Grade 6

Life Science: Diversity of Life

Unit Overview

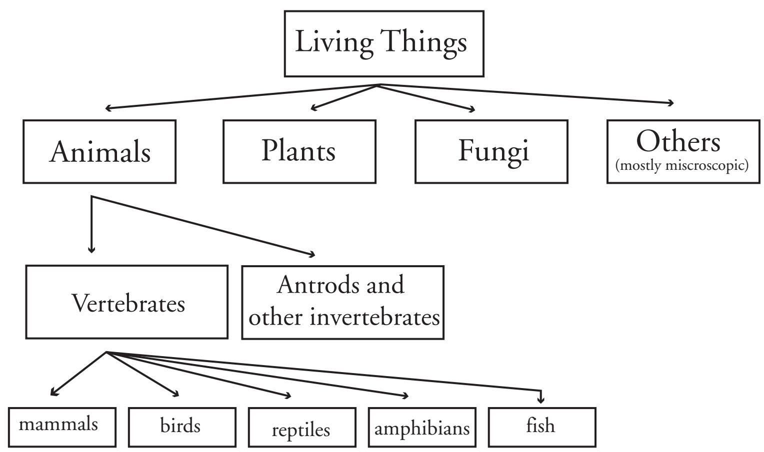
Introduction

Students are able to recognize that living things can be subdivided into smaller groups. As an introduction to the formal biological classification system, students should focus on plants, animals, and microorganisms. Students should have the opportunity to learn about an increasing variety of living organisms, both familiar and exotic, and become more precise in identifying similarities and differences among them.

Focus and Context

Inquiry is the focus in this unit, with an emphasis on observation and classification. Students should be involved in closely observing living things (plants, animals and microorganisms), noting their features, and constructing classification schemes that group organisms with like features. They should also be introduced to formal classification schemes through classification within the animal kingdom. Students will gain an appreciation for the diversity of life in their local habitat, in their province, in the world, and, through fossil studies, over time.

This diagram illustrates the organisms and classifications that will be addressed in this unit. Note that this is **not** a complete, formal biological classification scheme.



Science Curriculum Links

Students have investigated the needs and characteristics of living things, and explored the growth and changes in animals and plants in primary science.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

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

104-8 demonstrate the importance of using the languages of science and technology to compare and communicate ideas, processes, and results

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

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

Relationships Between Science and Technology

106-3 describe examples of improvements to the tools and techniques of scientific investigation that have led to new discoveries

Social and Environmental Contexts of Science and Technology

107-1 describe examples, in the home and at school, of tools, techniques, and materials that can be used to respond to their needs

107-6 provide examples of how science and technology have been used to solve problems around the world

107-11 identify examples of careers in which science and technology play a major role

Skills

Students will be expected to

Initiating and Planning

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

204-6 identify various methods for finding answers to given questions and solutions to given problems, and select one that is appropriate

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

Performing and Recording

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

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

Analysing and Interpreting

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

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

Communication and Teamwork

207-2 communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawing, and oral language

Knowledge

Students will be expected to

300-15 describe the role of a common classification system for living things

300-16 distinguish between vertebrates and invertebrates

300-17 compare the characteristics of mammals, birds, reptiles, amphibians, and fish

300-18 compare the characteristics of common arthropods

300-19 examine and describe some living things that cannot be seen with the naked eye

302-12 describe how microorganisms meet their basic needs, including: obtaining food, water, and air, and, moving around

301-15 compare the adaptations of closely related animals living in different parts of the world and discuss reasons for any differences

301-16 identify changes in animals over time, using fossils

The Role of a Common Classification Scheme for Living Things

Outcomes

Students will be expected to

- identify different ways to classify living things in their local habitat, and select one (204-6)
- classify living things in the local habitat and create a chart or diagram that shows the method of classifying (206-1)
- present a selected classification scheme to others (207-2)
- describe how classifications may vary and suggest possible explanations for variations (104-5)
- identify communication problems that arise from the differences in classification schemes for living things, and describe the role of a common classification system (206-9, 300-15)

Elaborations–Strategies for Learning and Teaching

Students should start this unit by going out to a local habitat (forest, seashore, pond, meadow, park, wooded area), and observe and record the wide variety of species that they see. Using other sources, such as magazines, videos, field guides and other media, they can appreciate the greater diversity of life. From their observations and research, students can classify their organisms into groups based on characteristics they select. They may use fairly specific characteristics or more general groupings related to insects, plants, fungi, trees, animals or combinations of each. Students can then attempt to sort them using different characteristics, and come up with a totally different classification scheme. As they compare their schemes with others in the class, they will see that their classification schemes will not be the only way to classify organisms.

Teachers could initiate a discussion around the necessity for a common classification scheme in order for scientists to communicate using the same language and terminology. There are more than one million species of living things, with the possibility of millions more yet to be discovered. This raises questions about how we can simplify the presentation of information about so many different species. Discussion should lead to the advantages of grouping or classification of organisms on the basis of common characteristics and the necessity of a common classification scheme.

Background: Classification schemes have changed over the years as new information has accumulated. An early classification scheme had all organisms divided into two kingdoms: plants and animals. A more recent classification scheme divides all organisms into five kingdoms (monerans, protists, fungi, plants and animals). At this level, students should be able to identify three of the five kingdoms: animals, plants, and fungi. The other two kingdoms can be grouped together as being microorganisms. These will be further distinguished in high school biology.

See the introductory page for the extent to which organisms will be classified in this unit. The use of the terms kingdom, phylum, and species may be used, but it is not necessary to go into the full formal classification scheme for individual species. It is enough to show the common characteristics of some phyla, and to look at some examples of species that belong to them.

The Role of a Common Classification Scheme for Living Things

Suggested Assessment Strategies

Performance

- Students could collect leaves in their neighbourhood. After careful observation, they should decide on a way to group the leaves they have collected. In their note book, they should write or chart the characteristics they decided on to group the leaves, and then draw pictures of the leaves in each group, or paste the leaves into their book in the appropriate place. Students might be challenged to identify the plant to which they belong. (Classification should be done with a variety of living things, such as insects and flowers). (204-6, 206-1)
- Students could share their classification scheme with other groups, and compare and contrast the schemes. (207-2)

Journal

- On my trip to the farm (seashore, park, garden centre), I saw many types of organisms ... (Students can continue to write about their experience, recording their point of interest during the trip. Teachers should encourage them to organize their journal entry into sections: one for animals, plants, fungi, if appropriate). (206-9, 300-15)

Paper and Pencil

- Here is an example of what could happen if scientists did not group and name organisms the same way: Fred, a scientist, is studying living things in Africa, and groups all the frogs, toads, and lizards (cold-blooded creatures) in a group called "grogs". Marie, another scientist doing a similar study, groups frogs, fish, and whales (water creatures) together and calls them "moists".
    a. Are Fred and Marie grouping their living things the same way? Is one better than the other? Explain. Could they compare their results of their investigations?
    b. If every scientist grouped living things the way they wanted, and called their groups by different names, what problems would it cause when they talked to each other about their ideas? (206-9, 300-15)

Interview

- Did your group classify things the same way other groups did? Why or why not? Is there more than one way we can classify organisms? (104-5)

Resources

(204-6)

TR	*Lesson 4,*	*p. 32-38*
SR	*4,*	*p. 14-17*

(206-1)

TR	*Lesson 2,*	*p. 16-23*
SR	*2,*	*p. 6-9*
TR	*Lesson 4,*	*p. 32-37*
SR	*4,*	*p. 14-17*

(207-2)

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

(104-5)

TR	*Lesson 2,*	*p. 16-23*
SR	*2,*	*p. 6-9*
TR	*Lesson 4,*	*p. 32-37*
SR	*4,*	*p. 14-17*

(206-9, 300-15)

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

The Animal Kingdom: Vertebrates and Invertebrates

Outcomes

Students will be expected to

- classify animals as vertebrates or invertebrates (104-8, 300-16)
- compare the characteristics of mammals, birds, reptiles, amphibians, and fish (300-17)
- record observations while investigating common arthropods (205-7)
- compare characteristics of common arthropods (300-18)
- classify invertebrates as arthropods or "other invertebrates" (206-1)

Elaborations–Strategies for Learning and Teaching

In this section, students are introduced to classifying animals as vertebrates (animals with a backbone) or invertebrates (animals without backbones).

Students can attempt to classify the animals from their list of organisms as vertebrates or invertebrates (most of the organisms from the habitat study will probably be invertebrates—invertebrates outnumber vertebrates in diversity and number, and most of the vertebrates will have, in all probability, remained well hidden). They can also classify other animals that they have seen from magazines, journals, software, books, field trips to zoos, natural history museums, or aquaria. Students should have opportunities to see reconstructed backbones or models of backbones, and compare and contrast them with exoskeletons of lobsters or crabs.

From their list of vertebrates, students, individually or in groups, can classify the organisms further. Teachers should challenge students to find a variety of ways to group their vertebrates. Students can report their schemes to the class, and explain why they choose them. As long as their schemes are based on set characteristics, they are valid classifications. However, for global communication, a common classification scheme has to be agreed on, and, at some point, the common groups of vertebrates (fish, amphibians, reptiles, birds and mammals) should be introduced, and their common characteristics identified. As much as possible, students should be given opportunities to study live and preserved organisms or view videos of animals that are representative of these groups.

The invertebrates will not be completely classified in this unit. Of approximately thirty invertebrate phyla, this unit will only distinguish the arthropods (many jointed legs). Students could collect real specimens and/or pictures of common arthropods, and bring them to class where they could observe and record characteristics of this group. Insects make up a large portion of arthropods, and provide interesting and motivating specimens for investigations. Students can investigate these organisms outdoors, or set up artificial indoor habitats for them, such as ant farms or jars with dirt, leaves and food or wood scraps. Other arthropods that can be explored are lobsters and crabs, centipedes and millipedes, and spiders.

The Animal Kingdom: Vertebrates and Invertebrates

Suggested Assessment Strategies

Performance

- From drawings, specimens, pictures, or a list of animals, students could classify each organism as a vertebrate or invertebrate, and then further classify them as mammals, birds, reptiles, amphibians, fish, arthropods, or other invertebrates. (Provide drawings, pictures, or list of animals) (104-8, 206-1, 300-16, 300-17)
- Students could examine pictures or specimens of arthropods. They should investigate the relationship between the mouth parts and feeding behaviour of Arthropods. How does the arthropod's mouth parts help it feed? Students should record their findings (Sketches and description). (205-7)

Journal

- In their journal, students could draw pictures and describe some of the arthropods they have investigated. Was it easy to see the similarities in these different organisms? What similarities did they find first? Were there any features that they thought all arthropods had, but then found out that they did not? (205-7, 300-18)

Paper and Pencil

- Students could respond to questions such as, "What questions would you ask to determine if an animal is a mammal, bird, reptile, fish or amphibian?" (300-17)

Interview

- Students are shown pictures or specimens of skeletons of various vertebrates, including some fish, birds, mammals. How are these skeletons alike? How are they different? Teachers should note whether students indicate that animals that can look very different on the outside can have very similar skeletons. (300-17)

Portfolio

- Students could select one of their best pieces of work on invertebrates or vertebrates. Teachers should evaluate this work on the Portfolios Assessment sheet.

Resources

(104-8, 300-16)

TR	*Lesson 7,*	*p. 52-56*
SR	*7,*	*p. 26-29*
TR	*Lesson 8,*	*p. 57-65*
SR	*8,*	*p. 30-33*

(300-17)

TR	*Lesson 8,*	*p. 57-65*
SR	*8,*	*p. 30-33*

(205-7)

TR	*Lesson 5,*	*p. 39-45*
SR	*5,*	*p. 18-21*
TR	*Lesson 6,*	*p. 46-51*
SR	*6,*	*p. 22-25*

(300-18)

TR	*Lesson 5,*	*p. 39-45*
SR	*5,*	*p. 18-21*
TR	*Lesson 6,*	*p. 46-51*
SR	*6,*	*p. 22-25*
TR	*Lesson 7,*	*p. 52-56*
SR	*7,*	*p. 26-29*

(206-1)

TR	*Lesson 8,*	*p. 57-65*
SR	*8,*	*p. 30-33*

Microorganisms

Outcomes

Students will be expected to

- identify and use correctly appropriate tools to examine and describe some living things that cannot be seen with the naked eye (204-8, 300-19)
- describe how microorganisms meet their basic needs, including obtaining food, water, and air, and moving around (302-12)
- provide examples of how science and technology have been involved in identifying and controlling the growth of microorganisms (107-6)
- describe products and techniques that can be used at home to protect against unwanted microorganism growth (107-1)

Elaborations–Strategies for Learning and Teaching

When using microscopes, students should start with hands on instruction on the proper way to use and care for a microscope. Microscope video cams can be connected to a large screen television, computer monitor, or projection unit to show the whole class the features of microorganisms. Hand lenses and mini microscopes can be used to view microscopic characteristics.

A magnifying learning centre that also includes illustrations of other magnifying devices, such as electron microscopes, would be ideally suited for this purpose. A field trip to a local university or research facility might be arranged so that students can see some of the more advanced devices used in the study of the microscopic world.

Students should describe how microorganisms meet basic needs. Samples of pond water, compost material, aquarium glass scrapings or prepared slides can provide specimens for study. Features of the microorganisms, such as flagella or cilia, that are used to help the microorganisms meet their needs, should be highlighted. Commercially prepared slides of microorganisms, some stained so that features are more visible, can be used. Microorganisms can also be explored through the use of videos that show how microorganisms move, meet their other basic needs such as food, air and water, as well as the role some of these microorganisms have in disease, composting and other areas.

Students should understand that microorganisms can be both advantageous (e.g., food digestion in the bowel, composting sanitation, food preservation, and disease control) and disadvantageous (e.g., spreading many germs and diseases) to humans. Guest speakers, or students' interviews with grocers, food processors, fish plant workers, sanitation workers, health inspectors, public health nurse or other people in their community, are good exercises.

Students could discuss examples of technological innovations that have been developed to protect against unwanted microorganisms such as cleaning solutions, processed lunch packages, canned goods, preserving jars, and antibacterial hygienic products like toothpaste, creams, and soaps. In the section "Adaptations and Natural Selection", the impact of using antibacterial products can be discussed again. These activities provide an excellent opportunity for students to appreciate and connect the role and contribution of science and technology in their lives.

Microorganisms

Suggested Assessment Strategies

Performance

- Using a prepared slide, students could use a microscope (or microviewer) to focus the slide properly. When they have finished adjusting the microscope, they should ask the teacher to check their technique. They should draw a sketch of what they see. (204-8, 300-19)

Journal

- Students could write a paragraph about two microorganisms: one that can be harmful to humans and one that can be good for humans. They should collect or draw pictures of these microorganisms, and research the features in these microorganisms that help their movement and feeding. (302-12)

Paper and Pencil

- Research Assignment: Using a specific example (e.g., strep throat, e-coli in food products) students could describe the roles of both science and technology in controlling harmful bacteria in one of the following: sanitation, food preservation and disease control. (Students should differentiate between scientific study of the organisms, and technological products and techniques that have been developed to control the organisms.) (107-6)

Presentation

- Students could prepare a poster showing some pictures or drawings of magnified objects using magnifying glasses, microscopes and electron microscopes. Under each picture, they should identify the object that was magnified, the instrument that magnified it, and the extent to which it was magnified (for example (40x). (204-8, 300-19)
- Students could collect the labels and brochures of disinfectants and antibacterial hygienic products. They should make a poster displaying product labels which are used to protect against microorganism growth. (107-1)
- A short skit could be developed on good and bad bacteria. This could be video recorded or presented live. (107-1)

Portfolio

- Students could select one of their best pieces of work on microorganisms for their portfolio. (302-12, 107-6, 107-1)

Resources

(204-8, 300-19)
TR Lesson 9, p. 66-73
SR 9, p. 34-37

(302-12)
TR Lesson 10, p. 74-79
SR 10, p. 38-41

(107-6)
TR Lesson 10, p. 74-79
SR 10, p. 38-41

(107-1)
TR Lesson 10, p. 74-79
SR 10, p. 38-41

Adaptations and Natural Selection

Outcomes

Students will be expected to

- propose questions about the relationship between the structural features of organisms and their environment, and use a variety of sources to gather information about this relationship (204-1, 205-8)
- compare the adaptations of closely related animals living in different parts of the world and discuss reasons for any differences (301-15)
- describe reasons why various animals are endangered, and describe efforts to study their population size and ensure their continued existence (105-1, 107-6)
- identify changes in animals over time, using fossils (301-16)
- identify the theory of natural selection as one that has developed based on the gradual accumulation of evidence (105-5)
- identify palaeontologists as people who study fossils, and describe examples of improvements to some of their techniques and tools that have resulted in a better understanding of fossil discoveries (106-3, 107-11)

Elaborations–Strategies for Learning and Teaching

In classroom discussion, teachers can encourage students to ask questions about the adaptations and structural features of organisms. For example, students could ask, "Why does this frog have such a long tongue?" Questions like these should be rephrased to "What does the frog use his long tongue for?" and used as the basis of an investigation. Students can study the organisms they found in their field study to see the features that they have they help them live in their particular habitat.

They should explore similar organisms that live in different parts of the world (e.g., arctic hare and snowshoe hare), and inquire about the structural differences in these organisms, and how these structural differences help them in their environment.

Students can inquire into the conditions that have led to the endangerment of various species. They can investigate local and global examples to see how information about population size is determined, and what efforts are being made to ensure the survival of these species. This will encourage students to be aware of and develop a sense or responsibility for the welfare of living things.

Students should explore what types of fossils have been found and the theories that exist about what caused particular organisms (e.g., dinosaurs) to become extinct. Field trips to fossil exhibits or local sites are encouraged. The use of software, the Internet, print resources and audiovisual resources would also be good sources of information about fossils.

Students should explore evidence of natural selection from studies of bacterial strains that are resistant to antibiotics. Superbugs have developed due to the overuse of antibacterials creams. Students can explore genetic research on genetically modified organisms, for example, tomato, potato, corn, and fish.

Students should also investigate the tools and techniques paleontologists use to acquire knowledge about fossils. The focus is on how paleontologists used to do their work (finding and cleaning fossils, trying to piece together skeletal remains, trying to estimate the age of the fossils) and contrast is with some of the techniques and tools available (computer generated drawings of dinosaurs, carbon-dating) so that a more accurate age of the fossil can be determined. The goal is for students to see that improvements in scientific techniques and technological tools can lead to better scientific knowledge, and not to be able to explain how these new techniques and technological tools actually work.

This section provides an excellent opportunity for students to explore a variety of science-related careers related to the diversity of life.

Adaptations and Natural Selection

Suggested Assessment Strategies

Journal

- Students could write about their personal feelings regarding endangerment of local species. (105-1, 107-6)

Paper and Pencil

- Students could choose a pair of animals from the list below and find out what part of the world they are usually found. They should describe one difference between each of them and explain how that difference helps that animal survive in its habitat. Examples that might be used include:

    a. brown bear and polar bear
    b. red fox and arctic fox
    c. red-eyed tree walker frog and poison dart frog
    d. Beluga whale and Orca whale (301-15)

- Students could write a report about palaeontologists. They should include a description of what they study, some of the techniques they use in their work, and how their work has contributed to our understanding of life on Earth in the past. (106-3, 107-11)

Presentation

- Students could choose an organism and describe the structural features that enable it to survive in its environment. They should focus on the structural features that the organism has for moving, obtaining food, and protecting itself. Students should describe how these help it to survive in its environment. They should present their findings to the class using drawings, pictures, video or skit. (204-1, 205-8)
- From a list of endangered species, students could choose one and research it. Why is it endangered? What is being done to protect it? They could work in pairs and present their findings to the class. (105-1, 107-6)
- Students could create a poster showing extinct organisms that lived on Earth long ago and similar organisms that live on Earth today. (204-1,301-16)

Resources

(204-1, 205-8)

TR	*Lesson 3,*	*p. 24-31*
SR	*3,*	*p. 10-13*
TR	*Lesson 11,*	*p. 80-86*
SR	*11,*	*p. 42-45*
TR	*Lesson 14,*	*p. 99-106*
SR	*14,*	*p. 54-57*
TR	*Lesson 15,*	*p. 107-116*
SR	*15,*	*p. 58-63*

(301-15)

TR	*Lesson 3,*	*p. 24-31*
SR	*3,*	*p. 10-13*
TR	*Lesson 11,*	*p. 80-86*
SR	*11,*	*p. 42-45*

(105-1, 107-6)

TR	*Lesson 14,*	*p. 99-106*
SR	*14,*	*p. 54-57*

(301-16)

TR	*Lesson 12,*	*p. 87-92*
SR	*12,*	*p. 46-49*
TR	*Lesson 14,*	*p. 99-106*
SR	*14,*	*p. 54-57*
TR	*Lesson 15,*	*p. 107-116*
SR	*15,*	*p. 58-63*

(105-5)

TR	*Lesson 14,*	*p. 99-106*
SR	*14,*	*p. 54-57*

(106-3, 107-11)

TR	*Lesson 12,*	*p. 87-92*
SR	*12,*	*p. 46-49*
TR	*Lesson 13,*	*p. 93-98*
SR	*13,*	*p. 50-53*

Grade 6
Physical Science: Electricity

Unit Overview

Introduction

Students encounter electricity every day of their lives. A basic understanding of how electricity works can help students recognize the need for safe practices when around electricity, begin to realize that they have control over how much electricity they use in the home and at school, and begin to understand the impact energy consumption has on resources used to generate electricity.

Focus and Context

There is a dual focus in this unit, inquiry and problem solving. Students should be encouraged to investigate which materials conduct electricity, and compare a variety of circuit pathways. From this, they should be able to design solutions to electrical problems by completing various circuit pathways.

The context for this topic should be on electrical systems. Our society's reliance on electricity is pervasive; one need only think about the implications of an extended blackout to realize the extent to which our society depends on electricity. Electrical appliances, houses, small towns, and large cities use and depend on electricity to function.

Science Curriculum Links

This unit follows from a primary science unit, Invisible Forces, in which students explore static electricity. Students will explore electricity again in intermediate.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

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

105-3 describe examples of scientific questions and technological problems that have been addressed differently at different times

Relationships Between Science and Technology

106-3 describe examples of improvements to the tools and techniques of scientific investigation that have led to new discoveries

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

Social and Environmental Contexts of Science and Technology

107-9 compare past and current needs, and describe some ways in which science and technology have changed the way people work, live, and interact with the environment

108-5 describe how personal actions help conserve natural resources and protect the environment in their region

108-8 describe the potential impact of the use by humans of regional natural resources

Skills

Students will be expected to

Initiating and Planning

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

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

204-4 define objects and events in their investigations

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

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

Performing and Recording

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

205-3 follow a given set of procedures

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

205-9 use tools and apparatus in a manner that ensures personal safety and the safety of others

Analysing and Interpreting

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

Communication and Teamwork

207-2 communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawings, and oral language

Knowledge

Students will be expected to

303-31 identify and explain the dangers of electricity at work or at play

303-23 compare a variety of electrical pathways by constructing simple circuits

300-20 compare the conductivity of a variety of solids and liquids

303-24 describe the role of switches in electrical circuits

303-25 compare characteristics of series and parallel circuits

303-22 compare the characteristics of static and current electricity

303-27 describe the relationship between electricity and magnetism when using an electromagnet

303-26 demonstrate how electricity in circuits can produce light, heat, sound, motion, and magnetic effects

303-28 identify various methods by which electricity can be generated

303-29 identify and explain sources of electricity as renewable or nonrenewable

303-30 identify and explain different factors that could lead to a decrease in electrical energy consumption in the home and at school

Electrical Safety

Outcomes

Students will be expected to

- use tools and apparatus such as batteries, bulbs, and wires in a manner that ensures personal safety and the safety of others (205-9)
- identify and explain the dangers of electricity at work or at play (303-31)
- describe examples of how our knowledge of the hazards of electrical shock has led to the development of electrical safety features (106-4)

Elaborations–Strategies for Learning and Teaching

Students should use tools and apparatus such as batteries, bulbs, and wires for the various activities throughout this unit. Since students will be working with various electrical devices, safety outcomes should be reinforced as the unit is completed.

Students should be made aware of the dangers of shock related to electrical sockets, especially when it comes to inserting metallic objects in them. This could be addressed with outcomes related to insulators and conductors.

Project work, safety videos, classroom discussions, or class presentations by electricians or fire department are recommended. Qualified people should be used. Students should be made aware of electrical dangers like

- taking electrical devices like radios into the bathroom or near the bath
- fallen power lines
- climbing transmission towers and climbing trees or flying kites near power lines
- frayed or exposed wires
- pulling out plugs by the cord
- taking apart electrical appliances (some contain capacitors which store electrical charge even if unplugged)

Students can read articles and/or identify preventive or safety features that have been developed, such as the three prong plug, circuit breakers, grounding wires and fuses. Guest speakers, such as utility company personnel, could be invited to the class.

Students can create charts, collages, videos or other displays that illustrate electrical safety.

Electrical Safety

Suggested Assessment Strategies

Presentation

Students could:

- Create a poster (web page), including illustrations, labels, and captions to: (106-4, 303-31)
  a. identify electrical dangers at work and play
  b. identify electrical safety devices/procedures which protect us from these dangers.
- Make a public service advertisement which provides safety information about electricity. (106-4, 303-31)

Informal/Formal Observation

- Suggested checklist and anecdotal record: As students work through the activities in this unit, the teacher can observe to ensure safety is paramount. Any concerns about safety should be addressed. (205-9)

Resources

(205-9)

TR	*Lesson 4,*	*p. 24-29*
SR	*4,*	*p. 12-15*
TR	*Lesson 12,*	*p. 77-88*
SR	*12,*	*p. 42-47*

(303-31)

TR	*Lesson 2,*	*p. 15-19*
SR	*2,*	*p. 6-9*

(106-4)

TR	*Lesson 2,*	*p. 15-19*
SR	*2,*	*p. 6-9*
TR	*Lesson 6,*	*p. 36-43*
SR	*6,*	*p. 20-23*

Investigating Static Electricity

Outcomes

Students will be expected to

- record observations while exploring and solving static electricity challenges (205-7)
- suggest possible explanations for variations in the results of investigations involving static electricity (104-5, 206-3)
- use the terms attraction, repulsion, electrons, positive charge and negative charge in meaningful contexts while exploring static electricity (204-4)

Elaborations–Strategies for Learning and Teaching

Static electricity experiments and demonstrations work best when the air is dry (low relative humidity).

Students will have already investigated static electricity in Grade 3. Teachers should brainstorm with students about their previous experiences and do activities with static electricity by exploring with a variety of materials, like balloons, fur, fabrics, rubber rods, Styrofoam balls, bits of paper or confetti, and plastic combs. Teachers should challenge students with a combination of materials which, when rubbed, will attract or repel small pieces of paper confetti or rice. Students should explore the following questions: Which combination of materials when rubbed will pick up the most pieces of confetti or puffed rice? Which combination of materials when rubbed will attract a hanging piece of yarn the most? Can they get two identical objects to attract? Can they get two identical objects to repel? Can they get two different objects to attract? Can they get two different objects to repel? Students should record their observations, measurements, and procedures.

In their tasks that involved trying to attract the most puffed rice, for example, students can compare their results with those of other students and attempt to explain any differences. They can decide if all the variables were controlled in the same manner, or are uncontrolled. Students may need to be reminded of the concept of fair test, manipulated variables, responding variables and control variables at this time. Even if two groups have seemingly identical conditions, there may be differences in their results due to experimental error (e.g., human error, slight differences in yarn or confetti, slight differences in rubbing). Students should realize that often in science, identical results are not always achieved. Static electricity is very difficult to control and students should not expect to get the same result every time.

Teachers should explore students' explanations for why objects may attract, while other times they repel. What causes attraction and repulsion? Teachers can write and display these explanations for the class to examine. This guided discussion should lead to the development of the concepts of positive charges and negative charges, and how these two types of charges interact in terms of attraction and repulsion. The concept of electric charges can be concretely developed by students getting a shock when they walk over carpet. The concept of "static electricity" or charge that is stationary, or localized electrons on one object, should also be developed. Current electricity, or moving electrons/charge, is explored during the rest of this unit.

Investigating Static Electricity

Suggested Assessment Strategies

Performance

- Students could select from the materials provided and solve the static electricity challenge. They should record each strategey they tried in solving the challenge, and their observations. Students should identify the strategy that gave them the best results. (205-7, 204-4)

Electricity Observations

Activity	Observations	Inferences

Journal

- Static electricity can be very tricky! ... (Students should be encouraged to write about their results—did they get the same results when they repeated a set of steps, for example, rub a balloon three times, then see how many pieces of confetti they picked up. They can compare their results with other groups. They should recognize that sometimes results will vary). (104-5, 206-3)

Paper and Pencil

- Students could use the clues provided to construct or complete a crossword puzzle or word search. (204-4)

Resources

(205-7, 104-5, 206-3, 204-4)

TR	*Lesson 3,*	*p. 20-23*
SR	*3,*	*p. 10-11*

Circuit Pathways

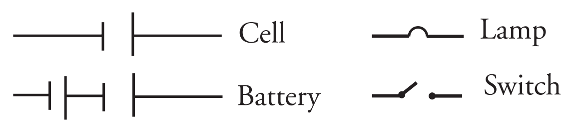
Outcomes

Students will be expected to

- compare a variety of electrical pathways by constructing simple circuits, and illustrate the electrical circuits with drawings and appropriate symbols (303-23, 207-2)
- follow instructions for testing the conductivity of different solids and liquids, and draw conclusions as to which materials tested were insulators or conductors (205-3, 300-20)
- describe the role of switches in electrical circuits, and identify materials that can be used to make a switch (303-24, 204-8)
- compare characteristics of series and parallel circuits (303-25)

Elaborations–Strategies for Learning and Teaching

After reacquainting themselves with static/stationary electricity, students then move on to an exploration of current, or moving, electricity. Students can use batteries, wires, and light bulbs to try to make a variety of circuit pathways, and find out which pathways allow electricity to flow. Teachers can guide their students in the proper way to draw their circuit diagrams, using appropriate symbols for cells, batteries, light bulbs, switches, and other devices they may add later in the unit. Drawings should show which pathways allowed electricity to flow and which ones did not.



Students can make a conductivity tester using batteries, wires, a low-voltage light bulb or compass to detect when a current is flowing. Groups of students could work with materials such as lengths of copper wire, light bulbs, tape and a variety of material to test for conductivity, such as paper clips, plastic spoon, beakers of water, salt water, or sugar water. They can then group materials as either conductors or insulators. The results could be recorded in chart form. Students would discuss the role of switches.

Teachers could draw a variety of diagrams of circuits, some of which do not have a switch, and some of which are not complete circuits. Students should be able to decide which circuits would conduct electricity. Teachers should probe their understanding of the circuits without switches. These circuits do not have any way to turn off the electricity. Switches allow a person to control when the circuit is completed, allowing electricity to flow. Students should be able to relate their findings about conductors and insulators to the types of materials that would make a good switch.

Students should compare the intensity of lights in series and parallel circuits, determine whether a current will flow given different switch positions and locations in series and parallel circuits, and determine whether a current will flow if a light in a series of parallel circuit extinguishes. Students can then explore various circuit pathways, in particular, series and parallel circuits. Using batteries, wire, light bulbs and connectors (either tape or electrical connectors), students can construct both types of circuits, and investigate the properties of each by breaking the circuit at various points (bulb will go off in a series circuit) or the relative brightness of lights. Since students have gained an understanding of the importance of a complete circuit, they can practice their problem-solving abilities when circuits do not work as anticipated: Is the battery “dead”? Are the connections tight? or Is there a break in the wire? How can they test these possibilities?

Circuit Pathways

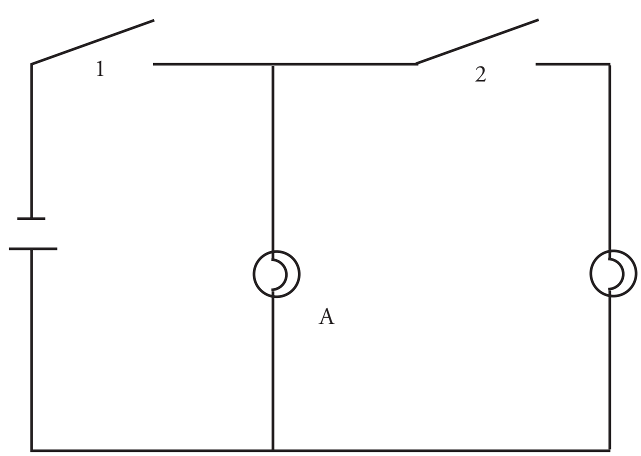
Suggested Assessment Strategies

Performance

- Students could determine which of the materials (e.g., paper clips, erasers, aluminium foil, salt water, cotton) are insulators or conductors. They should create a wall chart of conductors/ insulators from students' collected results. From the diagram of the simple circuit, students should construct a working model with the materials provided. (Teachers should provide students with a diagram of a series or parallel circuit with one or two batteries, light sources, or other electrical devices.) (303-23, 207-2, 303-24, 204-8, 205-3, 300-20)
- Students could construct electrical circuits using a variety of electrical equipment. They should draw and chart their results using appropriate symbols. (204-8, 207-2, 303-23, 303-24, 303-25)

Paper and Pencil

- What light bulbs (A, B, or both) will be "on" if
  a. Switch 1 is open and Switch 2 is closed
  b. Switch 1 is closed and switch 2 is open (303-24, 204-8)
- If a second bulb is added to a series circuit: (303-25)
  a. the light gets brighter
  b. the light gets duller
  c. the light goes out
  d. the brightness stays the same



Interview

- What is the difference between insulators and conductors? Give examples of each. (205-3, 300-20)

Resources

(303-23, 207-2)

TR	*Lesson 4,*	*p. 24-29*
SR	*4,*	*p. 12-15*
TR	*Lesson 6,*	*p. 36-43*
SR	*6,*	*p. 20-23*

(205-3, 300-20)

TR	*Lesson 5,*	*p. 30-35*
SR	*5,*	*p. 16-19*
TR	*Lesson 10,*	*p. 62-65*
SR	*10,*	*p. 34-37*

(303-24, 204-8, 303-25)

TR	*Lesson 6,*	*p. 36-43*
SR	*6,*	*p. 20-23*

Circuit Pathways (continued)

Outcomes

Students will be expected to

- compare characteristics of series and parallel circuits (303-25) **cont'd**
- compare the characteristics of static and current electricity (303-22)

Elaborations–Strategies for Learning and Teaching

Students can take apart and examine a variety of simple electrical devices, like flashlights, or a plug and wire, to try to explain how the circuit is completed. Circuit testers and simple voltmeters can be used to accurately measure changes in electrical characteristics.

Teachers should probe students' conceptions of electricity by asking questions such as, "How is the static electricity on our clothes or in our hair different from the electricity that runs this clock (or some other appliance)? Can I use static electricity to light the bulb in a series circuit?" Teachers should lead the discussion so that students understand that current electricity is a charge (electrons) that can move along a closed path, while in the case of static electricity, the charge is localized on an object.

These activities encourage students to willingly observe, question, explore and investigate.

Circuit Pathways (continued)

Suggested Assessment Strategies

Journal

- From home and school experiences, students could write about two examples each of static and current electricity and how each affects their daily life. (303-22)

Resources

(303-22)

TR	*Lesson 4,*	*p. 24-29*
SR	*4,*	*p. 12-15*

Electromagnets and their Applications

Outcomes

Students will be expected to

- describe the relationship between electricity and magnetism when using an electromagnet (303-27)
- propose questions about the factors that affect the strength of electromagnets, state predictions and hypotheses related to these factors and carry out a fair test of these factors (204-1, 204-3, 205-1)
- describe how knowledge of electromagnets has led to the development of many electrical devices that use them (106-3)

Elaborations–Strategies for Learning and Teaching

Teachers should provide students with the materials to make an electromagnet. Electromagnets use a length of insulated wire, battery, and a long iron nail or spike to wrap the wire around, and a compass or paper clips, staples or other small magnetic objects to detect the magnetism. **Caution: Do not test electromagnets or magnets near computers, computer diskettes, or CD-Roms.** ⚠

Once students make an electromagnet, they can experiment with ways to increase its strength. They can then state their thoughts in the form of a testable question, and compose a hypothesis and predictions. Some factors they might like to try are: the voltage of the batteries (see caution below), the number of wraps of wire around the nail, the type of nail, the size of the nail, and the type of wire. They can test the electromagnet by seeing how much a compass needle deflects, or by counting the number of staples or paper clips the electromagnet attracts. In groups, they can plan their strategies, brainstorming possibilities, making predictions, and testing their hypotheses.

Caution: Students should not use battery sources of any more than 3 volts. ⚠

The electromagnets they make have circuits with little resistance, only conductive wires. The current that flows in the electromagnets will be relatively large compared to the other circuits they have constructed, and the wires get hot quite quickly. If they wish to test the effect of increased voltage, they should use one 1.5 V battery, then repeat with two 1.5 V batteries connected in series. **Caution: students are not to try house current coming from the wall in their house, and not to try a car battery.** ⚠

Many devices that use electromagnets (telephones, televisions, radios, and microphones) can be displayed in the classroom. Pictures of heavy objects that are being lifted using electromagnets can be used to illustrate the power that they have. Students can investigate simple devices, such as doorbells, to see how the electromagnets cause the bell to work. These activities will encourage students to appreciate the role and contribution of technology in their understanding of the world.

Electromagnets and their Applications

Suggested Assessment Strategies

Performance

- Students could carry out procedures to test a variable that could affect the strength of an electromagnet. The plan should include clear statements of the problem, hypothesis, materials, procedure, controlled variables, manipulated variables, and responding variables, observations, and results. (303-27, 204-1, 204-3, 205-1)

Journal

- Students could explain what they learned about electromagnets? They could indicate what else they would like to know? (204-1, 204-3, 204-7)

Interview

- What is an electromagnet? What do you need to make an electromagnet? What makes an electromagnet stronger? (204-1, 204-3, 204-7)

Presentation

- Students could collect or draw pictures of devices which use electromagnets. For each, they should state the role of the electromagnet in the device. (106-3)

Resources

(303-27, 204-1, 204-3, 205-1, 106-3)

TR	*Lesson 7,*	*p. 44-48*
SR	*7,*	*p. 24-25*

Uses for Electricity

Outcomes

Students will be expected to

- demonstrate how electricity in circuits can produce light, heat, sound, motion and magnetic effects (303-26)
- propose electrical circuitry problems to investigate, and plan a set of steps to solve them (204-1, 204-7)
- describe how knowledge of electricity has led to many new inventions that have changed the way we live, and describe ways in which we have become increasingly dependent on electricity over the years (107-9, 106-4)

Elaborations–Strategies for Learning and Teaching

Bring on the gadgets! All kinds of buzzers, lights, solar cells, motors, and electromagnets can be used. Heat can be demonstrated by feeling the light bulb warm up, or by displaying electrical devices that convert electrical energy into heat (toasters, curling irons, kettles). **Caution: Check the voltage rating on the gadget—some of them need a power supply with greater than three volts.** Teachers must make sure the minimum voltage required for the device is between one–three volts, or else students will be using too many batteries to get it to work. Students can make circuits using these devices to see how they work.

⚠

Students should design a circuit. Teachers should challenge students to think of an electrical task, e.g., design circuits that will not shut off if one light bulb is removed, or one that will; design a circuit with switches that activate the circuit on contact, or one with switches that turn off the circuit on contact; circuits that have two places to turn a circuit off or on; or circuits with buzzers that are activated by touching something. They should use a wide variety of electrical apparatus (such as wires, buzzers, light bulbs) to try to design solutions.

Students should identify and describe the uses of electricity in everyday life. One activity that can get students thinking about the many electrical inventions they use and how they depend on electricity is to describe their experiences when the power goes out. How did they cope without electricity?

Students could interview parents, grandparents, or older people in the community about electrical devices that have been developed in their lifetimes and how these devices have changed their lives. This connects with the English Language Arts Curriculum Outcome students will be expected to use writing and other forms of representation to explore, clarify and reflect on their thoughts, feelings, experiences, and learnings; and to use their imagination.

Uses for Electricity

Suggested Assessment Strategies

Performance

- Students could use the design process to solve a problem such as: (204-1, 204-7)
  - turn on/off a light from either end of a corridor
  - create an alarm for a toy box

Paper and Pencil

- Students could put checks in the chart below to indicate the types of effects which an electrical device might create. They should test their predictions. (303-26)

Effects Created by Electrical Devices

Device	Heat	Motion	Sound	Magnetic	Light
buzzer					
speaker					
: :					

Journal

- Students could pretend they live in the days before electricity. In their journal, they could write about their activities. Students should be sure to refer to activities for which we would use electricity today. (107-9, 106-4)

Resources

(303-26)
TR Lesson 11, p. 66-76
SR 11, p. 38-41

(204-1, 204-7)
TR Lesson 12, p. 77-88
SR 12, p. 42-47

(107-9, 106-4)
TR Lesson 2, p. 15-19
SR 2, p. 6-9

Sources of Electricity

Outcomes

Students will be expected to

- describe how knowledge that magnets can produce electric current led to the invention of electrical generators (106-4)
- identify and investigate various methods of generating electricity (past, present and future) and describe some ways in which these methods affect the environment (303-28, 105-3, 108-8)

Elaborations–Strategies for Learning and Teaching

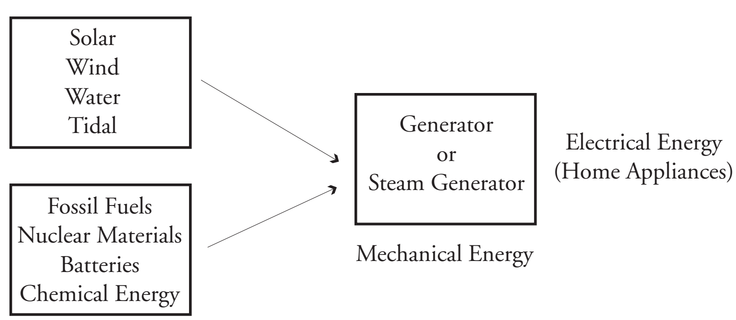
Students should understand that the production of electricity by wrapping a magnet in wire has lead to the invention of electrical generators. Students have already investigated how electricity can generate magnetism (electromagnets). A good way to lead into this section is to investigate the reverse of this (generating electricity from magnets). Students will need a fairly sensitive way to detect electricity (galvanometer, compass). Using a wire coiled around a tube and connected to a galvanometer, students can move a magnet in various directions around the coil and watch the way the needle on the galvanometer deflects. If they insert the bar magnet in and out of the tube, they should also detect a current in the wire. Alternatively, generators can be purchased from science supplies catalogues. Students could look carefully at these to see the components (coils of wire, rotating magnet) of the generator. By turning the crank at sufficient speed, students can get light bulbs and buzzers to work.

Teachers should brainstorm with students and record their ideas on how electricity is produced.

Students should identify chemical (batteries), mechanical (wind, falling water, steam) and solar energy as forms of energy that can be converted into electrical energy. Energy can be converted from chemical, mechanical, solar and nuclear to electrical energy. Some forms of chemical energy would be batteries and fossil fuel combustion. Sources of energy would be wind, water, tidal, solar and nuclear.

Renewable forms of energy would be wind, solar, water and tidal. Non renewable forms of energy are fossil fuels and nuclear energy.

Sources of Energy



Sources of Electricity

Suggested Assessment Strategies

Paper and Pencil

- Students could compare and contrast electromagnets and generators in terms of: (106-4, 303-27)
  a. what they are made from
  b. their source of energy
  c. what they do

Interview

- What invention came from the discovery that magnets can produce an electric current? How is this invention useful to us? (106-4)

Resources

(106-4, 303-28, 105-3, 108-8)

TR	*Lesson 8,*	*p. 49-55*
SR	*8,*	*p. 26-29*
TR	*Lesson 9,*	*p. 56-61*
SR	*9,*	*p. 30-33*

Sources of Electricity (continued)

Outcomes

Students will be expected to

- identify and explain sources of electricity as renewable or nonrenewable (303-29)

Elaborations–Strategies for Learning and Teaching

Students can generate their own electricity from chemical energy by making some simple electrochemical cells using copper and zinc strips or nails that are embedded in fruit. Teachers can demonstrate a more traditional electrochemical cell by resting the copper nail in a copper solution (copper (II) sulphate or some other salt of copper), and the zinc nail or strip in a solution of zinc (II). Connect the two nails by a wire that is hooked up to something that shows that electricity is flowing (bulb or multi-meter), and connect the two beakers by soaking a paper towel in a salt (NaCl) solution. Kits such as potato/fruit clocks can be purchased.

Students can connect solar cells in circuits to see solar energy being converted into electrical energy. Solar energy kits are available from scientific suppliers.

Students can do a research project using print and electronic sources on how various ways of generating electricity affect the environment. This will encourage students to be sensitive to and develop a sense of responsibility for the welfare of the environment.

Sources of Electricity (continued)

Suggested Assessment Strategies

Presentation

Students could:

- Create a pictorial concept map showing energy conversions.
- Choose either chemical, mechanical, or solar energy and research:
  a. how electrical energy is produced from the source
  b. whether the source is renewable or non-renewable
  c. positive and negative impacts on the environment of using this source to create electricity
- Report their findings (web page, report, oral presentation with visual aids). (303-28, 105-3, 108-8, 303-29)
- Do a video or skit on the impacts on the environment in using a source of energy (renewable or non- renewable) to create electricity. (303-29)

Resources

(303-29)

TR	*Lesson 9,*	*p. 56-61*
SR	*9,*	*p. 30-33*

Electrical Energy Consumption and Conservation

Outcomes

Students will be expected to

- identify and explain different factors that could lead to a decrease in electrical energy consumption in the home and at school and how this will help protect the environment (108-5, 303-30)

Elaborations–Strategies for Learning and Teaching

Students should see the effects of their effort to conserve energy by collecting data about consumption before and after they try to reduce electrical usage.

Students can keep an “electrical use” journal, noting the various electrical devices/systems they encounter over the course of a period of time.

Students can be introduced to some of the units that are used to quantify electrical energy, such as watts and kilowatt hour. (The depth of treatment should be minimal. It is enough that they understand that the watt is a unit of measuring how much electrical energy a device uses, and that a kilowatt hour is the amount of energy being consumed if the device is used for one hour. They should understand that the more watts or kilowatt hours a device is rated for, then the more electrical energy is being used.) A guest speaker from a power company could be invited to speak to the class about electrical power usage, conservation of electricity, and peak power usage times, and how to read an electrical meter.

Students could turn on electrical devices, and watch how fast their metre runs. They could turn off the devices to see how this affects the metre. Students could categorize devices according to whether they are high-, medium-, or low-consumption devices (some discussion of kilowatt hours will be needed). Students could carry out a household inventory of electrical appliances and light bulbs, noting the wattage of bulbs, and describing use patterns.

Students could propose ways that consumption could be decreased. Students should discuss the advantages to the environment of using less energy. Students could investigate how the damming of a river affects a local environment, or how fossil fuel energy sources contribute to greenhouse gases.

Electrical Energy Consumption and Conservation

Suggested Assessment Strategies

Journal

- Students could describe how to conserve electricity and what affect this will have on the home and family budget. (108-5, 303-30)
- Students could reflect on how wasting energy may affect the environment. (108-5, 303-30)

Paper and Pencil

- Students could develop strategies to conserve energy in the school. They should present their report to the administration. (303-30)

Presentation

- Students could do a skit/video on how energy conservation benefits the environment. (108-5)

Portfolio

- Students could choose a piece of work from this unit to include in their portfolio.

Resources

(108-5, 303-30)

TR	*Lesson 2,*	*p. 15-19*
SR	*2,*	*p. 6-9*
TR	*Lesson 9,*	*p. 56-61*
SR	*9,*	*p. 30-33*
TR	*Lesson 10,*	*p. 62-65*
SR	*10,*	*p. 34-37*

Grade 6

Physical Science: Flight

Unit Overview

Introduction

The capability of flight is shared by a variety of living things and human inventions. For many centuries, humans have marvelled at the ability of living things to attain flight, and they have developed a variety of devices to recreate that ability. Students learn to appreciate the science and technology involved as they investigate how things fly and develop and test a variety of prototype devices. Through their investigations they learn that many different approaches are used, and that each provides a means to achieve varying amounts of lift, movement, and control.

Focus and Context

The emphasis in this unit is on how things fly or stay afloat in air, and the variables that affect flight. This focus of this unit is, for the most part, problem solving. Students should be immersed in rich experiences with many aspects of air/aerodynamics and flight. Activities related to solving problems, like "How can I get the airplane to stay in the air longer?", require students to design, test, and then modify their designs and retest their models. Students should use their imagination, creativity, and research skills in designing model planes, various wing shapes, and in devising methods to test their designs. After much classroom experimentation, design and testing, teams of students should have the opportunity to investigate an aspect of flight that interests them most, and present their findings. By providing opportunities to re-examine and retest, research and rebuild, and share, students will grow in the four broad areas of skills: initiating and planning, performing and recording, analysing and interpreting, and communications and teamwork.

Science Curriculum Links

Students are introduced to the concept of air taking up space and being able to be felt as wind in primary science.

Students will use many of the concepts in this unit in high school physics.

Curriculum Outcomes

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
Nature of Science and Technology	**Initiating and Planning**	**301-18** describe and demonstrate methods for altering drag in flying devices
104-3 demonstrate and explain the importance of selecting appropriate processes for investigating scientific questions and solving technological problems	**204-2** rephrase questions in a testable form	**303-32** describe the role of lift in overcoming gravity and enabling devices or living things to fly
104-5 describe how results of similar and repeated investigations may vary and suggest possible explanations for variations	**204-7** plan a set of steps to solve a practical problem and to carry out a fair test of a science-related idea	**301-17** describe and demonstrate how lift is affected by the shape of a surface
105-3 describe examples of scientific questions and technological problems that have been addressed differently at different times	**Performing and Recording**	**300-21** identify characteristics and adaptations that enable birds and insects to fly
Relationships Between Science and Technology	**205-1** carry out procedures to explore a given problem and to ensure a fair test of a proposed idea, controlling major variables	**303-33** identify situations which involve Bernoulli's principle
106-3 describe examples of improvements to the tools and techniques of scientific investigation that have led to new discoveries	**205-2** select and use tools in manipulating materials and in building models	**303-34** describe the means of propulsion for flying devices
106-4 describe instances where scientific ideas and discoveries have led to new inventions and applications	**205-5** make observations and collect information that is relevant to a given question or problem	**300-22** describe and justify the differences in design between aircraft and spacecraft
Social and Environmental Contexts of Science and Technology	**205-8** identify and use a variety of sources and technologies to gather pertinent information	
107-6 provide examples of how science and technology have been used to solve problems around the world	**Analysing and Interpreting**	
107-9 compare past and current needs, and describe some ways in which science and technology have changed the way people work, live, and interact with the environment	**206-6** suggest improvements to a design or constructed object	
107-12 provide examples of Canadians who have contributed to science and technology	**Communication and Teamwork**	
	207-2 communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawings, and oral language	

Drag

Outcomes

Students will be expected to

- rephrase questions about drag in a testable form and then carry out procedures, and make and record observations, to test the performance of a flying device (204-2, 205-5, 207-2)
- describe and demonstrate methods for altering drag in flying devices (301-18)

Elaboration–Strategies for Learning and Teaching

The unit could start with a Know-Want to Learn-Learned (K-W-L) activity that focuses on flight and aerodynamics. Students could brainstorm what they know and have experienced with respect to wind, air resistance, flying, bird and insect flight and leaves falling. They could also raise questions they have and would like to investigate. This activity will help the teacher gauge students' conceptions, and help focus the investigations in the unit.

There are four forces acting on flying objects: drag is the force that slows the flying device, gravity is the force that pulls it towards earth, thrust is the force that propels, and lift is the force that keeps it up in the air.

In classroom discussion, teachers can introduce the concept of drag, and encourage students to ask questions about drag that could be investigated. As students pose questions, the teacher can model for students how to change the question to a testable form (such as, "How can I reduce the drag in my glider?" to "Will folding the wings in half reduce the drag?"). Students should be able to see the difference between these two questions, and write similar types of questions.

Drag is the force caused by air resistance. Air is invisible, so students need to be reminded that air has real substance, and can affect things in many ways. They can feel moving air, or wind, simply by standing outside on a windy day. Even on a still day, when a person or object is moving, the effect of air resistance can be felt. Students can brainstorm techniques and products used to reduce drag while walking (bending into the wind) or taking part in sports (streamlined helmets, bathing suits, haircuts, for example). Small windmill toys and pollen blowing around can be used to show how air can be used to move things. Students can time each other as they run the length of the gymnasium—the first time holding a large piece of Bristol board in front of them, and the second time without to see the effect of wind resistance. Students are so used to experiencing life with air that they have to stretch their imaginations to think of how things would be affected without it. Students can explore this idea by dropping sheets of paper, and taking part in discussion with questions such as: "Why does the paper flutter to the ground?" "What is holding it up?" "What would happen to the sheet if there was no air?" They could time how long papers folded in different ways take to reach the ground, graph their results, and propose explanations for any trends they may see.

Drag

Suggested Assessment Strategies

Performance

- Students could construct a paper glider. They should test, modify and retest their design to reduce drag as much as possible. They should record evidence (flight time, flight distance) which demonstrates drag has been reduced. Students should be prepared to discuss their modifications with their teacher.
- Using similar methods, students could construct a paper glider which will turn left (or turn right or gain altitude or make a loop) as it flies. (204-2, 205-5, 207-2)

Journal

- Students could modify the question "How can I reduce the drag in my glider?" into testable hypotheses. (204-2, 205-5, 207-2)

Informal/Formal Observation

- Observation checklist (possible criteria) (204-2, 205-5, 207-2, 301-18)
  - – student revises design
  - – student is recording distance and length of time
  - – student analyses the design with respect to distance travelled, time in the air, and other factors that they want to test
- As the students move from trying to figure out the factors that affect drag (science) to designing stable, long-flying aircraft (technology), creativity should be encouraged. There is no fixed "right" design. Students should be encouraged to try a variety of designs, and as they test them out, analyse their effectiveness. (204-2, 205-5, 207-2, 206-6)
- Possible Criteria:
  - – student attempts to improve the glider's performance
  - – student tries a wide variety of designs and is creative in approach to design
  - – student attempts to control the performance of the glider by making it turn, loop or gain altitude

Paper and Pencil

- Students could suggest improvements to the design of a plane (truck, car, boat) that would decrease the amount of drag that it experiences. (Teachers should provide students with a picture of an older model airplane, truck, car, or boat). (107-6, 206-6)

Resources

(204-2, 205-5, 207-2)

TR	*Lesson 6,*	*p. 44-51*
SR	*6,*	*p. 20-23*

(301-18)

TR	*Lesson 6,*	*p. 44-51*
SR	*6,*	*p. 20-23*
TR	*Lesson 9,*	*p. 67-75*
SR	*9,*	*p. 30-33*
TR	*Lesson 10,*	*p. 76-86*
SR	*10,*	*p. 34-37*

Drag (continued)

Outcomes

Students will be expected to

- describe how the results of similar and repeated investigations testing drag may vary and suggest possible explanations for variations (104-5)
- suggest improvements to the design of a flying device to improve its performance (206-6)
- provide examples of how technological research and design has resulted in many product designs that have reduced the amount of drag experienced (107-6)

Elaboration–Strategies for Learning and Teaching

The two main factors that affect the amount of drag are shape and texture. Students should compare the drag in various flying devices. They can make gliders using various shapes and textures of papers, and see which ones travel the fastest (and therefore has the least drag) when released or launched (same student throwing glider with same force). This can be done by seeing which glider passes by a certain point first. Note that the one that stays in the air the longest does not necessarily have the least drag. Since air and water are both fluids, they could even try to show how shape affects drag by dragging objects with various shapes and textures under water, and using a spring scale to measure the drag. Students could also design parachutes and see which ones stay aloft the longest.

Students should identify some variables and determine why variations in flight path and time exist. They can work on redesigning their flying devices to improve performance. There are many variables in these types of activities (such as force that the students use, air currents).

Students can also investigate methods for altering drag by examining various highspeed transportation devices, such as trucks or cars. They can also look at how airplane designs have become more streamlined over the years, and examine designs like the Concorde, or other high speed planes, and compare them with other commercial airliners. This will encourage students to appreciate the role and contribution of technology in their understanding of the world.

Drag (continued)

Suggested Assessment Strategies

Interview

- Teachers could ask questions such as "Why do you think your plane does not travel the same distance each time?" (104-5)

Presentation

- Students could prepare a poster of cars, planes, motorcycles, and the like which have an aerodynamic shape. For comparison, they should include similar machines which are not as aerodynamic. (107-6)
- Students could present a paper glider to demonstrate the various aircraft and performance abilities. Students should describe or show how they refined their paper gliders to improve its performance. (206-6, 301-18)
- Students could research and display shapes of cars and trucks historically to show improvements in aerodynamic design. (107-6)

Resources

(104-5)

TR	*Lesson 6,*	*p. 44-51*
SR	*6,*	*p. 20-23*

(206-6)

TR	*Lesson 9,*	*p. 67-75*
SR	*9,*	*p. 30-33*
TR	*Lesson 12,*	*p. 97-106*
SR	*12,*	*p. 42-47*

(107-6)

TR	*Lesson 9,*	*p. 67-75*
SR	*9,*	*p. 30-33*

Lift and Wing Shape

Outcomes

Students will be expected to

- describe the role of lift in overcoming gravity and enabling devices or living things to fly (303-32)
- plan and carry out a set of steps to investigate the effect of wing shape on lift, and select and use tools in building models of various wing shapes, (204-7, 205-1, 205-2)
- demonstrate and describe how lift is affected by the shape of a surface (301-17)
- identify characteristics and adaptations that enable birds and insects to fly (300-21)
- describe how knowledge of how wing shape affects lift has led to the development of aerodynamically designed wing and features on planes that allow wing shape to be altered during the flight (106-4)

Elaboration–Strategies for Learning and Teaching

Heavy, solid objects do not normally stay aloft. Discussions held throughout this unit will undoubtedly raise the question, "How do heavy flying devices, like commercial planes, lift off the ground and fly?".

Students can design various wing shapes using materials such as cardboard, paper, tape, and something to attach strings onto (like a pencil) and blow on these shapes using a straw held at varying angles, and see how far the various shapes rise. Students should investigate both the factors of wing shape and angle of attack (angle that the air is blown at the wing, or the orientation of the wing with respect to the air blowing on it) in their investigations.

Lift can also be achieved through temperature differences in air, since warm air is less dense than cold air. Hot air balloons are examples of how warm air rises to float on the denser cold air. Students can investigate this by inflating garbage bags inflated with the warm air from a hair dryer. Students can investigate the uses of solar balloons, which are made from material that warms the air in the balloon when exposed to the sun, and gives the balloon its lift.

Part of their designing process should involve an investigation into the shapes of the various insects and birds that fly. By noting shapes that make them more aerodynamic, they can try to incorporate similar shapes in their design.

Students can also investigate wing designs on aircraft, and look at features that planes have that can increase or decrease the angle of attack during the flight. If possible, a field trip to an airport or a flight museum would provide students with the experience of seeing the wing flaps move first-hand. Students could prepare a list of questions they wish to investigate as they examine a real plane, and talk to informed personnel at the airport. Students can design paper airplanes that incorporate different types of flaps to see the effect they have on the flight path of the flying device. Teachers should encourage students to work collaboratively while designing their flying devices.

Students may also be interested in exploring different car designs that also use the aerodynamic principles. Spoilers, for example, are designed so that cars hug the road.

Lift and Wing Shape

Suggested Assessment Strategies

Performance

Students could:

- Design, test, evaluate, and modify a wing shape to achieve the best lift. They should use questions such as "What worked?, What didn't and why?" (301-17)
- Compare, using illustrations, animations, personally narrated video clips, poetry or dance, the movements of two things (e.g., birds, insects) that naturally fly or glide. They should include the unique structures or characteristics that enable this creature to fly. (205-5, 300-21)

Paper and Pencil

Students could:

- Look up "birds" and "insects". They should write four jot notes which identify characteristics and adaptations that enable birds and insects to fly. They should try to provide examples or pictures of aircraft that use similar features. (300-21)
- Draw and label diagrams of the profiles of at least two of their wings, indicating areas where improvements were made. As part of their completed diagram, they should answer the question, "Why is lift important to flight?" (204-7, 205-2, 205-2, 301-17, 303-32)
- Do the necessary research and draw/label a diagram that illustrates how the shape of wings on a plane change during flight. (106-4)

Resources

(303-32, 204-7, 205-1, 205-2, 301-17)

TR	*Lesson 6,*	*p. 44-51*
SR	*6,*	*p. 20-23*

(301-17)

TR	*Lesson 5,*	*p. 38-43*
SR	*5,*	*p. 16-19*

(300-21)

TR	*Lesson 11,*	*p. 87-96*
SR	*11,*	*p. 38-41*

(106-4)

TR	*Lesson 10,*	*p. 76-85*
SR	*10,*	*p. 34-37*
TR	*Lesson 11,*	*p. 87-96*
SR	*11,*	*p. 38-41*

Lift and Bernoulli's Principle

Outcomes

Students will be expected to

- identify situations which involve Bernoulli's principle (303-33)
- describe how aerodynamic research using wind tunnels and/or computers can contribute to new airplane designs (106-3)
- explain why using computer simulations and/or wind tunnels are appropriate processes for investigating wing and airplane designs (104-3)
- identify and use a variety of sources to investigate the use of wind tunnels in testing aircraft shapes (205-8)

Elaboration–Strategies for Learning and Teaching

Once students have seen the effect that different wing shapes have on the amount of lift, they can be introduced to explanations involving Bernoulli's principle: fast moving air exerts less pressure than slow moving air. Students should explore many situations involving Bernoulli's principle, and give explanations as to why objects move as they do using this principle:

- Suspend two ping pong balls from a metre stick across two chairs at the same level, about 6–10 cm apart, and predict how the balls will move when the students blow between them. Test their predictions.
- Baseball curve balls also work using Bernoulli's principle. Students can view a demonstration or video of someone throwing balls to get the most curve. Research to find out why throwing the baseball with a spin results in a curve ball.
- With the fingers of both hands, students hold a single sheet of paper just below their lower lip. Allow the paper to bend and hang downward, then blow across the top surface of the paper.
- Identify everyday situations which illustrate Bernoulli's principle, for example, the movement of the shower curtain after the shower is turned on, or the way long hair will fly out an open window of a moving car.

Investigations in wind tunnels show streams of air moving faster over the top of a wing illustrating how wings get their lift. As air moves around the wing, there is a net force pushing the plane up (lift).

Students should demonstrate an understanding that wind tunnels and/or computers are appropriate for testing and designing aircraft. Students could use print, Internet, and other media to research the use of wind tunnels and computer simulations, in designing wing shapes and airplane designs both of which allow wings and airplanes to be tested safely.

Lift and Bernoulli's Principle

Suggested Assessment Strategies

Performance

- Students could set up an activity, or create a visual or multimedia presentation, that illustrates Bernoulli's principle. (Groups of students can set up stations around the class with their activity or presentation, and the class can circulate around the classroom to try out the various activities at each station) (303-33)

Journal

- Students could illustrate and label a situation that involves Bernoulli's principle. (303-33)

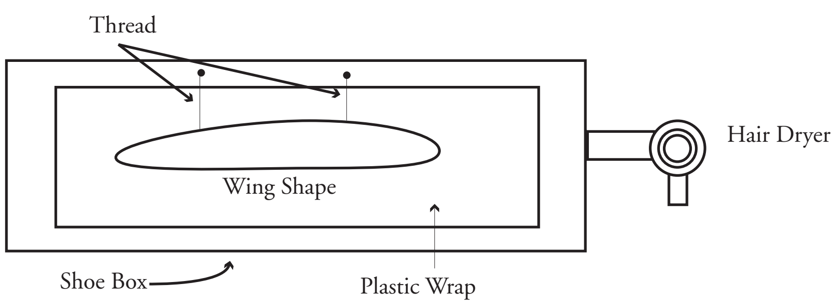
Paper and Pencil

- Using point form, students could write brief answers to the following questions:

  a. What is a wind tunnel?
  b. How are wind tunnels used in aircraft design?
  c. Why are wind tunnels appropriate methods of testing and designing aircraft? (106-3, 104-3, 205-8)

Presentation

- Students could create a presentation that shows pictures of wind tunnels and the investigations that are performed in them. (205-8)



- Students could make their own wind tunnel using a hair dryer, and a shoe box with windows cut out on the side so they can see what is happening inside the box. They should attach different shaped wings, and see how they are affected by the wind. (205-8)

Resources

(303-33)

TR	*Lesson 5,*	*p. 38-43*
SR	*5,*	*p. 16-19*
TR	*Lesson 6,*	*p. 44-51*
SR	*6,*	*p. 20-23*
TR	*Lesson 8,*	*p. 60-66*
SR	*8,*	*p. 26-29*

(106-3, 104-3, 205-8)

TR	*Lesson 9,*	*p. 67-75*
SR	*9,*	*p. 30-33*

Thrust and Propulsion

Outcomes

Students will be expected to

- describe and demonstrate the means of propulsion for flying devices (303-34)
- describe and justify the differences in design between aircraft and spacecraft (300-22)
- compare current and past air and space craft (105-3)
- describe some ways that flying devices have changed the way people work and live (107-9)
- provide examples of Canadians who have contributed to the science and technology of aircraft (107-12)

Elaboration–Strategies for Learning and Teaching

Students should investigate propellers. The third force that acts upon flying devices is thrust, the force that propels the flying device forward. There are two main types of propulsion: propulsion based on gases being projected away from the plane (pushing the plane through the air), and propulsion pulling the plane through the air.

Some early and present-day aircraft use propellers for thrust. Propellers turn in a way that pulls the air in front to the back, similar to a screw being twisted into wood. Propellers must have an atmosphere to work, since they rely on the resistance of air to provide the thrust. Students could make propellers or propellers can be purchased from electronic or hobby stores. They may also use a propeller under water.

All of the flying objects explored in this unit so far have depended on air to fly. Space craft cannot use propellers, since there is very little air in space for it to catch in its blades. They must make their own gas to shoot out to propel the plane forward. This is illustrated by blowing up a balloon and then letting it go. It will zoom around the room because it is being propelled by the escaping gas. Alternatively, straws could be attached to the balloon, with a thread or string threaded through the straws and attached to a far wall, and the balloons could be propelled along the string track. Teachers could challenge a class to identify craft that work by jet propulsion (such as rocket ships, jet, and space shuttles).

Students should examine designs for spacecraft and airplanes, and note features that rely on an atmosphere (large wings, engines, propellers) and those that indicate the craft will be flying in space (small wings or rudders, large booster containers for fuel as these are needed).

In the past, there were large differences between air and space craft, but increasingly, more flying devices (like space shuttles) are being developed that have the ability to fly both in space and in air and thus have features of both. Examples of Canadians who have contributed to flight are Wallace R. Turnbull from New Brunswick, who invented the variable speed propeller, and Robert Noorduyn from Québec who designed the bush plane. J. D. McCurdy built and flew the first aircraft in the British Commonwealth. Alexander Bell built the Silver Dart and several kites. Additional Canadian achievements in flight and space research could be researched (examples Bombardier, Canadian Aerospace Agency, Avro Arrow).

Thrust and Propulsion

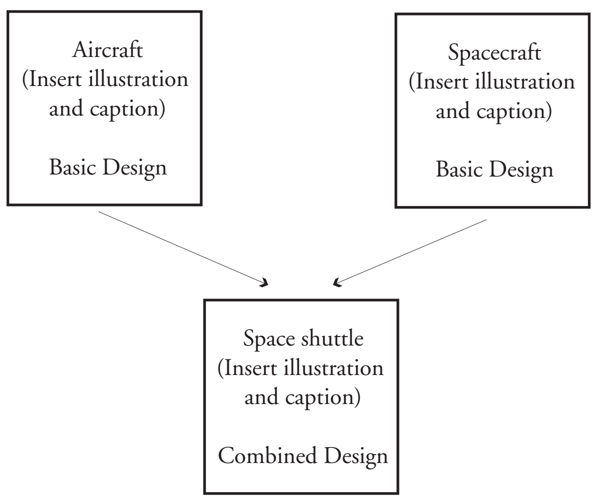
Suggested Assessment Strategies

Paper and Pencil

- Students could write a paragraph which compares and contrasts thrust and propulsion. (303-34)

Presentation

- Students could create a display that illustrates a variety of aircraft showing developments from past to present day. They should be sure their work has Canadian content! (105-3, 107-9, 107-12)
- In a group, students could design a poster that illustrates the difference between aircraft and space craft, and how the space shuttle has features of both. They should follow the outline shown below: (300-22)



Portfolio

- Students could select pieces of work for their portfolio.

Resources

(303-34)

TR	*Lesson 7,*	*p. 52-59*
SR	*7,*	*p. 24-25*
TR	*Lesson 8,*	*p. 60-66*
SR	*8,*	*p. 26-29*

(300-22)

TR	*Lesson 7,*	*p. 52-59*
SR	*7,*	*p. 24-25*

(105-3)

TR	*Lesson 3,*	*p. 25-30*
SR	*3,*	*p. 10-11*
TR	*Lesson 7,*	*p. 52-59*
SR	*7,*	*p. 24-25*

(107-9)

TR	*Lesson 3,*	*p. 25-30*
SR	*3,*	*p. 10-11*

(107-12)

TR	*Lesson 10,*	*p. 76-86*
SR	*10,*	*p. 34-37*

Grade 6

Earth and Space Science: Space

Unit Overview

Introduction

Space science involves learning about objects in the sky to discover their form, their movements, and their interactions. For students, developing a concept of Earth and space presents a new challenge. It requires extensive experience with models to explore relationships of size, position, and motion of different bodies. In learning about space, students come to appreciate that human ability to observe and study objects in space is now greatly enhanced by technology. Students learn that screwed and unscrewed probes and earth-based devices are contributing to our knowledge of space, and that new capabilities are being developed for monitoring the Earth, for communications, and for the further exploration of space.

As the various components of the solar system are discussed and researched, students can learn about technologies (such as telescopes, satellites, and space probes) that have been developed to explore the solar system, the experiences that astronauts have as they live in space, and how space exploration has been undertaken as a largely international affair.

Focus and Context

The focus in this unit is inquiry. Students can create and use models to simulate and explore the interactions within the major components of the solar system and universe. By constructing models, the students can investigate, for example, the causes for the seasons. A second focus is on giving students opportunities to find up-to-date information about space exploration, and about the various components of the solar system and constellations. Students will be exposed to electronic and print resources that can illustrate the wealth of knowledge that has accumulated about space, and learn skills for searching out and personalizing this knowledge.

Science Curriculum Links

From the unit, Daily and Seasonal Changes in primary science, students have been introduced to the concept of daily and seasonal cycles. In this unit on space, students will account for these cycles, and expand their knowledge of space by studying the components of space.

Curriculum Outcomes

STSE	Skills	Knowledge
Students will be expected to	*Students will be expected to*	*Students will be expected to*
Nature of Science and Technology	**Initiating and Planning**	**301-21** describe how astronauts are able to meet their basic needs in space
104-8 demonstrate the importance of using the languages of science and technology to compare and communicate ideas, processes, and results	**204-6** identify various methods for finding answers to given questions and solutions to given problems, and select one that is appropriate	**301-19** demonstrate how Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons
105-1 identify examples of scientific questions and technological problems that are currently being studied	**Performing and Recording**	**301-20** observe and explain how the relative positions of Earth, the moon, and the sun are responsible for the moon phases, eclipses, and tides
105-6 describe how evidence must be continually questioned in order to validate scientific knowledge	**205-2** select and use tools in manipulating materials and in building models	**300-23** describe the physical characteristics of components of the solar system—specifically, the sun, planets, moons, comets, asteroids, and meteors
Relationships Between Science and Technology	**205-8** identify and use a variety of sources and technologies to gather pertinent information	**302-13** identify constellations in the night sky
106-3 describe examples of improvements to the tools and techniques of scientific investigation that have led to new discoveries	**Analysing and Interpreting**	
Social and Environmental Contexts of Science and Technology	**206-4** evaluate the usefulness of different information sources in answering a given question	
107-3 compare tools, techniques, and scientific ideas used by different people around the world to interpret natural phenomena and meet their needs	**Communication and Teamwork**	
107-12 provide examples of Canadians who have contributed to science and technology	**207-2** communicate procedures and results, using lists, notes in point form, sentences, charts, graphs, drawings, and oral language	
107-15 describe scientific and technological achievements that are the result of contributions by people from around the world		

Space Exploration

Outcomes

Students will be expected to

- describe how astronauts are able to meet their basic needs in space (301-21)
- provide examples of Canadians who have contributed to the science and technology of space exploration (107-12)
- describe examples of improvements to the tools and techniques of exploring the solar system that have led to discoveries and scientific information (106-3)
- describe scientific/ technological achievements in space science that are the result of contributions by people from around the world (107-15)
- identify examples of scientific questions and technological problems about space and space exploration that are currently being studied (105-1)

Elaborations–Strategies for Learning and Teaching

Students should speculate, discuss and gather information about how astronauts meet their basic needs. One way to approach this is to ask students to describe their day, and then, bit by bit, try to figure out how they would do the same things in space. What challenges would they face?

Students could research Canadian scientists sand engineers who have contributed to the space program, such as astronauts Marc Garneau, Roberta Bondar, Julie Payette, Chris Hadfield, Bob Trisk, Steve MacLEan, Dave Williams, Bjarnie Trygvasson, and George J. Klein.

Students should describe examples of tools that have been developed and have improved our ability to explore the universe, such as binoculars, telescopes, the lunar buggy, the Canadarm™, the Hubble telescope, space probes and the space station. Students could also learn about products that were developed for space travel and that have been applied to everyday use, such as Tang ™, freeze-dried food and velcro ™.

Many countries are involved in space exploration and often teams are put together for various projects. Students could note the construction of the space station and investigations on space shuttle missions as examples of these types of international collaborative efforts.

Students could explore current investigations/observations in space such as the movements of comets, space exploration missions, the origin of the solar system and universe and the movement of asteroids.

Two excellent sources of information on current space initiatives are NASA's home page on the Internet and the Canadian Space Agency. Students can get daily reports of space shuttle missions, see pictures from various space probes and ask questions to astronauts, as well as many other educational features.

Space Exploration

Suggested Assessment Strategies

Journal

- Students could imagine they are a Canadian Astronaut. Over a one week period, they could compose a daily journal entry as if they were on a space shuttle mission. They should write about their personal observations while living and working in space. (105-1, 106-3, 107-15, 301-21)

Paper and Pencil

- Students could research an astronaut they admire or would like to learn more about. If they had a chance to write/meet him/her, what questions would they ask? (107-12)

Interview

- Teachers could ask questions such as, "Do you think the space shuttle is an improvement over earlier rockets? Explain why or why not." (106-3)

Presentation

- As a starting point to the unit, a class chart could be created as a wall chart. This chart would be a reference for the unit and could be added to as the unit progresses. (205-2, 104-8, 300-23, 105-1, 205-8, 207-2)

Our Solar System

Name	Relative size to Earth	Length of Orbit	Make-up: Solid, liquid, and/or gas	. . .
Sun				
Moon				
Mars				
○ ○				

Resources

(301-21, 107-12)
TR Lesson 13, p. 86-98
SR 13, p. 46-49

(106-3)
TR Lesson 6, p. 47-53
SR 6, p. 20-23
TR Lesson 10, p. 70-75
SR 10, p. 34-37

(107-15)
TR Lesson 6, p. 47-53
SR 6, p. 20-23

(105-1)
TR Lesson 10, p. 70-75
SR 10, p. 34-37
TR Lesson 11, p. 76-79
SR 11, p. 38-41
TR Lesson 12, p. 80-85
SR 12, p. 42-45
TR Lesson 14, p. 99-107
SR 14, p. 50-55

Relative Position and Motion of the Earth, Moon, and Sun

Outcomes

Students will be expected to

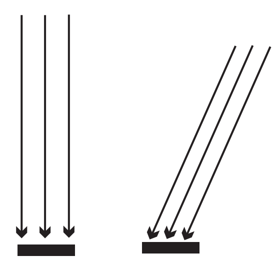
- describe how peoples' conceptions of the Earth and its position in the solar system have been continually questioned and have changed over time (105-6)
- demonstrate how Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons (301-19)
- observe and explain how the relative positions of Earth, the moon, and the sun are responsible for the moon phases, eclipses, and tides (301-20)

Elaborations–Strategies for Learning and Teaching

This unit could start with an open discussion with students about their conceptions of the Earth and its place in the solar system: What is the shape of the Earth, the motion of the Earth relative to the sun, the moon, and the planets? Throughout this discussion, teachers should probe where the students got their information, and intersperse early conceptions of the Earth and its place in the solar system. These early conceptions (flat Earth, the sun rotating around the Earth) seem quite common sense in the absence of contrary evidence, and, in fact, the idea that the Earth actually revolved around the Sun was met with considerable resistance when first proposed. What today's students may take for granted and not question, was very controversial in its time.

Students can use models to show the effects of moving celestial bodies (use balls, globes, flashlights, or lamps to show how day and night occur, for example).

Before students can understand the causes of the seasons, they need to investigate the effect of the angle of the Sun's rays on temperature. If possible, light meters can be used to investigate the difference in light intensity at various points on a globe or circular object when light from a lamp or flashlight is shone it. Diagrams can also be drawn to show that the angle will cause the light to be spread out over a larger area and therefore the light is not as concentrated and it will not be as warm.



Students can note the differences in temperature at various times of the day and relate these differences to the angle of the sun. (This may replace the model activity above.)

Once students understand the effect the angle of the sun has, they can investigate the causes of the seasons by using four globes tilted on the axes and positioned so that the same geographic feature faces the lamp. The centre and the axis of each globe must be parallel to each other for this to work.

Students should describe how people's perception of the Earth's position has changed from a flat Earth to a round Earth and from an Earth-centred system to a sun-centred system.

Relative Position and Motion of the Earth, Moon and the Sun

Suggested Assessment Strategies

Performance

- Students could put a light in the middle of the room to represent the sun. A basketball (mark or paste something on it to represent Atlantic provinces) or globe can represent the Earth and a tennis ball can represent the moon. The teachers could ask a student to position or move the Earth and/or the moon to simulate the following situations: (105-6), (301-19)
  - Position the Earth so that it is night in the Atlantic provinces.
  - Position the Earth so it is summer in the Atlantic provinces.
  - Move the Earth to show its path for one year (no rotation, just revolution).
  - Move the Earth to show its motion for one day.

Paper and Pencil

- In the past, many people believed that the Earth was the centre of the solar system. What information has caused people to change their belief? (105-6)

Resources

(105-6, 301-19)

TR	*Lesson 5,*	*p. 38-46*
SR	*5,*	*p. 16-19*

(301-20)

TR	*Lesson 7,*	*p. 54-59*
SR	*7,*	*p. 24-29*
TR	*Lesson 8,*	*p. 60-63*
SR	*8,*	*p. 26-29*

Relative Position and Motion of the Earth, Moon, and Sun

Outcomes

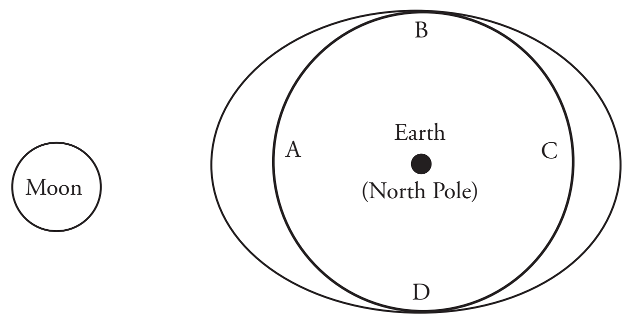
Students will be expected to

- observe and explain how the relative positions of Earth, the moon and the sun are responsible for the moon phases, eclipses and tides (301-20) **cont'd**

Elaborations–Strategies for Learning and Teaching

Models using globes, balls and lamps or flashlights should also be used to illustrate the phases of the moon and eclipses. Students should be able to draw diagrams or hold models of the Earth, moon and sun in positions to show how the various phases of the moon occur and how a solar and lunar eclipse occur.

Students could look for evidence of tides (for example, How high do you think the tides go? What signs do you see as evidence?) on a field trip to a tidal zone. Explanations of tides should be limited to simple models or diagrams that involve the Earth and the moon. Other factors affect tides, such as the gravitational pull of the sun on the Earth and the oceans, but these factors should be ignored for now, or explored as an enrichment activity (neap tides, spring tides). Note in the diagram below, high tide occurs at points A and C, while low tides are at points B and D. As the moon revolved around the Earth, the high tides move with it.



Diagrams are not nearly as useful as models, but they provide a simple framework for students who have a hard time visualizing exactly what is going on in a 2 dimensional diagram. For example, they may think that point B is the North Pole, since that is the way they are used to seeing the Earth in pictures. Since the diagram looks down on the Earth, the North Pole is actually in the centre.

Students can observe the phases of the moon, the rise and fall of tides and Sun's position over a period of time. Students are able to relate this to their models of earth, moon and sun.

Relative Position and Motion of the Earth, Moon, and Sun

Suggested Assessment Strategies

Performance

- The performance item on p. 183 groups students for this task. Teachers should ask students to position and/or move the Earth and moon to show:
  - when the people of the Atlantic provinces would see a full (half, new) moon
  - high tide and low tide in the Atlantic provinces
  - a solar and lunar eclipse in the Atlantic provinces (301-20)
- Students could check their local newspaper (or Internet site) for tide times and heights (search key words: "tide table"). They should keep track of high and low tide times, and the tide heights for one week. They should e-mail a student in another community or Atlantic province and compare their tide data. Students should propose explanations for why there are differences in the times and heights. (301-20)
- Students could examine next month's calendar page showing phases of the moon. They should draw their predictions of the interim position/images of the moon between each phase shown. Students should check their predictions with actual observations or use an Astronomy Software program for similar results. (301-20)

Journal

- Every night for one month, students could draw a picture of the moon if it is visible, and date it. They should identify the date of a full moon, a half moon, new moon and quarter moon. (301-20)

Resources

The Solar System

Outcomes

Students will be expected to

- select and use tools in building models of the solar system that show approximate relative size of the planets and sun and the approximate relative orbits of the planets around the sun (205-2)
- describe the physical characteristics of components of the solar system (104-8, 300-23)

Elaborations–Strategies for Learning and Teaching

Students should construct models that give them a concrete picture of the scale of the solar system and the interactions between the planets. Depending on the scales chosen, this model may be constructed in a classroom, or in the gym, or outside in the school yard. A useful model uses various lengths of string to show the distance of a planet from a sun, and different sized balls or balloons to represent different planets. If students are given a ball (planet) and the string attached to the sun to hold on to, they can simultaneously revolve around the sun to simulate the planets in their orbits. Other students may be given other props to signify what they are, for example, a small ping-pong ball or a pea could signify an asteroid, and then move throughout this model to show the path they might follow.

Students should be able to distinguish between the identified components in terms of the paths they follow (for example, Do they orbit the sun? Do they orbit a planet?), their general make-up (solid, liquid and/or gas) and ability to radiate light. Students should also be expected to know the names of the planets and be able to identify the closest planets to Earth. They should not be required to know the order of all nine planets, but could perhaps name the planets closest and furthest from the sun. The focus should be on introducing them to the concept of a solar system, and then teaching them the skills to seek out specific information instead of memorizing it.

Students should

- describe the sun as the centre of the solar system and the main source of energy for everything in the solar system
- describe planets as bodies that move around the sun and do not give off their own radiation
- state the names of all the planets and name the planets on either side of the Earth
- identify examples of planets that are made from rocky materials and those that are made up of gases
- describe moons as bodies that move around the planets and do not give off their own radiation
- describe the general composition, relative size, appearance, and paths of asteroids, comets, and meteors

The Solar System

Suggested Assessment Strategies

Performance

- In a group of two or three, students could construct a model from the suggested list below:
  - model of the moon rotating and revolving around the Earth
  - model of another planet and its moon(s), illustrating the paths and relative size
  - model of the planets of the solar system and sun, showing relative size or distance from the sun
  - model illustrating the difference between a rocky planet and one composed mostly of gases.
  - model illustrating the relative size, path and composition of a comet, meteor, or asteroid (205-2, 104-8, 300-23, 105-1, 205-8, 207-2)

Journal

- Students could describe how the sun is very important to them. They should describe why. (104-8, 300-23)

Paper and Pencil

- Students could respond to questions such as "What is the difference between the orbit of a planet and the orbit of a moon?" (104-8, 300-23)

Interview

- Do all the planets have the same type of composition? What types of planets are there? (104-8, 300-23)

Resources

(205-2)

TR	*Lesson 2,*	*p. 19-26*
SR	*2,*	*p. 6-7*
TR	*Lesson 3,*	*p. 27-31*
SR	*3,*	*p. 8-11*

(104-8, 300-23)
Covered all throughout the resource module.

The Solar System (continued)

Outcomes

Students will be expected to

- identify and use a variety of sources and technologies to gather pertinent information about a planet, moon, asteroid, or comet and display their findings using diagrams, pictures and/or descriptions from recent explorations (105-1, 205-8, 207-2)

Elaborations–Strategies for Learning and Teaching

Students will select one of the components of the solar system to research using the Internet, software, videos, or other sources. If they research a planet, they can collect information on moons, planet's surface temperature or the amount of gravity. The focus should be on developing the skills to seek out the information and trying to make the facts they collect as relevant and real to them as possible. They can display their findings in project form. Alternatively, students could write a letter home describing their holiday on a planet, moon, or asteroid other than the Earth and include in the description the key characteristics, drawings or pictures of the planet. Students can participate in an "Invent an Alien" contest where students can use recyclable material to construct an alien that could survive on a planet other than Earth, or write a story about this alien, its experiences, and its adaptive features. Students could draft a travel brochure to a planet.

Software and Internet sites are available that can provide an excellent, motivating source of information about the components of the solar system.

- evaluate the usefulness of different information sources when getting information about the components of the solar system (206-4, 204-6)

Students should examine, critically, a variety of information sources on the solar system. Sources include science fiction books, television programs, Internet sites, and scientific books and magazines. There are a wide variety of science fiction shows on television. Students could evaluate these shows to try to pick out fact from fiction in some of these episodes. This can connect to language arts outcomes related to critical literacy. An interesting project is to show old science fiction shows and discuss how some of technologies used in those shows were not even invented at that time, but are now common place. Another source of fact versus fiction can be explored by students or teachers reading science fiction and factual accounts of phenomena (such as the apparent canals on Mars). Discussions can ensue on the merits and purpose (entertainment versus information) of each account. It can also help to highlight the concept that as technology improves, ideas in science constantly evolve. Hubble, who first used his telescope to look at Mars, concluded that it was crisscrossed with canals, which led him to conclude that it had intelligent life forms that used advanced technologies. This spurred on scientific investigation to determine the nature of these canals, which led in turn to a better theory as to the origin of the canals.

The Solar System (continued)

Suggested Assessment Strategies

Paper and Pencil

- Students could select a component of the solar system, a current event in space travel or exploration, or a technology used to explore space and using a variety of sources to obtain information, and write a report on this topic. (105-1, 205-8, 207-2, 107-12, 106-3, 107-3)
- Students could explain how planets are different from stars? (105-1, 205-8, 207-2)

Interview

- When you watch science fiction shows, how much of it do you think is based on fact? How much of it is fiction? Select one for discussion. (206-4, 204-6)

Presentation

- Students could create a model of a component of the solar system that they are researching and present their project to the class. (105-1, 205-8, 207-2)
- Students could write a short story about space travel incorporating the component of the solar system they are researching. How long would it take to get there? What would they see when they arrived? Could they walk on the planet? What kinds of things would they experience? (105-1, 205-8, 207-2)

Resources

(105-1, 205-8, 207-2)

TR	*Lesson 3,*	*p. 27-31*
SR	*3,*	*p. 8-11*

(206-4, 204-6)

TR	*Lesson 3,*	*p. 27-31*
SR	*3,*	*p. 8-11*
TR	*Lesson 14,*	*p. 99-107*
SR	*14,*	*p. 50-55*

Stars and Constellation

Outcomes

Students will be expected to

- identify constellations from diagrams, pictures and/or representations of the night sky (302-13)
- use electronic, print resources and/or visit a planetarium to gather information on the visual characteristics and mythology of constellations (205-8)
- compare how different cultures have used the positions of stars for such things as the appropriate time to plant and harvest crops, navigate the oceans and/or foretell significant events (107-3)

Elaborations–Strategies for Learning and Teaching

Obviously, viewing the night sky is not going to be possible during school hours. Depending on weather conditions, the stars may not be visible for long periods of time. Whenever possible though, students should be involved in observing the night sky and identifying patterns and differences over the evening, and from night to night. As a home activity, students should pick out one star/constellation and note its position at the same time each night. Students should not be asked to memorize large numbers of constellations. Teachers may want to focus on one or two that are visible at that time of the year, so that students can recognize them and show them to others in their household. Given a picture of the night sky, students can invent their own constellations and name them. This will emphasize to them that constellations are human inventions and different places around the world have defined different constellations with a variety of names.

Students can try to identify constellations using pictures of the night sky, or viewing the constellations using a portable planetarium, or visiting a planetarium. Students can make their own planetarium by selecting a constellation and using construction paper, poking holes and shining light through them to project a constellation on a screen.

Students should investigate how different stars have been used to plant and harvest crops, foretell significant events.

Students can investigate, using electronic and print resources, how the stars have been used by different cultures (e.g., Celts, Aztecs, and Egyptians) over the years and how various constellations got their names. Fishers, explorers, and astrologers have used the position of the stars to help them. Students can investigate some of the ways that stars have been used in the past, and, if possible, try using the same techniques to see if they have merit.

Stars and Constellations

Suggested Assessment Strategies

Performance

- Using dark construction paper, students could draw a constellation, and mark the stars that define it. **Caution: Using a pin or sharp point of a pencil or pen put holes in the paper where the stars appear could be dangerous.** Using an overhead projector, students should show their class their constellation. (205-8)

Journal

- Three times this month, on clear nights, students could record their observations of the night sky. They should create their own constellation, name it, and draw it in their journal. (205-7, 302-13)

Paper and Pencil

- Students could research and write a brief report on a constellation. They should refer to the origin of its name, and its importance to ancient and/or modern culture. (205-8)
- Students could research how the Egyptians, Aztecs, and other cultures used the Sun and stars to explain natural phenomena. (107-3)

Interview

- Do we always see the same stars when we look out at night? Do the patterns of stars change over the year? (205-7), (302-13)

Portfolio

- Students could select pieces of work to include in their portfolio.

Resources

(302-13, 205-8, 107-3)

TR	*Lesson 9,*	*p. 64-69*
SR	*9,*	*p. 30-33*