity 36: Disappearing Act

## Outcome

*Students will be expected to*

- describe the structure and function of the major organs of the digestive, excretory, respiratory, and circulatory systems (302-5)

## Assessment

- Students are able to describe the path that food takes through the body.
- Students are able to describe the role that enzymes play in helping food to break down in the stomach.

## Questions

- What makes the tomato stain seem to disappear?
- Is this a fair test? What else could we try that would leave a stain on a cotton cloth?
- Does the amount of laundry detergent mixed into the second bowl of warm water make a difference?
- What is the smallest amount of laundry detergent needed to make the stain disappear?

## Materials

- cotton cloth
- laundry detergent (with enzymes)
- other food items suggested by students to use another time, to compare results
- small pieces of tomato for squeezing onto a cloth
- two bowls of warm water per group

## Procedure

Divide the students into small groups or pairs. Give each group two pieces of cotton cloth, two bowls of warm water, and a small piece of tomato to squeeze onto the cloth. Allow the groups to measure out 30 millilitres of laundry detergent for one of the warm-water bowls, or suggest different measurements for different groups, to compare results. After preparing both cloths with tomato drippings, submerse them in the bowls and watch as the water with the added detergent breaks down the tomato stain. As a class, suggest other drippings that could be tested. Do a whole-class demonstration, using these materials, during another time.

# Activity 37: Comparing Lung Capacity

## Outcome

*Students will be expected to*

- propose questions and carry out procedures to investigate the factors affecting breathing and heartbeat rate, and compile and display data from these investigations in a graph (205-1, 206-2)

## Assessment

- Students are able to compare their lung capacity to that of other students.
- Students are able to decide if the learning experience they try is a fair test and explain their reasoning.

## Questions

- Does the lung capacity of individuals differ?
- How can we tell if the lung capacity of one individual differs from that of another?

## Materials

- balloons (of the same type)
- different types of balloons
- measuring tapes (metric)

## Procedure

Students will be given the opportunity to see how much they can blow up a balloon in one breath. Prior to having students try this learning experience, discuss with them what they think the term **lung capacity** means and how it might be measured. Discussions could also include whether students feel that the lung capacity of individuals differs.

Give each student a balloon. The first test could be that not all students are given the same type of balloon. Have them blow into the balloon with one breath. Have them measure the circumference of the balloon. Students should compare their results and make a graph showing the various circumferences.

Discuss with students if this is a fair test. Have them explain their reasoning and see if they can come up with a way to make it a fair test. Have them try the experience again and compare their results.

# Activity 38: Response Time

## Outcome

*Students will be expected to*

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

## Assessment

- Students are able to demonstrate how the skeletal, muscular, and nervous systems work together to allow someone to catch an object.

## Questions

- How did the response time differ for individual students in catching the object?
- How do the skeletal, muscular, and nervous systems work together?

## Materials

- metre sticks (enough for one per every two students)
- graph paper

## Procedure

In this learning experience, students will develop an understanding of how various systems work together to produce and control movement. Students should work in groups of two. Have one student release a metre stick and have his or her partner try to catch it. The metre stick should be held just above the student's outstretched arm and hand prior to being released. Have the student measure the distance on the metre stick to see how far it fell before the student was able to catch it. Then have students reverse their roles. Students should try this several times to see if their response time increases or decreases. As a class, students should graph their results. Discussions should take place on what parts of the body were used and how they worked together.

# Activity 39: Building Body Systems

## Outcome

*Students will be expected to*

- select and use tools in building models of organs or body systems (205-2)

## Assessment

- Students are able to use a variety of materials and tools to build models of body systems.

## Questions

- What types of materials would you need to build a model of an organ or body system?
- How would you use these materials to build organs of the body?

## Materials

- Activity 39: Building Body Systems, My Investigations
- modelling clay
- newspaper
- paper-towel rolls
- plaster of Paris

## Procedure

In this learning experience, students will be given the opportunity to design a model of an organ of the body or a body system. Students should explore the types of materials they might want to use and draw a diagram of what they plan to make. Resources should be available for students to see what the actual system or organ looks like. Students should be given the opportunity to share their models with the class and to explain the process they used and the problems they encountered.

## Activity 39: Building Body Systems, My Investigations

Name of my organ or body system: _____

Diagram of the organ or body system I am going to build with the parts and materials labelled:

Materials I will need to build my organ or body system:

_____

_____

_____

_____

Problem(s) that were encountered:

How the problem(s) were resolved:

The function of my body system or organ:

# Activity 40: The Role of the Skin

## Outcome

*Students will be expected to*

- describe the body's defences against infections and describe the role of the skin (302-7, 302-8)

## Assessment

- Students are able to create a model that includes the layers of the skin and orally explain the role that skin plays in protecting the body's interior from the external environment and its ability to sense pain, temperature, and pressure.

## Questions

- How does the skin protect internal body systems and organs?
- What actions can we take to protect our skin?

## Materials

- information texts that show the layers of the skin or an LCD projector to share access to this information from the Internet
- modelling clay of different colours/shades of skin tone where possible
- toothpicks

## Procedure

As a class, research information on the role of the skin and its components. Skin has two layers. The outer layer is called the epidermis. It is this layer that has pigment-producing cells called melanocytes that produce the melanin responsible for a skin colour and, in part, protection from the sun's harmful ultraviolet light. The inner layer of our skin is called the dermis. The dermis is comprised of nerve endings and blood vessels. It provides physical and nutritional support for the skin. Skin also plays a role in the central nervous system, carrying signals from our skin, through its sense of touch, to the brain. It plays a role in keeping harmful germs out of our bodies and keeping water in.

As a connection to math, try to find out the thickness of each layer of the skin. Challenge students, when they are creating a model of the skin, to measure its thickness or to label their model, referring to how many sizes greater the model is in thickness than the actual size of skin.

Provide students with microscopes to observe their own skin up close. What do they see? Have students discuss their observations as you provide them with materials to create their model. Students may wish to use different-coloured clay to add in sweat glands, blood vessels, hair follicles, hair, nerve endings, and/or dead cells on the surface of the skin.

As students finish their model, allow for the opportunity to explain the role of the skin in protecting the body's interior from the external environment.

# Activity 41: Culture and Maintaining Good Health

## Outcome

*Students will be expected to*

- describe examples of medical techniques and technologies developed by other Canadians and other cultures that have contributed to the knowledge of body organisms, systems, and health issues (106-2, 106-4, 107-12, 107-14)

## Assessment

- Students will, through thoughtful questioning and inquiry, either orally, or through writing and other ways of representing, display an interest in learning more about medical techniques and technologies developed by other cultures.

## Questions

- Which techniques and technologies that we have learned about have the longest recorded history?
- Which are relatively new?
- How do beliefs and culture play a role in attitudes and habits for maintaining a healthy body?

## Materials

- access to the Internet
- various information texts on topics such as Eastern medicine, First Nations medicine, herbal remedies, chiropractic, alternative medicine, yoga, tai chi, qigong, acupressure, acupuncture, naturopathy, and ancient remedies and/or access to health professionals in the community

## Procedure

It is important for the teacher and students to explore the concept of culture before investigating the various cultural techniques, technologies, and beliefs around maintaining good health. Develop a working definition of culture with the class and contrast it with the concept of heritage. It is vital that teachers be sensitive to the fact that not all students of visible minority have cultural connections to their heritage and may, therefore, have little knowledge or experience of various techniques and technologies.

It may be very interesting to explore the topic of culture before beginning this unit of study. Chiropractic is rooted in its connection to the nervous system, for example, and acupuncture and acupressure can directly contribute to the health and well-being of all systems and organs of the body. Inviting doctors into the classroom who practise these and other forms of alternative medicine and who will, in many

cases, bring models of the human body is an excellent way to focus interest, in the class, in the way the human body works and displays signs of ill health. Health education and educating the community on alternative practices is important to many of these health practitioners, and you will probably find several who are eager to come in and share their knowledge and address questions with the class.

Connections can be linked to the teaching of and learning about ancient and aboriginal societies from the grade 5 social studies curriculum.

# Appendix H: Activities for Physical Science: Properties of and Changes in Materials

## Activity 42: Solids, Liquids, or Gases

### Outcome

*Students will be expected to*

- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)

### Assessment

- Students are able to distinguish between a solid, liquid, or gas.

### Questions

- What is a solid?
- What is a liquid?
- What is a gas?

### Materials

- materials such as wood, paper, thread, salt, sand, water, vinegar, or molasses
- containers (pill bottles or film canisters, if available) to hold the liquids
- bottle with air in it
- Activity 42: Solids, Liquids, or Gases, My Investigations

### Procedure

In this learning experience, students will explore the differences between solids, liquids, and gases. Provide students with a variety of each and have them sort them into their appropriate category. After each sample, have the students explain the reasoning for deciding if it was a solid, liquid, or gas. From this activity, working definitions could be made for each property.

**Teacher Note:**

- Solid: a substance with a definite shape and volume
- Liquid: a substance with a definite volume but no definite shape
- Gas: a substance with no definite shape or volume

## Activity 42: Solids, Liquids, or Gases, My Investigations

| Material | Solid, Liquid, or Gas | Reason for Your Decision |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

# Activity 43: Solids

## Outcome

*Students will be expected to*

- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)

## Assessment

- Students are able to describe the various properties and characteristics of a variety of solids.

## Questions

- What is a solid?
- How are you able to distinguish that an object is a solid?
- What are the properties of a solid?
- What characteristics do solids have?

## Materials

- a variety of solids, such as a block of wood; paper; and powders such as flour, salt, and sugar
- Activity 43: Solids, My Investigations
- hand-held magnifiers and/or microscopes

## Procedure

In this learning experience, students will explore various types of solids and explain their distinguishing characteristics and properties, such as colour, shape, and texture. This learning experience could be done using a centres approach (i.e., students moving in groups from one set of solids to another) or with each group having their own set of solids to observe.

## Activity 43: Solids, My investigations

| Type of Solid | Properties/Characteristics | Illustration |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

What did the solids have in common?

How did the solids differ?

# Activity 44: Liquids

## Outcomes

*Students will be expected to*

- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)

## Assessment

- Students are able to describe the various properties and characteristics of a variety of liquids.

## Questions

- What is a liquid?
- How are you able to distinguish that something is a liquid?
- What are the properties of a liquid?
- What characteristics do liquids have?

## Materials

- a variety of liquids, such as vinegar, water, pop, molasses, or corn syrup
- Activity 44: Liquids, My Investigations
- clear pill bottles
- hand-held magnifiers and/or microscopes

## Procedure

In this learning experience, students will explore various types of liquids and explain their distinguishing characteristics and properties, such as colour, smell, and consistency. This learning experience could be done using a centres approach (i.e., students moving in groups from one set of liquids to another) or with each group having their own set of liquids to observe.

## Activity 44: Liquids, My Investigations

| Type of Liquid | Properties/Characteristics | Illustration |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

What did the liquids have in common?

_____

_____

How did the liquids differ?

_____

_____

# Activity 45: Gases

## Outcome

*Students will be expected to*

- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)

## Assessment

- Students are able to describe the various properties and characteristics of a variety of gases.

## Questions

- What is a gas?
- How are you able to distinguish that something is a gas?
- What are the properties of a gas?
- What characteristics do gases have?

## Materials

- balloons
- transparent bottles or plastic 500 mL bottles
- kettle
- plastic container to hold water
- plastic syringes (without needles)
- water

## Procedure

In this learning experience, students will explore various gases and explain their distinguishing characteristics and properties. This learning experience can be done as a teacher-directed demonstration or with students in groups. Using the kettle to make steam should be a teacher-directed activity.

Have students pull the plunger on a syringe back. Then have them place their finger on the end while pushing the plunger back in. Have students describe what happened. Ask them what caused the plunger to stop moving. Have students pull back on the plunger and then press on it while holding the open end in water. Have them describe and explain what happened.

Have students place a deflated balloon over the top of a bottle and then put the bottle in hot/warm water. Have them describe and explain what happens. Boil water, using a kettle, and have the students describe what happens as the water boils. Explain that the water has changed into a gas or vapour.

# Activity 46: Physical Changes

## Outcome

*Students will be expected to*

- observe and identify changes in an object's appearance, state, and/or reversibility and classify it as a physical change or not (301-9, 205-5, 301-10)

## Assessment

- Students are able to demonstrate an understanding of a physical change.

## Questions

- What is a physical change?
- How does a physical change make a difference in the appearance of an object?
- How are you able to make a physical change in a specific object?

## Materials

- Activity 46: Physical Changes, My Investigations
- bars of soap (preferably a softer bar, unscented)
- bowls
- butter knife
- Jell-O powder
- measuring cups
- modelling clay
- paper
- pencils or dowels
- plastic cups
- spoons
- water

## Procedure

In this learning experience, students will explore various ways to change materials in a physical way. Discussions could take place around what a physical change is. Examples could be given, and demonstrations such as the breaking of a dowel or pencil or tearing of a material could take place. The following are a few student-directed activities that could take place.

Students can be asked to bring in a bar of soap and do soap sculptures to illustrate physical changes. Modelling clay could be used to make a geometric solid to illustrate a physical change. Students can also be given a variety of materials and asked to show how their physical properties could be changed. As a class, a workable definition of physical change should be developed.

Students can be given the opportunity to make Jell-O. Students enjoy this activity as they are able to observe a powder dissolving in hot water and turning into jelly after being cooled. This activity lends itself to a variety of observations.

**Teacher Note:** This activity could be done in centres, allowing you to be with students when they are pouring boiling water for the Jell-O.

Physical change: Only the physical properties of matter are changed. No new substances are formed.

## Activity 46: Physical Changes, My Investigations

| Material/Object | Description of the Physical Change | Illustration of the Physical Change |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

Describe what you think a physical change is.

# Activity 47: Reversible Physical Changes

## Outcome

*Students will be expected to*

- observe and identify changes in an object's appearance, state, and/or reversibility and classify it as a physical change or not (301-9, 205-5, 301-10)

## Assessment

- Students are able to demonstrate an understanding of a reversible physical change.

## Questions

- What is meant by a reversible physical change?
- How is a reversible physical change different from a non-reversible physical change?

## Materials

- Activity 47: Reversible Physical Change, My Investigations
- cups
- salt
- shallow containers
- sugar
- water
- Science Safety Guidelines

## Procedure

In this learning experience, students will explore various ways to see if a physical change is reversible or not. Discussions should take place regarding the terms **reversible** and **non-reversible**. Working definitions should be developed.

Provide the students with salt or sugar. Have them dissolve it in a small amount of water. Pose the question Is it possible to reverse the change and have the salt (sugar) crystals return? Discuss with the students their answers and how they could test their ideas.

Allow the water with dissolved sugar or salt to evaporate, and have the students examine the results. Discuss their findings and ask the question Was it a reversible or non-reversible physical change? Have them explain their answer. Have students record their work in their science journals or scribblers.

Students can place water in a container and freeze it. Discussions could take place around reversible or non-reversible changes.

Have students think about the physical changes that took place in Activity 46: Physical Changes. Ask the students to discuss which ones were reversible and which ones were not. Have them explain their answers.

## Activity 47: Reversible Physical Changes, My Investigations

### Activity A

**Materials:** one bar of soap per group, paper, knife

1. Using the above materials, try to make a physical change in a bar of soap. Be creative.
2. Using paper, what physical changes can be made to the paper? What can you make out of the paper and still have the properties of paper?

### Activity B

**Materials:** modelling clay, sugar, water, Petri dish

1. How can you change the modelling clay so it still has its original properties? Be creative.
2. Add a small amount of water to a shallow container or lid. Then add small amounts of sugar and stir until the sugar has dissolved. Place the container on a window ledge. What happened to the sugar? How can you get it back to a solid form?

### Activity C

**Materials:** Jell-O powder, hot water, bowls, cups, spoons

Follow the directions on the container to make the powder into a gel. Decide whether or not this is a physical change.

# Activity 48: Playdough

## Outcome

*Students will be expected to*

- describe and give examples of the interactions among materials, including gases, and discuss their properties (301-11, 301-12)

## Assessment

- Students are able to demonstrate an understanding of a chemical change.

## Questions

- What is meant by chemical change?
- How does combining materials create a chemical change?

## Materials

- bowls
- flour
- food colouring
- measuring cups
- salt
- water

## Procedure

In this learning experience, students will make salt clay or playdough. From this activity, the students can decide if, by combining the materials, it is a chemical change or not. The clay that is made could be used to cover outcomes in the visual arts guide or to make geometric solids for the geometry unit (to discuss the properties of various geometric solids).

### Salt Clay

*Ingredients*

500 mL flour
225 mL salt
225 mL water
food colouring

*Directions*

- Mix the flour and salt together in a bowl.
- Add several drops of food colouring to the water if you want coloured clay.
- Add the cold water to the mixture in the bowl.
- Mix the ingredients.

**Playdough**

*Ingredients*

500 mL flour
125 mL water (or more if needed)
food colouring

*Directions*

- Mix the flour and water together.
- Add several drops of food colouring if you want coloured dough.

# Activity 49: Chemical Changes

## Outcome

*Students will be expected to*

- describe and give examples of the interactions among materials, including gases, and discuss their properties (301-11, 301-12)

## Assessment

- Students are able to demonstrate an understanding of a chemical change in a material.

## Questions

- What is meant by a chemical change?
- How does a chemical change make a difference in the appearance of an object?

## Materials

- aluminum foil
- aluminum plate (tart-size)
- baking soda
- clear plastic cups
- diapers (good quality, large size)
- garbage bags
- matches
- paper
- pieces of wood or splints of wood
- salt
- vinegar
- water

## Procedure

**Part 1:** *Teacher-directed activity:* Review with the students what a physical change is. Have the students discuss what they think a chemical change is. Place their ideas on the board or chart paper. Break or tear a match in half. Ask the students if this is a physical or chemical change. Now light a match and ask the students what type of change it is. Do the same for a piece of wood or wooden splint.

*Student-directed activity:* Have the students place a small amount of baking soda on a piece of aluminum foil that is shaped like a pie plate. Have them add a small amount of vinegar and describe what they observe. Discuss with the students if what happened is a physical or chemical change.

**Part 2:** How do diapers absorb liquid? Lay plastic over the students' desks. Give each group of students a diaper. Have them scrape the powder from the lining into a cup. Once they have gathered all of the powder, have them add water to it a little at a time. Have them observe how the powder becomes a gel as it absorbs the water. The students should observe how the powder expands as it continues to absorb the water. They should be given the opportunity to see what it feels like.

After the powder has gelled, have the students add salt to it and observe what happens. The gel will turn into a liquid as it is stirred. Discuss with the students the changes they observed. A chemical change causes the material to change into something completely different.

**Teacher Note:** The gel and plastic should be put in the garbage rather than poured down the drain. Putting the material down the drain will plug the drains in the school, leading to costly repairs.

# Activity 50: Known Substances

## Outcomes

*Students will be expected to*

- work with team members to develop and carry out a plan to distinguish a material based on its chemical properties and display the results of the data (204-7, 207-3, 206-2, 204-5)
- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)
- observe and identify changes in an object's appearance, state, and/or reversibility and classify it as a physical change or not (301-9, 205-5, 301-10)
- describe and give examples of the interactions among materials, including gases, and discuss their properties (301-11, 301-12)

## Assessment

- Students are able to use a variety of powders to carry out various observations and experiments.
- Students are able to distinguish various powders according to their properties.
- Students are able to follow a set of procedures to carry out an experiment.

## Questions

- How can we distinguish powders by using our senses (other than taste)?
- How do the results of a chemical reaction distinguish one powder from another?

## Materials

- Activity 50: Known Substances, My Investigations A and B
- aluminum foil
- aluminum plates (tart-size)
- baking powder
- baking soda
- candles (e.g., votive)
- flour
- hand-held magnifiers
- matches
- microscopes
- salt
- sand
- sugar
- vinegar
- water

## Procedure

This activity is designed to give students an opportunity to use their senses to make observations about various powders. They will use a small amount of each powder for the various tests. Caution should be taken when using candles, and a container of water should be kept nearby. Observations could be recorded on the activity sheet provided. The students should identify the states of matter.

## Activity 50: Known Substances, My Investigations A

| **Substance** | **Colour** | **Shape** (as observed with a magnifier or microscope)<br>**Drawing and Description** | **Touch**<br>(how it feels) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

## Activity 50: Known Substances, My Investigations B

| **Substance** | **Water Test** (Does the substance dissolve or does a reaction occur when water is added?) | **Heat Test** (Describe what happens when heat is applied to the substance.) | **Vinegar Test** (Describe what happens when vinegar is added to the substance.) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# Activity 51: Unknown Substances

## Outcomes

*Students will be expected to*

- work with team members to develop and carry out a plan to distinguish a material based on its chemical properties and display the results of the data (204-7, 207-3, 206-2, 204-5)
- classify materials as solids, liquids, or gases and illustrate this classification in a property chart (206-1, 300-9)
- observe and identify changes in an object's appearance, state, and/or reversibility and classify it as a physical change or not (301-9, 205-5, 301-10)
- describe and give examples of the interactions among materials, including gases, and discuss their properties (301-11, 301-12)

## Assessment

- Students are able to use a variety of procedures to identify what a particular substance is.
- Students are able to distinguish between the three states of matter.

## Question

- What procedures or experiments could you do to identify an unknown substance or substances?

## Materials

- Activity 51: Unknown Substances, My Investigations A and B
- aluminum foil
- aluminum plates (tart-size)
- baking soda
- candles (e.g., votive)
- hand-held magnifiers
- matches
- microscopes
- salt
- vinegar
- water

## Procedure

This learning experience is designed to give students an opportunity to use their previous knowledge to identify unknown substances. Have the students mix together two powders that they used in Activity 50: Known Substances. Explain to the students that they are going to follow the procedures they used in this experiment to try to identify some unknown powders. Provide them with the materials and allow them to experiment.

## Activity 51: Unknown Substances, My Investigations A

| **Colour** | **Shape** (as observed with a magnifier or microscope)<br>**Drawing and Description** | **Touch**<br>(how it feels) |
|---|---|---|
| | | |
| | | |
| | | |

## Activity 51: Unknown Substances, My Investigations B

| **Water Test** (Does the substance dissolve or does a reaction occur when water is added?) | **Heat Test** (Describe what happens when heat is applied to the substance.) | **Vinegar Test** (Describe what happens when vinegar is added to the substance.) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

I think the powders are:

I concluded this from:

# Activity 52: Mass of Objects

## Outcome

*Students will be expected to*

- follow a given set of procedures to relate the mass of a whole object to the sum of the masses of its parts and suggest possible explanations for variations in the results (104-5, 205-3, 300-11)

## Assessment

- Students are able to use a balance to find the mass of a variety of objects.

## Questions

- How do balances help us to find the mass of objects?
- Does the shape of an object have an impact on its mass?

## Materials

- Activity 52: Mass of Objects, My Investigations
- balances
- objects to be weighed
- various masses

## Procedure

This learning experience is designed to give students an opportunity to use their previous knowledge to use balances to find the mass of objects. Finding the mass (g) of an object is different than finding the weight (N) of an object. Teachers may need to go over how to use balances and how to measure for accuracy. This learning experience will lend itself to Activity 53: Mass of the Parts of Objects. Have students try to find two objects with the same mass but a different shape.

## Activity 52: Mass of Objects, My Investigations

| **Object** | **Estimated Mass** | **Actual Mass** | **Shape** (description) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Did your estimation of the mass of an object improve as you did more estimating?

What impact did the shape of the object have on its mass?

Were you able to find two objects with a different shape but the same mass? If so, how would you explain your findings?

# Activity 53: Mass of the Parts of Objects

## Outcome

*Students will be expected to*

- follow a given set of procedures to relate the mass of a whole object to the sum of the masses of its parts and suggest possible explanations for variations in the results (104-5, 205-3, 300-11)

## Assessment

- Students are able to see if the mass of a whole object is equal to the sum of the masses of its parts.
- Students are able to distinguish if the mass of an object changes in relation to the state of matter.

## Questions

- What impact does changing the whole object into parts have on its total mass?
- What impact does changing the property of an object have on its mass?

## Materials

- Activity 53: Mass of the Parts of Objects, My Investigations
- balances
- masses
- objects to be weighed (e.g., paper, rocks, pencils, erasers, nut-free granola bar)

## Procedure

This learning experience has several parts. Discussions should take place around changing a whole object into different parts. Some examples could be changing a whole piece of cardboard into several pieces; cutting an apple in half, quarters, etc.; or dividing a bar of soap.

**Part 1:** Give each group of students a balance and some objects. Have them find the mass of a whole object. Then have the students divide the object up and find the masses of the individual parts. Have them add these masses and see if they are the same as the total. For example, find the mass of a nut-free granola bar. Then break it into two pieces. Find the mass of each piece and add the masses together. Does the total equal the original mass of the bar prior to its being divided? If not, discussions should take place as to what may have caused the differences (i.e., inaccuracy or a loss of pieces of the whole when it was divided).

**Part 2:** Have the students find the mass of a container of water. Then have them freeze it and find the mass of the frozen water. Have them compare the two masses and discuss their results.

## Activity 53: Mass of the Parts of Objects, My Investigations

| Object | Total Mass of the Object | Masses of the Object's Parts | Difference in the Masses |
|---|---|---|---|
| **Part 1: nut-free granola bar** | | | |
| **apple** | | | |
| | | | |
| | | | |
| **Part 2: water** | Mass of water and container prior to being frozen | Mass of water and container after turning to ice | |
| **water** | | | |

How did the mass of the total object differ from the masses of its parts?

What might have caused the difference (if there was any)?

Illustration of one of the measurements.

# Activity 54: What Are Materials Made Of?

## Outcome

*Students will be expected to*

- use a variety of sources and technologies to identify and describe the source of the materials found in an object, changes to the natural materials required to make the object, and how manufactured materials have been developed to improve living conditions (107-8, 205-8, 300-12)

## Assessment

- Students are able to carry out a research assignment to find how materials used in everyday life are made up of a variety of substances.
- Students are able to find out, through research, how materials are combined to form new ones.

## Questions

- How does the creation of new materials help society?
- How does the creation of new materials cause a negative impact on society and nature?
- How are natural materials combined to make new materials?

## Materials

- books
- computers (with Internet access)
- various manufactured materials

## Procedure

This learning experience could be done as part of the language arts program. It is designed to have students see that many of the items we use today are a result of physical and chemical changes to various materials. As a class, discuss materials that are used on a daily basis and materials that have helped society and improved our living conditions. From this list, have the students research how each material was made, what materials were combined to make it, the process that was carried out, how it is used, of what benefit it is and to whom, and if there is any negative impact to society or the environment as a result of it or of the manufacturing of it.

# Appendix I: Print Resources

## Authorized Learning Resources

The following resources to support teaching and learning in science are currently available through the Nova Scotia School Book Bureau (NSSBB). The NSSBB number is given in parentheses. Many of the following titles were sent to schools as part of the Active Readers initiative. Several of the titles are packaged sets of individual titles that have information texts related to the units of study in Science 5. For more details and title annotations, visit the NSSBB website (https://w3apps.EDnet.ns.ca/nssbb).

*Allie's Basketball Dream* (16722)

*Ancient Science: 40 Time-Travelling World-Exploring, History-Making Activities for Kids* (17030)

*Archers, Alchemists and 98 Other Medieval Jobs You Might Have Loved or Loathed* (17059)

*Galimoto* (17038)

*Head to Toe Science: Over 40 Eye-Popping, Spine-Tingling, Heart-Pounding Activities That Teach Kids about the Human Body* (17029)

*Homes Everywhere* (13581)

*Inquisitive Green Level* (13802)

*Mainsails, Grade 4* (16689)

*Mainsails, Grade 5* (16690)

*Mainsails, Grade 6* (16691)

*Make Your Own Weather Station* (13165)

*National Geographic Reading Expeditions* (13497, 13498, 13499, 13500, 13501, 13502)

*National Geographic Reading Expeditions*, Language, Literacy, and Vocabulary: Physical Science Complete Kit (17034)

*National Geographic Theme Sets*, Using Simple Machines (17035)

*National Geographic: Windows on Literacy*, Fluent Plus (13610)

*National Geographic: Windows on Literacy*, Fluent Plus, Science Classroom Set (13646)

*On the Move* (13719)

*Power Magazine Introductory Package, Grade 4* (16687)

*Power Magazine Introductory Package, Grade 5* (16688)

*Power Magazine Introductory Package, Grade 6* (16766)

*Sci-Tech Connections 5* (17026)

*Science and Technology 5* (to be listed)

*Show Me! Grades 3–4* (13152)

*Show Me! Grades 5–6* (13153)

*Sky Tree: Seeing Science through Art* (16767)

*Sport Skills* (13721)

*The News Library Pack* (13567)

*The News II Library Pack* (13568)

*Weather, Stages 3–9* (6 titles) (13165)

## Professional Resources

*Make it Real* (16890)

*Non-Fiction Craft Lessons Teaching Information Writing K–8* (13623)

*Show Me! Teaching Information and Visual Texts* (13152, 13153)

## Software

*My Amazing Human Body* (51318)

*Science Court Water Cycle*, MAC/Win CD (51218)

## Other Print Resources

The following are resources that are currently not listed in *Authorized Learning Resources* but that teachers may wish to access to support the science curriculum for grade 5. Where possible, an ISBN number is included to aid in locating a title. Many of the titles are trade books available through Canadian publishers and educational distributors and can more than likely be found in publishers' catalogues. They can be found as part of classroom sets of individual titles or guided reading packs. Many of these titles would be ideal for use during independent reading time in English language arts or as short read-/think-aloud experiences by the teacher. The following titles are ones that will support students reading at grade level, struggling readers, and students reading at challenging levels. Check publisher catalogues for more information.

**Weather**

Catala, Ellen. 2004. *Stormy Weather*. Austin, TX: Steck-Vaughn-Harcourt. ISBN: 0739876376

Chambers, Catherine. 2001. *Disasters in Nature: Hurricanes*. Chicago, IL: Heinemann Library. ISBN: 158810334X

Chambers, Catherine. 2000. *Disasters in Nature: Tornadoes*. Chicago, IL: Heinemann Library. ISBN: 1588103358

Chambers, Catherine. 2002. *Wild Weather: Flood*. Chicago, IL: Heinemann Library. ISBN: 1403401128 (Other titles in this series written by the same author include *Big Freeze, Blizzard, Drought, Heat Wave, Hurricane, Thunderstorm,* and *Tornado*.)

Clifford, Pat. 2004. *Natural Disasters*. Oakville, ON: Harcourt Canada. ISBN: 189709602X

Cosgrove, Brian. 2004. Eyewitness Books, *Weather*. New York, NY: Dorling Kindersley. ISBN: 0756607361

Howell, Laura. 2003. *Introduction to Weather and Climate Change*. London, UK: Usborne Publishing. ISBN: 0794506291

Hughes, Monica. 2004. *Nature's Patterns: Water Cycle*. Chicago, IL: Heinemann Library. ISBN: 1403458863

Hughes, Monica. 2004. *Nature's Patterns: Weather Patterns*. Chicago, IL: Heinemann Library. ISBN: 1403458871

Jennings, Terry. 2000. *Make Your Own Weather Station*. Oxford, UK: Oxford University Press. ISBN: 0199157081

McDonald, Fiona. 2000. *El Niño*. Oxford, UK: Oxford University Press. ISBN: 0199157095

Miles, Elizabeth. 2005. *Watching the Weather: Wind*. Chicago, IL: Heinemann Library. ISBN: 140346555X

Owen, A., and M. Ashwell. 1999. *What Is Weather: Snow*. Chicago, IL: Heinemann Library. ISBN: 1403458863 (Other titles in this series written by the same authors include *Rain, Sunshine, Watching the Weather,* and *Wind*.)

Riley, Peter. 2000. *Weather Encyclopedia*. Oxford, UK: Oxford University Press. ISBN: 0199157065

Rodgers, Alan. 2002. *Cloud Cover*. Chicago, IL: Heinemann Library. ISBN: 1403401268

Rodgers, Alan. 2003. *Forecasting the Weather*. Chicago, IL: Heinemann Library. ISBN: 1403401276

Rodgers, Alan. 2003. *Precipitation*. Chicago, IL: Heinemann Library. ISBN: 1403401284

Rodgers, Alan. 2002. *Wind and Air Pressure*. Chicago, IL: Heinemann Library. ISBN: 1403401306

Rose, Emma. 2005. *Warning! Extreme Weather*. Bloomington, MN: Red Brick Learning. ISBN: 0736839534

Sacks, Janet. 2002. *Linking Art to the World around Us: Arty Facts, Weather and Art Activities*. New York, NY: Crabtree Publishing Company. ISBN: 0778711463 (Other titles in this series by various authors, include *Structures, Materials and Art Activities, Planet Earth; Animals; Insects and Bugs; Oceans; Plants;* and *Machines and Transportation*.)

Stewart, Sharon. 2005. *Sun at Midnight: Amazing Arctic Climate*. Don Mills, ON: Pearson Education Canada. ISBN: 0131234331

**Forces and Simple Machines**

Gaynor, Bill. 2004. *Move it!* Toronto, ON: Thomson-Nelson. ISBN: 0176283844

Glover, David. 1997. *Simple Machines—Screws*. Chicago, IL: Rigby Education. ISBN: 1403485666

Henderson, Corinne, and Alastair Smith. 2001. *Energy, Forces and Motion*. London, UK: Usborne Publishing. ISBN: 0746046308

Olien, Rebecca. 2005. *Motion*. Mankato, MN: Capstone Press. ISBN: 0736851585

Paren, Elizabeth. 2005. *Playground Science*. Don Mills, ON: Pearson Education Canada. ISBN: 0131274015

Parker, Steve. 2005. *The Science of Forces*. Chicago, IL: Heinemann Library. ISBN: 1403472920

Royston, Angela. 2001. *Machines in Motion: Levers*. Chicago, IL: Heinemann Library. ISBN: 1403440840

Royston, Angela. 2001. *Machines in Motion: Pulleys and Gears*. Chicago, IL: Heinemann Library. ISBN: 1403440859

Royston, Angela. 2001. *Machines in Motion: Ramps and Wedges*. Chicago, IL: Heinemann Library. ISBN: 1403440867

Royston, Angela. 2001. *Machines in Motion: Wheels and Cranks*. Chicago, IL: Heinemann Library. ISBN: 1403440891

Webster, Christine. 2005. *Energy*. Mankato, MN: Capstone Press. ISBN: 0736851569

**Meeting Basic Needs and Maintaining a Healthy Body**

Blevins, Wiley. 2005. *Germs*. Bloomington, MN: Red Brick Learning. ISBN: 0736839348

Butterworth, Christine. 2001. *A History of the Flu*. Oxford, UK: Oxford University Press. ISBN: 0199173702

Daniel, Claire. 2005. *Skeletons: Inside and Out*. Don Mills, ON: Pearson Education Canada. ISBN: 0131274252

Health Canada. *Eating Well with Canada's Food Guide*. (hc-sc.gc.ca)

Llewellyn, Claire. 2001. *A Body Dictionary*. Oxford, UK: Oxford University Press. ISBN: 0199173680

Nova Scotia Department of Education. 2003. *Health Education: Grades 4–6*. Halifax, NS: Province of Nova Scotia. ISBN: 0888718152

Ring, Susan. 1999. *Incredible Cells*. New York, NY: Newbridge Educational Publishing Pearson Ed. ISBN: 1582730261

Winston, Robert. 2005. *Body, An Amazing Tour of Human Anatomy*. New York, NY: Dorling Kindersley. ISBN: 9780756613716

**Properties of and Changes in Materials**

Donovan, Barbara. 2005. *It's All Matter*. Bloomington, MN: Red Brick Learning. ISBN: 0736839399

# Appendix J: Pan-Canadian Outcomes Chart

The following outcomes are from *Common Framework of Science Learning Outcomes K to 12* that were used as guidelines for this science document; column one outcomes were developed from these pan-Canadian outcomes.

## Earth and Space Science: Weather

| STSE | Skills | Knowledge |
|---|---|---|
| *Students will be expected to* | *Students will be expected to* | *Students will be expected to* |
| **Nature of Science and Technology** | **Initiating and Planning** | **300-13** describe weather in terms of temperature, wind speed and direction, precipitation, and cloud cover |
| **104-4** compare the results of their investigations to those of others and recognize that results may vary | **204-8** identify appropriate tools, instruments, and materials to complete their investigations | **300-14** describe situations demonstrating that air takes up space, has weight, and expands when heated |
| **104-7** demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results | **Performing and Recording** | **301-13** relate the constant circulation of water on Earth to the processes of evaporation, condensation, and precipitation |
| **105-1** identify examples of scientific questions and technological problems that are currently being studied | **205-4** select and use tools for measuring | **302-11** describe the key features of a variety of weather systems |
| **105-2** identify examples of scientific questions and technological problems addressed in the past | **205-7** record observations using a single word, notes in point form, sentences, and simple diagrams and charts | **303-21** relate the transfer of energy from the sun to weather conditions |
| **Relationships between Science and Technology** | **205-8** identify and use a variety of sources and technologies to gather pertinent information | |
| **106-4** describe instances where scientific ideas and discoveries have led to new inventions and applications | **205-10** construct and use devices for a specific purpose | |
| **Social and Environmental Contexts of Science and Technology** | **Analysing and Interpreting** | |
| **107-14** identify scientific discoveries and technological innovations of people from different cultures | **206-1** classify according to several attributes and create a chart or diagram that shows the method of classifying | |
| | **206-5** draw a conclusion, based on evidence gathered through research and observation, that answers an initial question | |

## Physical Science: Forces and Simple Machines

| STSE | Skills | Knowledge |
|---|---|---|
| *Students will be expected to* | *Students will be expected to* | *Students will be expected to* |
| **Nature of Science and Technology** | **Initiating and Planning** | **303-12** investigate different kinds of forces used to move objects or hold them in place |
| **105-5** identify examples of scientific knowledge that have developed as a result of the gradual accumulation of evidence | **204-1** propose questions to investigate and practical problems to solve | **303-13** observe and describe how various forces, such as magnetic, mechanical, wind, and gravitational, can act directly or from a distance to cause objects to move |
| **Social and Environmental Contexts of Science and Technology** | **204-3** state a prediction and a hypothesis based on an observed pattern of events | **303-14** demonstrate and describe the effect of increasing and decreasing the amount of force applied to an object |
| **107-8** describe examples of technologies that have been developed to improve their living conditions | **204-5** identify and control major variables in their investigations | **303-15** investigate and compare the effect of friction on the movement of an object over a variety of surfaces |
| | **204-7** plan a set of steps to solve a practical problem and to carry out a fair test of a science-related idea | **303-16** demonstrate the use of rollers, wheels, and axles in moving objects |
| | **Performing and Recording** | **303-17** compare the force needed to lift a load manually with that required to lift it using a simple machine |
| | **205-2** select and use tools in manipulating materials and in building models | **303-18** differentiate between the position of the fulcrum, the load, and the effort force when using a lever to accomplish a particular task |
| | **205-4** select and use tools for measuring | **303-19** design the most efficient lever to accomplish a given task |
| | **205-5** make observations and collect information that is relevant to a given question or problem | **303-20** compare the force needed to lift a load using a single pulley system with that needed to lift it using a multiple pulley system |
| | **205-6** estimate measurements | |
| | **205-8** identify and use a variety of sources and technologies to gather pertinent information | |
| | **Analysing and Interpreting** | |
| | **206-9** identify new questions or problems that arise from what was learned | |

# Life Science: Meeting Basic Needs and Maintaining a Healthy Body

| STSE | Skills | Knowledge |
|---|---|---|
| *Students will be expected to* | *Students will be expected to* | *Students will be expected to* |
| **Relationships Between Science and Technology** | **Initiating and Planning** | **301-8** relate bodily changes, such as acne on the skin and growth of body hair, to growth and development |
| **106-2** describe examples of tools and techniques that have contributed to scientific discoveries | **204-1** propose questions to investigate and practical problems to solve | **302-4** describe the role played by body systems in helping humans and other animals to grow and reproduce and to meet their basic needs |
| **106-4** describe instances where scientific ideas and discoveries have led to new inventions and applications | **Performing and Recording** | **302-5** describe the structure and function of the major organs of the digestive, excretory, respiratory, circulatory, and nervous systems |
| **Social and Environmental Contexts of Science and Technology** | **205-1** carry out procedures to explore a given problem and to ensure a fair test of a proposed idea, controlling major variables | **302-6** demonstrate how the skeletal, muscular, and nervous systems work together to produce movement |
| **107-12** provide examples of Canadians who have contributed to science and technology | **205-2** select and use tools in manipulating materials and in building models | **302-7** describe the role of the skin |
| **107-14** identify scientific discoveries and technological innovations of people from different cultures | **Analysing and Interpreting** | **302-8** describe the body's defences, such as tears, saliva, skin, certain blood cells, and stomach secretions, against infections |
| | **206-2** compile and display data, by hand or by computer, in a variety of formats including frequency tallies, tables, and bar graphs | **302-9** describe nutritional and other requirements for maintaining a healthy body |
| | **206-4** evaluate the usefulness of different information sources in answering a given question | |

## Physical Science: Properties of and Changes in Materials

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