

*Catholic District School Board Writing Partnership*

# Course Profile **Science**

Grade 9  
Academic

• *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. 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 also encouraged to amend, revise, edit, cut, paste, and otherwise adapt this material for educational purposes.

Any references in this document to particular commercial resources, learning materials, equipment, or technology reflect only the opinions of the writers of this sample Course Profile, and do not reflect any official endorsement by the Ministry of Education or by the Partnership of School Boards that supported the production of the document.

© Queen's Printer for Ontario

## **Acknowledgments**

Catholic Curriculum Cooperative of Central Ontario (CCCC) Writing Partnership - Science

### Lead Board

Hamilton-Wentworth Catholic District School Board  
Remo Presutti, Manager

### Course Profile Writing Team

Alexandre Annab, Dufferin-Peel CDSB  
Josephine Ciapanna, Hamilton-Wentworth CDSB  
Maurice DiGiuseppe, Toronto CDSB  
Gerry Fuchs, Hamilton-Wentworth CDSB  
Ted Laxton, Wellington CDSB  
Marion Poole, Toronto CDSB  
Milan Sanader, Dufferin-Peel CDSB  
Siria Szkurhan, Hamilton-Wentworth CDSB  
Robert Warren, Hamilton-Wentworth CDSB

### Course Profile Internal Review Team

Dr. Anthony Cuschieri, Hamilton-Wentworth CDSB  
Milan Sanader, Dufferin-Peel CDSB

### Course Profile Format Editor

Rachael Szkurhan

Institute for Catholic Education (ICE)

---

## Course Overview

### Science, Academic, Grade 9

#### Identifying Information:

**School:**

**Department:**

**District:**

**Course Title:** Science

**Grade:** 9

**Course Type:** Academic

**Ministry Course Code:** SNC1D

**Credit Value:** 1

**Course Developer(s):** CCCC

**Development Date:** July 31, 1999

#### Description/Rationale

This course enables students to understand basic concepts in biology, chemistry, earth and space science, and physics; to develop skills in the processes of scientific inquiry; and to relate science to technology, society, and the environment. Students learn scientific theories and conduct investigations related to cell division and reproduction; atomic and molecular structures and the properties of elements and compounds; the universe and space exploration, and the principles of electricity.

#### How This Course Supports The Ontario Catholic School Graduate Expectations

The study of the knowledge of science helps students to learn, to be reflective, critical and creative thinkers, as well as discerning believers who understand the theories of science and can apply them to the world around them yet make appropriate decisions in light of Gospel values and Church teachings for the good of their fellow human beings. Through the study of the techniques of science, particularly experimentation, students learn to be collaborative contributors to an interdependent team, respecting the rights, responsibilities, and contributions of others. Overall through this course, students become aware of the sacramental dimension of the physical world in all its aspects and of their role as stewards of God's creation.

#### Unit Titles (Time and Sequence)

Unit 1	Chemistry: Atoms and Elements	27.5 hours
Unit 2	Physics: The Characteristics of Electricity	27.5 hours
Unit 3	Biology: Reproduction	27.5 hours
Unit 4	Earth and Space Sciences: The Study of the Universe	27.5 hours

---

## Unit Organization

### Unit 1: Chemistry: Atoms and Elements

**Time:** 27.5 hours

#### Description

This unit focusses on the physical and chemical properties and changes of matter, the history and structure of the atom, and the arrangement of elements in the periodic table. Through the study of the technologies associated with the refining and recycling of elements and compounds, the students obtain the scientific and technological knowledge within a context enriched by their Catholic Faith culture. This enables the students to make informed decisions and to consider their responsibilities as informed Catholic citizens in a rapidly changing society. This unit provides the background information for the Physics, Biology, and Earth and Space Sciences units.

#### Strand(s) and Expectations

**Ontario Catholic School Graduate Expectations:** CGE 1d,i; 2a,b,c,d,e; 3b,c,d,e,f; 4a,b,c,d,e,f,g; 5a,b,c,d,e,f,g,h; 7a,b,d,e,f,h,i.

**Strand(s):** Chemistry

**Overall Expectations:** CHV.01, CHV.02, CHV.03

**Specific Expectations:** CH1.01 to CH1.15, CH2.01 to CH2.10, CH3.01 to CH3.04

### Unit 2: Physics: The Characteristics of Electricity

**Time:** 27.5 hours

#### Description

In this unit students describe and apply models of static and current electricity, and design and conduct investigations into electrical circuits found in everyday life and the quantitative relationships among current, potential difference, and resistance. Students also evaluate the social, economic, ethical, and environmental costs and benefits arising from the methods of electrical energy production used in Canada. This unit should follow the Chemistry Unit which develops models of the atom to aid in understanding the electrical nature of matter. It should be followed by the Earth and Space Sciences Unit, since much of the understanding of the universe has come from the application of the knowledge of electricity.

#### Strand(s) and Expectations

**Ontario Catholic School Graduate Expectations:** CGE 1d; 2a,b,c,d,e; 3b,c,d,f; 4a,b,e,f; 5a,b,d,e,f,g; 7h,i,j.

**Strand(s):** Physics

**Overall Expectations:** PHV.01, PHV.02, PHV.03.

**Specific Expectations:** PH1.01 to PH1.07, PH2.01 to PH2.09, PH3.01 to PH3.05.

---

## Unit 3: Biology: Reproduction

**Time:** 27.5 hours

### Description

In this unit, students describe and apply the cell theory to the reproductive processes of plants and animals (including humans). Students investigate and analyse cell division and factors affecting cell reproduction within a context that recognizes God as the author of life. They evaluate, from a Catholic perspective, the implications for social decision making regarding scientific research and technological developments about reproductive issues.

### Strand(s) and Expectations

**Ontario Catholic School Graduate Expectations:** CGE 1c,d,e; 2a,c,e; 3b,c,d,e,f; 4a,g; 5e; 6b,c.

**Strand(s):** Biology

**Overall Expectations:** BYV.01, BYV.02, BYV.03

**Specific Expectations:** BY1.01 to BY1.10, BY2.01 to BY2.10, BY3.01 to BY3.04.

## Unit 4: Earth and Space Sciences: The Study of the Universe

**Time:** 27.5 hours

### Description

This unit is the culmination of the course, making students aware of the wonder and awe of God's creation. Students become aware of how scientific evidence and technological advances support the development of theories about our solar system and the universe. They have the opportunity to investigate the appearance and the motion of visible celestial objects. As a result of this unit, students evaluate how human endeavours and interest in space have contributed to our understanding of outer space, the Earth, and living things. Emphasis is placed on Canadian contributions to space explorations. Students reflect on the cost/benefit of space exploration as a societal issue. Is it ethical to spend money in this way when there is homeless and poor medical care for the poor of the Earth?

### Strand(s) and Expectations

**Ontario Catholic School Graduate Expectations:** CGE 1a,d,f,h,i; 2a,b,c,d,e; 3b,c,d,e,f; 4a,b,c,d,e,f,g,h; 5a,b,c,d,e,f,g; 7a,b,d,e,f,g,h,i,j.

**Strand(s):** Earth and Space

**Overall Expectations:** ESV.01, ESV.02, ESV.03.

**Specific Expectations:** ES1.01 to ES1.07, ES2.01 to ES2.10, ES3.01 to ES3.05.

## Strategies and Resources

### Instructional Strategies

Instructional strategies include the following:

Computer-based Learning - students use simulations and relevant computer programs to explore science problems

Brainstorming - group generation of initial ideas expressed without criticism or analysis

Case Study - investigation of real and simulated problems

Collaborative/Co-operative Learning - various small group learning techniques

---

Conferencing - student to student or student to teacher discussion  
Field Study - students perform investigations on locations beyond the school  
Independent Study - students explore and research a topic of interest  
Lab Based Inquiry - students perform investigations in the laboratory  
Report/Presentation - oral and written presentation of researched topic to class

### **Assessment Strategies**

The assessment plan includes the following:

Personal Communication

- journals/conferencing logs
- self-assessment
- student-teacher conferences

Paper and Pencil Tests

- unit tests (knowledge)
- mid-term and final exams

Observation

- formal/informal

Performance Assessment

- research project/essay
- model building assignment

Assessment tools include:

- checklists
- marking schemes
- rubrics
- anecdotal comments with suggestions for improvement

### **Main Resources**

The following resources are suggested to support teaching and learning:

#### Textbooks

Various approved textbooks that exist for the previous Grade 9 and 10 Science courses as well as those that exist for the Biology, Chemistry, and Physics courses should be consulted

#### Journals

*Crucible*

*The Science Teacher*

*Sky News: The Canadian Magazine of Astronomy and Stargazing*

and other relevant science journals

#### Videotapes

Various science series are available such as: *Bill Nye the Science Guy*, *World of Chemistry*, *National Geographic*, and TVO Series

#### Computer Software

Various computer software and Internet websites listed in the introduction to each unit

#### Models and Manipulatives

Microscopes, telescopes, batteries, multimeters, and assorted laboratory equipment

## Evaluation of Student Achievement

Assessment is the process of gathering information from a variety of sources that accurately reflects how well a student is achieving the curriculum expectations. In science these expectations include the Understanding of Basic Concepts which may be assessed for Knowledge and Understanding; the Developing Skills of Inquiry and Communication which may be assessed for Inquiry and Communication and Relating Science to Technology, Society, and the Environment which may be assessed for Making Connections.

Evaluation refers to the process of judging the quality of student work on the basis of established criteria, and then assigning a value to represent that quality. The value assigned is in the form of a percentage grade. According to Ministry Program Planning and Assessment Policy, 70% of the student's course grade is based on the assessments and evaluations conducted throughout the course and 30% is based on an examination, performance, essay, and/or other method of evaluation suitable to the course content and administered towards the end of the course. The assessment and evaluation in this academic science course reflects course emphasis on ideas, theories, and concepts. Each component should be evaluated for all four categories identified in the Achievement Chart, the relative value depending upon the emphasis in the unit as it was taught. The final mark may be calculated as follows:

<b>Term Assessment Weighting</b>	<b>70%</b>	<b>Final Assessment Weighting</b>	<b>30%</b>
Unit Tests <ul style="list-style-type: none"> <li>• Knowledge/Understanding</li> <li>• Inquiry</li> <li>• Communication</li> <li>• Making Connections</li> <li>•</li> </ul>	25%	Final Examination <ul style="list-style-type: none"> <li>• Knowledge/Understanding</li> <li>• Inquiry</li> <li>• Communication</li> <li>• Making Connections</li> <li>•</li> </ul>	20%
Unit Research Assignments <ul style="list-style-type: none"> <li>• Knowledge/Understanding</li> <li>• Inquiry</li> <li>• Communication</li> <li>• Making Connections</li> <li>•</li> </ul>	20%	Science World Activities <ul style="list-style-type: none"> <li>• Knowledge/Understanding</li> <li>• Inquiry</li> <li>• Communication</li> <li>• Making Connections</li> <li>•</li> </ul>	5%
Lab-Based Inquiry <ul style="list-style-type: none"> <li>• Knowledge/Understanding</li> <li>• Inquiry</li> <li>• Communication</li> <li>• Making Connections</li> </ul>	25%	Lab Practical <ul style="list-style-type: none"> <li>• Knowledge/Understanding</li> <li>• Inquiry</li> <li>• Communication</li> <li>• Making Connections</li> </ul>	5%

---

## **Additional Information**

### **Course Notes**

Science is an activity as much as it is an organized body of knowledge. It cannot be learned in any meaningful way by reading and discussion alone. The experimental nature of science is emphasized by providing ample opportunities for students to engage in safe, effective, laboratory activities in all units of the course. The health and safety of teachers and students must be of paramount importance when conducting laboratory activities. All must comply with the provisions of Workplace Hazardous Materials Information Systems (WHMIS) legislation and must practise established safe laboratory procedures.

Students are expected to use computer technology that has been developed for use in science. Computer-based simulations, multimedia applications, databases, and computer-assisted laboratory apparatus and learning modules should be used wherever appropriate to do so. Care must be taken, however, to ensure that computer-assisted laboratory programs are not used in situations where students' own technical skills should be developed. Whenever possible, students should be provided with opportunities to experience the world of science first-hand by participating in field trips and excursions.

### **OSS Policy Applications**

Teachers must consider the needs of exceptional students in planning the delivery of the science curriculum. Modifications to the program and/or to the environment may be necessary.

ESL/ELD students require science teachers to respond to their needs by providing support with respect to their comprehension and use of language in a scientific context.

Students can benefit from experience in science related activities in the workplace through Co-operative Education experiences. Students may consider a Co-operative Education experience after they have completed their first course in science.

### **Course Evaluation**

Course evaluation serves to guide teachers in adapting curriculum and instruction to students' needs and in assessing the overall effectiveness of programs and classroom practices.

Teachers should consider conducting evaluations at the end of each unit. Evaluations may be as simple as asking students to identify those activities they enjoyed and those that they didn't enjoy, and then asking for their suggestions for improvement or by providing students with a more detailed rating scale (1 to 5) for each of the activities of the unit. Teachers may refer to resources such as *Program Planning and Assessment, Making the Grade and Assessing for Success* for additional suggestions for course evaluations.

---

## Ontario Catholic School Graduate Expectations

The graduate is expected to be:

### **A Discerning Believer Formed in the Catholic Faith Community** who

- CGE1a** -illustrates a basic understanding of the **saving story** of our Christian faith;
- CGE1b** -participates in the **sacramental life** of the church and demonstrates an understanding of the centrality of the Eucharist to our Catholic story;
- CGE1c** -actively reflects on **God’s Word** as communicated through the Hebrew and Christian scriptures;
- CGE1d** -develops attitudes and values founded on Catholic **social teaching** and acts to promote social responsibility, human solidarity, and the common good;
- CGE1e** -speaks the **language of life** ... “recognizing that life is an unearned gift and that a person entrusted with life does not own it but that one is called to protect and cherish it.” (Witnesses to Faith)
- CGE1f** -seeks intimacy with God and celebrates **communion** with God, others and creation through prayer and worship;
- CGE1g** -understands that one’s purpose or **call in life** comes from God and strives to discern and live out this call throughout life’s journey;
- CGE1h** -respects the **faith traditions**, world religions and the life-journeys **of all people of good will**;
- CGE1i** -integrates faith with life;
- CGE1j** -recognizes that “sin, human weakness, conflict and forgiveness are part of the human journey” and that the cross, the ultimate sign of forgiveness is at the heart of **redemption**. (Witnesses to Faith)

### **An Effective Communicator** who

- CGE2a** -listens actively and critically to understand and learn in light of gospel values;
- CGE2b** -reads, understands and uses written materials effectively;
- CGE2c** -presents information and ideas clearly and honestly and with sensitivity to others;
- CGE2d** -writes and speaks fluently one or both of Canada’s official languages;
- CGE2e** -uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life.

### **A Reflective and Creative Thinker** who

- CGE3a** -recognizes there is more grace in our world than sin and that hope is essential in facing all challenges;
- CGE3b** -creates, adapts, evaluates new ideas in light of the common good;
- CGE3c** -thinks reflectively and creatively to evaluate situations and solve problems;
- CGE3d** -makes decisions in light of gospel values with an informed moral conscience;
- CGE3e** -adopts a holistic approach to life by integrating learning from various subject areas and experience;
- CGE3f** -examines, evaluates and applies knowledge of interdependent systems (physical, political, ethical, socio-economic and ecological) for the development of a just and compassionate society.

---

**A Self-Directed, Responsible, Life Long Learner** who

- CGE4a** -demonstrates a confident and positive sense of self and respect for the dignity and welfare of others;
- CGE4b** -demonstrates flexibility and adaptability;
- CGE4c** -takes initiative and demonstrates Christian leadership;
- CGE4d** -responds to, manages and constructively influences change in a discerning manner;
- CGE4e** -sets appropriate goals and priorities in school, work and personal life;
- CGE4f** -applies effective communication, decision-making, problem-solving, time and resource management skills;
- CGE4g** -examines and reflects on one's personal values, abilities and aspirations influencing life's choices and opportunities;
- CGE4h** -participates in leisure and fitness activities for a balanced and healthy lifestyle.

**A Collaborative Contributor** who

- CGE5a** -works effectively as an interdependent team member;
- CGE5b** -thinks critically about the meaning and purpose of work;
- CGE5c** -develops one's God-given potential and makes a meaningful contribution to society;
- CGE5d** -finds meaning, dignity, fulfillment and vocation in work which contributes to the common good;
- CGE5e** -respects the rights, responsibilities and contributions of self and others;
- CGE5f** -exercises Christian leadership in the achievement of individual and group goals;
- CGE5g** -achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others;
- CGE5h** -applies skills for employability, self-employment and entrepreneurship relative to Christian vocation.

**A Caring Family Member** who

- CGE6a** -relates to family members in a loving, compassionate and respectful manner;
- CGE6b** -recognizes human intimacy and sexuality as God given gifts, to be used as the creator intended;
- CGE6c** -values and honours the important role of the family in society;
- CGE6d** -values and nurtures opportunities for family prayer;
- CGE6e** -ministers to the family, school, parish, and wider community through service.

**A Responsible Citizen** who

- CGE7a** -acts morally and legally as a person formed in Catholic traditions;
- CGE7b** -accepts accountability for one's own actions;
- CGE7c** -seeks and grants forgiveness;
- CGE7d** -promotes the sacredness of life;
- CGE7e** -witnesses Catholic social teaching by promoting equality, democracy, and solidarity for a just, peaceful and compassionate society;
- CGE7f** -respects and affirms the diversity and interdependence of the world's peoples and cultures;
- CGE7g** -respects and understands the history, cultural heritage and pluralism of today's contemporary society;
- CGE7h** -exercises the rights and responsibilities of Canadian citizenship;
- CGE7i** -respects the environment and uses resources wisely;
- CGE7j** -contributes to the common good.

---

## Coded Expectations: Science, Academic Grade 9

### Chemistry: Atoms and Elements

#### Overall Expectations

**CHV.01**

- describe various models of the atom, the atomic structure of common elements, and their organization in the periodic table;

**CHV.02**

- investigate the physical and chemical properties of elements and compounds and use the periodic table to predict the properties of elements;

**CHV.03**

- describe technologies associated with the refinement, use, and recycling of chemical elements and compounds.

#### Specific Expectations

##### Understanding Basic Concepts

**CH1.01**

- explain the characteristics and utility of a scientific model;

**CH1.02**

- describe and explain the particle theory of matter;

**CH1.03**

- describe an element as a pure substance made up of one type of particle or atom with its own distinct properties;

**CH1.04**

- recognize compounds as pure substances which may be broken down into elements by chemical means;

**CH1.05**

- demonstrate an understanding of compounds and elements by describing them in terms of molecules and atoms;

**CH1.06**

- describe the evolution of models of the atom (e.g., from Dalton to Bohr);

**CH1.07**

- describe the Bohr-Rutherford model of atomic structure and apply it to atoms and their common ions to atomic number 20;

**CH1.08**

- 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);

**CH1.09**

- relate the Bohr-Rutherford atomic model to properties of elements and their positions in the periodic table;

**CH1.10**

- compare similarities in properties both between and within families of elements to similarities in their atomic structure (e.g., alkali metals, halogens, noble gases);

**CH1.11**

- use the periodic table to predict the physical and chemical characteristics of an element (e.g., predict that a metal such as sodium will be extremely reactive with a non-metal such as chlorine);

---

**CH1.12**

- identify and write the symbols for common elements and the formulae for common compounds (e.g., C, Cl, S, N; H<sub>2</sub>O, CO<sub>2</sub>, NaCl);

**CH1.13**

- solve density problems – given any two of mass, volume, and density, determine the third – using the formula  $D = M/V$  and appropriate SI units;

**CH1.14**

- describe, through observations, the evidence for chemical changes (e.g., changes in colour, production of a gas, formation of a precipitate, production or absorption of heat, production of light);

**CH1.15**

- identify, through their observations, the characteristic physical and chemical properties of common elements and compounds (e.g., aluminum is a good conductor of heat; magnesium reacts with oxygen to produce magnesium oxide).

**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; be aware of WHMIS guidelines and emergency procedures; be aware of proper handling and storage procedures);

**CH2.02**

- formulate scientific questions about physical and chemical properties of elements and compounds;

**CH2.03**

- demonstrate the skills required to plan and conduct an inquiry into the properties of elements and compounds, using instruments, tools, and apparatus safely, accurately, and effectively (e.g., investigate the reactions of some metals and some non-metals);

**CH2.04**

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

**CH2.05**

- gather and record qualitative and quantitative data using an appropriate format, and analyse the data to explain how the evidence gathered supports or refutes an initial hypothesis (e.g., conclude from data obtained from the electrolysis of water that the proportion of hydrogen to oxygen in water molecules is 2:1);

**CH2.06**

- communicate scientific ideas, procedures, results, and conclusions using appropriate SI units, language, and formats, and evaluate the processes used in planning, problem solving, decision making, and completing the task (e.g., use appropriate vocabulary such as substance, compound, element, atomic number, mass number);

**CH2.07**

- formulate definitions of major variables and other aspects of their investigations (e.g., define mass, electrons, protons, neutrons, ions, and isotopes);

**CH2.08**

- design and conduct experiments to determine the physical and chemical properties of everyday and common laboratory substances such as carbon, copper nitrate, starch, and wax (e.g., physical properties: colour, change of state, solubility; chemical properties: combustibility, reaction with water);

---

**CH2.09**

- use molecular models to illustrate the structure of simple molecules (e.g., H<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>O, NH<sub>3</sub>, CH<sub>4</sub>, CO<sub>2</sub>);

**CH2.10**

- use proper notation to represent elements, including their atomic number and mass number (e.g., represent the C-12 isotope, which has an atomic number of 6 and a mass number of 12, as <sup>12</sup>C).

**Relating Science to Technology, Society, and the Environment****CH3.01**

- describe the methods used to extract elements in Canada, and outline associated economic and environmental considerations (e.g., use various sources to explain how gold, nickel, carbon, or uranium is obtained and refined);

**CH3.02**

- compare the physical and chemical properties of elements to assess their potential uses and associated risks (e.g., hydrogen versus helium in balloons, copper versus aluminum in wiring, copper versus lead in plumbing);

**CH3.03**

- describe technologies that have depended on understanding atomic and molecular structure (e.g., television, X-rays, nuclear medicine, nuclear power, electron microscopy);

**CH3.04**

- investigate potential careers associated with an understanding of the physical and chemical properties of elements and compounds.

**Physics: The Characteristics of Electricity****Overall Expectations****PHV.01**

- describe and apply models of static and current electricity;

**PHV.02**

- design and conduct investigations into electrical circuits found in everyday life and into the quantitative relationships among current, potential difference, and resistance;

**PHV.03**

- evaluate the social, economic, and environmental costs and benefits arising from the methods of electrical energy production used in Canada.

**Specific Expectations****Understanding Basic Concepts****PH1.01**

- describe the properties of static electric charges, and explain electrostatic attraction and repulsion using scientific models of atomic structure;

**PH1.02**

- describe charging by contact and by induction;

**PH1.03**

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

**PH1.04**

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

---

**PH1.05**

- explain how electric current, potential difference, and electrical resistance are measured using an ammeter and a voltmeter;

**PH1.06**

- state the SI units of potential difference, electric current, electrical resistance, electrical energy, and power (e.g., volt, ampere, ohm, joule, watt, and kilowatt);

**PH1.07**

- describe the relationship among electrical resistance R, potential difference V, and current I;

**PH1.08**

- solve simple problems involving these quantities ( $V=IR$ );

**PH1.09**

- describe the potential difference and current characteristics in a series and a parallel circuit;

**PH1.10**

- compare the electrical resistance of a series and a parallel connection of identical resistors to that of a single resistor;

**PH1.11**

- determine quantitatively the percent efficiency of an electrical device that converts electrical energy to other forms of energy, using the relationship

$$\text{Percent Efficiency} = \text{Energy Output} / \text{Energy Input} \times 100$$

**PH1.12**

- describe the relationship among electrical energy transformed E, power P, and elapsed time  $\Delta t$ , and solve simple problems involving these physical quantities ( $E=P\Delta t$ );

**PH1.13**

- compare methods of producing electrical energy, including their advantages and disadvantages (e.g., voltaic cells; primary and secondary cells; photoelectric cells and thermocouples; hydro-electric and fossil-fuelled power; wind, and tidal power).

**Developing Skills of Inquiry and Communication****PH2.01**

- demonstrate knowledge of electrical safety procedures when planning and carrying out an inquiry and choosing and using materials, tools, and equipment;

**PH2.02**

- formulate scientific questions about electricity and restate them in a testable form, identifying the relationships among variables (e.g., “What is the relationship among the number of dry cells connected, in series or in parallel, the potential difference of the source, and the electric current that passes through a resistor?”);

**PH2.03**

- demonstrate the skills required to plan and conduct an inquiry into electricity, using instruments, tools, and apparatus safely, accurately, and effectively (e.g., use an ammeter and a voltmeter to measure current and potential difference in a circuit);

**PH2.04**

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

**PH2.05**

- gather and record qualitative and quantitative data using an appropriate format, and analyse the data to explain how the evidence gathered supports or refutes an initial hypothesis (e.g., explain the variations in the monthly costs of electrical energy);

---

**PH2.06**

- communicate ideas, procedures, results, and conclusions using appropriate SI units, language, and formats, and evaluate the processes used in planning, problem solving, decision making, and completing the task;

**PH2.07**

- design, draw, and construct series and parallel circuits for a given purpose, and measure current, potential difference, and resistance at various points in the circuit, using appropriate instruments and SI units (e.g., design and construct a circuit used to enable one of several light bulbs to be switched on and off independently of the others);

**PH2.08**

- formulate operational definitions for physical quantities involved in electricity (e.g., potential difference, current, resistance, electrical energy, and power);

**PH2.09**

- charge an electroscope by contact and by induction;

**PH2.10**

- predict, verify, and explain the effect of a nearby charged object on a charged electroscope;

**PH2.11**

- use appropriate instruments and techniques to investigate potential difference against current for an ohmic resistor in a simple series circuit, graph the data, and determine resistance from the slope of the graph.

**Relating Science to Technology, Society, and the Environment****PH3.01**

- explain practical applications of static and current electricity (e.g., an air cleaner, an electrostatic paint sprayer);

**PH3.02**

- devise a plan for a self-contained system to generate energy, using renewable energy sources, to meet the energy requirements of a dwelling, farm, or community in Ontario (e.g., design a plan to use any combination of wind, solar, or hydroelectric power);

**PH3.03**

- identify problems related to electrostatic charge in everyday situations and evaluate solutions (e.g., use of static straps to reduce charge build-up in automobiles; use of electrostatic precipitators to decrease pollution; use of lightning rods to protect buildings).