# Course Profile

## Science

Grade 9
Applied

• *for teachers by teachers*

Course Profiles are professional development materials designed to help teachers implement the new Grade 9 secondary school curriculum. These materials were created by writing partnerships of school boards and subject associations. The development of these resources was funded by the Ontario Ministry of Education and Training. This document reflects the views of the developers and not necessarily those of the Ministry. Permission is given to reproduce these materials for any purpose except profit. Teachers are encouraged to amend, revise, edit, cut, paste, and otherwise adapt this material for educational purposes.

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# Course Overview
**Applied Science Course Grade 9**

## Description

This course enables students to understand basic concepts in biology, chemistry, earth and space science, and physics to develop practical skills in scientific investigation and to apply their knowledge of science to everyday situations. Student learning will include designing and conducting investigations into practical problems and issues related to cell division and reproduction, the structure and properties of elements and compounds, static and current electricity, and astronomy and space exploration.

## Unit Titles with Sequence and Timing

This Grade 9 Applied Science course profile has been developed to link units through a progression of skills and in some cases content. Local circumstances may dictate some variation in the sequence suggested below, but it is essential to begin with Unit 1, the skill development unit, since the skills developed are applied in other units. Unit 6, the final assessment task, must be the last unit of the course.

The profile structure is one suggestion. It would also be possible to develop themes which address expectations from a number of the science strands. For example, an alternate course profile might develop units with titles such as "Nutrition", which would address expectations from the Biology and Chemistry strands, or "Science: A Changing Discipline", which would address expectations from all four strands.

Observing the skies in the astronomy unit is best done sometime between late November and early February, when nights are long and there is the option to do direct observation in the early evening or morning. It may be necessary for semestered schools to deliver parts of both Units 1 and 5 near the beginning of semester 2 to do this.

The teacher is responsible for creating long-range plans, detailed timing for units and activities, and making decisions about the best order of activities in a given unit. It is important to read through an entire unit prior to making specific plans, since later activities may require introduction early in the unit.

| ***Unit Name and Timing*** | ***Unit Title*** | ***Skill Development*** |
|---|---|---|
| Unit 1 (14 hours) | Weird Water and Skill Builders | • selection of cognitive and manipulative skills for diagnosis of prior learning and skill development |
| Unit 2 (22 hours) | Reproduction - Processes and Applications | • inquiry, with a research focus |
| Unit 3 (22 hours) | Exploring Matter | • inquiry, with an experimental focus |
| Unit 4 (22 hours) | Electrical Applications | • inquiry, with a design focus |
| Unit 5 (22 hours) | Space Exploration | • developing investigative skills beyond the laboratory |
| Unit 6 (8 hours) | Making Connections | • final assessment task |

## Unit Descriptions

### Unit 1: Weird Water - Skill Builders
### Time: 14 hours

#### Description

This unit uses some of the unique properties of water as a unifying theme and provides an opportunity for the teacher to assess the current competence of students in science inquiry, their knowledge of the safe and appropriate use of equipment, and their ability to work independently, in small groups and as a whole class during instruction. The second overall expectation in each strand describes the development of cognitive and manipulative science skills. These are the focus of this unit.

**Overall Expectations**: BYV.01, BYV.02, CHV.01, CHV.02, PHV.01, PHV.02, ESV.01, ESV.02, ESV.03
**Specific Expectations**: BY1.01, BY2.02, BY2.03, BY2.07, PH1.01, PH2.01, PH2.03, BY2.07, PH1.01, PH2.01, PH2.03, PH2.05, PH2.07, CH1.04, CH2.03, CH2.04, CH2.06, CH2.10, ES1.03, ES2.02, ES2.04, ES2.05, ES2.06, ES3.04

### Unit 2: Reproduction - Processes and Applications
### Time: 22 hours

#### Description

The reproduction unit is introduced by examining a wide variety of careers related to Biotechnology. The primary focus will involve learning and using the inquiry skills necessary to investigate and understand an issue. Students will be able to propose and evaluate ideas, think critically, and make decisions based on information from a wide variety of sources including electronic and print resources. The end-of-unit task will involve students researching and reporting on a specific occupation related to Biotechnology.

**Overall Expectations**: BYV.01, BYV.02, BYV.03
**Specific Expectations**: BY1.01 to .07; BY2.01 to .09; BY3.01 to .05

### Unit 3: Exploring Matter
### Time: 22 hours

#### Description

In this unit, students will design and conduct investigations into the properties of common elements and compounds with a focus on laboratory and environmental safety. The topics of this unit lend themselves naturally to experimentation and provide opportunities for students to collect, record, organize, analyze and interpret data. A culminating activity for the unit addresses environmental concerns and health and safety issues and relates to the production and use of common elements and compounds.

**Overall Expectations**: CHV.01, CHV.02, CHV.03
**Specific Expectations**: CH1.01 to .09; CH2.01 to .10; CH3.01 to .04

### Unit 4: Electrical Applications
### Time: 22 hours

#### Description

In this unit, students will gain an understanding of concepts of static and current electricity. They will develop skill in gathering qualitative and quantitative data using a variety of electrical instruments and tools, and will compare the relationships among electrical current, resistance and potential difference. Students will apply their knowledge to the design and construction of an electrical circuit which performs a specific function. Safety concerns related to static and current electricity in daily life, and the safe use of tools and electrical equipment, are addressed. Students will evaluate the risks and benefits associated with electrical energy production and distribution in Canada.

**Overall Expectations**: PHV.01, PHV.02, PHV.03
**Specific Expectations**: PH1.01 to .07; PH2.01 to .09; PH3.01 to .05

### Unit 5: Space Exploration
### Time: 22 hours

#### Description

This unit builds on students' curiosity about space and their place in the universe and develops their observational skills in situations other than the laboratory. Students will explore the universe and study applications of space science to understand better how scientists investigate the universe and how the resulting technologies affect their lives. Skills of inquiry, problem-solving, critical thinking, collaboration and communication are developed. Current space work, such as the construction of the new international space station, is stressed. As a culminating activity, the students will develop a proposal for a Science Fiction movie.

**Overall Expectations**: ESV.01, ESV.02, ESV.03
**Specific Expectations**: ES1.01 to .05; ES2.01 to .08; ES3.01 to .04

### Unit 6: Making Connections
### Time: 8 hours

#### Description

This unit, which comprises the summative assessment tasks, occurs towards the end of the course. It accounts for 30% of the students' overall course grade and assesses all three goals of the science course (relating science to technology, society and the environment; inquiry and communication skills; and basic concepts). The course has been designed to allow students to practise skills, and to identify and correct misconceptions in preparation for the final assessment. This assessment also allows the teacher to establish how well students have achieved Expectations according to the Achievement Chart for Science (see *The Ontario Curriculum, Grades 9 and 10: Science, 1999* – pp. 46-47). The remaining 70% of the course grade will be based on assessments and evaluations conducted throughout the course.

## Course Notes

There is a common misconception that science consists solely of a basic set of agreed-upon facts that every student should know. This perception ignores the rapid expansion of knowledge, especially in the areas of science and technology. The established core of science education is not

one of facts alone, but of the concepts, skills, attitudes and dispositions which enable learners to interpret and respond to the events, changes and challenges of their world. It is important that all students achieve such scientific literacy, however the path they follow will differ, reflecting local issues and situations, community-based planning and management, and individual student interest.

- The paramount task of science education is to equip all students with *scientific literacy* – that combination of values, knowledge and skills that will enable them to think creatively, reason logically, evaluate information critically and communicate effectively. This is an essential base for making productive and ethical decisions, not only about scientific and technological issues but in all areas of life. At the same time, science education must prepare students who require scientific knowledge and skills for employment or further education in trades, technology and other science related fields.

- To help students achieve this vision, Grade 9 Science is grounded in three goals which parallel those of *The Ontario Curriculum, Grades 1-8: Science and Technology*, and which are in turn reflected directly in the three overall expectations for each unit in the course. These goals for students are:
  - To relate science to technology, society and the environment;
  - To develop skills, strategies and habits of mind required for scientific inquiry; and,
  - To understand basic concepts of science

  The three goals are of equal importance, and the activities and assessment tasks in this profile reflect that balance

- An emphasis on science inquiry skills is maintained throughout the course. Through a variety of investigations, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. They identify their assumptions, use critical and logical thinking, and consider alternative explanations.

- The expectations are central to all aspects of this course profile. The context in which each unit is delivered, the skills and concepts developed and the assessment tasks used are interconnected, and linked to the expectations. The assessment data accumulated throughout the course must be sufficient (in kind and number) to permit teachers to evaluate the *consistent level of performance* for each student in each of the categories in the Achievement Chart for Science (policy document, pages 44-47).

- Students should be made fully aware, in advance, of the processes by which they will be assessed and evaluated in each unit of the course and in the summative course evaluation. Use of the Achievement Chart for Science is the basis of assessment of all aspects of the course, and is introduced and discussed in Unit 1.

- This profile describes a science course in which students are taught how, and are actively encouraged, to ask their own questions, and in many cases to find their own answers by inquiry – through experiment, research or the innovation of a device or process. The teacher must make decisions about when and how to intervene to ensure that students are being successful, without usurping their opportunities to find their own way. In this model the teacher is a facilitator of learning, rather than the only source of knowledge - the ‘guide on the side’, not the ‘sage on the stage’. The teacher spends more class time refocusing groups and individual students; less directing whole-class activities.

- Although there is still the need for direct instruction for some skills and concepts, that strategy is only one of a wide range of instructional strategies promoted in this profile. Consequently, there is

a much reduced emphasis on traditional laboratory activities in which students are provided step-by-step instructions, and more emphasis on developing students' ability to devise and carry out their own procedures within well-defined limits. Again, the teacher's role is to decide what knowledge and skills students must have for them to proceed safely and successfully in a laboratory setting, without reducing their part in the process to being followers of recipes with entirely predictable results.

- Research across a variety of disciplines indicates that each student interprets new information in terms of what he or she already knows. The student tries to make sense of what is taught by trying to fit it with his or her experience. This implies that teachers must engage students in activities from which the students construct meaning. This does not imply, however, that students must always 'reinvent the wheel'. For example, basic computation and algorithms "were invented precisely so that people would not have to count on their fingers and toes to solve each problem." (Sykes, 1995). Formulas in science serve similar practical purposes. However the formulas and algorithms should be viewed by students as tools for solving problems not as problems to be solved, and should not dominate the curriculum.

- The need for students to interact with others as they expand their experience with new concepts is so vital that cooperative learning is a primary teaching strategy. Cooperative learning allows individuals to examine their current thinking and to make adaptations in light of input from others. Learners need time to experience, reflect on their experiences in relation to what they already know, and resolve any problems that arise. Accordingly, learners need time to clarify, elaborate, describe, compare, negotiate, and reach consensus on what specific experiences mean to them. Educating students to be effective learners is an important priority in the science program.

- Not all specific expectations are of equal value. Those that are critical to the development of scientific literacy are emphasized in the learning activities, and are often revisited. These are expectations which are taught, assessed, evaluated and where necessary revisited using alternate instructional strategies in a cyclic process that stops only when students have *achieved* the expectations.

- The course begins with a unit which assesses and develops prior knowledge and skills. This pattern is continued by beginning each unit with activities which help students build the necessary background to succeed and which help teachers determine areas for remediation to be addressed during instruction.

- Safety issues should be introduced as appropriate throughout the course. Teachers should consult local and Ministry policy documents, and conform with local Health and Safety practices. Refer also to The Ontario Curriculum, Grades 9 and 10: Science (p. 43).

- As implementation of the Grade 1-8 program proceeds, teachers of Grade 9 Science will find that some of the introductory activities now required to assess and develop student background knowledge and skills will be less time consuming, leaving more time for enhancements and extensions. A chart is provided in the Teacher Support Materials (TSM - Ontario Curriculum, Grades 1 - 8: Science and Technology) which outlines succinctly the areas of the Grade 1-8 program which relate to Expectations in Grade 9 Science.

- There are many opportunities for students to do inquiry by research in this profile. Where activities suggest particular resources and techniques for research, the teacher must decide if the suggestions are feasible, and if not, to adjust them so that the intent of the activity is maintained even if the details are altered to accommodate local circumstances.

Students should be taught how to use all available tools to access information – from people, print, other media and online sources, both within the school and beyond in the community. They should also be given opportunities to use those skills, and to experience the frustrations that invariably accompany the location and acquisition of quality information.

However, care must be taken that student time is spent primarily on *processing* information rather than *accessing* information, so that the research does not become an end in itself. It is more time efficient for students to be provided with appropriate resource materials for some activities, rather than having them search them out. For example, a selection of appropriate books, magazines, vertical files and other media on a topic could be located in advance by the teacher and/or teacher librarian and brought to the classroom. Where Internet access if limited, or slow, whole sites can be downloaded to the hard drive of a computer using a commercial software package like WebWhacker (Classroom Connect - ISBN 0932577-39-3 -- web site **http://www.classroom.net**) then used in the classroom. Teachers should also develop collections of articles from various sources that could be maintained in a classroom vertical file for use by students as required, or bundled into packages specific to particular activities.

- The instructional plan for each unit encourages connections to a broad range of community resources. These may include print or electronic sources of information, sites for field trips, resource people, physical resources, commercial enterprises and post-secondary institutions. These can also be resources for students planning for careers and further education.

- The implementation of Grade 9 Science is a process, not an event. The program will take a number of years to become institutionalized in schools. Beginning in September 1999, it will be necessary that those involved at all levels in the education system make continuous and measurable progress towards the implementation.

- Students who successfully complete Grade 9 Science, whether the Academic or the Applied course, may choose either course option in Grade 10. To ensure that all students have the necessary knowledge and skills to succeed in Grade 10, there is considerable similarity in the learning activities described for both the Academic and Applied courses.

## Teaching/Learning Strategies

Most learning activities in this profile focus on the inquiry process, draw on scientific skills and concepts and are set in a context of science as it relates to technology, society and the environment. This approach is a significant, intentional change from past practice which tended to focus first on content, and is critical to the development of scientific literacy for all students. There has been a conscious effort to address the principles of best practice in instruction, as outlined below, in the student activities throughout this profile.

Instructional strategies in Grade 9 Science:
- include whole class, small group and individual instruction
- promote the role of teacher as guide and facilitator in the classroom
- use electronic technology in investigations as appropriate (including computer software, laboratory interface devices, calculators, video and digital cameras)
- address a variety of learning styles in each unit
- can be modified for special needs students
- promote direct involvement in a variety of concrete experiences with the natural world which enable students to construct their own understanding of concepts and principles

- provide challenging experiences appropriate to the needs of a broad spectrum of students
- encourage maximum student engagement in the learning activities
- encourage student choice regarding the processes and products of learning in the science classroom
- provide opportunities for genuine inquiry - to generate questions, apply a variety of investigative approaches in learning, and communicate findings in a variety of ways
- provide options which enable students to demonstrate Achievement Level 4
- use formative assessment to provide opportunities for re-learning
- link assessment tools to the expectations addressed
- allow students to practise during the course tasks like those on which they will be assessed and evaluated
- connect with expectations from other subject areas when appropriate
- support opportunities for transfer – to solve problems and innovate by applying scientific concepts and processes to their lives outside the school and beyond the artificial boundaries which separate school subjects.

## Assessment/Evaluation

*Assessment* is a systematic process of collecting information or evidence about student learning; *evaluation* is the judgment we make about the assessments of student learning based on established criteria.

The assessment strategies in this profile support the view that assessment must be embedded within the instructional process throughout each unit rather than being an isolated event at the end. In that view, assessment drives the course and each activity within it. Making the details of the assessment and evaluation process public to all students is a powerful way to promote student success in the achievement of expectations. By making assessment central to the learning process, a wide variety of assessment tools can be used in each unit, maximizing the opportunity for each student to succeed.

There has been a conscious effort to address the principles of best practice in assessment and evaluation, as outlined below, throughout this profile.

## Quality Assessment and Evaluation

- can be modified to accommodate a variety of learning styles
- can be modified to accommodate special needs students
- include both performance tasks and paper-pencil instruments
- can be diagnostic, formative or summative
- are clearly linked to the Expectations and to the Achievement Levels Chart for Science
- may assess both individual and group performance
- employ a wide variety of assessment and evaluation tools and procedures
- are used to improve learning, both from the perspective of the student and the teacher
- make the student a partner in the assessment process through helping to set criteria and through self and peer assessments
- provide judgments about student achievement in the four categories described in the Achievement Levels Chart for Science
- are criterion referenced, comparing student performance to the Expectations, not to other students

## Resource Summary

### A. General References on Science Education


Armstrong, Thomas. (1994) Multiple Intelligences in the Classroom. Alexandria, VA: Association for Supervision and Curriculum Development. ISBN 0-87120-230-1

Brown, John L. (1995) Observing Dimensions of Learning in Classrooms and Schools. Alexandria, VA: Association for Supervision and Curriculum Development. ISBN 0-87120-255-7

Burke, Kay. (1993) How to Assess Thoughtful Outcomes. Palatine, Illinois: IRI/Skylight Puhlishing, Inc. ISBN 0-932935-58-3 (1-800-348-4474)

Herman, Aschbacher and Winters. (1992) A Practical Guide to Alternative Assessment. Association for Supervision and Curriculum Development. ISBN 0-87120-197-6

McDonald, Joseph P. et al. (1993) Graduation by Exhibition: Assessing Genuine Achievement. Alexandria, VA: Association for Supervision and Curriculum Development. ISBN 0-87120-204-2

The Minister of Education and Training, Ontario. (1993) Assessment Planning Guide: Junior Science OAIP. Toronto, ON: Queen's Printer. ISBN 0-7778-0716-5

The Waterloo County Board of Education. (1993) Windows on Learning. Kitchener, ON.

The Waterloo County Board of Education. (1993) Assessment for Learning in the Transition Years and the Specialization Years. Kitchener, ON.

Zemelman, Daniels and Hyde. (1993) Best Practice: New Standards for Teaching and Learning in America's Schools. Portsmouth, NH: Heinemann. ISBN 0-435-08788-6


B. A Selection of Science and Education Internet Sites (and sites that lead to them)

American Association for the Advancement of Science
**http://www.aaas.org/**

Association for Supervision and Curriculum Development -- variety of high quality publications and videos on a wide variety of topics -- many principals and superintendents have memberships and can purchase materials at reduced rates. Also the home of Educational Leadership magazine.
**http://www.ascd.org/**

Canadian government and research sites related to science and engineering
**http://www.nserc.ca/relate.htm**

Education Network of Ontario
**http://www.enoreo.on.ca/**

Education resources on the web (Canadian site)
**http://www.educ.uvic.ca/depts/snsc/pages/weblinks/weblinks.htm**

Gateway to Educational Materials
**http://www.thegateway.org/**

Kathy Schrock's Guide for Educators.
**http://discoveryschool.com/schrockguide/**

MET Web Index -- to find anything on the Ministry's web site.
**http://www.edu.gov.on.ca/eng/webmap.html**

Midwest Mathematics and Science Consortium (MSC)
**http://www.ncrel.org/msc/msc.htm**

National Science Foundation (USA)
**http://www.nsf.gov/**

National Staff Development Council -- issues of implementation
**http://www.nsdc.org/**

Online Resources for Assessment
**http://www.rmcdenver.com/useguide/assessme/online.htm**

Ontario Ministry of Education and Training (MET) -- curriculum documents page
**http://www.edu.gov.on.ca/eng/document/curricul/curricul.html**

Regional Education Laboratories in the USA -- focus on educational research
**http://www.sedl.org/RELs.html**

Rubric for scoring a physics laboratory project
**http://www.glenbrook.k12.il.us/gbssci/phys/projects/q1/tparub.html**

Science Teachers Association of Ontario (STAO) links to science sites
**http://www.stao.org/hotlinks.htm**

STAR Centre for Academic Renewal (Texas)
**http://www.starcenter.org/**

USA National Academy of Sciences
**http://www.nas.edu/**

## Course Evaluation

We will know when we are progressing towards the vision described for Grade 9 Science when we observe:

- students who are actively curious, habitually asking questions about the world around them.
- students who can transfer the skills, concepts and habits of mind learned through science to describe, analyze and explain issues elsewhere in the curriculum and beyond the school that relate science, technology, society and the environment.
- students interacting with others in ways that reflect personal and communal values that have been examined, in part, through the study of science.
- students who are able to consider further studies and/or careers in science and technology since we have maximized the choices open to each by providing engaging learning opportunities and inspiring role models.
- teachers functioning as a community of learners, questioning what they do and how they do it, and improving their craft by sharing their experiences.

## Coded Expectations: Science, Grade 9, Applied

### Biology: Reproduction - Processes and Applications

### Overall Expectations

**BYV.01**
- demonstrate an understanding of the processes of cell division, including mitosis, and the function of sexual (including human) and asexual reproductive systems;

**BYV.02**
- conduct investigations into questions arising from reproductive issues;

**BYV.03**
- examine the impact of scientific research and technological developments on issues related to reproduction.

### Specific Expectations

***Understanding Basic Concepts***

**BY1.01**
- describe the basic process of cell division, including what happens to the cell membrane and contents of the nucleus (e.g., stages of mitosis - prophase, metaphase, anaphase, and telophase);

**BY1.02**
- demonstrate an understanding of the importance of cell division to the growth and reproduction of an organism (e.g., describe changes in cell division in an organism during its lifespan);

**BY1.03**
- demonstrate an understanding that the nucleus of a cell contains genetic information and determines cellular processes;

**BY1.04**
- describe various types of asexual reproduction that occur in plant species or in animal species and various methods for the asexual propagation of plants (e.g., fission, budding, production of spores; fission in the amoeba and planaria flatworm, budding in the hydra and sponge; use of bulbs, cuttings, grafting, and modified stems in plants);

**BY1.05**
- describe the various types of sexual reproduction that occur in plants and in animals, and identify some plants and animals, including hermaphrodites, that exhibit this type of reproduction (e.g., conjugation, cross-fertilization, internal and external fertilization);

**BY1.06**
- compare sexual and asexual reproduction (e.g., asexual reproduction does not require a partner and can take place whenever environmental conditions such as food, warmth, and moisture are suitable);

**BY1.07**
- explain signs of pregnancy in humans and describe the major stages of human development from conception to early infancy.

***Developing skills of Inquiry and Communication***

**BY2.01**
- explain signs of pregnancy in humans and describe the major stages of human development from conception to early infancy.

**BY2.02**
- formulate scientific questions about the problem or concern, and develop a plan to answer these questions;

**BY2.03**
- demonstrate the skills required to plan and conduct an inquiry into reproduction, using instruments and tools safely, accurately, and effectively (e.g., use a microscope at an appropriate level of magnification to locate and view mitosis on a slide);

**BY2.04**
- demonstrate the skills required to plan and conduct an inquiry into reproduction, using instruments and tools safely, accurately, and effectively (e.g., use a microscope at an appropriate level of magnification to locate and view mitosis on a slide);

**BY2.05**
- organize, record, and analyse the information gathered (e.g., interpret patterns and trends; discuss relationships among variables; and predict consequences of action or inaction);

**BY2.06**
- predict the value of a variable by interpolating or extrapolating from graphical data (e.g., graph data on the optimum reproductive years of women and predict trends for upcoming years);

**BY2.07**
- communicate scientific ideas, procedures, results, and conclusions using appropriate language and formats;

**BY2.08**
- defend orally a position on the concern or problem investigated;

**BY2.09**
- use a microscope to observe and identify (in living tissue and prepared slides) animal and vegetable cells in different stages of mitosis, as well as cells undergoing asexual reproduction (e.g., budding in yeast).

***Relating Science to Technology, Society, and the Environment***

**BY3.01**
- describe the use of reproductive technologies in a workplace environment and explain the costs and benefits of using such technologies (e.g., use of reproductive technologies by: a horticulturalist – cloning; a doctor – in vitro fertilization; a farmer or breeder – selective breeding processes);

**BY3.02**
- examine some Canadian contributions to research and technological development in the field of genetics and reproductive biology (e.g., describe the development of the McIntosh apple or of canola; do research on foetal alcohol syndrome or cystic fibrosis);

**BY3.03**
- identify local environmental factors and individual choices that may lead to a change in a cell's genetic information or an organism's development, and investigate the consequences such factors and choices have on human development (e.g., identify the consequences of exposure to X-rays or the use of cigarettes or illegal drugs for the development of the foetus);

**BY3.04**
- provide examples of the impact of developments in reproductive biology on global and local food production, populations, the spread of disease, and the environment (e.g., genetic engineering of crops; reproductive technologies and the production of hybrid species);

**BY3.05**
- describe careers that involve some aspect of reproductive biology.

**Chemistry: Exploring Matter**

## Overall Expectations

**CHV.01**
- describe the atomic structure of common elements and their organization in the periodic table;

**CHV.02**
- investigate the physical and chemical properties of common elements and compounds, and relate the properties of elements to their location in the periodic table;

**CHV.03**
- demonstrate an understanding of the importance, production, use, and environmental hazards of common elements and simple compounds.

### Specific Expectations

***Understanding Basic Concepts***

**CH1.01**
- demonstrate an understanding of the importance, production, use, and environmental hazards of common elements and simple compounds.

**CH1.02**
- recognize compounds as pure substances that may be broken down into elements by chemical means;

**CH1.03**
- describe compounds and elements in terms of molecules and atoms;

**CH1.04**
- identify each of the three fundamental particles (neutron, proton, and electron), and its charge, location, and relative mass in a simple atomic model (e.g., the Bohr-Rutherford model);

**CH1.05**
- identify general features of the periodic table (e.g., arrangement of the elements based on atomic structure, groups or families of elements, periods or horizontal rows);

**CH1.06**
- demonstrate an understanding of the relationship between the properties of elements and their position in the periodic table (e.g., metals appear on the left of the periodic table; non-metals appear on the right);

**CH1.07**
- identify and write symbols/formulae for common elements and compounds (e.g., H, Mg, S, N and NaCl, $O_2$, $H_2O$, $CO_2$);

**CH1.08**
- describe, using their observations, the evidence for chemical changes (e.g., energy change, formation of a gas or precipitate, change in colour or odour, change in temperature);

**CH1.09**
- distinguish between metals and non- metals and identify their characteristic properties (e.g., most metals are lustrous or shiny and good conductors of heat; most non-metals in solid form are brittle and not good conductors of heat)

***Developing Skills of Inquiry and Communication***

**CH2.01**
- demonstrate knowledge of laboratory, safety, and disposal procedures while conducting investigations (e.g., wear safety glasses; practise orderliness and cleanliness; follow WHMIS guidelines and emergency procedures; use proper procedures for handling and storage);

**CH2.02**
- determine how the properties of substances influence their use (e.g., how the reactions of metals with air influence their use);

**CH2.03**
- formulate scientific questions about a problem or issue involving the properties of substances;

**CH2.04**
- demonstrate the skills required to plan and conduct an inquiry into the properties of substances, using apparatus and materials safely, accurately, and effectively (e.g., investigate the physical properties of common elements and classify them as metals or non-metals);

**CH2.05**
- select and integrate information from various sources, including electronic and print resources, community resources, and personally collected data, to answer the questions chosen;

**CH2.06**
- organize, record, and analyse the information gathered (e.g., interpret patterns and trends; discuss relationships among variables; predict consequences of action or inaction);

**CH2.07**
- communicate scientific ideas, procedures, results, and conclusions using appropriate language and formats (e.g., present data on different chemical substances in a table using appropriate headings such as *compound, element, chemical property, physical property*);

**CH2.08**
- investigate, by laboratory experiment or classroom demonstration, the chemical properties of representative families of elements (e.g., combustibility, reaction with water of Mg, Ca or C, Si);

**CH2.09**
- investigate the properties of changes in substances, and classify them as physical or chemical based on experiments (e.g., solubility, combustibility, change of state, changes in colour);

**CH2.10**
- construct molecular models of simple molecules (e.g., $H_2$, $O_2$, $H_2O$, $NH_3$, $CH_4$, $CO_2$).

***Relating Science to Technology, Society, and the Environment***

**CH3.01**
- identify uses of elements in everyday life (e.g., iron and other elements in steel; aluminum, oxygen, chlorine in water);

**CH3.02**
- describe the methods used to obtain elements in Canada, and outline local environmental concerns and health and safety issues related to the ways in which they are mined and processed (e.g., explain how gold, nickel, carbon, or uranium is obtained and processed);

**CH3.03**
- explain how a knowledge of the physical and chemical properties of elements enables people to determine the potential uses of the elements and assess the associated risks (e.g., helium versus hydrogen in balloons, copper versus aluminum in wiring, copper versus lead in plumbing);

**CH3.04**
- identify and describe careers that require knowledge of the physical and chemical properties of elements and compounds.

## Earth and Space Science: Space Exploration

### Overall Expectations

**ESV.01**
- demonstrate an understanding of the formation, evolution, structure, and nature of our solar system and of the universe;

**ESV.02**
- design and conduct investigations into the appearance and motion of visible celestial objects;

**ESV.03**
- describe how human endeavours and interest in space have contributed to our understanding of outer space, the Earth, and living things, and identify Canadian contributions to space exploration.

### Specific Expectations

*Understanding Basic Concepts*

**ES1.01**
- recognize and describe the major components of the universe using appropriate scientific terminology and units (e.g., record the location and movement of planets and satellites, stars, galaxies, and clusters of galaxies using Astronomical Units and light years);

**ES1.02**
- describe the generally accepted theory of the origin and evolution of the universe (i.e., the "big bang" theory) and the observational evidence that supports it;

**ES1.03**
- describe, compare, and contrast the general properties and motions of the components of the solar system (e.g., the composition and physical properties – such as size and state, rotation, size and period of orbit – of the Sun, planets, moons, asteroids, comets);

**ES1.04**
- describe the Sun and its effects on the Earth and its atmosphere (e.g., the Sun as an energy source, solar activity, aurora borealis);

**ES1.05**
- describe and explain the effects of the space environment on organisms and materials (e.g., the effects of microgravity and temperature on organisms during space exploration).

***Developing Skills of Inquiry and Communication***

**ES2.01**
- identify problems and issues that scientists face when investigating celestial objects and describe ways these problems can be solved (e.g., use of a telescope to collect light from a faint object);

**ES2.02**
- formulate scientific questions about a problem or issue in space exploration;

**ES2.03**
- demonstrate the skills required to plan and conduct an inquiry about space exploration, using instruments, tools, and apparatus safely, accurately, and effectively;

**ES2.04**
- select and integrate information from various sources, including electronic and print resources, community resources, and personally collected data, to answer the questions chosen;

**ES2.05**
- organize, record, and analyse the information gathered (e.g., interpret patterns and trends; discuss relationships among variables; predict consequences of action or inaction);

**ES2.06**
- communicate scientific ideas, procedures, results, and conclusions using appropriate SI units, language, and formats (e.g., prepare a comparative data table on various stars);

**ES2.07**
- conduct investigations on the motion of visible celestial objects, using instruments, tools, and apparatus safely, accurately, and effectively (e.g., graph sunrise and sunset data and relate them to the motions of the Earth);

**ES2.08**
- gather, organize, and record data through regular observations of the night sky and/or use of appropriate software programs, and use these data to identify and study the motion of visible celestial objects (e.g., track the position of the Moon and planets over time).

***Relating Science to Technology, Society, and the Environment***

**ES3.01**
- identify and assess the impact of developments in space research and technology on other fields of endeavour (e.g., the advancement of robotics, agriculture, resource management, navigation, and telecommunications);

**ES3.02**
- relate the beliefs of various cultures concerning celestial objects to aspects of their civilization (e.g., aboriginal beliefs, Greek mythology, Mayan civilization);

**ES3.03**
- provide examples of the contributions of Canadian research and development to space exploration and technology;

**ES3.04**
- explore careers in science and technology that are related to the exploration of space, and identify their educational requirements.

## Physics: Electrical Applications

### Overall Expectations

**PHV.01**
- demonstrate an understanding of the principles of static and current electricity;

**PHV.02**
- design and build electrical circuits that perform a specific function;

**PHV.03**
- analyse the practical uses of electricity and its impact on everyday life.

### Specific Expectations

***Understanding Basic Concepts***

**PH1.01**
- explain common electrostatic phenomena (e.g., clothes that “stick” together, attraction of hairs to combs);

**PH1.02**
- compare qualitatively static and current electricity (e.g., a charge on a charged electroscope and the charge in an operating circuit);

**PH1.03**
- describe the concepts of electric current, potential difference, and resistance, with the help of a water analogy;

**PH1.04**
- explain how electric current, potential difference, and resistance are measured using an ammeter and a voltmeter;

**PH1.05**
- describe qualitatively the effects of varying electrical resistance and potential difference on electric current in an electrical circuit;

**PH1.06**
- apply the relationship *potential difference=resistance x current* to simple series circuits;

**PH1.07**
- determine quantitatively the percent efficiency of an electrical device that converts electrical energy to other forms of energy, using the relationship
  *percent efficiency = energy output/energy input X 100*

***Developing Skills of Inquiry and Communication***

**PH2.01**
- demonstrate knowledge of electrical safety procedures when planning and carrying out investigations and choosing and using materials, tools, and equipment;

**PH2.02**
- identify an authentic practical challenge or problem related to the use of electricity (e.g., to design household wiring; to increase the efficiency of electrical usage in the school);

**PH2.03**
- formulate questions about the problem or issue;

**PH2.04**
- demonstrate the skills required to plan and conduct an inquiry into the use of electricity, using instruments, tools, and apparatus safely, accurately, and effectively;

**PH2.05**
- select and integrate information from various sources, including electronic and print resources, community resources, and personally collected data, to answer the questions chosen;

**PH2.06**
- select and integrate information from various sources, including electronic and print resources, community resources, and personally collected data, to answer the questions chosen;

**PH2.07**
- communicate scientific ideas, procedures, results, and conclusions using appropriate SI units, language, and formats (e.g., electrical power, voltage, resistance; drawings, charts, graphs);

**PH2.08**
- design, draw, and construct series and parallel circuits that perform a specific function (e.g., given light bulbs, wires, and batteries, produce circuits with: one light bulb on; two light bulbs of the same brightness; one light bulb disconnected and the other light bulb on);

**PH2.09**
- use appropriate instruments to collect and graph data, and determine the relationship between voltage and current in a simple series circuit with a single resistor.

***Relating Science to Technology, Society, and the Environment***

**PH3.01**
- describe and explain household wiring and its typical components (e.g., parallel circuits with switches, fuses, circuit breakers, outlets);

**PH3.02**
- develop a solution to a practical problem related to the use of electricity in the home, school, or community (e.g., choose an appropriate fuse or circuit breaker for a specific circuit);

**PH3.03**

- compare electrical energy production technologies, including risks and benefits (e.g., explain the advantages and disadvantages of using hydro, photovoltaic, wind, and tidal generators to produce electrical energy);

**PH3.04**

- explain how some common household electrical appliances operate (e.g., electric kettle, electric baseboard heater, electric light bulb);

**PH3.05**

- describe careers that involve electrical technologies, and use employability- assessment programs, newspaper job advertisements, and/or appropriate Internet sources to identify the knowledge and skill requirements of such careers.