Unit 1
Space
Suggested Time: 21 Hours

Unit Overview

Introduction

Innovations and advancements in computers and other technologies related to astronomy in the past 20 years have enabled astronomers to collect new evidence about the nature of the universe. The study of space exploration is an opportunity for students to develop an understanding of the origin, evolution, and components of the solar system and the universe. As students become more aware of the solar system and the universe and understand them better, they develop a greater appreciation of them and how they function.

Students will continue their study of our solar system by exploring the various theories that exist to explain its formation. As well, students will learn about other parts of the universe such as galaxies, red giants, black holes and quasars.

Focus and Context

The focus of this unit is inquiry. In addition to learning more about space and what is in it, students should learn how we have come to know and understand the solar system and the rest of the universe.

Science Curriculum Links

In the unit, “Daily and Seasonal Changes” in primary science, students were introduced to the concept of daily and seasonal cycles. In **grade 6,** students describe the physical characteristics of components of the solar system - specifically, the sun, planets, moons, comets, asteroids, and meteors. They also investigate how the relative positions of the earth, the moon, and the sun are responsible for the moon phases, eclipses, and tides. Major constellations are investigated and identified.

In **high school**, students have the option of continuing their study of Astronomy. They will continue to compare and contrast a variety of theories for the origin of the universe. Also, they will describe the life cycle of stars and compare the composition of stars at different stages of their life cycles.

Curriculum Outcomes

STSE

Students will be expected to

Nature of Science and Technology

109-3 describe and explain the role of experimentation, collecting evidence, finding relationships, proposing explanations, and imagination in the development of scientific knowledge.

109-11 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary study areas.

109-13 explain the importance of using precise language in science and technology

110-6 explain the need for new evidence in order to continually test existing theories.

Relationships Between Science and Technology

111-5 describe the science underlying particular technologies designed to explore natural phenomena, extend human capabilities, or solve practical problems.

Social and Environmental Contexts of Science and Technology

112-6 provide examples of how Canadian research projects in science and technology are supported.

112-11 describe examples of science- and technology-based careers in Canada, and relatethese careers to their studies in science.

113-3 describe possible positive and negative effects of a particular scientific or technological development, and explain why a practical solution requires a compromise between competing priorities

Skills

Students will be expected to

Initiating and Planning

208-4 propose alternative solutions to a given practical problem, select one and develop a plan.

208-8 select appropriate methods and tools for collecting data and information and for solving problems

Performing and Recording

209-3 use instruments effectively and accurately for collecting data

209-4 organize data using a format that is appropriate to the task or experiment.

Analyzing and Interpreting

210-3 identify strengths and weaknesses of different methods of collecting and displaying data

210-9 calculate theoretical values of a variable.

210-13 test the design of a constructed device or system

210-15 evaluate designs and prototypes in terms of function, reliability, safety, efficiency, use of materials, and impact on the environment

210-16 identify new questions and problems that arise from what was learned.

Communication and Teamwork

211-1 receive, understand and act on the ideas of others.

211-3 work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise

211-4 evaluate individual and group processes used in planning, problem solving, decision making, and completing a task

211-5 defend a given position on an issue or problem, based on their findings.

Knowledge

Students will be expected to

312-4 describe and explain the apparent motion of celestial bodies.

312-1 describe theories on the formation of the solar system.

312-5 describe the composition and characteristics of the components of the solar system.

312-6 describe the effects of solar phenomena on Earth.

312-3 describe theories on the origin and evolution of the universe.

312-2 describe and classify the major components of the universe.

Observing Celestial Bodies

Outcomes

Students will be expected to

- describe and explain the apparent motion of celestial bodies (312-4)
  - define celestial body
  - list and recognize examples of constellations and asterisms. Include:
    - (i) Ursa Major, the Great Bear (including the Big Dipper)
    - (ii) Ursa Minor, the Little Bear -(including the Little Dipper)
    - (iii) Orion (including Orion's belt)

Elaborations—Strategies for Learning and Teaching

Teachers could begin this unit by having students do a "What I Know - Want to Know - Learned" (K-W- L) activity to activate students' prior knowledge of concepts in astronomy as well as provide a time to reflect on their understanding of what they have learned in Grade 6 about the solar system and stars.

Students could observe the planets which are visible at the time of year that this unit is being addressed. As well, students could be asked to identify any constellations that are obvious at this time of year. Throughout the rest of the school year students could identify other constellations or celestial events as they occur.

Students could to brainstorm questions they have about the universe using the Roundtable approach (See Appendix B). Some questions could be addressed early to engage students. Questions that relate to topics outside the course content could be given to students as challenge or enrichment topics. Alternatively, students could be directed to websites (such as the Hubble site) which provide answers to many space-related questions.

Students couldobserve the night sky to locate constellations and asterisms using sky charts from print and digital sources. Teachers could also have students construct their own star map to aid in the identification of the constellations and asterisms. As an extension to this activity, students could keep a journal, with sketches of their observations of the night sky, noting differences in the location of the constellations/asterisms and the moon. If teachers choose to do this activity, it should be introduced early in the unit and be carried out over an extended period of time. Web resources could be used to supplement this activity.

Teachers could also relate the constellations with zodiac mythology (horoscopes). If time permits, teachers could incorporate stories and backgrounds for some of the constellations.

Teachers could encourage students to identify questions and problems associated with theories and/or topics related to the universe such as, "What are the limits of space travel?", "How old is the universe?", and "Are there other planetary systems similar to ours in the Universe?"

As we continue to seek answers to questions of the unknown related to space, humans will continue to create technologies to find those answers. Students could be encouraged to pose some questions we still seek answers to concerning space, such as, "Is there life somewhere else?" and "If so, is it an intelligent life form?"

Observing Celestial Bodies

Suggested Assessment Strategies

Paper and Pencil

- Imagine you are answering a letter from an alien in another part of the universe. How would you write your return address? (Street, Community/Town/City, Province, Country, Planet, Solar System, Galaxy, Universe).
- What is a celestial body and how do they move relative to other celestial bodies?
- Using a star map, identify the following constellations: Ursa Major, Ursa Minor, Orion, Cassiopeia, and Leo.
- Students could complete the "Constructing Constellations" activity 10-1A on page 9 in the textbook.

Journal

- Throughout the course of the unit, sketch your observations of the night sky (constellations and moon) in a journal.
- Using your zodiac sign (horoscope), sketch your constellation and research the history of this constellation.

Presentation

- Students could create a collage or poster on a particular constellation. Students could include galaxies, nebulae, star clusters or any other objects that can be found in that region of the sky.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

TR AC 24

ST p. 352

Observing Celestial Bodies (continued)

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• describe and explain the apparent motion of celestial bodies (312-4)	
(continued)	
- describe and explain the apparent motion of: (i) stars (ii) moon (iii) sun (iv) planets (v) comets (vi) asteroids	Students could investigate the moon, sun, and planets in order to describe their apparent motion. Students should be involved in activities that demonstrate rotation and revolution of planets and moons as well activities that illustrate the paths or orbits of the planets and our moon. Students could use plastic cups to trace and compare circular and elliptical orbits. The orbits of comets and asteroids should be explored. Teachers could use the suggested activity 10-1B in the textbook or refer to NASA's Spaceplace website to help address this outcome.
- identify that celestial bodies move in cyclic paths called orbits and that these orbits result from gravitational forces.	A student could spin a basketball on his/her finger (pending talent) and walk around the room in an orbit. Teacher can discuss how this represents celestial bodies rotating around a central axis while orbiting other celestial bodies.
- identify that planets, suns, and moons revolve on a central axis.	Teachers could a globe to demonstrate this.

Observing Celestial Bodies (continued)

Suggested Assessment Strategies

Paper and Pencil

- Students could start a Mind Map with "Solar System" being the center (See Appendix B for Mind Mapping guidelines) and "Apparent Motion" being the first branch. The Mind Map will be used throughout the section.
- Students can add the information (motion of celestial objects) to their Mind Maps
- What is the difference between rotation and revolution? For Earth, how long are one rotation and one revolution?
- What roles do gravitational forces play in celestial orbits?
- Compare and contrast the rotations and revolutions of the planets in our solar system.

Presentation

- Students could complete the recommended activity and discuss why they think orbits are elliptical rather than circular.
- Students could research the reasoning behind our knowledge of celestial movement and present their findings.

Performance

- Students could complete the recommended activity to sketch various orbits.
- Students could complete the activity, "The length of the school year on different planets" in the textbook to supplement the rotation and revolution outcome.
- Students could complete the activity, "easy ellipses" in the textbook to describe the apparent motion of celestial bodies.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 354, 358, 364
BLM 4-6, 4-7, 4-8

Early Models of the Universe

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• describe theories on the formation of the solar system (312-1)	
- describe the contributions made by various individuals to our knowledge and understanding of celestial bodies and their motions. Include: (i) Aristotle (ii) Ptolemy (iii) Copernicus (iv) Galileo (v) Kepler (vi) Newton	Teachers should clarify that our understanding of Earth's revolution around the sun is relatively recent (Copernicus, 1543). The societal and scientific issues involved in the evolution of our understanding of the solar system provide an excellent opportunity to address the Nature of Science. Teachers could relate that scientific discoveries cannot be seen as separate from the culture and beliefs in which they are made. Particular attention should be paid to the contributions of Kepler and Galileo. Teachers should emphasize that Galileo used a careful scientific methodology and applied it to astronomy for the fist time. Kepler determined that planets follow an elliptical path (students do not need to know Kepler's Laws of Planetary Motion). Teachers should focus the discussion on the contributions made by these scientists to the scientific body of knowledge rather than on their life history. Describing the contributions of these scientists should be limited to one class or less. As part of the NOS treatment teachers could point out that many of the contributions of later scientists were based on those proposed by earlier theorists (for example, Ptolemy modified Aristotle's, etc).
- identify early technologies that advanced scientific observations about the solar system. Include: (i) stone circles (ii) astrolabe (iii) early telescope	Teachers should clarify the role and importance of the telescope in advancing our understanding first of the solar system and then later of the universe. (Note: technologies that contribute to our knowledge of the universe will be discussed in more detail later in the unit). Teachers could use the Astroscan telescope, which was supplied to their school, as a demo of a reflecting telescope. Students could be challenged to construct simple working models of a telescope and/or an astrolabe. Teachers could have students complete the activity found at the University of Berkeley "At Home Astronomy" website.

Early Models of the Universe

Suggested Assessment Strategies

Journal

- It was originally believed that Earth was the center of the universe. However, it was Copernicus that theorized that Earth revolved around the sun. Discuss the possible impacts this may have on a society. Do you think the theory was easily accepted? Explain.

Presentation

- Students could develop a timeline highlighting the contributions by Aristotle, Ptolemy, Copernicus, Galileo, Kepler, and Newton to celestial bodies and their motions.

Paper and Pencil

- What are the two main types of telescopes used to observe solar systems?
- Sketch and label the components of some early technologies that has advanced our knowledge of the solar system (stone circles, astrolabe, telescopes).
- Students can add "early technologies" to the Mind Map.
- Investigate the two types of visual telescopes (refracting and reflecting) and identify which one was the type used by Galileo.
- Students could add this information (contributions) to their Mind Map.
- Describe how our scientific knowledge of celestial bodies has changed from Aristotle to Newton.
- What contributions did the following make to the field of astronomy: Aristotle, Ptolemy, Copernicus, Galileo, Kepler, and Newton?

Performance

- Construct a working model of stone circles, astrolabe, or telescope and describe how the device functions.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 368-372, 376-380
BLM 4-10

ST pp. 366-367, 374
BLM 4-9

Early Models of the Universe (continued)

Outcomes

Students will be expected to

- select appropriate methods and tools for collecting data and information and for solving problems (208-8)
- use instruments effectively and accurately for collecting data (209-3)
- organize data using a format that is appropriate to the task or experiment (209-4)
- evaluate designs and prototypes in terms of function, reliability, and use of materials (210-15)
- receive, understand and act on the ideas of others (211-1)
- work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise (211-3)
- relate personal activities and various scientific and technological endeavours to specific (109-11)
- describe the science underlying particular technologies designed to explore natural phenomena, extend human capabilities, or solvepractical problems (111-5)

Elaborations—Strategies for Learning and Teaching

Core Laboratory Activity: Strolling Through the Solar System

The laboratory outcomes 208-8, 209-3, 209-4, 210-15, 211-3, and, in part, 312-5 are addressed by completing CORE LAB 10-3B "Strolling Through the Solar System."

The **CORE STSE** component of this unit incorporates a broad range of Grade 9 outcomes. More specifically, it targets (in whole or in part) 109-11, 111-5, and, in part, 312-4. The STSE component "**Celestial Navigation"** can be found in Appendix A.

Early Models of the Universe (continued)

Suggested Assessment Strategies

Resources

www.gov.nl.ca/edu/science_ref/main.htm

Core Lab #1: "Strolling Through the Solar System"
ST pp. 382-383
TR pp. 4-14, 4-15, 4-16
BLM 4-12

Core STSE #1: " Celestial Navigation," Appendix A

Characteristics of Celestial Bodies in our Solar System

Outcomes

Students will be expected to

- describe the composition and characteristics of the following components of the solar system. Include: (312-5)
  - (i) the sun
  - (ii) terrestrial and gas planets
  - (iii) dwarf planets (Pluto)
  - (iv) moons
  - (v) periodicity of comets
  - (vi) asteroids/meteoroids
- describe the characteristics of the sun. Include:
  - (i) sun-spots
  - (ii) solar flares
  - (iii) solar prominences
- compare and contrast the composition of the four inner rocky (terrestrial) planets with the four outer gaseous (Jovian) planets

Elaborations—Strategies for Learning and Teaching

Teachers should limit the discussion of the sun to the following:

Criteria	Characteristics
Mass	contains 300 000 times more mass that Earth
Motion	rotates
Composition	contains hydrogen and helium atoms
Function	chemical reactions in the sun give off electromagnetic radiation, including heat and light which support life in our solar system
Special Features	contains sun-spots, solar flares and solar prominences

Students should be able to compare and contrast the inner terrestrial planets (inner) with the outer gaseous planets (Jovian). Sample criteria for comparison of these two groups should include: size, motion, composition, distance from sun, density, and temperature. Teachers should limit the discussion of terrestrial and Jovain planets to the following information:

Criteria	Terrestrial Planets (Inner)	Jovian Planets (Outer)
Size	Small (all Earth size or smaller)	Large (4 to 11 times larger than Earth)
Motion	Slow spinning, small orbits	Faster spinning, large orbits
Composition	Solid and rocky	Gaseous
Distance from Sun	Closer	Further awar
Temperature	Warmer, but temperatures vary	Colder, but temperatures vary
Density	Greater	Lesser

Teachers should clarify the relationships that exist between distance from the sun and the temperature, composition and density.

Although this topic was introduced in Grade 6, there have been many new discoveries and space missions resulting in many new images and other discoveries.

Teachers could use a mnemonic device to help students remember the names and order of the planets. For example, My Very Educated Mother Just Served Us Nachos (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune).

Pluto should be dsicussed in order to determine its similarities and differences when compared with the other planets. Through this investigation, students should be able to state why Pluto is no longer considered a planet.

Characteristics of Celestial Bodies in our Solar System

Suggested Assessment Strategies

Paper and Pencil

- Compare and contrast terrestrial planets and gas planets.
- Compare and contrast the composition of the four inner rocky (terrestrial) planets with the four outer gaseous (Jovian) planets
- Students can add the information to their Mind Maps (See Appendix B).

Journal

- Why are the outer planets less dense than the inner planets?
- Why is Pluto now considered a dwarf planet?
- What criteria are necessary to be considered a planet?

Presentation

- Students could research one of the planets in our solar system and create a poster/collage/multimedia presentation.

Performance

- Because of the textual content, students can participate in the Quiz-Quiz-Trade activity (See Appendix B) to review material.
- Students could work in groups to create a comparison table of all planets based on size, motion, composition, distance from sun, temperature, and density.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 398-401
BLM 4-16

Characteristics of Celestial Bodies in the Solar System (continued)

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• describe the composition and characteristics of the following components of the solar system. Include: (312-5) (i) the sun (ii) terrestrial and gas planets (iii) dwarf planets (Pluto) (iv) moons (v) periodicity of comets (vi) asteroids/meteoroids **(continued)**	
- explain why Pluto is now called a Dwarf Planet - describe how Pluto differs from the other eight planets	Teachers could consult news articles from July and August, 2006 which explained the criteria used by astronomers to determine whether Pluto was truly a planet. Teachers could expand on this through an investigation of the various technologies used to study Pluto's characteristics.
- describe the composition of comets	Teachers could explain the composition of a comet by comparing it to a "dirty snowball". Teachers should highlight that comets are usually characterized by one or more "tails" due to a loss of dust and ice due to exposure to solar radiation.
- define periodicity as it relates to comets	Students will have been introduced to comets in Grade 6. In this course, students will learn that comets have unique orbits around the sun and tend to follow a pattern with regards to their passage by Earth and the Sun. Comet types are separated into two categories based on this periodicity – short and long period comets – which affects their origin and composition. Further exploration of the periodicity of comets would provide an opportunity to learn how predictions are made regarding these part time members of our solar system. Teachers could mention that Halley's comet was the first comet whose return was predicted. Students could investigate a well-known comet in order to learn about its periodic nature and why it is easier to view during some pass-bys than during others. Some common comets are: Hale-Bopp, Shoemaker-Levy, and Halley's Comet.

Characteristics of Celestial Bodies in the Solar System (continued)

Suggested Assessment Strategies

Journal

- Imagine that you are Pluto and you just learned that they are going to downscale your status from Planet to Dwarf Planet. How would you respond? What information would you give the space agencies to reconsider their decision?
- Comets are said to be responsible for the water on Earth due to frequent impacts over 4 billion years ago. Explain why?

Paper and Pencil

- What is the difference between short-period and long-period comets?
- Students can add information regarding comets to their Mind Maps (See Appendix B).
- Where did comets originate from?
- Students could research the following comets: Hale-Bopp, Shoemaker-Levy, and Halley's comet.
- Why is Pluto now considered a dwarf planet?
- How does Pluto differ from the eight planets in our solar system?
- What are the characteristics of comets?

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p. 403

ST pp. 360, 404-405

Characteristics of Celestial Bodies in the Solar System (continued)

Outcomes

Students will be expected to

- describe the composition and characteristics of the following components of the solar system. Include: (312-5)
  - (i) the sun
  - (ii) terrestrial and gas planets
  - (iii) dwarf planets (Pluto)
  - (iv) moons
  - (v) periodicity of comets
  - (vi) asteroids/meteoroids

(continued)

- compare and contrast asteroid, meteor and meteorite

Elaborations—Strategies for Learning and Teaching

In Grade 6, students studied the physical characteristics of the various components of our solar system. Students should be able to compare and contrast asteroids, meteors, and meteorites with respect to their size, composition, and location. Teachers could use specific examples to illustrate differences and similarities.

Teachers should highlight that meteoroids are solar system debris, while meteors are identified as the trail that is associated with meteoroids as they enter the atmosphere. Meteorites are the surviving portions of a meteor that actually reaches Earth.

Teachers should point out that the main location for asteroids in our solar system is between Mars and Jupiter and most asteroids have orbits similar to the planets. Students should understand that some asteroids have irregular orbits due to gravitational attraction of the planets and collisions.

Teachers could have students watch some popular movies (e.g., Armageddon, Deep Impact) and critique their depiction of asteroids, meteors, and meteorites based on the science they have learned about them. Teachers could use this to further address NOS by having students discuss how these popular media productions depict the scientists and the science involved.

Characteristics of Celestial Bodies in the Solar System (continued)

Suggested Assessment Strategies

Presentation

- Students could research some popular media (e.g., movies, TV shows) and critique their depiction of asteroids, meteors, and meteorites (sizes, compositions, motion).

Performance

- Students could develop a poster/collage/multimedia presentation of asteroids, meteors, and meteorites.

Paper and Pencil

- Compare and contrast asteroids, meteors, and meteorites.
- Students could add the information to their Mind Maps (See Appendix B).

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 403, 406-407

Characteristics of Celestial Bodies in the Solar System (continued)

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to • describe the composition and characteristics of the following components of the solar system. Include: (312-5) (i) the sun (ii) terrestrial and gas planets (iii) dwarf planets (Pluto) (iv) moons (v) periodicity of comets (vi) asteroids/meteoroids **(continued)**	
- define impact sites	Teachers should clarify that impact sites provide evidence, of meteor/asteroid impacts on both our planet, as well as other planets. In relation to astronomy, an impact site is the place where a relatively small object (meteorite) has collided with a larger object (planet) to produce a fairly circular depression on the surface of the larger object. The impact site is often referred to as an impact crater due to the circular depression that was formed. Teachers could model the creation of impact sites by dropping a marble into a soft medium (a layer of flour covered with a layer of sand works well). Students could then report their observations. Students should note that the size of the depression created is often much larger than the object involved in the collision. Teachers could include discussion of the NEAR Earth monitoring program that monitors the asteroids, comets, etc that are found close to Earth. This discussion could include why we are interested in these small bodies and the technology used to monitor/study them. Teachers could use the Malin Space Science Systems website for background information.

Characteristics of Celestial Bodies in the Solar System (continued)

Suggested Assessment Strategies

Presentation

- Conduct an Internet search for websites that show examples of impact sites on Earth and around our solar system. Using a multimedia program such as Power Point, share these images with the class.

Performance

- Students could model an impact site by doing the recommended activity (marble dropped into flour/sand)

Paper and Pencil

- Students could research information on the possibility that asteroid impacts may have caused mass extinctions in the past.

Journal

- Discuss how a meteor/asteroid impact could affect life on Earth.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p.407

The Sun's Effects on Earth

Outcomes

Students will be expected to

- describe the effects of solar phenomena on Earth (312-6)
  - define and describe how the following phenomena affect life on Earth
    - (i) solar radiation
    - (ii) solar wind and auroras

Elaborations—Strategies for Learning and Teaching

Teachers should clarify the fact that the sun influences almost all natural phenomena on Earth. From being the source of energy for green plants to impacting upon our communication systems, the sun's influence is ever present. Students will already have had the chance to associate the sun's effect on weather on Earth, and will do this in greater detail in Grade 10 science.

Teachers could use the discovery of sunspots and their properties to illustrate how one discovery can lead to other discoveries. For example, the fact that the sunspots appear to move indicates that the sun actually rotates. Teachers could have students investigate the periodicity of sunspot activity on the sun and how some types of solar activity have influences on electromagnetic waves (radio, TV, etc.) created on Earth. The "northern lights" or Aurora Borealis and the "southern lights" or Aurora Australis could be investigated to demonstrate another observable influence the sun has on earth.

Teachers could have students complete Activity 11-1A to help clarify the concepts of sun spots and how it can help show that the sun rotates.

Teacher could use a "Round Robin Brainstorming" session (See Appendix B) by asking students to think of all the things on Earth that directly or indirectly use the sun's energy (e.g., plants, water cycles, electronics).

If necessary, teachers should clarify that all life on Earth is dependent on solar energy in the form of radiation. Plants, for example, use it to produce food on which most organisms depend on for life.

Teachers could have students research and identify various methods and technologies used to protect our bodies and eyes from harmful UV rays. Students could request information from the Canadian Cancer Society to inquire how and why exposure to sunlight can be dangerous. Recent studies on the impact that UV rays have on plankton and fish fry in the ocean could be investigated.

The Sun's Effects on Earth

Suggested Assessment Strategies

Paper and Pencil

- What are solar flares and how do they form?
- What are sun-spots?
- Students can add "solar phenomena" to their Mind Maps (See Appendix B).
- How do the Northern Lights form? What roles does the sun play in the Northern Lights?
- How does Earth protect us from solar radiation?

Performance

- Teacher can facilitate a Round Robin Brainstorming session (See Appendix B) on Earth's dependence on the sun.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 391-393
BLM 4-15

Canadian Contributions to Space Exploration

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• provide examples of how the Canadian Government and/or Canadian Space Agency are involved in research projects about space (112-6)	
- recognize that Canada plays a major role in space research and exploration.	Teachers should point out that Canada has a large space industry and has been involved in space exploration and missions since the very early days. Teachers should clarify that participating in space exploration does not need to involve sending missions into space. Teachers should use two examples from the list below to illustrate Canadian contributions and partnerships to space research and exploration: (i) the Canadarm 1 (ii) the International Space Station (iii) Canadian Space Station Remote Manipulator System (SSRMS) or Canadarm 2 (iv) Special Purpose Dexterous Manipulator (SPDM) or Canadahand
- give examples of Canadian astronauts.	Some examples of Canadian astronauts are: (i) Roberta Bondar (ii) Marc Garneau (iii) Chris Hadfield Teachers should give at least two examples of Canadian astronauts, either from the list above or from the Canadian Space Agency website. The Canadian Space Agency website will provide information on Canadian astronauts. Teachers could have students conduct research on one of the Canadian astronauts to understand their personal desires for becoming astronauts. Students should understand that the Canadian Space Agency's astronaut program is relatively new compared to other countries like the United States and Russia. Some other astronauts that students could research are: Steve MacLean, Ken Money, Robert Thirsk, and Julie Payette.

Canadian Contributions to Space Exploration

Suggested Assessment Strategies

Paper and Pencil

- Students could list and describe things to consider when building a space station such as life support, power, etc.
- Research the involvement and contributions Canada has made to space exploration and the understanding of our solar system.
- Students could write a short biography of one of the Canadian astronauts.

Journal

- Have students write a letter home describing their experience living on a space station.
- Students could make a list of the things they would take to the station if they are planning to stay for a period of six months.
- Students could add the information to their Mind Maps.

Presentation

- Students could develop a poster/collage/multimedia presentation of past space stations by either the Russians or Americans.

Performance

- Students could design their own space station and/or construct a model out of Styrofoam.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 414-415

TR AR 8
TR AC 21, 22

Technologies used to Explore Space

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• identify some technologies designed to explore space. (109-11, 111-5) Include: (i) rocket propulsion (ii) space suits (iii) satellites (iv) probes (v) rovers (vi) optical telescopes (vii) radio telescopes	Students should recognize the contribution of various scientific disciplines to the technologies designed to explore space. Examples include the Hubble telescope (optics and electromagnetic waves from the field of physics), preserved food and propulsion (chemistry), radio telescopes (physics). Teachers could have students investigate the basic science behind the technologies designed to explore space. Jet propulsion (chemical reaction and forces), reflecting and refracting telescopes (properties of light), and radio telescopes (electromagnetic radiation) are some of the technologies that could be explored.
- understand that various technologies have improved our capacity to observe space and have increased our knowledge of the universe.	Teachers should remind students that our knowledge of the universe is the result of centuries of observation and data collection using more and more advanced technologies. For example, we now know about the existence of many other celestial phenomena like quasars and black holes; we can accurately calculate the distance to and from other galaxies and stars and even determine the composition of those stars; we have learned that some parts of the universe continue to expand or move away from us. Students should know some examples of technologies that have increased our knowledge of the universe, including (i) the Hubble space telescope (ii) the Canada-France-Hawaii Telescope, (iii) the Very Large Array Radio Telescope Students should be able to relate how each type of telescope is different and how each is used.
• propose alternative solutions to a given practical problem, select one, and develop a plan (208-4) • work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise (211-3) • evaluate individual and group processes used in planning, problem solving, decision making, and completing a task (211-4)	**Core Laboratory Activity: Designing a Space Station** The laboratory outcomes 208-4, 210-4, 211-3, 211-4, and, in part, 111-5 are addressed by completing CORE LAB 11-3B "Designing a Space Station."

Technologies used to Explore Space

Suggested Assessment Strategies

Paper/Pencil

- Describe the things that need to be considered when designing a space suit.
- Students could do a research paper on how reflecting telescopes work with examples of recent very large telescopes such as the MMT.
- Students could compare and contrast the types of objects that optical and radio telescopes can see.
- Students should describe what each of these technologies is and how they enable us to get a better view of the universe.

Presentation

- Students could make a poster of the different type of rockets used by NASA and the ESA.
- Students could pick a favourite picture taken by the Hubble and report to the class what it is and why they chose that picture.
- Describe how these technologies are used to search for other solar systems and life elsewhere in the universe (SETI program).
- Students could pick a probe that is exploring space now and create a presentation on its mission plan and discoveries.

Performance

- Students could design a water rocket and describe how it compares to rockets used by NASA and the principles behind it.
- The Canadian Science and Technology Museum provides a water bottle rocket kit. Website: www.technomuses.ca

Journal

- Name an object of interest in space they would like to observe such as a black hole, a quasar, or planet and which type of telescope would be most appropriate.
- Pick a planet and design a probe to explore it including how to land it, survive on the surface, move samples, and collect samples.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 413, 416-421

ST pp. 419-420

Core Lab #2: “Designing a Space Station”
ST p. 422
TR 4-32
TR AC 6, 21, 22

Theories for the Origin of the Universe

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• explain the need for new evidence in order to continually test existing theories about the composition and origin of our universe (110-6, 210-3)	Teachers could have students explore the ways by which scientists gather information about our universe. Earth-based telescopes, the Hubble telescope, and planetary space missions should be highlighted in the discussion of this topic.
- recognize that astronomical theories are based on data collected remotely. - define galaxy, solar system, universe	Teachers should clarify that our understanding of the universe has changed and improved with improved technologies. For example, teachers could use the "face" on Mars as an example to illustrate how newer and more effective data collecting technologies help reshape our thinking about certain theories. Teachers could use this topic to reinforce the idea that new evidence forces rethinking of old theories and to provide a nature of science focus. Teachers could continue to address NOS relative to this point in the remaining topics of this unit.
• describe theories on the origin and evolution of the universe (312-3) Include: (i) Big Bang Theory (ii) Oscillating Theory	While some students may want to include religious-based beliefs for the formation of the universe, this is not a topic for this course. Teachers should be respectful of religious-based beliefs but limit discussion to the science-based theories as outlined in the textbook. Students should be able to describe the current scientific theories about the origin and evolution of the universe. The Big Bang Theory suggests that, because of the evidence we have for an expanding universe, the universe must have been more compact at an earlier time. Scientists estimate that the present matter in the universe was compressed together into a hot, dense mass 13.7 billion years ago. This matter began to move outward after a massive explosion. Teachers could demonstrate the expansion of the universe by placing colored, hole-punched pieces of construction paper on a balloon. Blow up the balloon and pop it using a needle or pin. The energy will expand the pieces representing the Big Bang Theory. The Oscillating Theory suggests that the universe will expand to a certain point in time and then, due to the forces of gravitation among the stars and galaxies, contract. Some scientists believe that this will result in a "Big Crunch" followed by another Big Bang. Teachers could help students visualize this by imagining a bungee jumper. As the jumper falls, they accelerate due to gravity but eventually the force of the bungee will pull back the jumper.

Theories for the Origin of the Universe

Suggested Assessment Strategies

Paper and Pencil

- Students could compare Galileo's view of Jupiter and Saturn to the new view provided by the Galileo and Cassini Spacecraft.
- Download a view of the 'Face' on mars taken by the Viking spacecraft in the 70's with the new photos recently provided by the Mars Orbiter spacecraft. Website: www.science.nasa.gov/headlines/y2001/ast24may_1.htm.
- Students could view pictures of various components of the solar system taken from Earth and from satellites and spacecraft in order to compare and contrast the quality of the two.
- Describe the Big Bang Theory.
- How are the Big Bang Theory and Oscillating Theory similar? How are they different?

Presentation

- Students could prepare a multimedia presentation/poster/collage on either of the two theories.
- Students could start a new Mind Map (See Appendix B) with "The Universe" in the centre. They could add these two theories to this Mind Map (See Appendix B).

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p. 428

ST pp. 431-433, 441

Theories for the Origin of the Universe (continued)

Outcomes	Elaborations—Strategies for Learning and Teaching
Students will be expected to	
• describe past and present theories related to the formation of our solar system. (312-1) Include: (i) Stellar Collision Theory (ii) Nebular hypothesis	Teachers should have students investigate the major scientific theories that try to explain the formation and origin of the solar system. Students should focus on a description of the theory as opposed to personal viewpoints that may be biased. The discussion of religious-based beliefs and counter beliefs is not appropriate for this course. Teachers should be respectful of religious-based beliefs but should emphasize that, while religion and science do coexist and sometimes conflict, this course is limited to theories of solar system formation that are based on empirical evidence derived from observations using the scientific method. As a means of addressing the nature of science, teachers could point out that theories about the origin and formation of the solar system and the universe themselves change and evolve based on evidence and ideas that bring new light to our understandings of these events. This is a normal process of science. Teachers could remind studetns that theories are attempts to explain observations related to a particular phenomena. As more and more observations are made (data) to support a theory the more confidence we will have in the theory's ability to predict and/or explain events. When contradictory evidence is obtained (eg. an observation that conflicts with the theory) scientists will, after making sure the new data is accurate, rework the theory to take into account the new information. If the new information cannot be incorporated into a modified theory, the old theory will be abandoned and a new theory developed to explain the new and previous observations. For a more detailed discussion, see "Atomic Theory" in Unit 2.
• compare units used to measure distances in space. (109-13, 210-9) Include: (i) astronomical units (ii) light year - define astronomical units - define light year	Teachers should clarify that a "light year" is a unit of measurement for extremely large distances so that students do not confuse "light-year" as a unit of time rather than distance. Students do not need to calculate distances between planets and stars. Teachers should also highlight to students that the light we see from distant stars has traveled for many years. When we look into the night sky we are actually seeing the light from the past (that star may not even exist now). For example, the light we see from the star Sirius is actually 8.6 years old.

Theories for the Origin of the Universe (continued)

Suggested Assessment Strategies

Performance

- Teachers could facilitate a Round Robin Brainstorming session (See Appendix B) on either "Life in the Universe", "What will happen to us in the future?", etc.

Paper and Pencil

- How do the other planetary systems found so far compare to ours?
- What would scientists look for to suggest signs of life on other planets?
- How do scientists determine the age of the universe?
- Have students investigate the unusual characteristics related to traveling close to the speed of light such as time travel, etc.
- Students could add the information to their Mind Maps (See Appendix B).

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 434-436

ST pp. 436-437, 454

Components of the Universe

Outcomes

Students will be expected to

- describe and classify the major components of the universe. (312-2) Include:
  - (i) nebula
  - (ii) spiral and elliptical galaxies
  - (iii) high mass stars
  - (iv) intermediate mass stars
  - (v) low mass stars
  - (vi) quasars
  - (vii) black holes

Elaborations—Strategies for Learning and Teaching

Teachers could point out that this topic will expand upon the differences between galaxies, nebulas, and individual stars which they previously encountered in Grade 6.

When discussing nebulae, teachers should stress that stars generally form from the dust, hydrogen gas, and plasma of nebulae. There are many images online of various nebulae such as the Crab Nebula or the Cat's Eye Nebula. There are different types of nebulae, but teachers do not need to go into detail on them.

Videos from sources such as "You Tube" could be used to show the relative sizes of each of these as the student is taken on an animated journey.

Teachers could provide students with opportunity to trace the evolution of stars starting with the nebula cloud. The student textbook may be used to show how the origin and evolution of stars results in different star types.

When discussing black holes, teachers can search for video clips ("You Tube") on black holes.

Teachers could have students complete the ASTROSCAN solar Activity 11-2D.

Components of the Universe

Suggested Assessment Strategies

Paper and Pencil

- Students can add information to their Mind Maps (See Appendix B).
- Use a concept map to develop a classification of the major components of the universe (i.e. nebula, galaxies, high mass stars, intermediate mass stars, low mass stars, quasars, and black holes).
- What evidence would suggest the presence of a black hole?

Journal

- Students could describe what it would be like to be on Earth as the sun comes to the end of its life cycle.

Performance

- Students could do a quiz-quiz-trade activity (See Appendix B) that will identify the characteristics of nebula, galaxies, high mass stars, intermediate mass stars, low mass stars, quasars, and black holes.

Presentation

- Students could create a poster on: nebulae, galaxies, high mass stars, intermediate mass stars, low mass stars, quasars, or black holes.

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST pp. 434-450

The Future of Space Exploration

Outcomes

Students will be expected to

- recognize that there are many science and technology-based careers in Canada that are associated with space exploration. (112-11)

- defend a position regarding societal support for space exploration (113-3, 211-5)

  - identify potential scientific and social benefits and negative consequences of Canadian partnerships in space exploration. Include:
    (i) medical
    (ii) industrial
    (iii) agricultural
    (iv) meteorological
    (v) military
  - identify the risks associated with space exploration and travel.

Elaborations—Strategies for Learning and Teaching

This section also provides an excellent opportunity to demonstrate and illustrate the wide variety of professions that work together when studying various aspects of the universe. Astronauts, scientists, engineers, doctors, pilots, technicians, astrophysicists, computer programmers, astrobiologists, lens makers, and many others could be highlighted during the study of the unit.

Students should be encouraged to view their position from various perspectives, for example, as a Canadian citizen and a World citizen. Students should recognize that there are potential conflicts between the different points of view on the time, energy, and resources allotted to space exploration.

Teachers could have students look at the issue through the lens of "sustainable development". Is space exploration sustainable? Should we use the funds invested in space exploration to try to solve economic, environmental, and social issues on Earth before looking to the stars? How does space exploration possible contribute to economic, environmental, and social issues on Earth?

Teachers could have students research, discuss, and debate the "need" to explore the solar system and the financial costs associated with space exploration. Canada's role, primarily through the Canadian Space Agency or NASA, could be investigated. Students should also recognize other factors, other than purely scientific, that have motivated the exploration of our solar system.

Teachers could use a debate forum to defend various positions related to space exploration. Students could be asked to defend their position on the continued support for space exploration.

The Future of Space Exploration

Suggested Assessment Strategies

Presentation

- Students could prepare a multimedia presentation/poster/collage on careers in space.
- Students could prepare a multimedia presentation/poster/collage on the applications of space technology in our daily live.

Performance

- Students could perform a role play exercise with each of the students taking on the part of a person in one of the fields listed.
- Explore a technology-based career related to space exploration and determine the educational background require. Make an informational poster of your findings.
- Teachers could use a debate forum to defend various positions related to space exploration. Students should be asked to defend their position on the continued support for space exploration.

Paper/Pencil

- What are the benefits of space exploration?
- What are the potential hazards of space exploration?
- Describe the role of each of the careers listed with respect to the exploration of space.
- What other countries are involved in the exploration and habitation of space?

Resources

www.gov.nl.ca/edu/science_ref/main.htm

ST p. 453
TR AC 21, 22
TR AR 3, 8

ST pp. 461-464
TR AR 9