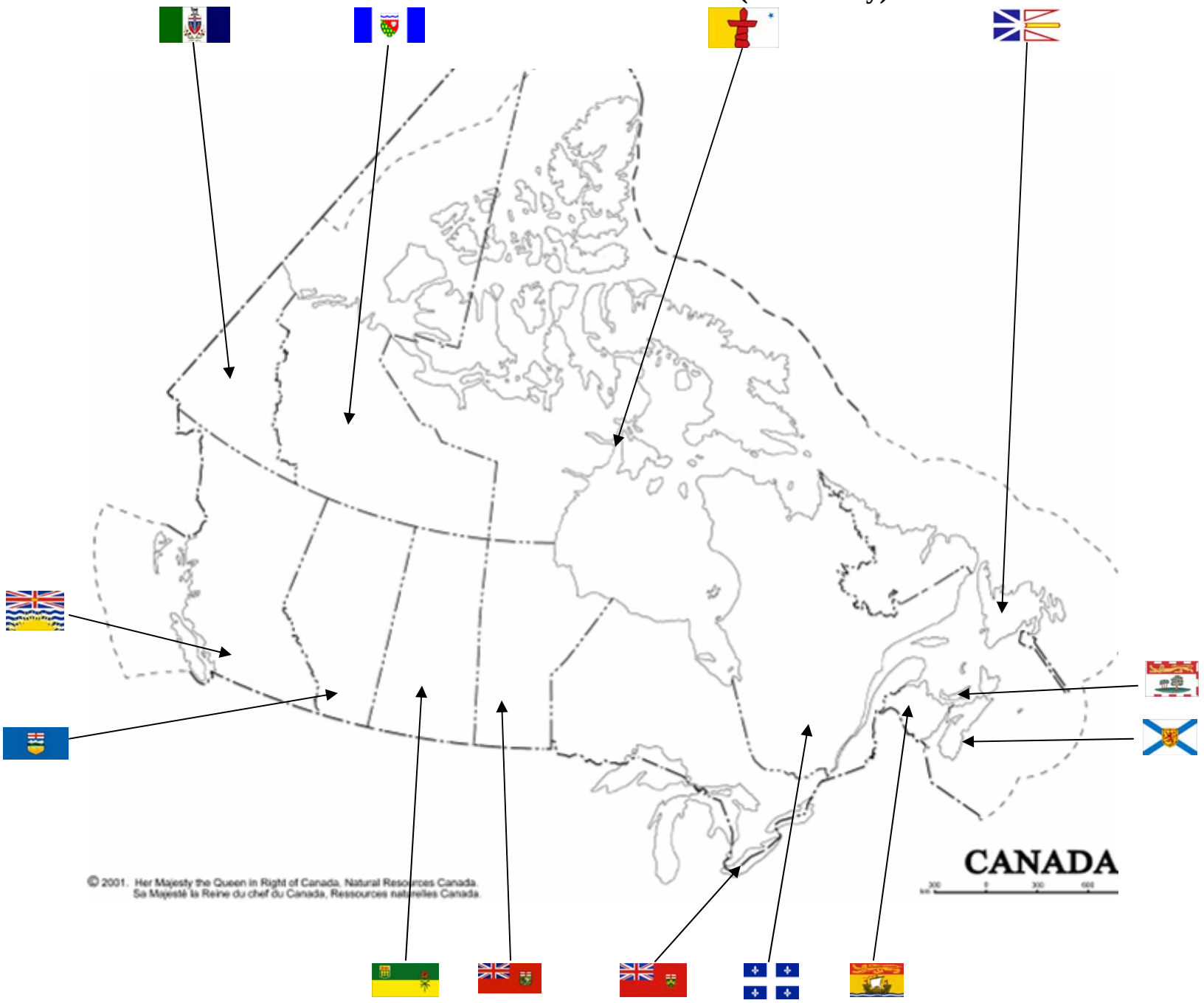
Canadian Curriculum Review 2009 (Astronomy)



This is an interactive document please click on the Provincial or Territorial flags to manueover within it

British Columbia & Yukon 

In this section we present an analysis of the current astronomy content as it is taught within the province of B.C. (please note that the Yukon Territory uses the B.C. curriculum). Drawing upon the science curriculum as outlined by the B.C. Ministry of Education (as can be found at http://www.bced.gov.bc.ca/irp/irp_sci.htm) we can see that the most direct link to astronomy occurs in the Grade 3 curriculum. The Grade 3 Integrated Resource Packages (IRPs) are found at http://www.bced.gov.bc.ca/irp/sci_3.pdf (note we will make extensive use of the IRPs guide and when possible will refer to specific pages of the document).

SCIENCE K TO 7: TOPICS AT A GLANCE

	Processes and Skills of Science	Life Science	Physical Science	Earth and Space Science
Kindergarten	• Observing • Communicating (sharing)	Characteristics of Living Things	Properties of Objects and Materials	Surroundings
Grade 1	• Communicating (recording) • Classifying	Needs of Living Things	Force and Motion	Daily and Seasonal Changes
Grade 2	• Interpreting Observations • Making Inferences	Animal Growth and Changes	Properties of Matter	Air, Water, and Soil
Grade 3	• Questioning • Measuring and Reporting	Plant Growth and Changes	Materials and Structures	Stars and Planets
Grade 4	• Interpreting Data • Predicting	Habitats and Communities	Light and Sound	Weather
Grade 5	• Designing Experiments • Fair Testing	Human Body	Forces and Simple Machines	Renewable and Non-Renewable Resources
Grade 6	• Controlling Variables • Scientific Problem Solving	Diversity of Life	Electricity	Exploration of Extreme Environments
Grade 7	• Hypothesizing • Developing Models	Ecosystems	Chemistry	Earth's Crust

http://www.bced.gov.bc.ca/irp/sci_3.pdf p.12

BC - Grade 3(astronomy)
http://www.bced.gov.bc.ca/irp/sci_3.pdf
Key pages: 12
(Revised 2005)

"Earth and Space Science: Stars and Planets
OVERVIEW:

- describe characteristics and movements of objects in our solar system
- compare familiar constellations in seasonal skies
- demonstrate awareness of the special significance of celestial objects for Aboriginal peoples"

VOCABULARY:
seasonal cycle, day/night, sun, star, planet, meteor, comet, orbit, moon, axis, rotate, solar system, Milky Way, galaxy, constellation

KEY KNOWLEDGE:

- stars are made of burning gases
- the Sun is a star
- other stars are in the sky all the time, but are invisible because the Sun is too bright during the day
- the energy from the Sun is essential for life on Earth (either directly or indirectly)
- planets do not make their own light, but reflect light
- planets revolve around a star
- moons revolve around planets
- comets, asteroids, and meteors are smaller bodies also revolving around stars
- the cycle of day and night is a result of the Earth's rotation about its axis
- the Earth revolves around the Sun once a year
- constellations are groups of stars (humans have imagined pictures and names for these groups)
- the position of these constellations appears to change over the year because our planet travels in a very
- large orbit around the Sun
- celestial objects have a special significance to Aboriginal peoples

BC - Grade 4 (light)
http://www.bced.gov.bc.ca/irp/sci_4.pdf
Key pages:
(Revised 2005)

"Physical Sciences: Light and Sound
OVERVIEW:

- use appropriate vocabulary to describe observations, explorations, and experiments
- predict the results of light experiments
- compile and interpret data to record and present results using tally charts, tables, and graphs
- communicate the procedures and results of investigations by using oral presentations, written notes and
- descriptions, drawings, and diagrams

VOCABULARY:
Light - reflect, refract, absorb, transmit, natural, artificial, light beam, transparent, translucent, opaque, spectrum

KEY KNOWLEDGE:

- light carries energy
- brighter light carries more energy
- forms of light can be either visible or invisible
- natural and artificial light have measurable properties (e.g., colour, wavelength, brightness)
- light can travel in a straight path (rays)
- light rays change direction (bend, refract) as they pass from one medium to another
- materials may transmit, absorb, or reflect light sound carries energy
- vibrations are measured in the number of oscillations per time (called the frequency)

BC - Grade 8 (optics)
http://www.bced.gov.bc.ca/irp/sci8.pdf
Key pages: 30, 46, 72, 74-81
(revised 2006)

Grade 8	• safety • scientific method • representing and interpreting scientific information • scientific literacy • ethical behaviour and cooperative skills • application of scientific principles • science-related technology	Cells and Systems	Optics Fluids and Dynamics	Water Systems on Earth
Grade 9		Reproduction	Atoms, Elements, and Compounds Characteristics of Electricity	Space Exploration
Grade 10		Sustainability of Ecosystems	Chemical Reactions and Radioactivity Motion	Energy Transfer in Natural Systems Plate Tectonics

"Physical Sciences: Optics
OVERVIEW:

- demonstrate knowledge of the behaviour of waves
- explain the properties of visible light
- compare visible light to other types of electromagnetic radiation

VOCABULARY:
amplitude, angle of incidence, angle of reflection, angle of refraction, concave, converging, convex, crest, diverging, electromagnetic radiation, energy, focal point, frequency, gamma rays, infrared, lens, microwaves, normal, opaque, pupil, radio waves, refraction, spectrum, translucent, transparent, trough, visible light, ultraviolet, wave, wavelength, X-rays

KEY KNOWLEDGE:

- waves: reflection, refraction, and energy transfer
- light: properties, transmission, reflection, absorption, refraction
- electromagnetic spectrum
- types and applications of electromagnetic radiation
- human vision and optical systems
- use a ray box
- use mirrors and lenses

BC - Grade 9 (astronomy)
http://www.bced.gov.bc.ca/irp/sci9.pdf
Key pages: 30, 47-49, 83-94
(Revised 2006)

"Earth and Space Sciences: Space Exploration
OVERVIEW:

- explain how a variety of technologies have advanced understanding of the universe and solar system
- describe the major components and characteristics of the universe and solar system
- describe traditional perspectives of a range of Aboriginal peoples in BC on the relationship between the Earth and celestial bodies
- explain astronomical phenomena with reference to the Earth/moon system
- analyse the implications of space travel

VOCABULARY:
asteroids, axis tilt, Big Bang, colonization, comets, constellations, Copernicus, galaxies, Kepler, moons, nebulae, planets, probes, Ptolemy, revolution, rotation, satellites, solar and lunar eclipses, spectroscopes, star clusters/types, Sun, telescopes, terraforming

KEY KNOWLEDGE:

- technologies advance understanding of the solar system, stars, and universe
- components of the universe and solar system
- significance of Earth's rotation, revolution, and axis tilt
- celestial sphere in relation to constellations and their location
- motion of constellations, planets, moons, sun, asteroids, and comets
- solar and lunar eclipses
- implications of space travel
- illustrate astronomical phenomena
- show respect for Aboriginal perspectives

BC - Physics 11 (optics)
http://www.bced.gov.bc.ca/irp/phys1112_06.pdf
Key pages: 16, 17, 29-31, 42-43
(Revised 2006)

"Wave Motion and Geometrical Optics
OVERVIEW:

- analyze the behaviour of light and other waves under various conditions, with reference to the properties of waves and using the universal wave equation
- use ray diagrams to analyze situations in which light reflects from plane and curved mirrors
- analyze situations in which light is refracted

VOCABULARY:

- amplitude, angle of incidence, angle of reflection, centre and radius of curvature, critical angle, diffraction, Doppler shift, focal length, focal point, frequency, image and object distance, incident ray, index of refraction, interference (superposition principle), normal, period, phase, polarization, principal axis, reflected ray, reflection, refraction, total internal reflection, wavelength, wave speed

KEY KNOWLEDGE:

- wave properties
- universal wave equation
- wave phenomena and conditions
- visible light portion of the electromagnetic spectrum
- the law of reflection
- images produced by mirrors (plane, converging, and diverging)
- curved mirrors (concave or convex)
- focal length of a concave mirror
- Snell's law
- lens (convex or concave)
- images produced by converging and diverging lenses
- focal length of a convex lens

"Special Relativity
OVERVIEW:

- explain the fundamental principles of special relativity

VOCABULARY:

- inertial reference frame, length contraction, mass increase, null result, relativistic mass, relativistic multiplier, rest mass, speed of light, time dilation

KEY KNOWLEDGE:

- Michelson-Morley experiment

- special theory of relativity
- relativity principle
- constancy of the speed of light
- relativistic effects of time dilation, length contraction, and mass increase
- equivalence of energy and mass
- objects not exceeding the speed of light in a vacuum
- simultaneous events

BC - Physics 12 (physics)
http://www.bced.gov.bc.ca/irp/phys1112_06.pdf
Key pages: 16, 64-65
(Revised 2006)

"Gravitation
OVERVIEW:
- analyze the gravitational attraction between masses

VOCABULARY:
- distance of separation, gravitational force, gravitational field strength, gravitational potential energy, inverse square relationship

KEY KNOWLEDGE:
- Newton's law of universal gravitation
- distance of separation
- gravitational field strength
- work required to move an object in a gravitational field
- gravitational potential energy relative to zero at infinity
- satellites in circular orbits
- total energy of a satellite

Alberta 

Below we present a synopsis of the current astronomy content as it is taught within the province of Alberta. Drawing upon the science curriculum as outlined by the Alberta Ministry of Education (http://www.education.alberta.ca/teachers/program/science.aspx) we can see that the most direct link to astronomy occurs in the Grade 6 & 9 curriculum with indirect links occurring in Grade 4 & 8. It should be noted that the Alberta curriculum for grade 4-6 is currently under review a new curriculum path could be released within a year. There are also minor curriculum connections in both grade 11 and 12 physics courses but the links are too specific to merit close focus in the document

4	A. Waste and Our World B. Wheels and Levers C. Building Devices and Vehicles that Move D. Light and Shadows E. Plant Growth and Changes	Science Inquiry Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry
5	A. Electricity and Magnetism B. Mechanisms Using Electricity C. Classroom Chemistry D. Weather Watch E. Wetland Ecosystems	Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry Science Inquiry
6	A. Air and Aerodynamics B. Flight C. Sky Science D. Evidence and Investigation E. Trees and Forests	Science Inquiry Problem Solving through Technology Science Inquiry Science Inquiry Science Inquiry

AB - Grade 4 (optics)
http://education.alberta.ca/media/654825/elemsci.pdf
Key pages: A4 , B21
(Revised 1996 *it is under review this year and as such likely to change*)

"Topic D: Light & Shadow
OVERVIEW:

- Students learn about light by studying the effects of light on things within their environment. They learn about light sources, about materials that light can pass through and about what happens when a material blocks or changes the path of light. By observing shadows and their motions relative to a light source, students discover that light and shadows fall along a predictable path. They discover that mirrors, prisms and a variety of other materials can affect that path by reflecting and refracting light and by splitting light into colours.

KEY KNOWLEDGE:

- Recognize that eyes can be damaged by bright lights and that one should not look at the Sun—either directly or with binoculars or telescopes.
- Identify a wide range of sources of light including the Sun
- Distinguish objects that emit their own light from those that require an external source of light in order to be seen.
- Demonstrate that light travels outward from a source and continues unless blocked by an opaque material.
- Describe changes in the size and location of Sun shadows during the day—early morning, to midday, to late afternoon.
- Recognize that light can be reflected and that shiny surfaces, such as polished metals and mirrors, are good reflectors.
- Recognize that light can be bent (refracted) and that such objects as aquaria, prisms and lenses can be used to show that light beams can be bent.
- Recognize that light can be broken into colours and that different colours of light can be combined to form a new colour.
- Demonstrate the ability to use a variety of optical devices, describe how they are used, and describe their general structure.
- Suggested examples include: hand lens, telescope, microscope, pinhole camera etc

AB - Grade 6 (astronomy)

http://education.alberta.ca/media/654825/elemsci.pdf

Key pages: A4, B32

(Revised 1996 *it is under review this year and as such likely to change*)

"Topic C: Sky Science

OVERVIEW:

- Students learn about objects in the day and night sky. Through direct observation and research students learn about the motions and characteristics of stars, moons and planets. Using simple materials, such as balls and beads, students create models and diagrams which they use to explore the relative position and motion of objects in space. As a result of these studies, students move from a simple view of land and sky, to one that recognizes Earth as a sphere in motion within a larger universe. With new understanding, students revisit the topics of seasonal cycles, phases of the Moon and the apparent motion of stars.

KEY KNOWLEDGE:

- Recognize that the Sun and stars emit the light by which they are seen and that most other bodies in space, including Earth's Moon, planets and their moons, comets, and asteroids, are seen by reflected light.
- Describe the location and movement of individual stars and groups of stars (constellations) as they move through the night sky.
- Recognize that the apparent movement of objects in the night sky is regular and predictable, and explain how this apparent movement is related to Earth's rotation.
- Understand that the Sun should never be viewed directly, nor by use of simple telescopes or filters, and that safe viewing requires appropriate methods and safety precautions.
- Construct and use a device for plotting the apparent movement of the Sun over the course of a day; e.g., construct and use a sundial or shadow stick.
- Describe seasonal changes in the length of the day and night and in the angle of the Sun above the horizon.
- Recognize that the Moon's phases are regular and predictable, and describe the cycle of its phases.
- Illustrate the phases of the Moon in drawings and by using improvised models. An improvised model might involve such things as a table lamp and a sponge ball.
- Recognize that the other eight known planets, which revolve around the Sun, have characteristics and surface conditions that are different from Earth; and identify examples of those differences.
- Recognize that not only Earth, but other planets, have moons; and identify examples of similarities and differences in the characteristics of those moons.
- Identify technologies and procedures by which knowledge, about planets and other objects in the night sky, has been gathered.
- Understand that Earth, the Sun and the Moon are part of a solar system that occupies only a tiny part of the known universe.

Unit of Study	Grade 7	Grade 8	Grade 9
A	Interactions and Ecosystems	Mix and Flow of Matter	Biological Diversity
B	Plants for Food and Fibre	Cells and Systems	Matter and Chemical Change
C	Heat and Temperature	Light and Optical Systems	Environ-mental Chemistry
D	Structures and Forces	Mechanical Systems	Electrial Principles and Technologies
E	Planet Earth	Freshwater and Saltwater Systems	Space Exploration

AB - Grade 8 (optics)
http://education.alberta.ca/media/654829/sci7to9.pdf
Key pages: 6, 39-42
(Revised 2003)

"Topic C: Light and Optical Systems
OVERVIEW:

- Our understanding of the world is based largely on what we see—both directly, and aided by optical devices that improve and extend our vision. Such tools as the microscope and telescope have helped extend knowledge in a variety of science fields, from the study of cells and stars to studies of the nature of light itself. In learning about light, students investigate its interactions with different materials and interpret its behaviour using a geometric ray model. Students then use their understanding of light to interpret a variety of light-based technologies and envisage new technologies we may use in the future.

KEY KNOWLEDGE:

- microscopes and telescopes
- contribution of technologies to scientific development
- transmission and absorption of light
- sources of light
- reflection and refraction
- images
- vision and lenses
- imaging technologies

AB - Grade 9 (astronomy)
http://education.alberta.ca/media/654829/sci7to9.pdf
Key pages: 6, 70-73
(Revised 2003)

"Topic E: Space Exploration
OVERVIEW:

- Technologies have played an essential role in the study of space and in the emerging use of space environments. Our modern understanding of space has developed in conjunction with advances in techniques for viewing distant objects, for transmitting images and data through space, and for manned and unmanned space exploration. A study of space exploration provides an opportunity for students to examine how science and technology interact and to learn how one process augments the other. Students become aware that technologies developed to meet the challenges of space are applied to new purposes.

KEY KNOWLEDGE:

- technologies for space exploration and observation
- reference frames for describing position and motion in space
- satellites and orbits
- distribution of matter through space
- composition and characteristics of bodies in space
- life-support technologies
- communication technologies

Saskatchewan 

Herein we present the current astronomy content as it is taught within the province of Saskatchewan. A review of the Saskatchewan curriculum reveals direct links to Astronomy in the Grades 3,6 and 8 teaching units. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grades 1 & 4. For a full version of the curriculum, please refer to Saskatchewan Ministry of Education at the following link http://www.sasked.gov.sk.ca/branches/curr/ There are also minor curriculum connections in both grade 11 and 12 physics courses but the links are too specific to merit close focus in the document

SK - Grade 1 (optional unit - astronomy)
http://www.sasked.gov.sk.ca/docs/elemsci/gr1ugesc.html
Key pages: n/a
(Revised 1990)

"Optional Unit: The sky
OVERVIEW:

- Students examine the sky and identify some of the objects which appear in the sky.

KEY KNOWLEDGE:

- Realize that the sun is a star.
- Identify the sun as a source of light and heat.
- Realize that stars other than the sun are very far away.
- Observe some of the patterns which stars make in the sky.
- Identify Venus, Mars, and Jupiter in the sky.
- Observe the changes in the apparent shape of the moon.
- Observe the changes in the time of day when the moon appears in the sky.

SK - Grade 3 (astronomy)
http://www.sasked.gov.sk.ca/docs/elemsci/gr3udesc.html
Key pages: n/a
(Revised 1990)

"Topic D: The Solar System
OVERVIEW:

- This unit is a study of the structure of the solar system, the characteristics of the members of that system, and a more detailed look at the rotations and revolutions of the Earth and the Moon

KEY KNOWLEDGE:
Describe and demonstrate the motions of the Earth and the Moon.

- Define the terms revolution and rotation, with respect to the Earth and the Moon.

- Describe how the rotation of the Earth produces day and night.
- Recognize that the revolution of the Earth around the Sun produces the seasons.
- Investigate why the full moon and new moon occur, using models.
- Observe the full moon and the new moon in the sky.
- Show how the eclipses of the Sun and the Moon occur.

Describe the solar system.

- Compare the sizes of the Sun, the Moon, and the Earth.
- Name the planets.
- Describe some characteristics of each planet.
- Locate the planets Venus, Mars, and Jupiter in the sky or on sky charts.

SK - Grade 4 (optics)
http://www.sasked.gov.sk.ca/docs/elemsci/gr4ufesc.html
Key pages: n/a
(Revised 1990)

"Optional Unit: Light
OVERVIEW:

- This unit on light could be developed by showing that light is a form of energy. Ways in which other types of energy can be converted into light, and the way in which light can be converted into heat energy, should be explained.

KEY KNOWLEDGE:
Recognize that light is a form of energy.

- Identify ways that other forms of energy can be converted into light.
- Investigate how light can be converted into heat.

Investigate the characteristics and behaviour of light.

- Develop a variety of ways to change the direction in which light travels.
- Observe how shadows are formed.
- Examine the characteristics of images in a plane mirror.
- Observe the refraction of light.
- Identify ways in which lenses are used.
- View the spectrum that forms when sunlight passes through a prism.
- Infer what happens when sunlight passes through a colour filter.
- Observe what happens when two different colours of light combine.
- Predict what will happen when coloured objects are viewed using different colours of light.
- Infer why objects appear to have a certain colour.

SK - Grade 6 (astronomy)
http://www.sasked.gov.sk.ca/docs/midlsci/gr6udmsc.html
Key pages: n/a
(Revised 1993)

"Topic D: Exploring Space
OVERVIEW:

- The unit examines the impact of technology on the space program, in the past, and at present. Students also have an opportunity to speculate on the direction that space exploration could (or should) take in the future

KEY KNOWLEDGE:

- Explain how rockets work.
- Investigate how Landsat is used to monitor aspects of Canada's environment.
- Describe Canada's network of communications satellites.
- Study the problem of establishing geosynchronous orbits.
- Examine the successes and failures of the Hubble space telescope project.
- Compare the advantages and disadvantages of space missions which carry humans and ones which only carry remote sensing equipment.
- Discuss the impact of the space program on the development of new technologies.
- Predict the future impact of space exploration.
- List some examples of international cooperation in space.
- Discuss ways that space may be used in the future.
- Evaluate different scenarios of future space exploration.
- Appreciate the value and limitations of technology within society.
- Understand the dependence of the space program on technology.
- Explore innovations in technology which have led to advances in the space program.

SK - Grade 8
http://www.sasked.gov.sk.ca/docs/midlsci/gr8uemsc.html
Key pages: n/a
(Revised 1993)

"Topic E: The Earth and Space
OVERVIEW:

- Space exploration has an appeal which is hard to resist. The desire for knowledge of what is beyond the bounds of the Earth's atmosphere is strong. Radio-astronomy, the SETI project, the Apollo, Soyuz, Skylab and shuttle missions, the Venera, Pioneer, Voyager, and Mariner probes all have given people a glimpse of the extraterrestrial. Questions of the structure of space, the characteristics of stellar and planetary objects, and how humans inquire into these phenomena form the basis of this unit.

KEY KNOWLEDGE:

- Understand the movements of the planets and other bodies in the solar system.
- Describe how the rotation of the Earth produces day and night.
- Account for the differences of day length in midsummer and in midwinter.
- Explain why the Sun has a stronger heating effect in summer than in winter in the northern hemisphere.
- Compare the speed and the length of path of the orbits of the planets.
- Explain the retrograde motion of the planets in the sky.
- Identify by sight the planets Venus, Jupiter, and Mars.
- Recognize the conditions which govern life in space.
- Study the physiological and psychological experiences of astronauts and cosmonauts in the Skylab and Spacelab programs.
- Research the successes and failures of the space shuttle program.
- Consider the distances and times involved in interplanetary and interstellar space travel .
- Investigate ideas about space exploration expressed in science fiction.
- Reflect on the matter of interstellar travel.
- Determine how distances to stars are estimated.
- Examine the distribution of stars in the sky.
- Identify the various types of objects and groupings of objects in interstellar space.
- Generate alternatives to technological innovations in the study of space.
- Examine the place of space science and technology in North American science.

Manitoba 

Herein we present an analysis of the current astronomy content as it is taught within the province of Manitoba. A review of the Manitoba curriculum reveals direct links to Astronomy in the Grade 6 'Earth and Space Science' unit and the Grade 9 'Exploration of the Universe' unit. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grades 1, 4, 8 and 12. Below we present a comprehensive overview of the themes and key concepts. For a full version of the curriculum, please refer to Manitoba Ministry of Education at the following link http://www.edu.gov.mb.ca/k12/cur/index.html

Science

Kindergarten to Grade 4 Science Topic Chart

	Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4
Cluster 0	Overall Skills and Attitudes	Overall Skills and Attitudes	Overall Skills and Attitudes	Overall Skills and Attitudes	Overall Skills and Attitudes
Cluster 1	Trees	Characteristics and Needs of Living Things	Growth and Changes in Animals	Growth and Changes in Plants	Habitats and Communities
Cluster 2	Colours	The Senses	Properties of Solids, Liquids & Gases	Materials and Structures	Light
Cluster 3	Paper	Characteristics of Objects and Materials	Position and Motion	Forces That Attract or Repel	Sound
Cluster 4		Daily and Seasonal Changes	Air & Water in the Environment	Soils in the Environment	Rocks, Minerals and Erosion

http://www.edu.gov.mb.ca/k12/cur/science/scik_4.html

MB - Grade 1 (astronomy)
http://www.edu.gov.mb.ca/k12/cur/science/outcomes/k-4/clusters/grade1_dail.html
Key pages: n/a
(Revised 1999)

"Daily and Seasonal Changes
OVERVIEW:

- By observing their environment, students become aware of changes that can occur within it, such as changes in temperature, wind, and light, and in plant and animal life. Through observations and investigations, students learn that changes often occur in cycles, including the relatively short cycle of day and night and the longer cycle of the seasons. Recognizing these cyclical patterns prepares students to deal with daily and seasonal changes. Particular attention is given to studying ways in which humans are able to live comfortably throughout the seasons.

KEY KNOWLEDGE:

- Recognize that the Sun is a source of light and heat.
- Recognize that a day is divided into day time and night time based on the presence or absence of sunlight.
- Recognize that shadows are caused by blocking light.
- Observe and describe how the Sun appears to change position over the course of a day.
  Examples: track the location of the Sun using shadows
- Compare characteristics of the four seasons.

MB - Grade 4 (optics)
http://www.edu.gov.mb.ca/k12/cur/science/outcomes/k-4/clusters/grade4_light.html
Key pages: n/a
(Revised 1999)

"Light
OVERVIEW:

- Students become familiar with the properties of light by investigating and observing how light interacts with various objects in the environment. From these observations, students come to recognize that light travels in a straight line, knowledge which they will apply, along with their design-process skills, to the construction of simple optical devices.

VOCABULARY:

- energy, reflect, absorb, transmit, artificial, light beam, transparent, translucent, opaque, technological development, science, brightness

KEY KNOWLEDGE:

- Give examples of various forms of energy.
- Demonstrate that white light can be separated into colours.
- Recognize that energy is an integral part of daily life.

- Distinguish between objects that produce their own light and those that reflect light from another source. *Examples: the Sun emits its own light, the Moon reflects light from the Sun*
- Identify a variety of natural and artificial light sources. *Examples: Sun, candle, light bulb, firefly, lightning, aurora borealis, lasers*
- Observe and describe properties of light. Include: travels in a straight path, bends as it passes from one medium to another, can be reflected, can be different colours
- Explore to determine effects different materials and objects have on a light beam. *Examples: prisms and water bend light; some lenses intensify light, whereas others disperse light*
- Recognize that most objects that produce light also give off heat, and identify objects that produce light but give off little or no heat.
- Predict the location, shape, and size of a shadow based on the position of a light source relative to an object.
- Identify technological developments that extend our ability to see, and recognize their impact on science. *Examples: the telescope allows astronomers to obtain new information*
- Use the design process to construct a device that transmits and reflects light. *Examples: periscope, kaleidoscope*

Science

Grades 5 to 8 Science Topic Chart

	Grade 5	Grade 6	Grade 7	Grade 8
Cluster 0	Overall Skills and Attitudes	Overall Skills and Attitudes	Overall Skills and Attitudes	Overall Skills and Attitudes
Cluster 1	Maintaining a Healthy Body	Diversity of Living Things	Interactions Within Ecosystems	Cells and Systems
Cluster 2	Properties of and Changes in Substances	Flight	Particle Theory of Matter	Optics
Cluster 3	Forces and Simple Machines	Electricity	Forces and Structures	Fluids
Cluster 4	Weather	The Solar System	Earth's Crust	Water Systems on Earth

http://www.edu.gov.mb.ca/k12/cur/science/sci5-8.html

MB - Grade 6 (astronomy)
http://www.edu.gov.mb.ca/k12/cur/science/outcomes/5-8/clusters/grade6_sola.html
Key pages: n/a
(Revised 2000)

"The Solar System
OVERVIEW:

- In this cluster, students develop an understanding of the Earth in space, the solar system, and the role of space research programs in increasing scientific knowledge. Positive and negative impacts arising from space research programs are addressed, and the contributions of Canadians to these programs are highlighted. Students develop an appreciation for the nature of science by examining the changing conceptions of the Earth's position in space and by differentiating between astronomy and astrology. Students investigate the causes of phenomena such as the cycle of day and night, the yearly cycle of the seasons, moon phases, eclipses, and the reasons why the apparent movements of celestial bodies in the night sky are regular and predictable. An important distinction is made between weight and mass.

VOCABULARY:

- astronauts, communication and remote sensing satellites, solar system, inner and outer planets, asteroid belt, mass, weight, points of reference, apparent movement, celestial objects, astrology, astronomy, rotation, revolution, axis, moon phases, eclipses

KEY KNOWLEDGE:

- Identify Canadians who have contributed to space science or space technology, and describe their achievements.
- Describe how the conception of the Earth and its position in space have been continuously questioned and how our understanding has evolved over time.
  Include: from a flat Earth, to an Earth-centred system, to a Sun-centred system
- Recognize that the Sun is the centre of the solar system and it is the source of energy for life on Earth.
- Identify the planets in the solar system and describe their size relative to the Earth and their position relative to the Sun.
- Classify planets as inner or outer planets, based on their position relative to the asteroid belt, and describe characteristics of each type.
  Include: inner planets are small and rocky; outer planets (except Pluto) are giant balls of gas
- Recognize that mass is the amount of matter in an object, that weight is the force of gravity on the mass of an object, and that the force of gravity varies from planet to planet.
- Explain, using models and simulations, how the Earth's rotation causes the cycle of day and night, and how the Earth's tilt of axis and revolution cause the yearly cycle of seasons.

- Use the design process to construct a prototype that tells the time of day or measures a time span.
- Explain how the relative positions of the Earth, moon, and Sun are responsible for moon phases and eclipses.
- Identify points of reference in the night sky and recognize that the apparent movement of celestial objects is regular, predictable, and related to the Earth's rotation and revolution. *Examples: planets, constellations*
- Identify and describe how people from various cultures, past and present, apply astronomy in daily life. *Examples: using celestial bodies to navigate; knowing when to plant crops*
- Differentiate between astrology and astronomy, and explain why astrology is considered unscientific.

MB - Grade 8 (optics)
http://www.edu.gov.mb.ca/k12/cur/science/outcomes/5-8/clusters/grade8_opti.html
Key pages: n/a
(Revised 2000)

"Optics
OVERVIEW:

- In this cluster, students broaden their understanding of how light is produced, transmitted, and detected. Students identify colours as different wavelengths of light, and explore why objects appear to have colour. Various types of electromagnetic radiation are compared. The potential positive and negative impacts of technological devices that use electromagnetic radiation are discussed. Students explore the principles and properties of reflection and refraction, and their application in everyday situations. Students investigate the characteristics of concave and convex mirrors and lenses. They enhance their understanding of how these devices function in a variety of optical tools. Students also demonstrate the formation of images using lenses and compare the function of the human eye to that of a camera lens.

VOCABULARY:

- spectrum; additive theory; subtractive theory; frequency; wavelength; refraction; concave and convex mirrors and lenses; terms related to types of light sources, types of electromagnetic radiation, and the law of reflection

KEY KNOWLEDGE:

- Demonstrate that light is a form of energy, that light travels in a straight line, and can be separated into the visible light spectrum.
- Explain, using the additive theory, how colours are produced, and identify applications of this theory in daily life.
- Explain how the human eye detects colour, and how the ability to perceive colour may vary from person to person.

- Demonstrate, using the subtractive theory, how colours are produced, and identify applications of this theory in daily life.
- Compare and contrast various types of electromagnetic radiation, with respect to relative energy, frequency, wavelength, and human perception. Include: radio waves, microwaves, infrared radiation, visible light, ultra-violet radiation, x-rays, gamma rays.
- Provide examples of technologies that use electromagnetic radiation, and describe potential positive and negative impacts of their uses. *Examples: satellite dish, x-ray machine, light telescopes, motion sensors, microwave ovens*
- Conduct experiments to determine the law of reflection, and provide examples of the use of reflection in daily life. Include: the angle of reflection is the same as the angle of incidence; the incident beam, the normal and the reflected beam are all on the same plane
- Conduct experiments to compare the refraction of light through substances of different densities.
- Explain how reflection and refraction produce natural phenomena. *Examples: sun dogs, rainbows, blue sky*
- Investigate to determine how light interacts with concave and convex mirrors and lenses, and provide examples of their use in various optical instruments and systems.
- Demonstrate the formation of images using a double convex lens, and predict the effects of changes in lens position on the size and location of the image. *Examples: magnify or reduce an image by altering the placement of one or more lenses*

Science

Senior 1 Science Topic Chart

	Senior 1
Cluster 0	Overall Skills and Attitudes
Cluster 1	Reproduction
Cluster 2	Atoms and Elements
Cluster 3	Nature of Electricity
Cluster 4	Exploration of the Universe

http://www.edu.gov.mb.ca/k12/cur/science/scis1.html

MB - Grade 9 (astronomy)
http://www.edu.gov.mb.ca/k12/cur/science/outcomes/s1/clusters/s1_univ.html
Key pages: n/a
(Revised 2000)

"Exploration of the Universe
OVERVIEW:

- This cluster leads students through an exploration of the universe starting with some basic hands-on astronomy and ending with a critical look at issues surrounding space science and technology. Students observe and locate visible celestial objects. This knowledge provides them with an appreciation for the relevance of astronomy to various peoples. Students develop an understanding of the origin, evolution, and components of the universe. They concurrently research and study Canada's involvement in international space exploration and evaluate the impact of space science and technologies in terms of their benefits and risks to the human race.

KEY KNOWLEDGE:

- Use a coordinate system to locate visible celestial objects, and construct an astrolabe to determine the position of these objects. Include: altitude, azimuth
- Observe the motion of visible celestial objects and organize collected data. *Examples: graph sunrise and sunset data, track the position of the Moon and planets over time, maintain a log of changes in the night sky*
- Investigate how various cultures used knowledge of the position and motion of visible celestial objects for navigation.
- Compare and contrast historical perspectives on the relationship between Earth and space. Include: geocentric model, heliocentric model
- Explain reasons for the apparent motion of the Sun, stars, planets, and the Moon as seen from Earth. Include: daily rising and setting, seasonal constellations, retrograde motion
- Differentiate between units of measure used for astronomical distances, and perform simple calculations using these units. Include: astronomical unit, light year
- Compare and contrast scientific and cultural perspectives on the origin and evolution of the universe.
- Differentiate between the major components of the universe. Include: planets, moons, comets and asteroids, nebulae, stars, galaxies, black holes
- Explain how various technologies have extended our ability to explore and understand space. *Examples: robotics, Canadarm, Hubble telescope, Lunar Rover, shuttle, space station, Sojourner Rover, Pathfinder and Galileo space probes*
- Investigate ways in which Canada participates in space research and in international space programs, then use the decision-making process to address a related issue. *Examples: International Space Station, Canadarm*
- Evaluate the impact of space science and technologies in terms of their benefits and risks to humans. *Examples: search for extraterrestrial life and habitat,*

remote sensing, predictions of potentially catastrophic impacts, colonization of space by only a few countries

MB - Grade 12 Physics (astronomy)
http://www.edu.gov.mb.ca/k12/cur/science/found/physics30s/topic4_1.pdf
Key pages: n/a
(Revised 2003)

"Gravitational Fields
OVERVIEW:

- Students define the gravitational force constant *g* as a force per unit mass in N/kg, and the weight as F*g* = mg. The acceleration due to gravity (i.e., a*g* = *g*) is derived from Newton's laws and determined in the laboratory. Students describe the normal force in terms of the mutual attraction of masses, and draw simple freebody diagrams.

KEY KNOWLEDGE:

- Derive the acceleration due to gravity from free fall and Newton's laws.
- Diagram the Earth's gravitational field, using lines of force.
- Define the gravitational field qualitatively as the region of space around
- a mass where another point mass experiences a force.

Northwest Territories

Herein we present an analysis of the current astronomy content as it is taught within the Northwest Territory. It should be noted, that at present, the NT uses Alberta's (2003) curriculum for senior grade levels in both English and French (7-12). Please review the appropriate sections in the Alberta review for these levels. A review of the NT curriculum reveals a direct link during the Grade 6 'Earth and Space Systems' unit. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grades 1 & 4. For a full version of the curriculum, please refer to Northwest Territory Ministry of Education at the following link http://www.ece.gov.nt.ca/Divisions/kindergarten_g12/PDF%20Docs/The%20NWT%20Grades%20K-6%20Science%20and%20Technology%20Curriculum%20(2004).pdf)

Table 1. Strands and Topics: Science and Technology, Grades K-6

Strand	Grade Kindergarten	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Life Systems	Senses and the body	Character and Needs of Living Things	Growthand changes in Animals	Growth and changes in Plants	Habitat and Community	Human Organ Systems	Diversity of Living Things
Matter and Materials	Creating Colour	Characteristics of Objects and Properties of Materials	Properties of Liquids and Solids	Magnetic and Charged Materials	Materials that Transmit, Reflect or Absorb Light or Sound	Properties of Change in Matter	Properties of Air and Characteristics of Flight
Energy and Control	Keeping Warm	Energy in our Lives	Energy from Wind and Water	Forces and Movement	Light and Sound Energy	Conservation of Energy	Electricity
Structures and Mechanisms	Machines Around Us	Everyday Structures	Movement	Stability	Pulleys and Gears	Forces Acting on Structures and Mechanisms	Motion
Earth and Space Systems	Dinosaurs	Daily and Seasonal Cycles	Air and Water in the Environment	Soils in the Environment	Rocks, Minerals and Erosion	Weather	Space

NT - Grade 1 (astronomy)
http://www.ece.gov.nt.ca/Divisions/kindergarten_g12/PDF%20Docs/The%20NWT%20Grades%20K-6%20Science%20and%20Technology%20Curriculum%20(2004).pdf
Key pages: 94
(Revised 2004)

"Earth and Space systems: Daily and seasonal cycles
OVERVIEW:

- Demonstrate an understanding of changes that occur in daily and seasonal cycles

KEY KNOWLEDGE:

- Identify the sun as a source of heat and light
- Use units of time related to the Earth's cycles (e.g., days, months, seasons)
- Compare the different characteristics of the four seasons (e.g., length of day, type of precipitation)
- observe and describe how the position of the sun influences the length and shape of shadows

NT - Grade 4 (optics)
http://www.ece.gov.nt.ca/Divisions/kindergarten_g12/PDF%20Docs/The%20NWT%20Grades%20K-6%20Science%20and%20Technology%20Curriculum%20(2004).pdf
Key pages: 44-46, 64-66
(Revised 2004)

"Matter and materials: Materials that Transmit, Reflect or Absorb Light or Sound
OVERVIEW:

- Different materials can transmit, reflect, refract or absorb light and sound based on their properties

KEY KNOWLEDGE:

- Demonstrate understanding that certain materials can transmit, reflect, refract or absorb light
- Investigate materials that transmit, reflect, refract or absorb light or sound and use their findings in designing objects and choosing materials from which to construct them
- Recognize and describe how different materials affect light (e.g., water and prisms bend light as it passes through them; mirrors and polished metals reflect light)
- Demonstrate how opaque materials absorb light and thereby cast shadows

"Energy and control: Light and Sound Energy
OVERVIEW:

- Students will become familiar with the properties of light by investigating and observing how light interacts with various objects in the environment. From these observations, students will come to realize that light travels in a straight line, and they will begin to use this knowledge in constructing simple optical devices.

KEY KNOWLEDGE:

- Demonstrate an understanding of the characteristics and properties of light
- Investigate different ways in which light and sound are produced and transmitted, and design and make devices that use these forms of energy
- Identify a variety of natural and artificial light sources (e.g., the sun)
- Describe the behaviour of light/sound, using observations, and identify some of its basic characteristics (e.g., they travel in a straight path, light bends as it passes from one medium to another, and reflects off shiny surfaces, sound must travel through a medium and bends around/reflects off objects)
- Distinguish between objects that produce their own light and those that reflect light from another source
- Identify through observation, colour as a property of light (e.g., use prisms)
- Investigate and compare how light interacts with a variety of optical devices (e.g., kaleidoscopes, periscopes, telescopes magnifying glasses)
- Design, make and test an optical device

NT - Grade 6 (astronomy)

http://www.ece.gov.nt.ca/Divisions/kindergarten_g12/PDF%20Docs/The%20NWT%20Grades%20K-6%20Science%20and%20Technology%20Curriculum%20(2004).pdf

Key pages: 104-105

(Revised 2004)

"Earth and Space systems: Space

OVERVIEW:

- Space science involves learning about objects in the sky, particularly their form, movements, and interactions. In this strand, students will develop an understanding of Earth and space and of the relationship of Earth to the other bodies in the solar system and beyond. Investigations will involve extensive work with models of the different bodies to allow students to explore their relative size, position, and motion, as well as relationship to one another. In learning about space, students will come to appreciate that our ability to observe and study objects in space has been greatly enhanced by the use of technological devices.

VOCABULARY:

constellations, planets, moons, comets, asteroids, satellites, aurora and meteors

KEY KNOWLEDGE:

- Demonstrate an understanding of the patterns of change between heavenly bodies inside and outside the solar system as observed from Earth (e.g., solar and lunar eclipses, tides, phases of the moon, position of the constellations) and of the physical characteristics of the different components of the solar system
- Investigate, using models and simulations, the relationship between the sun, Earth, and moon, the patterns of change observable on Earth that result from the movement of these bodies, and the physical characteristics of the different components of the solar system (e.g., the sun and planets, inner planets and outer planets)
- Describe technological and scientific advances that enable humans to study space, and explain how these advances have affected the quality of life on Earth.

- Describe the physical characteristics of components of the solar system, the sun, planets, natural satellites, comets, asteroids, and meteoroids (e.g., relative size, surface, colour and temperature)
- Identify the bodies in space that emit light (stars) and those that reflect light (e.g., planets, moons, comets)
- Describe, using models or simulations, the features of the moon's surface (e.g., craters, Maria, rills)
- Identify cycles in nature (e.g., cycles of day and night and seasons) and describe the changes within the cycles (e.g., observe the phases of the moon over several months to determine the pattern of change, and record these observations)
- Describe, using models or simulations, how the Earth's rotation causes the cycle of day and night and how the Earth's revolution around the sun causes the cycle of the seasons

- Recognize major constellations visible at night and describe the origins of their names (e.g., such as Orion, Leo, Polaris);
- Describe, using models or simulations, the effects of the relative motion and positions of the Earth, moon and sun (e.g., solar and lunar eclipses, tides, phases of the moon)
- Follow safety procedures when observing the sun (e.g., never look at the sun directly or through a lenses or coloured glass; look only at a projection of the sun's image; do not use lens or magnifiers to focus the sun's rays on a small area; exercise extreme caution when using mirrors so they do not reflect the sun's image directly into someone's eyes).

Ontario 

Herein we present an analysis of the current astronomy content as it is taught within the province of Ontario. Ontario has recently revamped its curriculum providing a fresh face on astronomy teaching within our largest province. A review of the Ontario curriculum reveals direct links to Astronomy in the Grade 6 & 9 'Earth and Space Science' units. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grade 1, 4, 10 and. Below we present a comprehensive overview of the themes and key concepts. For a full version of the curriculum, please refer to Ontario Ministry of Education at the following link
http://www.edu.gov.on.ca/eng/document/curricul/curricul.html

Elementary Science and Technology Curriculum Overview				
	Understanding Life Systems	Understanding Structures and Mechanisms	Understanding Matter and Energy	Understanding Earth and Space Systems
Grade 1	Needs and Characteristics of Living Things	Materials, Objects, and Everyday Structures	Energy in Our Lives	Daily and Seasonal Changes
Grade 2	Growth and Changes in Animals	Movement	Properties of Liquids and Solids	Air and Water in the Environment
Grade 3	Growth and Changes in Plants	Strong and Stable Structures	Forces Causing Movement	Soils in the Environment
Grade 4	Habitats and Communities	Pulleys and Gears	Light and Sound	Rocks and Minerals
Grade 5	Human Organ Systems	Forces Acting on Structures and Mechanisms	Properties of and Changes in Matter	Conservation of Energy and Resources
Grade 6	Biodiversity	Flight	Electricity and Electrical Devices	Space
Grade 7	Interactions in the Environment	Form and Function	Pure Substances and Mixtures	Heat in the Environment
Grade 8	Cells	Systems in Action	Fluids	Water Systems

http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec18currb.pdf (p.19)

ON - Grade 1 (astronomy)
http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec18currb.pdf
Key pages: 53-55
(Revised 2007)

"Earth and Space systems: Daily and seasonal cycles
OVERVIEW:

- The study of Daily and Seasonal Changes focuses on easily observed changes that occur in cycles, including day and night and the four seasons... Since many of these cycles depend upon the light and/or heat of the sun, combining this topic with the Grade 1 topic Energy in Our Lives would enable the students to have a fuller understanding of the relationship among events in their environment and between the environment and themselves.

KEY KNOWLEDGE:

- identify the sun as Earth's principal source of heat and light
- define a cycle as a circular sequence of events
- describe changes in the amount of heat and light from the sun that occur throughout the day and the seasons
- describe and compare the four seasons *(e.g., in terms of amount of daylight, type of precipitation,*
- *temperature)*
- describe changes in the appearance or behaviour of living things that are adaptations to seasonal changes *(e.g., in fall, some plants she their leaves and some birds migrate; in winter some animals change colour)*

ON - Grade 4 (optics)
http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec18currb.pdf
Key pages: 90-92
(Revised 2007)

"Understanding Matter and Energy: Light and Sound
OVERVIEW:

- Students will become familiar with the properties of light and sound by investigating and observing how these forms of energy interact with various objects in the environment. Materials can be used to transmit, reflect, or absorb light and sound. By exploring the factors that affect sound and light, students will discover ways in which they can be controlled. Students will begin to apply this knowledge by constructing simple auditory and optical devices and by examining the impact of technologies related to sound and light on our everyday lives, including their use of energy...When conducting experiments with light and light-producing devices, students need to know why sunlight reflected from a mirror should be aimed away from people's eyes and from materials that might be ignited.

KEY KNOWLEDGE:

- Light and sound are forms of energy with specific properties.
- Light is required to see.
- Technological innovations involving light and sound have an impact on the environment.
- identify a variety of natural light sources *(e.g., the sun, a firefly)*
- distinguish between objects that emit their own light *(e.g., stars, candles, light bulbs)* and those that reflect light from other sources *(e.g., the moon, safety reflectors, minerals)*
- describe properties of light, including the following: light travels in a straight path; light can be absorbed, reflected, and refracted describe how different objects and materials interact with light and sound energy *(e.g., prisms separate light into colours; voices echo off mountains; some light penetrates through wax paper; sound travels further in water than air)*
- identify devices that make use of the properties of light and sound *(e.g., a telescope)*

ON - Grade 6 (astronomy)
http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec18currb.pdf
Key pages: 121-123
(Revised 2007)

"Earth and Space systems: Space
OVERVIEW:

- Our ability to observe and study objects in space has been greatly enhanced by the use of technological devices. The application of these technologies affects our lives in many ways. Space science involves learning about objects in the sky, particularly their form, movements, and interactions. In learning about space, students will focus on past and present-day contributions of space science to the quality of human life while developing an understanding of the phenomena that result from the movement of different bodies in space. Investigations will involve working with models of the different bodies to allow students to explore their size, position, and motion and help them gain an understanding of Earth as a component of larger systems.

KEY KNOWLEDGE:

- Earth is a part of a large interrelated system.
- Technological and scientific advances that enable humans to study space affect our lives.
- identify components of the solar system, including the sun, the earth, and other planets, natural satellites, comets, asteroids, and meteoroids, and describe their physical characteristics in qualitative terms *(e.g., The earth's surface is very young; much of it is covered with water. The moon is the earth's only natural satellite.*
- *Comets are the largest objects in our solar system; their centres contain rock particles trapped in frozen liquid; their tails are made up of gas and dust.)*
- identify the bodies in space that emit light *(e.g., stars)* and those that reflect light *(e.g., moons and planets)*
- explain how humans meet their basic biological needs in space *(e.g., obtaining air, water, and food and managing bodily functions)*
- identify the technological tools and devices needed for space exploration *(e.g., telescopes, spectroscopes, spacecraft, life-support systems)*
- describe the effects of the relative positions and motions of the earth, moon, and sun *(e.g., use models or simulations to show solar and lunar eclipses, phases of the moon, tides)*

Grades 9 and 10 (Strands B through E)				
	B. Biology	C. Chemistry	D. Earth and Space Science	E. Physics
Grade 9 Academic	Sustainable Ecosystems	Atoms, Elements and Compounds	The Study of the Universe	The Characteristics of Electricity
Grade 9 Applied	Sustainable Ecosystems and Human Activity	Exploring Matter	Space Exploration	Electrical Applications
Grade 10 Academic	Tissues, Organs, and Systems of Living Things	Chemical Reactions	Climate Change	Light and Geometric Optics
Grade 10 Applied	Tissues, Organs, and Systems	Chemical Reactions and Their Practical Applications	Earth's Dynamic Climate	Light and Applications of Optics

http://www.edu.gov.on.ca/eng/curriculum/secondary/science910_2008.pdf (p.18)

ON - Grade 9 Academic (astronomy)

http://www.edu.gov.on.ca/eng/curriculum/secondary/science910_2008.pdf
Key pages: 48, 54-55
(Revised 2008)

"Earth and Space Science: The Study of the Universe

OVERVIEW:

- Different types of celestial objects in the solar system and universe have distinct properties that can be investigated and quantified.
- People use observational evidence of the properties of the solar system and the universe to develop theories to explain their formation and evolution.
- Space exploration has generated valuable knowledge but at enormous cost.

KEY KNOWLEDGE:

- On the basis of research, and report on the contributions of Canadian governments, organizations, businesses, and/or individuals to space technology, research, and/or exploration (e.g., as part of the International Space Station mission; in the fields of telecommunications and satellite technology)
- use appropriate terminology related to the study of the universe, including, but not limited to: celestial objects, orbital radius, retrograde motion, and satellite

EARTH AND SPACE SCIENCE: THE STUDY OF THE UNIVERSE

- use direct observation, computer simulation, or star charts to determine the location, appearance, and motion of well-known stars and other celestial objects that are visible in the night sky (e.g., the stars Polaris, Sirius, Betelgeuse; the planet Venus)

- plan and conduct a simulation that illustrates the interrelationships between various properties of celestial objects visible in the night sky (e.g., set up flashlights of various intensities at different distances from an observation point to help illustrate why the brightness of a star viewed from Earth is a function of both its actual brightness and its distance from Earth)
- gather and record data, using an inquiry or research process, on the properties of specific celestial objects within the solar system (e.g., the composition of their atmosphere, if any; the composition of their surface; the strength of their gravitational pull)
- compare and contrast properties of celestial objects visible in the night sky, drawing on information gathered through research and using an appropriate format (e.g., compare the size of planets; represent the distance of stars from Earth using scientific notation; compare star temperatures and colour
- describe observational and theoretical evidence relating to the origin and evolution of the universe (e.g., evidence supporting the big bang theory)
- describe observational and theoretical evidence relating to the formation of the solar system (e.g., evidence that supports the theory that the solar system was formed from a contracting, spinning disc of dust and gas)
- describe the major components of the solar system and the universe (e.g., planets, stars, galaxies), using appropriate scientific terminology and units (e.g., astronomical units, scientific notation, light years)
- describe the sun's composition and energy source, and explain how its energy warms Earth and supports life on the planet (e.g., with reference to the types of radiation the sun emits and the interaction of the sun's energy with Earth's atmosphere)
- explain the causes of astronomical phenomena (e.g., the aurora borealis, solar eclipses, phases of the moon, comets) and how various phenomena can best be observed from Earth (e.g., solar eclipses should be viewed through a suitable solar filter or by projection, not with the naked eye)
- describe various reasons that humankind has had for studying space (e.g., to develop calendars for agricultural purposes, to forecast weather, for celestial navigation, for religious inspiration) and the conceptions of the universe held by various cultures and civilizations (e.g., Aboriginal peoples; ancient Greek, Mayan civilizations)

ON - Grade 9 Applied (astronomy)
http://www.edu.gov.on.ca/eng/curriculum/secondary/science910_2008.pdf
Key pages: 59, 66-67
(Revised 2008)

"Earth and Space Science: Space Exploration
OVERVIEW:

- Celestial objects in the solar system and universe have specific properties that can be investigated and understood.

KEY KNOWLEDGE:

- use appropriate terminology related to space exploration, including, but not limited to: *astronomical units, gravitational pull,* and *universe*
- investigate patterns in the night sky (e.g., constellations) and the motion of celestial objects (e.g., the sun, our moon, planets, stars, galaxies), using direct observation, computer simulations, and/or star charts, and record the information using a graphic organizer or other format
- use a research process to compile and analyze information on the characteristics of various objects in the universe (e.g., planets, stars, constellations, galaxies)
- investigate a technological challenge related to the exploration of celestial objects that arises from the objects' specific properties, and identify the solution that has been devised (e.g., multiple booster rockets power spacecraft travelling to distant planets; heat shields protect the space shuttle from extreme temperatures when re-entering Earth's atmosphere)

EARTH AND SPACE SCIENCE: SPACE EXPLORATION

- describe the major components of the universe (e.g., planets, moons, stars, galaxies), the motion of the different types of celestial objects, and the distances between certain objects, using appropriate scientific terminology and units (e.g., astronomical units, light years) compare the characteristics and properties of celestial objects that constitute the solar system, including their motion and their distance from other celestial objects in the solar system (e.g., composition, size, rotation, presence and composition of atmosphere, gravitational pull, magnetic field)
- identify the factors that make Earth well suited for the existence of life (e.g., a magnetosphere that protects the planet from solar wind; Earth's distance from the sun; the ability of Earth's atmosphere to trap heat, preventing extreme fluctuations in temperature)
- describe the characteristics of the sun and the effects of its energy on Earth and Earth's atmosphere
- describe the causes of major astronomical phenomena (e.g., the aurora borealis, solar/lunar eclipses) and how various phenomena can best be observed from Earth (e.g., solar eclipses should be viewed through a telescope equipped with a solar filter, not with the naked eye)
- describe the role of celestial objects in the traditions and beliefs of selected cultures and civilizations (e.g., Aboriginal peoples; ancient Greek, Mayan civilizations)

ON - Grade 10 Academic (optics)
http://www.edu.gov.on.ca/eng/curriculum/secondary/science910_2008.pdf
Key pages: 71, 80-81
(Revised 2008)

"Physics: Light and Geometrical Optics
OVERVIEW:

- Light has characteristics and properties that can be manipulated with mirrors and lenses for a range of uses.
- Society has benefited from the development of a range of optical devices and technologies.

KEY KNOWLEDGE:

- analyze a technological device or procedure related to human perception of light (e.g., eyeglasses, contact lenses, infrared or low light vision sensors, laser surgery), and evaluate its effectiveness
- use appropriate terminology related to light and optics, including, but not limited to: *angle of incidence, angle of reflection, angle of refraction, focal point, luminescence, magnification, mirage,* and *virtual image*
- use an inquiry process to investigate the laws of reflection, using plane and curved mirrors, and draw ray diagrams to summarize their findings
- predict the qualitative characteristics of images formed by plane and curved mirrors (e.g., location, relative distance, orientation, and size in plane mirrors; location, orientation, size, type in curved mirrors), test their predictions through inquiry, and summarize their findings

PHYSICS: LIGHT AND GEOMETRIC OPTICS

- use an inquiry process to investigate the refraction of light as it passes through media of different refractive indices, compile data on their findings, and analyze the data to determine if there is a trend (e.g., the amount by which the angle of refraction changes as the angle of incidence increases varies for media of different refractive indices)
- predict, using ray diagrams and algebraic equations, the position and characteristics of an image produced by a converging lens, and test their predictions through inquiry
- calculate, using the indices of refraction, the velocity of light as it passes through a variety of media, and explain the angles of refraction with reference to the variations in velocity
- identify and label the visible and invisible regions of the electromagnetic spectrum
- describe, on the basis of observation, the characteristics and positions of images formed by plane and curved mirrors (e.g., location, orientation, size, type), with the aid of ray diagrams and algebraic equations, where appropriate
- explain the conditions required for partial reflection/refraction and for total internal reflection in lenses, and describe the reflection/ refraction using labeled ray diagrams

- describe the characteristics and positions of images formed by converging lenses (e.g., orientation, size, type), with the aid of ray diagrams
- identify ways in which the properties of mirrors and lenses (both converging and diverging) determine their use in optical instruments (e.g., cameras, telescopes, binoculars, microscopes)
- identify the factors, in qualitative and quantitative terms, that affect the refraction of light as it passes from one medium to another
- describe properties of light, and use them to explain naturally occurring optical phenomena (e.g., apparent depth, shimmering, a mirage, a rainbow)

ON - Grade 10 Applied (optics)
http://www.edu.gov.on.ca/eng/curriculum/secondary/science910_2008.pdf
Key pages: 83, 92-93
(Revised 2008)

"Physics: Light and Applications of Optics
OVERVIEW:

- A wide range of technologies utilize the properties of light and colour.
- The behaviour of light depends on the materials with which it interacts.
- Light is a form of energy, produced from a variety of sources, and can be transformed into other useful forms of energy.

KEY KNOWLEDGE:

- use appropriate terminology related to light and optics, including, but not limited to: angle of incidence, angle of reflection, angle of refraction, centre of curvature, focal length, luminescence, magnification, principal axis, radius of curvature, and vertex
- use an inquiry process to investigate the laws of reflection; use these laws to explain the characteristics of images formed by plane, converging (concave), and diverging (convex) mirrors; and draw ray diagrams to illustrate their observations
- use an inquiry process to investigate the refraction of light as it passes through a variety of media (e.g., the angles of incidence and refraction as light passes through a clear acrylic block)
- predict the qualitative characteristics of images (e.g., location, orientation, size, type) formed by converging lenses, test their predictions through inquiry, and draw ray diagrams to record their observations
- investigate how various objects or media (e.g., opaque, translucent, and transparent materials; black-and-white surfaces) reflect, transmit, or absorb light, and record their observations using ray diagrams
- predict the effect of shining a coloured light on objects of different colours, and test their predictions through inquiry
- construct an optical device (e.g., a funhouse mirror, a device that produces an optical illusion, a solar oven) that uses a variety of mirrors
- identify and label the visible and invisible regions of the electromagnetic spectrum, and identify the colours that make up visible white light

- explain the laws of reflection of light, and identify ways in which light reflects from various types of mirrors (e.g., plane, converging, diverging)
- describe qualitatively how visible light is refracted at the interface between two different media
- use additive colour theory to predict the results of combining primary and secondary light colours
- use subtractive colour theory to describe the effect of colour filters on white light
- explain how the colour of an object is determined by reflection, absorption, and transmission of colour
- explain how the properties of light or colour are applied in the operation of an optical device (e.g., a reflecting telescope)

Quebec 

Below we list the current astronomy content as it is taught within the province of Quebec. A review of the Quebec program reveals direct links to Astronomy occur in Cycle 2/3 as well secondary cycle 1. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts are also listed below. For a full version of the curriculum, please refer to Quebec Ministry of Education at the following link http://www.mels.gouv.qc.ca/gr-pub/menu-curricu-a.htm

QC - Cycle 1 (astronomy)
http://www.mels.gouv.qc.ca/DGFJ/dp/programme_de_formation/primaire/pdf/educprg2001/educprg2001-062.pdf
pages: 165
(Revised (2005))

"Earth and Space Science
OVERVIEW:

- The essential knowledge in Cycle One are related to simple concepts and phenomena in the students' immediate environment.

KEY KNOWLEDGE:

- System involving the Earth, the moon, and the sun.

QC - Cycle 2/3 (astronomy)
****Note cycle 2 corresponds to grade 3,4 and cycle 3 corresponds to grade 5,6 ****
http://www.mels.gouv.qc.ca/DGFJ/dp/programme_de_formation/primaire/pdf/educprg2001/educprg2001-062.pdf
pages: 175
(Revised (2005))

"Earth and Space Science
OVERVIEW:

- The essential knowledge that students must acquire are divided into three main categories: the material world, Earth and space, and living things. The knowledge is structured around a set of unifying concepts that make it possible to see connections between these three categories. These unifying concepts are as follows: matter; energy; forces and motion; systems and interaction.

KEY KNOWLEDGE:

Forces and motion

- Rotation of the Earth (e.g. day and night, visible motion of the Sun and the stars) (2)
- The tides (3)

Systems and interaction

- System involving the sun, the Earth and the moon (2)
- Solar system (3)
- The seasons (3)
- The stars and the galaxies (e.g. constellations) (2) (3)
- Meteorological systems (e.g. clouds, precipitation, storms) and climates (2) (3)
- Technologies related to the Earth, the atmosphere and outer space (e.g. seismograph, prospection, weather forecasting, satellites, space station) (2) (3)

Techniques and instrumentation

- Use of simple observational instruments (e.g. binoculars, telescope) (2) (3)

Appropriate language

- Terminology related to an understanding of the Earth and the universe (2) (3)
- Conventions and types of representations (e.g. globe, constellations) (2) (3)
- Drawing, sketches (2) (3)

QC - Secondary Cycle 1 (astronomy)

****Note secondary cycle 1 corresponds to grades 7, 8 & 9 ****

http://www.mels.gouv.qc.ca/DGFJ/dp/programme_de_formation/secondaire/pdf/qep2004/chapter62.pdf

pages: 245

Revised (2004)

"Earth and Space Science: Astronomical Phenomenon

OVERVIEW:

- Although it looks virtually static at first glance, the sky is the scene of some remarkable activity. This activity is governed by Universal Gravitation between all celestial bodies, which regulates their motion and determines the structure of the solar system.

- The study of this motion and of the properties of light makes it possible to explain many phenomena that can be observed from the Earth, such as the cycles of day and night, the phases of the moon, eclipses, the seasons, and comets. The study of the solar system also makes it possible to identify certain conditions essential to the appearance and preservation of life.

KEY KNOWLEDGE:

Universal Gravitation (qualitative study)

- Solar system
- Light (properties)
- Cycles of day and night
- Phases of the moon
- Eclipses
- Seasons
- Comets
- Aurora borealis (northern lights)
- Meteoroid impact

Natural and Community Resources

- Astronomical observatories

- Planetarium
- *Events*
- Manicouagan craters
- Charlevoix astrobleme

Human Intervention

- Canadian Space Program
- Man-made satellites
- International Space Station

History

- Time zones
- Calendar
- History of space flight
- Conquest of space
- Extinction of the dinosaurs

Nova Scotia 

Herein we present an analysis of the current astronomy content as it is taught within the province of Nova Scotia. As discussed, at present the Atlantic Provinces use a common curriculum for much of their educational system. A review of the Nova Scotia curriculum reveals direct links to Astronomy in the Grade 6 'Earth and Space Science' unit. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grade 1, 4 & 11. Below we present a comprehensive overview of the themes and key concepts. For a full version of the curriculum, please refer to Nova Scotia Ministry of Education at the following link http://www.ednet.ns.ca/

NS - Grade 1 (astronomy)
http://www.ednet.ns.ca/pdfdocs/curriculum/science_1_sec-web.pdf
pages: 40-61
Revised (2005)

OVERVIEW:

- In observing their environment, students become aware of things that change… including the relatively short cycle of day and night and the longer cycle of the seasons.

KEY KNOWLEDGE:

- The inquiry focus in this unit will emphasize making observations of daily and seasonal events, recording these observations over time, and noting patterns or cycles that exist. The context for this unit is cycles. Students will learn that many things in life occur in cycles, and knowing about these cycles helps people make predictions and plan for the future. This unit could be addressed over the school year, so that students can explore the seasonal changes that occur.

NS - Grade 4 (optics)
http://www.ednet.ns.ca/pdfdocs/curriculum/Science4_web.pdf
pages: 40-55
Revised (2006)

"Physical Sciences: Light
OVERVIEW:

- Students become familiar with the properties of light by observing how light interacts with various objects in the environment.

KEY KNOWLEDGE:

- describe properties of light that have led to the development of optical devices that enhance our ability to observe
- identify women and men in their community who have careers using optics
- demonstrate that white light can be separated into colours (dispersion) and follow a set of procedures to make and use a colour wheel

- demonstrate and describe how a variety of media can be used to change the direction of light
- compare and describe how light interacts with a variety of optical devices and construct an optical device that performs a specific function
- observe, demonstrate, and make conclusions about how light travels and is dispersed from a variety of light sources
- investigate and predict how light interacts with a variety of objects (including changes in location, shape, and relative size of a shadow) in order to determine whether the objects cast shadows, allow light to pass, and/or reflect light

NS - Grade 6 (astronomy)
http://www.ednet.ns.ca/pdfdocs/curriculum/Science6_Web.pdf
pages: 50-63
Revised (2008)

"Earth and Space Science: Space
OVERVIEW:

- 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 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.

KEY KNOWLEDGE:

- describe and compare how different societies have interpreted natural phenomena, using a variety of sources, to validate scientific knowledge
- describe and give examples of information and contributions that have led to new inventions and applications
- gather information, describe, and display the physical characteristics of components of the solar system

- demonstrate how Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons
- observe and explain how the relative positions of Earth, the moon, and the sun are responsible for the moon phases, eclipses, and tides

- identify constellations from diagrams, pictures, and/or representations of the night sky

NS - Grade 11 (physics)
http://www.ednet.ns.ca/pdfdocs/curriculum/physics11_12.pdf
pages: 72-79
Revised (2002)

"Physics: Waves
OVERVIEW:

- Students should observe, predict, and explain specific wave behaviours, such as reflection, refraction and diffraction. Students could begin their study of waves with familiar waves such as mechanical waves, extend their study to sound waves, and then use wave principles that they have developed to explain and predict the behaviour of light and other electromagnetic waves.

KEY KNOWLEDGE:

- Apply the wave equation to explain and predict the behaviour of waves
- Apply the laws of reflection and the laws of refraction to predict wave behaviour
- Explain qualitatively and quantitatively the phenomena of wave interference, diffraction, reflection, and refraction and the Doppler-Fizeau effect.
- Compare and describe the properties of electromagnetic radiation and sound
- Describe how sound and EM radiation, as forms of energy are produced and transmitted

Newfoundland 

Herein we present an analysis of the current astronomy content as it is taught within the province of Newfoundland. As discussed, at present the Atlantic Provinces use a common curriculum for much of their educational system. A review of the Newfoundland curriculum reveals direct links to Astronomy in the Grade 6 'Earth and Space Science' unit. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grade 1, 4 and 8. Below we present a comprehensive overview of the themes and key concepts. For a full version of the curriculum, please refer to Newfoundland Ministry of Education at the following link http://www.ed.gov.nl.ca/edu/

NL - Grade 1 (astronomy)
http://www.ed.gov.nl.ca/edu/k12/curriculum/guides/science/primary/gr1outcomes.pdf
pages: 45-58
Revised (2002)

"Earth and Space Science: Daily and Seasonal Changes
OVERVIEW:

- In observing their environment…including the relatively short cycle of day and night and the longer cycle of the seasons.

KEY KNOWLEDGE:

- describe changes in heat and light from the sun

NL - Grade 4 (optics)
http://www.ed.gov.nl.ca/edu/k12/curriculum/guides/science/elementary/gr4.pdf
pages: 43-59
Revised: 2002

"Physical Sciences: Light
OVERVIEW:

- Students become familiar with the properties of light by observing how light interacts with various objects in the environment. These observations help them gain an understanding of light sources and of materials that block or change the path of light and reflect light. From these investigations, students begin to infer that light travels in straight lines, and can use this to construct simple optical devices.

KEY KNOWLEDGE:

Nature of Science and Technology

- demonstrate that specific terminology is used in science and technology contexts
- describe examples of tools and techniques that extend our senses and enhance our ability to gather data and information about the world
- describe instances where scientific ideas and discoveries have led to new inventions and applications

Social and Environmental Contexts of Science and Technology

- identify women and men in their community who work in science- and technology related areas
- identify positive and negative effects of familiar technologies
- construct and use devices for a specific purpose

- distinguish between objects that emit their own light and those that require an external source of light to be seen
- compare how light interacts with a variety of optical devices such as kaleidoscopes, periscopes, telescopes, and magnifying glasses
- demonstrate that light travels in all directions away from a source
- investigate how a beam of light interacts with a variety of objects, in order to determine whether the objects cast shadows, allow light to pass, or reflect light
- predict the location, shape, and size of a shadow when a light source is placed in a given location relative to an object
- demonstrate and describe how a variety of media can be used to change the direction of light
- demonstrate that white light can be separated into colours

NL - Grade 6 (astronomy)
http://www.ed.gov.nl.ca/edu/k12/curriculum/guides/science/elementary/gr6.pdf
pages: 211-225
Revised (2002)

"Earth and Space Science: Space
OVERVIEW:

- 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.

KEY KNOWLEDGE:

Nature of Science and Technology

- identify examples of scientific questions and technological problems that are currently being studied
- describe how evidence must be continually questioned in order to validate scientific knowledge

Relationships Between Science and Technology

- 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

- compare tools, techniques, and scientific ideas used by different people around the world to interpret natural phenomena and meet their needs
- provide examples of Canadians who have contributed to science and technology
- describe scientific and technological achievements that are the result of contributions by people from around the world

- demonstrate how Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons
- observe and explain how the relative positions of Earth, the moon, and the sun are responsible for the moon phases, eclipses, and tides
- describe the physical characteristics of components of the solar system—specifically, the sun, planets, moons, comets, asteroids, and meteors
- identify constellations in the night sky

NL - Grade 8 (optics)

http://www.ed.gov.nl.ca/edu/k12/curriculum/guides/science/grade8/Unit_2.pdf
pages: 63-123
Revised: Under review

"Physical Science: Optics

OVERVIEW:

- Applications using the principles of light have resulted in devices that have improved scientific techniques and contributed to the quality of life. In this unit of study, basic concepts that are introduced include the properties of visible light including the reflection and refraction of light. Various reflecting and refracting technologies will also be explored and investigated.

- Students should be given opportunities to experience and observe the properties of light using hands-on activities. Opportunities and activities designed to investigate and explore the properties of light would provide the basis for more in-depth experimentation with materials in order to investigate reflection and refraction of light.

KEY KNOWLEDGE:

Nature of Science and Technology

- describe how technologies develop as a systematic trial-and-error process that is constrained by the properties of materials and the laws of nature
- explain the importance of choosing words that are scientifically or technologically appropriate
- provide examples of ideas and theories used in the past to explain natural phenomena

Relationships Between Science and Technology

- provide examples of scientific knowledge that have resulted in the development of technologies
- provide examples of technologies that have enabled scientific research

- identify and describe properties of visible light
- describe the laws of reflection of visible light and their applications in everyday life
- describe qualitatively how visible light is refracted
- describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves
- compare properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves

New Brunswick 

Herein we present an analysis of the current astronomy content as it is taught within the province of New Brunswick. As discussed, at present the Atlantic Provinces use a common curriculum for much of their educational system. A review of the New Brunswick curriculum reveals direct links to Astronomy in the both Grade 6 and grade 9 'Earth and Space Science' units. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grade 4 and 8. Below we present a comprehensive overview of the themes and key concepts. For a full version of the curriculum, please refer to New Brunswick Ministry of Education at the following link http://www.gnb.ca/0000/index-e.asp

NB - Grade 4 (optics)
http://www.gnb.ca/0000/publications/curric/grade4science.pdf
pages: 38-55
Revised (2002)

"Physical Sciences: Light
OVERVIEW:
Students become familiar with the properties of light by observing how light interacts with various objects in the environment.

KEY KNOWLEDGE:

Nature of Science and Technology

- demonstrate that specific terminology is used in science and technology contexts
- describe examples of tools and techniques that extend our senses and enhance our ability to gather data and information about the world
- describe instances in which scientific ideas and discoveries have led to new inventions and applications

Social and Environmental Contexts of Science and Technology

- identify women and men in their community who work in science- and technology-related areas

- distinguish between objects that emit their own light and those that require an external source of light to be seen
- compare how light interacts with a variety of optical devices such as kaleidoscopes, periscopes, telescopes, and magnifying glasses
- demonstrate that light travels away from a source in all directions
- investigate how a beam of light interacts with a variety of objects, to determine whether the objects cast shadows, allow light to pass through, or reflect the light
- predict the location, shape, and size of a shadow when a light source is placed in a given location relative to an object
- demonstrate and describe how a variety of media can be used to change the direction of light
- demonstrate that white light can be separated into colours

NB - Grade 6 (astronomy)
http://www.gnb.ca/0000/publications/curric/grade6science.pdf
pages: 66-79
Revised (2002)

"Earth and Space Science: Space
OVERVIEW:
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 crewed and uncrewed flights carry probes which are contributing to our knowledge of space. They also learn that advances in technology provide new capabilities to monitor the Earth, for communications, and for the further exploration of space.

As 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. They will appreciate the experiences of astronauts as they live in space, and that space exploration has been undertaken as a largely international affair.

KEY KNOWLEDGE:

Nature of Science and Technology

- identify examples of scientific questions and technological problems that are currently being studied
- describe how evidence must be continually questioned in order to validate scientific knowledge

Relationships Between Science and Technology

- 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

- compare tools, techniques, and scientific ideas used by different people around the world to interpret natural phenomena and meet their needs
- provide examples of Canadians who have contributed to science and technology
- describe scientific and technological achievements that are the result of contributions by people from around the world

- demonstrate how Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons
- observe and explain how the relative positions of Earth, the moon, and the sun are responsible for the moon phases, eclipses, and tides
- describe the physical characteristics of components of the solar system—specifically, the sun, planets, moons, comets, asteroids, and meteors
- identify constellations in the night sky

NB - Grade 8 (optics)
http://www.gnb.ca/0000/publications/curric/grade8science.pdf
pages: 34-47
Revised (2002)

"Physical Science: Optics
OVERVIEW:
Applications using the principles of light have resulted in devices that have improved scientific techniques and contributed to the quality of life. In this unit of study, basic concepts that are introduced include the properties of visible light including the reflection and refraction of light. Various reflecting and refracting technologies will also be explored and investigated.

KEY KNOWLEDGE:

- provide examples of technologies that have enabled scientific research
- provide examples to illustrate that scientific and technological activities take place in a variety of individual or group settings
- identify and describe properties of visible light
- describe the laws of reflection of visible light and their applications in everyday life
- describe qualitatively how visible light is refracted
- describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves
- compare properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves

NB - Grade 9 (astronomy)
http://www.gnb.ca/0000/publications/curric/grade9science.pdf
pages: 64-75
Revised (2002)

"Earth and Space Science: Space Exploration
OVERVIEW:
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.

KEY KNOWLEDGE:

Nature of Science and Technology

- describe and explain the role of experimentation, collecting evidence, finding relationships, proposing explanations, and imagination in the development of scientific knowledge
- explain the need for new evidence in order to continually test existing theories

Relationships Between Science and Technology

- 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

- provide examples of how Canadian research projects in science and technology are supported
- describe examples of science- and technology-based careers in Canada, and relate these careers to their studies in science

- describe theories on the formation of the solar system
- describe and classify the major components of the universe
- describe theories on the origin and evolution of the universe
- describe and explain the apparent motion of celestial bodies
- describe the composition and characteristics of the components of the solar system
- describe the effects of solar phenomena on Earth

Prince Edward Island 

Herein we present an analysis of the current astronomy content as it is taught within the province of P.E.I. As discussed, at present the Atlantic Provinces use a common curriculum for much of their educational system. A review of the P.E.I curriculum reveals direct links to Astronomy in the both Grade 6 and grade 9 'Earth and Space Science' units. Indirect topic links involving units on optics and/or brief discussions of astronomical concepts can be found in Grade 1, 4 and 8. Below we present a comprehensive overview of the themes and key concepts. For a full version of the curriculum, please refer to P.E.I Ministry of Education at the following link http://www.gov.pe.ca/education/

P.E.I - Grade 1 (astronomy)
http://www.gov.pe.ca/photos/original/ed_gr1_sci.pdf
Key pages: 41-54

OVERVIEW:
In observing their environment, students become aware of things that change… including the relatively short cycle of day and night and the longer cycle of the seasons.

KEY KNOWLEDGE:

- The inquiry focus in this unit will emphasize making observations of daily and seasonal events, recording these observations over time, and noting patterns or cycles that exist. The context for this unit is cycles. Students will learn that many things in life occur in cycles, and knowing about these cycles helps people make predictions and plan for the future. This unit could be addressed over the school year, so that students can explore the seasonal changes that occur.

PE - Grade 4 (optics)
http://www.gov.pe.ca/photos/original/ed_gr4_sci.pdf
pages: 39-56

"Physical Sciences: Light
OVERVIEW:
Students become familiar with the properties of light by observing how light interacts with various objects in the environment.

KEY KNOWLEDGE:

- **Optical Devices**
- describe that knowledge of the properties of light has led to the development of optical devices that extend our ability to observe
- compare how light interacts with a variety of optical devices
- construct an optical device that performs a specific function
- identify women and men in their community who have careers that deal directly with lenses, mirrors, and prisms

Sources of Light

- distinguish between objects that emit their own light and those that require an external source to be seen
- identify positive and negative effects of exposure to light

Light Radiates from a Source

- make observations about how light is dispersed from a variety of light sources
- demonstrate that light travels in all directions away from a source
- conclude that light travels in a straight line based on evidence gathered through their own research and observation

Objects that Absorb, Transmit, and/or Reflect Light

- plan a procedure and make observations to determine changes in a shadow's location, shape, and relative size when an object is placed in different positions and orientations relative to a light source and screen make observations and collect information about the reflective properties of surfaces of different shapes and textures

Bending Light

- demonstrate and describe how a variety of media can be used to change the direction of light
- make observations and collect information about the refractive properties of materials of different shapes

Dispersion of Light

- demonstrate that white light can be separated into colours, and use the term "dispersion" for this process
- follow a set of procedures to make and use a colour wheel

PE - Grade 6 (astronomy)

http://www.gov.pe.ca/photos/original/ed_gr6_sci.pdf
pages: 65-80

"Earth and Space Science: Space

OVERVIEW:

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.

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.

KEY KNOWLEDGE:

Space Exploration

- provide examples of Canadians who have contributed to the science and technology of space exploration
- describe examples of improvements to the tools and techniques of exploring the solar system that have led to discoveries and scientific information
- describe scientific/technological achievements in space science that are the result of contributions by people from around the world
- identify examples of scientific questions and technological problems about space and space exploration that are currently being studied

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

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

The Solar System

- 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
- describe the physical characteristics of components of the solar system
- 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
- evaluate the usefulness of different information sources when getting information about the components of the solar system

Stars and Constellation

- identify constellations from diagrams, pictures and/or representations of the night sky
- use electronic print resources and/or visit a planetarium to gather information on the visual characteristics and mythology of constellations
- 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

PE - Grade 8 (optics)
http://www.gov.pe.ca/photos/original/ed_gr8_sciguide.pdf
pages: 37-49

"Physical Science: Optics
OVERVIEW:
Basic concepts that are introduced include the properties of visible light including the reflection and refraction of light. Various reflecting and refracting technologies will also be explored and investigated.

KEY KNOWLEDGE:

- identify and describe properties of visible light
- describe the laws of reflection of visible light and their applications in everyday life
- describe qualitatively how visible light is refracted
- describe different types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves
- compare properties of visible light to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves

PE - Grade 9 (astronomy)
http://www.gov.pe.ca/photos/original/ed_gr9_sciguide.pdf
pages: 65-77

"Earth and Space Science: Space Exploration
OVERVIEW:
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.

KEY KNOWLEDGE:

Nature of Science and Technology

- describe and explain the role of experimentation, collecting evidence, finding relationships, proposing explanations, and imagination in the development of scientific knowledge
- explain the need for new evidence in order to continually test existing theories

Science and Technology

- 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

- provide examples of how Canadian research projects in science and technology are supported
- describe examples of science- and technology-based careers in Canada, and relate these careers to their studies in science

- describe and explain the apparent motion of celestial bodies
- describe theories on the formation of the solar system
- describe the composition and characteristics of the components of the solar system
- describe the effects of solar phenomena on Earth
- describe theories on the origin and evolution of the universe
- describe and classify the major components of the universe

Nunavut 

The current astronomy content as it is taught within Nunavut is outlined by both the Alberta and Northwest Territory curriculum. Nunavut is revamping its curriculum. To glimpse the current program in place please refer to both the AB and NT guides or refer to the Nunavut department of education website
http://www.gov.nu.ca/education/eng/css/progstudies7_12.htm