

**Grade 5**  
**Life Science: Meeting Basic Needs**  
**and**  
**Maintaining a Healthy Body**

# Unit Overview

## Introduction

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

## Focus and Context

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

## Science Curriculum Links

Students have already investigated the needs and characteristics of living things, as well as growth and life cycles by the end of primary. 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 the intermediate grades.

# Curriculum Outcomes

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

## Growth and Development

### Outcomes

Students will be expected to

- propose questions to investigate about how the body works and what its components are (204-1)
- relate bodily changes, such as acne on the skin and growth of body hair, to growth and development (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)

### Elaboration—Strategies for Learning and Teaching

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

Students could brainstorm a list of questions about the functions and components of their bodies. The students could focus discussion on the following: “Why do we need to eat?”; “How does food give us energy?”; “What do my lungs do, and how do they work?”; “What happens to food after I eat it?”; “How do our bodies work?”. The point of this exercise is to get them thinking about how their bodies perform all the major functions, and to provide a focus for the rest of the unit. In keeping with the decision-making focus in this unit, questions should be raised about how substances like tobacco, alcohol, and drugs affect growth, development and their bodies. Teachers should be prepared for questions and concerns of parents who use tobacco/alcohol.

Students could, individually or in groups, make a list of body changes that occur as they grow older. When the list is completed, teachers could 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 and hair growth.

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

## Growth and Development

### Suggested Assessment Strategies

#### *Performance*

- Students could create a chart to help track changes in growth (height). They should collect data on the height of classmates and plot a graph indicating changes of height over a period of time. They should also note differences in gender and other bodily changes. (301-8)

#### *Journal*

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

#### *Paper and Pencil*

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

### Body Changes

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

#### *Presentation*

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

### Resources

*Student textbook module:*

#### *Body Works*

(204-1)

TR Lesson 1, p. 12-16

SR 1, p. 4-5

*Questions could be proposed as an introduction to all lessons.*

(301-8)

TR Lesson 1, p. 12-16

SR 1, p. 4-5

(302-4)

TR Lesson 15, p. 106-115

SR 15, p. 58-63

## The Digestive and Excretory Systems

### Outcomes

Students will be expected to

- describe the structure and function of the major organs of the digestive system (302-5a)
- carry out procedures to investigate how simulated saliva can start the digestion process by breaking down substances like starch into simple sugars, and record observations using sentences or charts (205-1, 205-7)
- describe the structure and function of the major organs of the excretory system (302-5b)
- describe examples of the products/technologies that have been developed in response to a need for the disposal, control, and containment of excrement (107-8)

### Elaboration—Strategies for Learning and Teaching

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

Students should explore the initial part of the digestive process by investigating the effect of simulated saliva (amylase) on starch. This can be explored by using the iodine test for starch: in the presence of starch, iodine turns a dark blue colour. **Caution: Iodine is poisonous.** Students can mix a soda cracker with water in a paper cup, add a drop of iodine solution, and show that starch is present by the dark colour. Then they can add their simulated saliva (a solution of amylase, available from science catalogues or health stores) to the mix, and watch the dark colour disappear as the simulated saliva breaks down the starch into simple sugars. **Caution: Due to 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 testable questions. 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 using a whole cracker in one paper cup, and a crunched up cracker in another paper cup to simulate the result of teeth action. They can then time how long it takes for the blue iodine colour to fade.

Students should investigate the role of the excretory system in ridding the body of harmful wastes and body products. Major organs include kidneys, bladder, ureters and urethra, as well as the skin and lungs. The excretory system deals with getting rid of harmful or useless materials from the body. Waste materials from the blood are collected in the kidneys, and are then sent to the bladder through the ureters, and expelled through the urethra. The lungs can also be considered part of the excretory system, since gasses not needed by the body are expelled through them. The skin also plays a role, as many chemicals are eliminated through sweat. Students can relate increased activity to sweat using their experiences in gym classes.

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

## The Digestive and Excretory Systems

### Suggested Assessment Strategies

#### Performance

- Students could complete the chart below for their observations. Teachers could ask “Why do you think there were differences in the times for the iodine to change colour?” (205-1, 205-7)

#### Starting to Digest!

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

#### Journal

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

#### Paper and Pencil

Students could:

- Label or draw a diagram (teeth, tongue, esophagus, stomach, small intestine, and large intestine) and use it to illustrate their answer. (302-5a)
- Label or draw a diagram (kidneys, bladder, ureters and urethra, as well as the skin and lungs) and use it to illustrate their answer. (302-5b)

#### Interview

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

### Resources

#### (302-5a)

TR	Lesson 4,	p. 32-37
SR	4,	p. 14-17
TR	Lesson 5,	p. 38-44
SR	5,	p. 18-21

#### (205-1)

TR	Lesson 4,	p. 32-37
SR	4,	p. 14-17
TR	Lesson 6,	p. 45-52
SR	6,	p. 22-25
TR	Lesson 7,	p. 53-59
SR	7,	p. 26-29
TR	Lesson 8,	p. 60-64
SR	8,	p. 30-31
TR	Lesson 13,	p. 90-98
SR	13,	p. 50-53

#### (205-7)

TR	Lesson 4,	p. 32-37
SR	4,	p. 14-17

#### (302-5b)

TR	Lesson 9,	p. 65-69
SR	9,	p. 34-37

#### (107-8)

TR	Lesson 9,	p. 65-69
SR	9,	p. 34-37

## The Respiratory and Circulatory Systems

### Outcomes

Students will be expected to

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

### Elaboration—Strategies for Learning and Teaching

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

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

The circulatory and respiratory systems should be investigated using pulse and breathing rates. Students should pose questions about factors they want to investigate, and design experiments around these questions. An investigation could include seeing how exercise affects breathing and pulse rates. These provide excellent opportunities to control variables, and compile and display results. **Caution: Teachers should be aware of any physical problems, like asthma, that students might have, and ensure that the investigations undertaken will not overtax these students.** 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 stop watches, spirometers and computer interface sensors can be used to accurately measure breathing and pulse rates.

Students could measure their lung capacity by blowing into a plastic tube that leads into an inverted jar filled with water. This jar should be partially submerged in a pan of water to keep the water 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. Alternatively, students could see how far they can blow a light object across a table. Students may be able to think of other ways to test lung capacity; they may have access to a spirometer through the local heart and lung association or from a local high school lab.

Students should be aware of the scientific processes they use when they do investigations. Students have just completed a fair test in which they investigated and carried out procedures in which variables were controlled and others measured. Students 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 Respiratory and Circulatory Systems

### Suggested Assessment Strategies

#### Performance

- With a partner, students could take their pulse for 15 seconds and count the number of times they breathe for two minutes. They should record this number in the chart, and then do some gentle exercise (running on the spot, skipping, push-ups, etc.) (Note: substitute other procedures related to other factors they may want to test)/ They should then take their pulse and count the number of times they breathe again. Students should draw a bar graph illustrating their results. (204-1, 204-2, 205-1, 206-2)

Trial	Pulse (before)	Pulse (after)	Breathing (before)	Breathing (after)
Person 1 Trial 1				
Person 1 Trial 2				
Person 2 Trial 1				
:				
:				

#### Journal

- Students could imagine they are in a capsule in the circulatory system. They could describe the parts through which they would move during their voyage (after leaving the heart until you return). (302-5d)

#### Interview

- What are some of the variables that need to be controlled to get a fair test during heart and breathing exercises. (104-2)
- Could we breathe without a diaphragm? Explain. (302-5c)

#### Presentation

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

### Resources

(302-5c)

TR Lesson 6, p. 45-52

SR 6, p. 22-25

TR Lesson 8, p. 60-64

SR 8, p. 30-33

(302-5d)

TR Lesson 7, p. 53-59

SR 7, p. 26-29

(204-2)

TR Lesson 6, p. 45-52

SR 6, p. 22-25

(205-1, 206-2)

Multiple references throughout resources

(104-2)

TR Lesson 6, p. 45-52

SR 6, p. 22-25

TR Lesson 8, p. 60-64

SR 8, p. 30-33

## The Skeletal, Muscular, and Nervous Systems

### Outcomes

Students will be expected to

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

### Elaboration—Strategies for Learning and Teaching

Students should investigate the structure and function of the major organs of the nervous system. Major organs include brain, spinal cord, and nerves. Students can use a variety of sources (print, electronic, software) to learn about the major organs of the nervous system.

Students could construct the skeletal system with attached muscles. These models should illustrate how the muscles are necessary to move the bones, and that the nervous system is the command centre for any movement. Teachers may want to use chicken wings, legs, and thighs to demonstrate whole muscles, tendons, ligaments, and bones, and pull away the muscle tissue to observe the bone structure. Students could compare and contrast the bones of the wing to the human arm and hand bones. The teacher may wish to get x-rays from a local hospital for use.

**Caution: Chicken parts must be cooked and dried at home by the teacher.**



Students could do 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. They should collect, analyse, and graph the response time data. The further down the ruler or pencil is caught, the slower the reaction time. These activities provide excellent opportunities to show how results from a single student can vary (the student will not be able to catch it in the exact same place every time due to variations in alertness and response time), and this will highlight the need for repeating tests and averaging results. Mathematics outcomes related to determining the mean can be addressed in this context.

Students could do research on the variety of artificial limbs that have been developed over the years, noting 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.

## The Skeletal, Muscular, and Nervous Systems

### Suggested Assessment Strategies

#### *Performance*

- Students could develop an experiment to test response time or muscular activity during physical exertion. They should compare and analyse the results of their experiment and express in graph form. (205-1, 206-3)

#### *Paper and Pencil*

Students could:

- Write a lyric or poem on the interconnection of the skeletal system. (302-6)
- Produce a report on how various technologies have arisen from the study of how our body moves. (106-4)

#### *Interview*

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

#### *Presentation*

- Students could build a model of an arm to show how the skeletal, muscular and nervous system work together. They should prepare an oral presentation using jot notes to explain how all the systems work together to produce movement. After showing their model and notes to the teacher for evaluation, they could take the model home, and give their presentation to a family member or neighbour. Students could ask them to write a brief evaluation of their presentation. (302-5e, 302-6)

### Resources

(302-5e)

TR	Lesson 12,	p. 83-89
SR	12,	p. 46-49
TR	Lesson 13,	p. 90-98
SR	13,	p. 50-53

(302-6)

TR	Lesson 11,	p. 76-82
SR	11,	p. 42-45
TR	Lesson 12,	p. 83-89
SR	12,	p. 46-49
TR	Lesson 13,	p. 90-98
SR	13,	p. 50-53

(205-1, 206-3)

*Multiple references throughout resources*

(106-4)

TR	Lesson 10,	p. 70-75
SR	10,	p. 38-41

## Body Systems

### Outcomes

Students will be expected to

- select and use tools in building models of organs or body systems (205-2)
- identify problems and work cooperatively with other students to refine their design of a model of an organ or system (207-5)

- provide examples of Canadians who have contributed to science and technology related to body organs, systems and health issues (107-12)

### Elaboration–Strategies for Learning and Teaching

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

Other possibilities include models of the respiratory system which can be made 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 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 panty hose. Models can show how muscles and bones move together. Teachers may want to set up displays or demonstrations using grocery store specimens of organs, such as beef or chicken hearts, or the skeletal system of a chicken.

Students can write a report on a local or regional scientist, inventor, or medical practitioner (male/female, variety of ethnic backgrounds) working in the medical field. Past notable Canadians include: Wilfred Bigelow, who invented the cardiac pacemaker; Banting and Best, co-discoverers of insulin; Ray Chu-Jeng Chiu, pioneer of a surgical technique for failing hearts; D. Harold Copp, discoverer of an effective treatment of osteoporosis (a bone disease); Phil Gold, developer of the first blood test for certain types of cancer; and Maude Abbott, developer of a classification for heart diseases. This could include researchers at local universities.

## Body Systems

### Suggested Assessment Strategies

#### *Paper and Pencil*

- Students could choose one of the Canadians studied in this unit, and write a paragraph about how he/she has helped us to keep healthy or contributed to our understanding of organs and/or systems. (107-12)

#### *Interview*

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

#### *Presentation*

- Students could 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. Students could work in small groups. (205-2)

#### *Informal/Formal Observation*

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

### Resources

(205-2) Multiple references throughout resource module

(207-5) Multiple references throughout resource module

(107-12)

TR Lesson 5, p. 38-44

SR 5, p. 18-21

## Maintaining a Healthy Body

### Outcomes

Students will be expected to

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

### Elaboration—Strategies for Learning and Teaching

This section can also be integrated with health/family living outcomes.

Students should discuss and investigate the body's natural defence mechanisms against diseases and illnesses (e.g., tears, saliva, skin, certain blood cells, and stomach secretions). Students may not be aware of how many germs they come in contact within 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 to contrast with people whose immune system is defective. This will highlight how we can take this for granted when it is working well.

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

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

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

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

## Maintaining a Healthy Body

### Suggested Assessment Strategies

#### *Journal*

- Students could respond to a question such as “What are some things that I eat that are nutritional?” (302-9)

#### *Paper and Pencil*

- Students could write a report about a health and/or fitness program in their community or region. They should describe what the program involves, and who it tries to help. (107-5)

#### *Interview*

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

#### *Presentation*

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

### Resources

(302-8)

TR Lesson 14, p. 99-105

SR 14, p. 54-57

(302-7)

TR Lesson 10, p. 70-75

SR 10, p. 38-41

(302-9)

*Multiple references throughout resource module*

(107-5)

TR Lesson 11, p. 76-82

SR 11, p. 42-45

*Teacher/class will need to identify local examples*

(107-2)

TR Lesson 3, p. 23-31

SR 3, p. 10-13

*Teacher/class will need to identify local examples*

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## Maintaining a Health Body (continued)

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### Outcomes

Students will be expected to

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

### Elaboration—Strategies for Learning and Teaching

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

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

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

**Caution:** Teachers should be aware of the physical limitations of students.

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**Maintaining a Healthy Body (continued)**

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**Suggested Assessment Strategies***Presentation*

- Students could develop a skit, video, song, or lyric on the importance of all the bodily systems working in harmony in maintaining a healthy body. (302-4)

*Portfolio*

- Students could select pieces of work from this unit for their portfolio. They should fill out the portfolio self-assessment.

*Interview*

- Students could interview a health care professional about changes in health care in various cultures. (105-2)

*Journal*

- I am interested in a cultural/medical technique. Why ...

**Resources**

(105-2, 107-14, 106-2)

TR Lesson 7, p. 53-59

SR 7, p. 54-57



**Grade 5**

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

# Unit Overview

## 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 in this unit should 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 that of household chemistry. Many physical and chemical changes occur as we eat, bake, clean, and repair or renovate the house. Students should relate what they are doing in this unit to household events, and inquire about the types of changes that may be occurring, and/or where the materials originated.

## Science Curriculum Links

Students are introduced to materials and their properties in the primary science program. Students address outcomes related to materials, explore buoyancy, as well as physical and chemical changes, and use their knowledge from earlier units to build structures.

In this unit, the concepts of physical and chemical changes are delineated further. This will lead to Mixtures and Solutions, Fluids, and Atoms and Elements in the intermediate grades.

# Curriculum Outcomes

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

## Properties of Materials

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

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

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



Students could brainstorm properties of solids, liquids, and gases.

Students should classify materials using their distinguishing properties:

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

Teachers can help students by demonstrating some properties of substances (swirling liquids to show that they do not keep the same shape, for example), and leading the discussion by asking questions such as, “Can you compress a liquid or solid?”

## Properties of Materials

### Suggested Assessment Strategies

#### Performance

- Students could explore the distinguishing characteristics or properties of solids or liquids, and record their observations in the table. (A similar table can be constructed for liquids.) (104-7, 300-10)

#### Properties of Solids

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

- Students could test the substances given below for solubility. They should chart their results. (104-7, 300-10)

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

#### Interview

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

#### Presentation

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

### Resources

Student textbook module:

#### *What's the Matter?*

(104-7, 300-10)

TR	Lesson 3,	p. 26-32
SR	3,	p. 10-11
TR	Lesson 4,	p. 33-40
SR	4,	p. 12-15
TR	Lesson 6,	p. 50-56
SR	6,	p. 20-21

(206-1300-9)

TR	Lesson 1,	p. 12-17
SR	1,	p. 4-5
TR	Lesson 2,	p. 18-25
SR	2,	p. 6-9

## Physical Changes

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

Students should investigate physical changes in this part of the unit - changes that affect the look, feel, strength, texture of an object, but do not actually change the object into a totally different material (cutting wood is a physical change, 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, sharpening a pencil are clearly physical changes since it is evident that no new materials are formed, but changes such as phase changes (boiling or freezing water, for example), or dissolving materials in water are not obviously physical changes, since in these cases, the change yields materials that have very different properties.

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

Some physical changes are reversible (boiling water, for example) and some are not (sanding wood into sawdust). Teachers should 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 back to pink again), and some reversible changes may be chemical rather than physical (e.g., paper changing colour).

## Physical Changes

### Suggested Assessment Strategies

#### *Performance*

- In groups, students could design an experiment to measure how temperature affects the flow rate of water, molasses, corn syrup, or milk. They should identify and control variables. Students should share their results with their classmates. They should draw a graph of the class results, and draw conclusions. **Caution: Do not exceed 20° C when heating.** (301-9, 205-5)



#### *Journal*

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

#### *Paper and Pencil*

- Students could write “physical” or “chemical” beside each change in the following list and explain their choice. (301-9, 205-5)  
Note: This assignment can be done after the section on “Chemical Changes”.
  - crumpling up paper
  - pouring water on the floor
  - lighting a match
  - mixing vinegar and baking soda
  - boiling water
  - melting a crayon to make a candle

### Resources

(104-7, 300-10)

TR	Lesson 2,	p. 18-25
SR	2,	p. 6-9
TR	Lesson 5,	p. 41-49
SR	5,	p. 16-19
TR	Lesson 8,	p. 63-71
SR	8,	p. 26-29

(104-7, 300-10)

TR	Lesson 6,	p. 50-56
SR	6,	p. 20-21
TR	Lesson 8,	p. 63-71
SR	8,	p. 26-29
TR	Lesson 10,	p. 78-84
SR	10	p. 34-37

## Chemical Changes

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

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

While it looks as though these chemical changes are not reversible, teachers should not encourage this thought. Some chemical reactions reverse quite easily, while others virtually never reverse. Instead, students should focus on the fact that new substances are formed.

Indicators are chemicals that easily undergo reversible chemical reactions, and in the process, change colours. Students could explore reactions by using blue litmus paper, which will turn pink when it reacts with chemicals such as vinegar, lemon juice, or other acids. It will turn blue when it reacts with chemicals such as baking soda, baking powder, or an anti-acid table (ENO™) dissolved in water, or other bases (alkalis).

Students can make natural indicators out of substances such as raspberries, blueberries, rhubarb, red cabbage, cherry juice, beet juice, strong tea, and carrot juice, they could simply mix one of these substances in hot water until it becomes coloured (the more colour, the better). The teacher may want to prepare some of these using boiling water. Students could experiment to try to change these indicators from one colour to another using acids and bases.

Connection to the Grade 5 Body Systems 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/she breathes in enough carbon monoxide, since it attaches to the blood in a virtually non-reversible chemical reaction. The blood is unable to bond with oxygen.

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

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



## Chemical Changes

### Suggested Assessment Strategies

#### *Performance*

- Students should explore the chemical changes that take place with approved chemicals. They should complete a table with observations. (301-12, 301-11, 301-10)
  
- After completing a table with their observations, they should then perform the same tests on the unknown (to the student) substance. Students should try to identify which of the substances it is. Note: Teachers should leave some of the tests blank, and let students decide which tests to do. (204-7, 207-3, 204-5, 206-2)

### Resources

(301-12, 301-11)

TR Lesson 11, p. 85-93  
SR 11, p. 38-41

(301-10)

TR Lesson 10, p. 78-84  
SR 10, p. 34-37

(204-7, 207-3, 204-5)

TR Lesson 11, p. 85-93  
SR 11, p. 38-41

(206-2)

TR Lesson 11, p. 85-93  
SR 11, p. 38-41

## Sources/Masses of Materials in Objects

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

Students should use a balance to determine the mass of an object. Students should determine that the total mass of an object equals the sum 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 some material, like cardboard or fabric, might be cut into pieces. The sum 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 accurate readings. Teachers might pose the question: “What happens when we burn a piece of paper? What happens to its chemical and physical characteristics? Can we measure changes in mass? Accuracy is 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 (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 the materials have been processed.

Students should do research on materials in daily life. These could include nylon, synthetic rubber, latex, Gortex<sup>TM</sup>, and household barrier wrap. Care must be taken that students do not get into the technical details of manufacturing to the extent that they are simply writing words from an encyclopedia. It is enough to determine the raw material from which the object is made, and then to have a general understanding of the processing involved. Students can look at various ores that contain some 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 material themselves. They may, for example, want to make their own paper. People from the community may be invited to show how wool from a sheep is spun. Students may take field trips to sawmills, oil refineries, or any manufacturing company. Video or other electronic media could be used to illustrate these processes and products where direct access is not possible.

## Sources/Masses of Materials in Objects

### Suggested Assessment Strategies

#### *Journal*

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

#### *Paper and Pencil*

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

#### *Presentation*

Students could:

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

#### *Portfolio*

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

### Resources

(104-5, 205-3, 300-11)

TR	Lesson 8,	p. 63-71
SR	8,	p. 26-29
TR	Lesson 9,	p. 72-77
SR	9,	p. 30-33

(107-8)

TR	Lesson 3,	p. 26-32
SR	3,	p. 10-11
TR	Lesson 5,	p. 41-49
SR	5,	p. 16-19
TR	Lesson 9,	p. 72-77
SR	9,	p. 30-33

(205-8, 300-12)

TR	Lesson 4,	p. 33-40
SR	4,	p. 12-15



**Grade 5**  
**Physical Science: Forces**  
**and Simple Machines**

# Unit Overview

## Introduction

The study of motion and the forces causing motion help students begin to build a more sophisticated understanding of forces. Students are able to move from qualitative to simple quantitative descriptions of forces acting on objects as they manipulate simple machines. 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 their advantages.

## Focus and Context

The principle focus in this unit is problem solving. Students should get many opportunities for hands-on exploration, finding how various simple machines reduce effort, and then should be given open ended challenges in which they can use simple machines, singly or in combinations, to design solutions. Assessment should focus on the students' abilities to design creative solutions, not the "right" one. Inquiry would 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 (nails, wrench, wheelbarrow) would make the unit relevant and useful. Another interesting context would be to relate the outcomes to the human body, and how biotechnology is developing machines to enhance or replace limbs. In both of these contexts, students can define problems to solve, and then design solutions involving simple machines.

## Science Curriculum Links

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

# Curriculum Outcomes

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

## Forces and their Effects

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

Teachers can engage students in a Know-Want to learn-Learned (K-W-L) activity about forces to start this unit. This will allow teachers to find out what are the students' conceptions about forces. It will provide some direction for investigations throughout the unit.

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

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

Alternatively, teachers could develop activity centres featuring different types of forces in which students rotate through a series of more structured experiences (for example, one centre could feature magnets, another could have students exploring the effect of mechanical forces, another could feature fans for exploring the force of wind).

As students are investigating the various types of forces, teachers should encourage them to find out how they can increase or decrease the amount of force that is being exerted, and note what happens. In classroom discussion afterwards, teachers should ask students what they found out. 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 downwards), teachers could ask them to hold out their hands, and lay the book on it. They will feel the force of the book on their hand, and feel their hands straining to hold the book up.

## Forces and their Effects

### Suggested Assessment Strategies

#### *Performance*

- Students could move a paper clip 0.5 m along their desk four times using four different forces, and describe the ways they moved the clip. They should identify whether they were contract or non-contact forces. (303-12, 303-13, 104-7)
- Without tipping a jar, students could describe how they could get the staple out of it? (303-13)

#### *Interview*

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

### Resources

*Student textbook module:*

#### *Putting it in Motion*

(303-12, 303-13)

*Multiple references throughout resource module*

(104-7)

TR Lesson 5, p. 36-41

SR 5, p. 18-21

(303-14)

TR Lesson 3, p. 24-30

SR 3, p. 10-13

TR Lesson 15, p. 94-103

SR 15, p. 58-63

## Forces and their Effects (continued)

### Outcomes

Students will be expected to

- make observations in order to describe force qualitatively and quantitatively (205-4, 205-5)

- estimate the force needed to lift or pull a given load in standard or nonstandard units (205-6)

### Elaborations—Strategies for Learning and Teaching

Once students are comfortable with the concept of a force, and how to increase or decrease the amount of a force (using terms such as “more” and “less”), they can measure forces quantitatively (using tools such as a spring scale or elastic bands). Students may construct their own instruments for measuring force, for example, using elastic bands (measuring how far they stretch), or Slinkies™ (measuring 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 may be introduced to the Newton as the unit of force using a spring scale that shows the force measured in Newtons. It is not important that they know the definition of a unit, but simply that it is a standard unit that indicates the amount of force being applied: The greater the force, the greater the number of Newtons. Using spring scales, students can note the number of Newtons it takes to lift or pull various objects.

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?”; “Does it take more force to move an object faster?” Students could estimate the amount of force using standard (Newton) or nonstandard (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)

### Suggested Assessment Strategies

#### *Performance*

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

#### *Paper and Pencil*

- A student lifts several objects with an elastic band, and records the force used as follows:
  - Estimate how far the elastic band would be stretched if it were used to lift an orange. (205-6)
  - Using a spring scale and a wagon, a student is to measure the force required to move the wagon (empty). Then they should repeat the experiment and add various weights to the wagon and record the results. (205-4)

### Resources

(205-4, 205-5)

TR	Lesson 7,	p. 48-54
SR	7,	p. 26-29
TR	Lesson 12,	p. 80-84
SR	12,	p. 46-49

(205-6)

TR	Lesson 8,	p. 55-59
SR	8,	p. 30-33

## Friction

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

During classroom activities in which students identify the forces acting on various objects in different situations (moving, stationary), teachers should highlight a situation in which an object was pulled (not lifted) along the floor, and the force was measured. Why do they think it took so much force to move the object? How could they reduce this amount of force? Teachers should introduce the term “friction” into the discussion. Can they describe friction? Do they know how to increase or decrease friction?

During these activities, teachers can encourage students to propose questions to investigate about the factors that affect friction. For example, if students suggest that heavier objects will experience more friction, teachers should ask them to phrase their proposal into a 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 skill of controlling variables. Factors that they may test for are mass, amount of surface that is in contact (for example, is there more friction between a 1 kg wooden cube and a surface? or a 1 kg rectangular-shaped wooden block and the same surface?), the speed at which the object is pulled (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 effect friction, students can suggest ways of reducing friction. Science Olympics activities, for example, challenge students to raise a standard object up an inclined plane with a minimum amount of force by reducing the friction involved. This can be an excellent vehicle for increasing students’ understanding of friction and the factors which affect it. Students should be exposed to the use of lubricants, surface smoothness, rollers, and wheels and axles as possible mechanisms for friction reduction. For example, they can measure the force needed to pull a book up a ramp, and then measure the forces when it is rolled up with drinking straws underneath it.

Following this, students may spend some time investigating and determining instances when friction is beneficial or necessary or when friction is harmful or unnecessary. Many types of writing activities, including fictional pieces about what would happen if there were no friction, can be used to help students clarify and broaden their thinking about the topic. For example, students could write an essay titled “Friction: It can slow you down and speed you up”, in which they include examples of how friction can help or hinder.

## Friction

### Suggested Assessment Strategies

#### *Performance*

Students could:

- Plan an experiment that investigates factors that affect friction. They could carry out the investigation, make a chart for their results, and fill out, “Let’s Experiment” write-up sheet. (204-7, 303-15)
- Pull a block across different surfaces, and record the force needed in a chart. Examples of surfaces include carpet, tiled floor, grass, or a soapy board. (303-15)
- Pull a block using various rolling objects, and record the force needed in a chart. Examples could include blocks with no wheels or rollers, blocks resting on pencils or straws, blocks resting on a skateboard, or a block resting on a ball. (106-4, 107-1)

#### *Paper and Pencil*

- Students could respond to a question such as “If you were pulling a toy, predict which surface would produce the least amount of friction: carpet, ice, gravel, or a wooden floor”. (303-15)
- Students could draw a picture of their ideas about friction. (107-1)

#### *Interview*

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

#### *Journal*

- Students could describe an invention: a machine that uses friction in a new way.

### Resources

(204-1, 204-5, 204-7)

TR Lesson 6, p. 42-47

SR 6, p. 22-25

Note misprint on p. 8 in TR: 205-1 should read 204-1

(303-15)

TR Lesson 6, p. 42-47

SR 6, p. 22-25

TR Lesson 7, p. 48-54

SR 7, p. 26-29

(107-8)

TR Lesson 7, p. 48-54

SR 7, p. 26-29

TR Lesson 8, p. 55-59

SR 8, p. 30-33

TR Lesson 11, p. 75-79

SR 11, p. 42-45

(106-4, 107-1)

TR Lesson 6, p. 42-47

SR 6, p. 22-25

TR Lesson 7, p. 48-54

SR 7, p. 26-29

## Simple Machines: An Introduction

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

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

As students explore these machines, 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 takes with the aid of a simple machine. Students can experimentally 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 measure the force required to move the object with the machine effort. For example, students could measure the force needed to lift an object 0.5 m straight up, and then measure the force needed to slide it up to a 2.0 m inclined plane to the same height. They could note that even though it was easier to slide up the ramp, they had to pull it for a longer distance. In cases where 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 where 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 about how much force it takes to move objects, and how much they can lift unaided. Until now, they have been using spring scales or constructed force sensors on smaller objects or moved things small distances. In classroom discussion, teachers should ask students how they would move something really heavy, or move something a long distance. For example, how can they lift a heavy box? Better yet, how could they lift it to the tenth floor of a building? Students will have seen heavy machinery, such as cranes and tractors, and may suggest using these, or may suggest pulleys or other simple machines that they may be aware of. Students should be encouraged to bring in household machines such as wrenches, hammers, or screwdrivers, or pictures or drawings of more complicated systems of machines 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.

## Simple Machines: An Introduction

### Suggested Assessment Strategies

#### Performance

- Students could take the table below with them to the centres around the room. Using a simple machine, they could determine if the force needed to move or lift the object is less than, equal to, or greater than the weight of the object. They should record their findings on the table beside the appropriate activity centre. (104-7, 205-2, 303-7)

#### Simple Machines Can Make My Life Easier

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

- Students should compare their findings. Which simple machine required the least force to move the mass? Which required the most? Do they see any advantage to using a simple machine to move the mass?

#### Journal

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

### Resources

(205-2)

TR	Lesson 10,	p. 67-74
SR	10,	p. 38-41
TR	Lesson 12,	p. 80-84
SR	12,	p. 46-49

(303-17)

TR	Lesson 10,	p. 67-74
SR	10,	p. 38-41

(107-8)

TR	Lesson 8,	p. 55-59
SR	8,	p. 30-33

## Simple Machines–Levers

### Outcomes

Students will be expected to

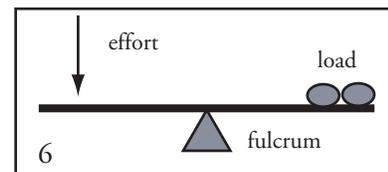
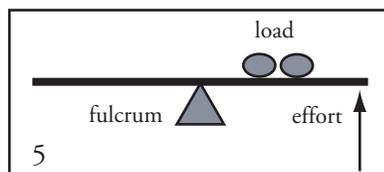
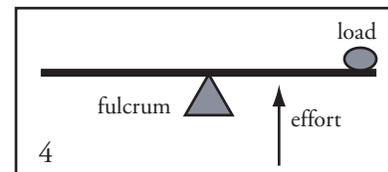
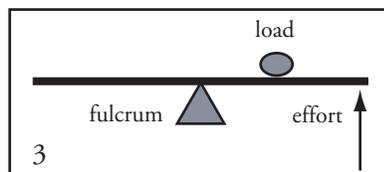
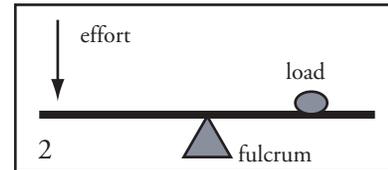
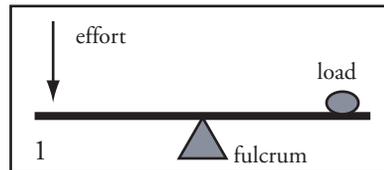
- differentiate between the position of the fulcrum, the load, and the effort force when using a lever to accomplish a particular task (303-18)
- design the most efficient lever to accomplish a given task (303-19)

### 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 (wrenches, nut crackers, wheelbarrows) can be displayed in class. While students should not be required to memorize 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 further away from the fulcrum (1 and 2). They can also try to lift the object up from the same side of the fulcrum and vary whether they are between the object and the fulcrum (4), or the object is between the lifting student and the fulcrum (3). They may also try lifting two objects (5 and 6).

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

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



## Simple Machines–Levers

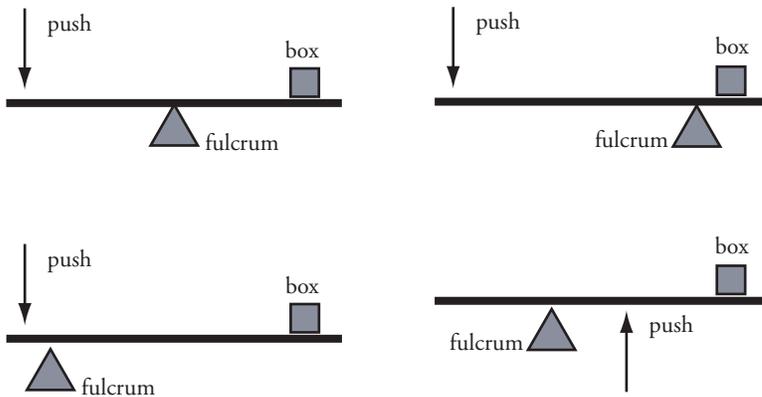
### Suggested Assessment Strategies

#### Performance

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

#### Paper and Pencil

- Students could describe in words which picture shows the easiest way to lift up a heavy box? Which show the hardest way? Which shows the box being lifted the greatest distance? (303-18, 303-19)



#### Interview

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

### Resources

(303-18, 303-19)

TR Lesson 9, p. 60-66

SR Lesson 9, p. 34-37

## Simple Machines–Pulleys, Systems of Machines

### Outcomes

Students will be expected to

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

### Elaborations–Strategies for Learning and Teaching

Students can further their investigations of simple machines 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 0.5 m, depending on the pulley combinations they use, it may take rope 2-4 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 is that has to be used.

Once students are familiar with the various simple machines, they can be given a task to explore a variety of them. They can 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 group has designed the system that matches the assigned task.

Students could dismantle discarded mechanical-based machines of various types (bathroom scales, fishing reel, clocks), label parts and observe the simple machines at work inside. **Caution: Do not use electrical appliances.** Teachers should encourage students to look around their house and community to find example of machines, such as wheelbarrows and conveyor belts, that facilitate the carrying and transportation of products, or pulleys which are used in a clothesline or in lifting the platforms used by window cleaners. Students can analyze the pictures they have 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. Examples such as the Egyptian pyramids, Britain's Stonehenge, the First Nation totem poles and inukshuks can intrigue students.

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



## Simple Machines–Pulleys, Systems of Machines

### Suggested Assessment Strategies

#### *Informal/Formal Observation*

- Teachers could assess a student’s group participation. (201-1, 206-6)

#### *Performance*

- Students could complete the table below as they carry out their investigations into pulleys. What do they notice about the force as the number of pulleys increases? What do they notice about the length of rope?
- From the simple machines they have used, students could select two or more to use together as a system of machines. They should use this system to raise a book one metre. Students should test their solution to see how much force it took, and see if they can improve it in any way. (Criteria for assessment: the use of different machines, creativity, how much did they reduce effort, space required for system) (204-7)

**Pulleys**

# of pulleys	force to lift weight 1 metre	length of rope used to lift the object 1 metre
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*

- Students could write a play, skit, or research paper (web page, oral presentation, poster) on machines. They should show how they are used today, and how they have been used in the past. (107-8, 205-8, 105-5)

#### *Portfolio*

- Students could select a piece of their best work from this unit for their portfolio.

### Resources

(303-20, 204-3)

TR Lesson 12, p. 80-84  
SR 12, p. 46-49

(204-7)

TR Lesson 15, p. 94-103  
SR 15, p. 58-63

(207-1, 206-6)

TR Lesson 8, p. 55-59  
SR 8, p. 30-33  
TR Lesson 15, p. 94-103  
SR 15, p. 58-63

(107-8)

TR Lesson 8, p. 55-59  
SR 8, p. 30-33  
TR Lesson 11, p. 75-79  
SR 11, p. 42-45

(205-8, 105-5)

TR Lesson 13, p. 85-89  
SR 13, p. 50-53



# **Grade 5**

## **Earth and Space Science: Weather**

# Unit Overview

## Introduction

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

## Focus and Context

The focus in this unit should be inquiry. Data collection and predicting are processes that 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 using instruments 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 been introduced to air, water and weather in primary. In this unit on weather, students further study the factors that affect weather. The topic is studied in further detail in Science 1206 in a unit called Weather Dynamics.

# Curriculum Outcomes

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

## Measuring and Describing Weather

### Outcomes

Students will be expected to

- identify and use weather-related folklore to predict weather (105-2)
- identify and/or construct, and use instruments for measuring weather information (204-8, 205-4, 205-10)
- use appropriate terminology in naming weather instruments and collecting weather data (104-7)
- record observations using measuring instruments in order to describe weather in terms of temperature, wind speed, wind direction, precipitation, and cloud cover (205-7, 300-13)
- classify clouds as stratus, cumulus, cirrus, or “other”, compare results with others, and recognize that results may vary (104-4, 206-1)

### Elaborations—Strategies for Learning and Teaching

Outcome 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.

Teachers should introduce students to this unit with weather sayings, folklore and indicators on how people have predicted weather in the past (for example, if cows are lying down, then it is going to rain). Students can try using these to see how well they work.

Students should construct and/or collect instruments for measuring weather information such as temperature, wind speed, wind direction, precipitation, humidity, and air pressure. Air and water thermometers, barometers, and other meteorological instruments could be constructed by students, and then used throughout this unit to collect data on the local weather.

Students could develop an illustrated glossary of terms related to the study of weather, such as the names of weather instruments, weather systems, and words that describe weather, like “humidity” and “windchill factor”.

Students could 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.

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

## Measuring and Describing Weather

### Suggested Assessment Strategies

#### Performance

- Students could use weather instruments to help they make observations. They should record these in the chart. (205-7, 300-13, 104-4, 206-1)

**Weather Observations**

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

#### Journal

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

#### Paper and Pencil

- Students could print the letter describing each instrument on the line in front of the description of the instrument. (This item can be combined with pictures of the instruments) (204-8, 205-4, 205-10, 104-7)
  - wind vane \_\_\_\_\_ Shows the direction of the wind
  - thermometer \_\_\_\_\_ Tells the air pressure, high or low
  - rain gauge \_\_\_\_\_ Tells the speed of the wind
  - anemometer \_\_\_\_\_ Provides a measure of rainfall
  - barometer \_\_\_\_\_ Tells the temperature

### Resources

Student textbook module:

#### Weatherwise

(105-2)

TR Lesson 9, p. 61-66  
SR 9, p. 34-37

(204-8, 205-4, 205-10)

TR Lesson 8, p. 55-63  
SR 8, p. 30-33  
TR Lesson 9, p. 61-66  
SR 9, p. 34-37

(104-7)

TR Lesson 4, p. 28-34  
SR 4, p. 14-17  
TR Lesson 8, p. 53-60  
SR 8, p. 30-33  
TR Lesson 9, p. 61-66  
SR 9, p. 34-37

(205-7, 300-13)

TR Lesson 8, p. 53-60  
SR 8, p. 30-33  
TR Lesson 9, p. 61-66  
SR 9, p. 34-37

(104-4, 206-1)

TR Lesson 4, p. 28-34  
SR 4, p. 14-17  
TR Lesson 9, p. 61-66  
SR 9, p. 34-37

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## Measuring and Describing Weather (continued)

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### Outcomes

Students will be expected to

- use a variety of sources to gather information to describe the key features of a variety of weather systems (205-8, 302-11)
- estimate weather measurements for various times of the day, week, or for weather systems (205-6)
- identify weather-related technological innovations and products that have been developed by various cultures in response to weather conditions (107-14)

### Elaborations—Strategies for Learning and Teaching

Examples of weather systems include hurricanes, tornadoes, sleet storms, and thunderstorms. Many 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, when various weather systems are forecast or occur both locally and globally. Students could be encouraged to estimate temperature and wind speed to assist in selecting appropriate outside clothing. Students could be encouraged to estimate the wind speed of a storm, or estimate the amount of precipitation after a rain or snowstorm.

Students should be encouraged to investigate the role and contributions of science and technology in the development of weather-related products. Students can use a variety of electronic media (television, Internet), as well as print resources, to identify weather-related products such as storm doors, weather proof clothing, Sou'wester hats, snow fences, dams and dikes in flood zones, hurricane shutters, igloos, snowshoes and sloped roofs. Teachers may wish to have individuals or pairs of students do research, and then display their findings as part of a classroom "Weather Collage/Exhibition".

## Measuring and Describing Weather (continued)

### Suggested Assessment Strategies

#### *Performance*

- Teachers could challenge students to estimate temperature and wind speed. They should take the actual temperature and wind speed, and compare predicted to actual results. (104-4, 205-6, 205-7)

#### *Paper and Pencil*

Students could:

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

#### *Interview*

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

#### *Presentation*

- Students could research in magazines, books, or electronic resources to find products that have been developed by various cultures to help them cope with their extreme weather. These products could be special clothing, roofing materials, shapes and structures of buildings, special forms of transportation, for example. Students should cut out or draw pictures for a classroom collage on weather. (107-14)

### Resources

(205-8, 302-11)

TR	Lesson 7,	p. 47-52
SR	7,	p. 26-29
TR	Lesson 8,	p. 53-60
SR	8,	p. 30-33

(205-6)

TR	Lesson 8,	p. 53-60
SR	8,	p. 30-33

(107-14)

TR	Lesson 8,	p. 53-60
SR	8,	p. 30-33
TR	Lesson 9,	p. 61-66
SR	9,	p. 34-37

## Sun's Energy Reaching the Earth

### Outcomes

Students will be expected to

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

### 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 an important role in determining the weather.

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

Students should investigate the temperature change of soil and water when exposed to a lamp for equal periods of time. They should investigate the temperature change after the lamp is removed, and draw conclusions based on their observations. 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 explored later in the next section.

## Sun's Energy Reaching the Earth

### Suggested Assessment Strategies

#### *Performance*

- With a partner, students could plan an experiment to see which heats up more quickly, water or soil. They should record their results in a chart, and graph their results using a line graph. (204-8, 205-4, 206-5)

#### *Paper and Pencil*

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

#### *Interview*

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

### Resources

(303-21)

*Multiple references throughout resource module.*

(204-8, 205-4, 206-5)

TR      Lesson 3,      p. 22-27

SR              3,      p. 10-13

## Properties of Air

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

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

Students can mass uninflated balloons or air mattresses, and then remass them when they are full of air to demonstrate 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 a greater pressure closer to sea level because of all of the air “stacked” on top of it.

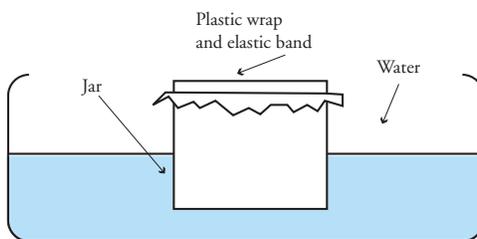
An example of a way to demonstrate that air expands when heated or contracts when cooled is to submerge a tube or bottle in water until it is partly filled with water, and the rest is air. Invert the bottle or tube so that it is upside down, with the opening sitting in the water, and the water level in the tube or bottle showing above it. Mark the side of the bottle to show the water level (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 submerge it in water of room temperature. Mark the water level with the balloon submersed. Then, using an identical amount of warm water, submerge the balloon again, wait a few minutes, and mark the water level with the balloon submersed. It should take up more space when it is warm. This can also be done with cold water. An alternative activity involves placing the balloon under a lamp or in the refrigerator.

## Properties of Air

### Suggested Assessment Strategies

#### Performance

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



#### Paper and Pencil

- Students could respond to questions such as “Why is the air pressure greater at sea level than at the top of a mountain? Draw a diagram to show your reasoning”. (300-14)

#### Interview

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

### Resources

(300-14)

TR Lesson 2, p. 14-21  
SR 2, p. 6-9

(206-5)

TR Lesson 5, p. 35-41  
SR 5, p. 18-21  
TR Lesson 6, p. 42-46  
SR 6, p. 22-25  
TR Lesson 7, p. 47-52  
SR 7, p. 26-29

## Movement of Air and Water

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

Patterns of indoor air movement are far more subtle than outdoor patterns of movement. Students can investigate patterns of indoor air movement putting their hands about 0.5 meters above a radiator, and noting the rising warmed air. They may try to detect the direction of the moving air by clapping a chalk eraser over it, or letting small feathers from a down pillow drift over the heater. **Caution: adding extra chalk dust and feathers in the classroom may irritate asthmatic students.** They will also note moving air with fans or open windows. Outdoor air movement is much more pronounced. Students can easily feel the wind, and can use a wind vane to measure its direction at various times of the day, and an anemometer to measure its speed. Satellite images can show the pattern of air movement on a more global level.

To illustrate the air pattern movements, teachers can use the fact that both air and water are considered fluids and behave similarly. Investigations regarding air flow patterns can more easily be shown by experimenting with water. Students can investigate these patterns by heating up one side of a large beaker or aquarium with heat lamps or a heat source. Alternatively, they might put a bag of ice on one side of the aquarium, and float a bowl of hot water on the other side. As the water is warming on one side, a drop of food colouring can be added to show how the water is moving. Students will see that the warm water moves up and over on top of the cold water, and the cold water moves down and across to replace the warm water. The same circular pattern, called convection, holds in air: warm air rises, and cool air sinks and moves 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 now 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 so 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 night-time, this situation reverses as the land cools down quickly once the sun disappears, while the water cools down much more slowly.

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



## Movement of Air and Water

### Suggested Assessment Strategies

#### Performance

- How often does the wind change direction and speed? Students could keep track by filling in the table for a week. (302-10)

#### Tracking the Wind

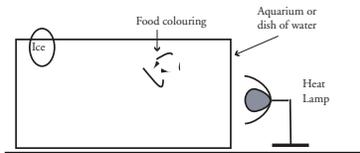
Time	Day 1				Day 2
	Before School	Recess	Lunch	After School	Before School
Wind Direction					
Wind Speed					

#### Journal

- One day it 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)
- Places where I can feel moving air when I am inside are: ... It moves (describe pattern, if any). (302-10)
- When I am outside, I feel moving air whenever I feel the wind. Over a one week period, ... (describe results of their observations, draw conclusions about patterns of outdoor air movement). (302-10)

#### Paper and Pencil

- From their observations, students could draw arrows to show the pattern of food colouring movement. They should write a conclusion about the direction of water movement of different temperatures. They should describe any evidence that air behaves the same way? (206-5)
- Students could draw arrows to show the direction of the wind in the middle of a hot summer day. They should explain their arrows. (206-5)



### Resources

(302-10)

TR	Lesson 5,	p. 35-41
SR	5,	p. 18-21
TR	Lesson 7,	p. 47-52
SR	7,	p. 26-29
TR	Lesson 11,	p. 73-84
SR	11,	p. 42-47

(301-13)

TR	Lesson 4,	p. 28-34
SR	4,	p. 14-17
TR	Lesson 11,	p. 73-84
SR	11,	p. 42-47

## Predicting the Weather

### Outcomes

Students will be expected to

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

### Elaborations—Strategies for Learning and Teaching

Students could continue to collect weather data throughout this unit, and will have explored some of the theory behind the causes of wind and precipitation. They should begin to analyze the data, looking for patterns. They should now look at how weather forecasts are made and how they have developed over the years.

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

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

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

Students can then make weather forecasts based on the indicators and sayings that they have collected and compiled. Since they have only collected weather data for a limited period of time, they will be able to see some patterns and be able to explain some of these based on the theory investigated in the last section, but the usefulness of this data for making predictions will be limited. They will find that they can make short term forecasts to a fair degree of accuracy using the indicators and sayings, but their ability to make long-range forecasts will be limited. These may improve if they include satellite images in their analysis which are available on the Internet.

## Predicting the Weather

### Suggested Assessment Strategies

#### Performance

- In the top row of the table below, students could fill in some of the different ways they have learned to predict the weather based on the people in the community you have talked to. They should fill in the table for a week, and write a paragraph describing their results. (107-2, 107-10, 204-3, 207-4, 301-14)

#### Predicting the Weather

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

#### Paper and Pencil

Students could:

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

#### Presentation

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

### Resources

(206-2, 206-3)

TR	Lesson 9,	p. 61-66
SR	9,	p. 34-37
TR	Lesson 11,	p. 73-84
SR	11,	p. 42-47

(107-2, 107-10, 207-4)

TR	Lesson 8,	p. 53-60
SR	8,	p. 30-33
TR	Lesson 9,	p. 61-66
SR	9,	p. 34-37

(107-5)

TR	Lesson 9,	p. 61-66
SR	9,	p. 34-37

(204-3, 301-4)

TR	Lesson 9,	p. 61-66
SR	9,	p. 34-37

## Environmental Issues

### Outcomes

Students will be expected to

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

### Elaborations–Strategies for Learning and Teaching

Examples of weather phenomena that can be studied are the effects thought to be caused by the Green House Effect or Global Warming, acid rain, and El Niño/La Niña. In this part of the unit, students should gain some awareness of some current weather and climate related issues. Students will be introduced to the causes and effects of global warming, depletion of the ozone, and acid rain. Other weather/environmental issues can also be addressed, such as volcanic emissions, and deforestation. 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, with information being gathered 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 using models. As an example, students may wish to simulate the effects of acid rain on plant growth. The greenhouse effect can be simulated by comparing the temperatures in two identical jars, one of which is covered in plastic wrap 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, 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 dependant 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 effect 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 a realization that the applications of science and technology can have both intended and unintended effects.

## Environmental Issues

### Suggested Assessment Strategies

#### *Presentation*

- Students could create a presentation (cartoon, brochure, poster, report, web page) on a current weather-related environmental topic from the list below. They should give a description of the environmental issue, and suggest inventions or innovations that have been developed because of the problem. (105-1, 106-4, 108-1)
  - acid rain
  - global warming
  - the ozone hole
  - El Niño or La Niña
  - volcanic emissions
  - others

#### *Portfolio*

- Students could select a piece of their best work from this unit for their portfolio.

### Resources

#### *(105-1)*

TR	Lesson 6,	p. 42-46
SR	6,	p. 22-25

#### *(108-1)*

TR	Lesson 10,	p. 67-72
SR	10,	p. 38-41

#### *(106-4)*

TR	Lesson 10,	p. 67-72
SR	10,	p. 38-41

