Course Profile

Science

Grade 9
Applied

• *for teachers by teachers*

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Acknowledgments

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Unit #1: Chemistry: Exploring Matter

Time: 27.5 hours

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Development Date: Mar 1, 1999.

Unit Description

This unit enables students to understand the basic concepts of chemistry, develop practical skills in scientific investigations, enhance their communication/research skills and apply their knowledge of chemistry to everyday situations within a context enriched by the Catholic Faith culture. Students will design and conduct investigations into practical problems related to matter and its properties. In researching career and job opportunities, students will gain a new respect for the dignity of work and gain knowledge on ways to contribute to the betterment of society.

Strand(s) & Expectations

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

Strand: Chemistry

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

Specific Expectations: CH1.01 to CH1.09, CH2.01 to CH2.10, CH3.01 to CH3.04

Activity Titles (Time + Sequence)

Activity 1	Introduction to Lab Safety	110 min
Activity 2	Matter and its Properties	225 min
Activity 3	Chemical and Physical Changes	300 min
Activity 4	Elements and Compounds	450 min
Activity 5	Classification of Metal and Non-Metals	340 min
Activity 6	The Periodic Table and the Atom	225 min

Unit Planning Notes

It is assumed that Chemistry: Exploring Matter will be the first unit taught in SNC1P. Consequently, take the time necessary to firmly establish the routines of your classroom. Also use this unit to assess the academic strengths and learning styles of your students. It may be necessary to review or teach material given in "Prior Knowledge Required" prior to proceeding with a given activity. Review site-specific safety procedures, lab routines, and waste disposal procedures prior to starting the course. Teachers should help students become aware of the Catholic perspective on the role of work in a person's life as well as the role of humans in the environment as stewards of the world's resources. Appendix C (A Catholic Perspective on the Applications of Science: Guiding Principles) also provides some guidance with respect to these roles. Alternatively, this aspect of the unit could be organized into a guided research activity with appropriate teacher/student conferencing. Teachers should also identify instances where students may engage in scientific inquiry/experience that students could include in their "Science World" portfolio (Appendix B)

Prior Knowledge Required

Students studied the three states of matter and changes of state in Grade 5. At that time, they also compared samples of matter using physical properties such as texture, hardness, strength, buoyancy, solubility, and flexibility. In grades 7, the particle theory of matter and separation of substances was studied. In grade 8, students studied the physical properties of fluids.

Teaching/Learning Strategies

The focus of this unit is the practical application of the properties of matter to everyday situations. The activities have been structured so as to accommodate students of varying abilities and learning styles.

Assessment/Evaluation

In this unit, student achievement of the expectations is evaluated based on a variety of assessments, tools and strategies. Assessment strategies used include: teacher-student conferences, formal teacher observations, roving conferences, peer conferences, self and peer assessment, pen and paper assessment, student logs, and wrap-up activities. Sample rubrics and a collaborative group skills rating scale have been included for the science process, lab product, and generic product which may be adapted by teachers to assess and evaluate students. Appendix A3 was intended to be a framework from which teachers could develop specific rubrics to assess research projects and not to be used "as is". In addition up to one period may be allotted for summative evaluation. The teacher may wish to evaluate students through the use of pencil/paper test, a culminating project, a laboratory activity design/practicum and/or extension essay.

Resources

Print

TESS. Teacher's Experiment Safety Sheets. (STAO Safety Committee)

Candido et al. Heath Science Connections 9. Toronto: D.C. Heath, 1987.

Ritter et al. Nelson: Science 9, Toronto: ITP, 1995.

Chemmatters American Chemical Society.

Maton et al. Matter Building Blocks of the Universe. New Jersey: Prentice Hall, 1994.

Donovan et al. Chemicals in Action. 2nd ed. Toronto: Holt, Rinehart and Winston, 1995.

Alyea, H.N. and Dutton, F.B. "Tested Demonstrations in Chemistry". Journal of Chemical Education Circulation Services. (1965).

Summerlin, Lee R. and Ealy, James L. Jr.Chemical Demonstrations: A Sourcebook for teachers 1 and 2. Washington: American Chemical Society.

Humphreys, David A. Demonstrating Chemistry Hamilton: McMaster University Chemistry Department, 1983.

Scripture:

Psalms: 19: 2 - 7
29: 3 - 9
104: 1 - 35
148: 1 - 10

Romans: 1: 20
Col: 1: 15 - 17

Catechism of the Catholic Church
Section 337
339
340
341
344

Computer Software:

Microsoft Encarta 98 CD-ROM
1998 Canadian Encyclopedia CD-ROM, McClelland & Stewart.
The Way Things Work CD-ROM, Dorling Kindersley.
Electric Chemistry Building

Videotapes

Bill Nye: The Science Guy Series, Magic Lantern (10 Meteor Drive, Toronto,) 800-263-1717

World of Chemistry Series, Magic Lantern (10 Meteor Drive, Toronto, M9W 1A4) 800-263-1717

Chemical Change. ITP Nelson

Taming the Demon Ore (INCO)

Mining Nickel (INCO)

STAO Lab Safety Video.

Befriending the Earth: Dream of Earth Sciences Series. Thomas Berry in dialogue with Thomas Clarke. Twenty Third Publications. 1990; 13 part series of videos. Mystic Conn.

Environmental Ethics: Ideas for Classrooms Discussion. Durango Col. Group for Telly Productions, 194.

Activity #1: Introduction to Lab Safety and Procedures

Time: 110 minutes

Description

This activity is an orientation to WHMIS and the lab safety skills and procedures required to function safely and effectively in the lab/classroom.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:

The graduate is expected to be: 2b; 5a; 7b, i

Strand: Chemistry

Overall Expectations

At the end of Grade 9, students will: CHV.02

Specific Expectations

Students will: CH2.01 ☆, CH3.04 ☆

Planning Notes

- It is recommended that this activity be completed prior to the first lab activity in the course.
- The procedures established in this unit should be consistent with specific school and Board policies.
- Book the school's camcorder if required.

Prior Knowledge Required

Students should have some familiarity with hazardous household products symbols and WHMIS symbols.

Teaching/Learning Strategies

1. Students are introduced to safety equipment and lab safety procedures, using AV or text resources. Student-produced safety videos, if available, can be far more interesting than those commercially available.
   - Small lab groups can videotape themselves conducting experiments which incorporate the safety routines and hazards encountered on site. These could be prepared later in the course as part of a year-end project or as a fun activity to do during the last few days of the school year. **(Possible Science World Idea)**

2. Students will identify hazardous materials associated with specific careers.
   - Students will consult a variety of sources to identify hazardous materials and other potential risks associated with a career of their choice, e.g., solvents used in hair salons, body fluids in medical and dental environments, poor air quality in offices.
   - Students will reflect on and understand the ethical imperative of safe working conditions
   - Students present their findings. This may be done in a variety of formats.

3. Students will examine product labeling systems and recognize the need for standardized labels.
   - The teacher provides samples of hazardous household and workplace products. Students will compare and contrast the two labeling systems by using a chart. The labels will be evaluated for use and effectiveness. Students may be asked to:
     (a) Identify the active ingredient in each product with teacher assistance.

(b) Evaluate the product use instructions. (e.g. Are the instructions clear? Do they list the safety precautions clearly?)
(c) The teacher should review the WHMIS labels which the students will most likely encounter in the lab/classroom. The importance of standardizing the labeling used in the workplace should be stressed.
(d) Students will identify the sites available in their area for the safe disposal of hazardous and harmful products. Students could also be encouraged to visit some of these sites and write a report.

Assessment/Evaluation

- Students will collaborate to produce a Safety Video. This will be assessed for knowledge/understanding and communication through the use of a product rubric (Appendix A3) (CH2.01)
- A safety mastery quiz will be given to assess the knowledge/understanding of safety procedures, terms and the use of WHMIS labels. The teacher may insist on a mastery of safety procedures before students participate in activities. Consider issuing an official lab certificate or "license" for students achieving mastery. (CH2.01)
- Students will submit a product label observation chart and their own product label. These will be assessed for knowledge/understanding, inquiry and communication through a product rubric. (Appendix A3) (CH3.04)

Resources

1. STAO Lab Safety Video.
2. TESS. Teacher's Experiment Safety Sheets. (STAO Safety Committee)

Accommodations

1. Where the student has an individual educational plan (IEP), this activity will be modified to meet the student's needs as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means while written English is developing (spoken English, direct demonstration and pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom and laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in all group and individual activities.
4. For the purpose of providing extensions and enrichment, students will have opportunities to investigate the topics presented here in greater detail. Close collaboration between teacher and student is required to ensure appropriate enrichment opportunities. In this particular activity students may develop a commercial for a Bill Nye: The Science Guy episode which "sells" the importance of a standardized workplace labeling system such as WHMIS.

Activity #2: Matter and Its Properties

Time: 225 minutes

Description

Students will learn about physical and chemical properties through observation and experimentation. These properties will be used to describe and identify common substances. Students will appreciate that the everyday use of these materials is a result of their chemical and physical properties.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:

The graduate is expected to be:

- 2b,c,d,e; 3b,c,f; 4f; 5a; 7b,i,j

Strand: Chemistry

Overall Expectations

At the end of Grade 9, students will:

- CHV.02

Specific Expectations

Students will:

- CH2.01 ☆, CH2.02 ☆, CH2.03 ☆, CH2.04 ☆, CH2.05 ☆, CH2.09 ☆, CH3.03 ☆

Planning Notes

- Review lab safety, consistent with your school board policy
- Test demos ahead of time
- Remind students of the ethical use of the Internet and other information technology sources.
- Check that the batteries for student conductivity testers are fully charged.

Prior Knowledge Required

- Matter is classified as homogeneous or heterogeneous.
- Matter exists in three physical states.

Teaching/Learning Strategies

1. Students will examine the physical properties of various substances.
   - The teacher will provide students with samples of materials which illustrate physical properties of matter such as: colour, odour, clarity, lustre, texture, hardness, brittleness, malleability, ductility, viscosity, electrical conductivity.
   - Students are instructed to define, with the assistance of their texts, the physical properties given above.
   - Students will prepare individual data tables using the headings: sample of matter(#), physical state, description of physical properties, identity of substance
   - Students examine the materials and record observations on their data sheet. Students will submit their lab report.

2. Students will determine the melting point of Lauric Acid.
   - Lauric acid is a white powdery substance with a relatively low melting point. Provide students with a test tube containing lauric acid, a thermometer, and a beaker of water at about 55%C. Students determine the melting point of the lauric acid. Stress that melting point is one method of determining the identity and sometimes the degree of purity of a substance.

Sample student procedure:

1. Place a test tube filled to a depth of 1-2 cm with lauric acid into the water bath and allow the lauric acid to melt.
2. Add the thermometer to the test tube.
3. Remove the test tube from the water bath and allow it to cool.
4. Observe the temperature at which the lauric acid solidifies.

Teacher Notes:

- One kettle will supply sufficient warm water for the entire class.
- It is not necessary to remove the lauric acid from the test tube. The test tubes can be stored for long periods of time and reused.
- Lauric acid has a melting point of 44%C.

3. Students will observe other physical properties of substances through student activity or teacher demonstration.
   - The physical properties studied are the:

   a) differences in electrical conductivity between sodium chloride crystals and a solution of sodium chloride
   b) differences in density and solubility illustrated by adding coloured drink crystals to an oil/water mixture

4. Students will determine the effective uses of a substance based on its physical and chemical properties.

- Students will observe through teacher demonstration or student activity the physical and chemical properties of magnesium such as malleability, reaction with acid, and combustibility.
- With teacher direction, students will discuss how the chemical and physical properties of a substance affect its use, e.g., the inflation of an automobile air bag by the detonation of sodium azide, the use of helium instead of hydrogen in airships (blimps).
- Students will select and integrate, from a variety of sources, information to describe the chemical and physical properties of a substance with unusual chemical and physical properties. Possible substances include: “glow in the dark” inks, fireworks, alternative fuels, memory metals, and crazy glue. Students will present their findings . This may be done as: posters, whole class presentations, or jigsaw format sharing among groups.

Assessment/Evaluation

- Use of roving conference to ensure students use proper laboratory technique and safety procedures and that observations are recorded. The teachers will record this with appropriate checklists and/or rating scales prepared in advance. (CH2.09)
- A paper and pencil quiz will be used to assess the student’s knowledge/understanding of physical and chemical properties.(CH2.09)
- Use of roving conference to ensure that the student melting point procedure (lauric acid) is feasible and safe. The teacher will use an appropriate checklist prepared in advance (CH2.01, CH2.04, CH2.09)
- The student integrates knowledge, skills and a co-operative attitude through the preparation, performance and reporting lab inquiries. The teacher can adapt the process rubric (Appendix A1) and the lab product rubric (Appendix A2) to assess and evaluate process and product. (CH2.09, CH2.01, CH2.04)
- Students will produce a poster or present information on unusual properties of substances, These will be assessed for knowledge/understanding, inquiry,communications and making connections through the use of a product rubric (Appendix A3). (CH2.02, CH2.09, CH3.03)

Resources

1. Heath Science Connections 9
2. Internet
3. Prentice Hall, Matter
4. "Airbags Chemical Reaction Saves Lives" Chemmatters magazine February 1997
5. Chemistry demonstration CDROMs or laserdisks
6. Alyea, H.N. and Dutton, F.B.Tested Demonstrations in Chemistry, Journal of Chemical Education Circulation Services (New York, 1965)
7. Summerlin, Lee R. and Ealy, James L. Jr. Chemical Demonstrations: A Sourcebook for teachers 1 and 2, American Chemical Society (Washington)
8. Humphreys, David A. Demonstrating Chemistry, McMaster University Chemistry Department (Hamilton, 1983).

Accommodations

1. Where the student has an individual educational plan, IEP, this activity will be modified to meet the student's needs as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means while written English is developing (spoken English, direct demonstration and pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom and laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in all group and individual activities.
4. For the purpose of providing extensions and enrichment, students will have opportunities to investigate the topics presented here in greater detail. Close collaboration between teacher and student is required to ensure appropriate enrichment opportunities. In this particular activity students may do the following:
   - The mineral known as fool's gold is very similar in appearance to real gold. Students will research how geologists distinguish fool's gold from real gold.
   - Challenge students to build a conductivity apparatus by soldering together an LED, 1 kiloohm resistor, a 9V battery and connecting wires. One conductivity apparatus can be built for less than $6. **(Possible Science World Idea)**
   - A computer-based temperature probe can be used to monitor the temperature changes occurring as liquid lauric acid cools and solidifies. **(Possible Science World Idea)**

Activity #3: Chemical and Physical Changes

Time: 300 minutes

Description

Students will use observations to distinguish between chemical and physical changes. They will also select a suitable chemical change to propel a toy boat of their own design and compare the operation of their boat with that of the internal combustion engine. Students will also question the ethics of industrial processes that are potentially harmful to humans or the environment.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:

The graduate is expected to be:

- 1d; 3b, c, d, f; 4a, b, c, f, g; 7i

Strand: Chemistry

Overall Expectations
At the end of Grade 9, students will:
- CHV.02

Specific Expectations
Students will:
- CH1.08 ☆, CH2.01 ☆, CH2.02 ☆, CH2.03 ☆

Planning Notes

- Prepare/order the materials for the demonstrations and experiments.
- Test all demonstrations prior to class.
- Consult with your library personnel to determine what research materials are available.
- Remind students of the ethical use of the Internet and other information technology sources.

Prior Knowledge Required

Students should be able to:
- identify a substance as being potentially hazardous from its product label.
- use appropriate vocabulary when describing matter, e.g., texture, hardness, strength, viscosity, density, buoyancy, solubility and flexibility

Teaching/Learning Strategies

1. Students will identify changes as physical or chemical.
- The teacher will create a series of lab stations at which students can conduct mini-experiments that produce chemical or physical changes. Students are directed to use their observations to generalize indications that a chemical change has occurred, i.e., changes in colour or odour, formation of a gas or precipitate, change in temperature, energy change.

2. Students will design a boat that uses a chemical change to propel it the length of a trough (i.e., wall paper trough or wider). Students are encouraged to experiment with the design of their boats and ratios of chemicals. Potential propulsion agents include: vinegar and baking soda, alka-seltzer and water. **Do not allow the use of conventional batteries and combustion sources**. Consider conducting a boat race in a highly visible location in your school.

3. Students will identify the chemical and physical changes required to move the piston of an automobile engine and note any similarities to their boats.
   - The reaction of baking soda and vinegar propels a boat by the rapid release of compressed gas. Compressed combustion gases are used to move the pistons of the four-stroke internal combustion engine. "The Way it Works" CD-ROM provides a description of the automobile engine as well as an animated sequence of the operation of a piston. Students will identify the chemical and physical changes required to move the piston and note any similarities to their boats.

4. Students will debate whether it is ethical to support the production of a substance which, potentially, could be unsafe to humans or harmful to the environment. Students should consider the Catholic perspective when formulating their arguments. (Appendix C1-C3)
   - The teacher will present the following information to the students:
     In the late nineteenth century Albert Nobel invented dynamite, an explosive considerably more powerful than any other developed to that point in human history. Although Nobel had not developed dynamite for military applications, its destructive forces were unleashed shortly after its discovery in the Franco-Prussian War. In 1945, after atom bombs were dropped on Japan, Albert Einstein noted that physicists were in a situation similar to that in which Nobel found himself. Einstein claimed that “To atone for this 'accomplishment' and to relieve his conscience, he (Nobel) instituted his award for the promotion of peace”.

- Source: Nobel web site: www.nobel.se/alfred/tagil/index.html
- Students will use this information to formulate a question which they will debate. The teacher may give other examples for possible debate.

Assessment/Evaluation

- Use of roving conference to ensure students use proper laboratory techniques and safety procedures and that observations on physical and chemical changes are recorded. The teacher will record this with appropriate checklists and/or rating scales. (CH1.08, CH2.01, CH2.02)
- A paper and pencil quiz will be used to assess the student's knowledge/understanding of physical and chemical changes. (CH1.08)
- Students, through collaboration, will design, build and test their boats. These will be assessed for knowledge/understanding/inquiry and communications through the use of a product rubric (Appendix A3). Self evaluation/Peer evaluation and collaboration skills may be evaluated through the use of a collaborative rubric. (Appendix A4) (CH2.02)
- Students will debate on the ethical production of substances. These will be assessed for knowledge/understanding/communication and making connections through the use of a rubric prepared in advance by the teacher. (CH2.03)

Resources

1. Bill Nye - Chemical Reactions Video
2. The Way it Works CD-ROM
3. Nobel Society Website www.nobel.se
4. A Catholic Perspective on the Applications of Science-Guiding Principles
5. The Riverview Public Hearing, Nelson 9, p.194

Accommodations

1. Where the student has an individual educational plan, IEP, this activity will be modified to meet the student's needs as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means while written English is developing (spoken English, direct demonstration and pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom and laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in all group and individual activities.
4. For the purpose of providing extensions and enrichment, students will have opportunities to investigate the topics presented here in greater detail. Close collaboration between teacher and student is required to ensure appropriate enrichment opportunities. In this particular activity students may:
   - conduct further research into the lives of Nobel and Einstein.
   - research and present the chemical changes responsible for the air pollution generated by automobiles.
   - research and report on alternatives to the internal combustion engine currently under development such as the fuel cell system developed by Canada's Ballard Power Systems. **(Possible Science World Idea)**
   - develop a vehicle powered by an electrochemical or solar source. This project can be used as a link between the chemistry and electricity units. **(Possible Science World Idea)**

Activity #4: Elements and Compounds

Time: 450 minutes

Description

Students will recognize that elements and compounds have distinct properties through the examination of various elements and compounds and through the demonstration of synthesis (addition) and decomposition reactions. They will also identify the element chemical symbols using the Periodic Table and they will be able to describe compounds in terms of their element composition. Students will also construct models of simple molecules.

Strand(s) and Expectations:

Ontario Catholic School Graduate Expectations:

The graduate is expected to be: 1d; 2a, b, c, d, e; 3b, c, e, f, g; 4a,b,c,e,f,g;5a, b, c, d, e, f;g,h; 7a, b, d, h, i, j

Strand: Chemistry

Overall Expectations

At the end of grade 9, students will: CHV.01, CHV.03

Specific Expectations

Students will: CH1.01 ☆, CH1.02 ☆, CH1.03 ☆, CH1.07 ☆, CH2.01 ☆, CH2.03 ☆, CH2.04 ☆, CH2.05 ☆, CH2.06 ☆, CH2.08 ☆, CH2.10 ☆, CH3.01 ☆, CH3.04 ☆

Planning Notes

- Provide element samples in clear, labeled vials (consult your department safety policies to see which elements are appropriate to include and which should be omitted).
- Keep construction of molecular models of molecules simple; explanation of geometric structures, orbitals and bonding should **NOT** be included.
- Give students access to a simple periodic table containing the element name, symbol and atomic number.
- The procedures for the electrolysis of water and the combination reactions of magnesium metal and oxygen are readily available in most science and chemistry text or laboratory manuals; make sure to perform these tests before showing students.
- Book time in the career education centre or with a councillor.
- The ethical use of the Internet and other information technology sources must be stressed to students and if possible monitored by teachers.

Prior Knowledge Required

The student should be able to:

- compare the three states of matter .
- use physical properties such as colour, hardness, texture, brittleness to describe matter .
- demonstrate an understanding of the characteristics of mechanical mixtures (heterogeneous) and solutions (homogeneous) and describe these characteristics using the particle theory.
- distinguish between pure substances and mixtures using the particle theory.
- identify the gas tests for hydrogen and oxygen gas.

Teaching/Learning Strategies

1. Students will classify pure substances as elements or compounds. The teacher should provide students with plenty of samples of different types of elements and compounds for examination.

If this is not possible, teachers can supplement with various forms of media. Teachers need to stress the importance of elements and compounds in our daily lives.

- Students are grouped in pairs. Each pair of students will examine and group various substances as elements or compounds using criteria collaboratively generated. They will be instructed to generate a hypothesis/problem and an observation table.
- The student will perform various experiments to show that compounds can be broken down chemically into its elements or that elements combine to produce compounds.
  (a) the combination (addition reaction) of magnesium and oxygen gas (remember to advise students not to look directly into the white flame); iron and oxygen; carbon/charcoal and oxygen
  (b) the electrolysis of water (have students recall the gas tests for hydrogen and oxygen gas)
- Students re-examine their lists of elements and compounds using the observations and discussions based on the demonstrations. These discussions may be done in pairs, whole class or in small groups. Students adjust their lists accordingly and are instructed to submit their results.

2. Students discover that most substances found in homes are compounds and that very few are pure elements, but that these elements are necessary for the formation of these compounds
   - Students are asked to survey the products found in their homes.
   - They are to examine the product label and identify the elements or compounds used in the product. (e.g. baking soda = sodium bicarbonate, a compound; vinegar = acetic acid, a compound; rubbing alcohol = isopropanol, a compound)
   - An observation chart set by the teacher or one designed by the students should be used to record information. The observation chart may include the following: Product name, Natural ingredients, Added Ingredients, Identification of the added ingredients as an element, compound or mixture, safety precautions and instructions for proper use of product. Some discussion may be needed to help students understand the difference between natural ingredients and added ingredients. It is also best to have students include a photocopy/hand drawn facsimile of the product label or submit the original product label with their observation chart.
   - Students should be directed to discuss (orally and/or written form) the following questions:
     (a) What were the proper uses of some of these products or the hazards of these products (e.g. mixing bleach with cleanser produces a highly toxic gas, drain cleaners are corrosive)? The teacher may need to assist students with this question.
     (b) Was the information on the labels listed clearly?
     (c) Was there information that was difficult to classify as natural ingredients, elements or compounds? Give examples of this.
     (d) Besides natural ingredients, were most of the other "added" ingredients elements or compounds? Give reasons why.
     (e) Should labels list all ingredients? Why?
     (f) Were the ingredients listed in words that most people could easily recognize? What difficulties could arise if the ingredients are not easily recognized?
     (g) What was/were the most common type of safety precautions listed on the labels?
   - Students are to submit the laboratory report. An extension to this activity may be to have students design a product label that they feel would give information more clearly . The student may choose a product that he/she has already chosen or chose any other product. They should indicate clearly the changes they would make to the product label and why. The product labels may be included with the report. Students may also discuss their product label in small/large groups and/or display them in the classroom.

3. Students will research careers requiring knowledge of the physical and chemical properties of elements and compounds.(e.g. Product quality control technician, Medical technician, Chemical Engineer)

- Students are asked to brainstorm in small groups various careers that they feel require the knowledge of physical and chemical properties of elements and compounds.
- Students share information. The teacher may wish to record the information on the board.
- Students are asked to choose a career that interests them and research using computer programs, career education center, Internet, media, guest speakers, etc.. The ethical use of the Internet and other information technology must be stressed and, if possible, monitored by the teacher.
- Students are to present their research. This can be done in a variety of ways, such as, a written report, pamphlet, poster, homemade video, skit, and/or a verbal report. The report may include the following information:
  (a) Why did you choose the career?
  (b) What knowledge of physical and chemical properties of elements and compounds impacts greatly on performing the jobs designated by the career?
  (c) What responsibilities or jobs will you have in this career?
  (d) How does this career contribute to the betterment of society? (Appendix C1-C3)
  (e) What are some of the ethical challenges connected with this career? (Human rights; environmental issues)
- If possible, this part of the activity should be connected to "Take Your Kids to Work" program or any local work program organization.

4. Students will describe elements as substances made up of atoms and compounds as substances made up of molecules. They will recognize that atoms and molecules maintain their own distinct properties.
   - Using the periodic table, students will identify chemical symbols for the first twenty elements and the following: iron (Fe) and copper (Cu) and formulae for sodium chloride (table salt) (NaCl), oxygen gas (O_2), water (H_2O), and carbon dioxide (CO_2). With direction from the teacher, the students will discover that the chemical symbols are either a capital letter or a capital letter followed by a lower case letter and that all chemical symbols are unique to the element.
   - Students may complete worksheets, puzzles, word searches, and/or play "Element " cards or bingo to show mastery of naming elements and their symbols. At least one of these vehicles will be used as a formative assessment by the teacher. (Element Card Game: teacher or students makes up a "deck" of cards. Each deck will have the following information: on one side of the card, the element symbol, and on the other side, the element name . The game may be played as solo or pair "flash cards". To increase difficulty, clues based on the element properties can be substituted for the element name.)
   - Through the use of models of various molecules and their formulas, students will discover that the formula shows exactly which elements make up the compound and that the subscripts used within a formula indicates the number of each of the elements. (e.g. H_2O = 2 hydrogen atoms and 1 oxygen atom). Students work on various examples.
   - Students will make models of common molecules (e.g., H_2, O_2, NH_3, CH_4, and CO_2) A variety of materials can be used if molecular modeling kits are not available. These include: plasticine, nuts and bolts, toothpicks and marshmallows, and styrofoam balls and dowels . It is important that the teacher keep this activity simple by supplying very simple rules for building molecules. Students will show mastery in building models to be assessed by the teacher and peers.
   - Students design and build a "board game" or any other form of game to examine and/or become proficient in elements. The student will "test" their game with the class or group of students. The game will then be evaluated by their peers and recommendations for improvement are implemented. To further this, students may design a marketing strategy to promote their game. **(Possible Science World Activity)**

Assessment/Evaluation

- Use of roving conference to ensure students are using proper laboratory technique and safety procedures and that observations and classification of pure substances are recorded. The teacher will record this using appropriate checklists and/or rating scales prepared in advance. (CH1.02, CH1.03, CH2.01, CH2.04, CH2.08)
- Students will submit a lab report and observations on classification of pure substances. These will be used to assess knowledge/understanding/inquiry and communications through the use of a process rubric (Appendix A1) and lab product rubric (Appendix A2). (CH1.01, CH1.02, CH1.03, CH2.02, CH2.06, CH2.08, CH3.01)
- Students will submit a product label examination chart and product label design. These will be used to assess knowledge/understanding, inquiry, communication and making connections through the use of a product rubric (Appendix A3). (CH1.03, CH2.02, CH2.05, CH5.01)
- Students will produce a career report, video or other products through collaboration (Appendix A4). This will be used to assess knowledge/understanding, communication and making connections through the use of a product rubric (Appendix A3). (CH2.05, CH3.04)
- Students will produce Molecule models. These will be used to assess knowledge/understanding and inquiry, through the use of a product rubric (Appendix A3). (CH1.03, CH1.07, 2.01, CH2.08)
- Students produce a board game for elements. These games will be assessed for knowledge/understanding/communication and making connections through the use of a product rubric (Appendix A3) making provisions for creativity and originality. (CH1.03, CH1.07, CH2.04, CH2.05, CH2.08)
- A paper/pencil test will be used to assess knowledge/understanding and communication. (CHI.01, CH1.02, CH1.03, CH1.07, CH2.08, CH2.10, CH3.01).

Resources

1. Electrochemistry Building- Computer software
2. Alchem Chemistry Exercise Book. Compounds, Bonding and Nomenclature, Molecular Models, LabB1. J.M.LeBel Enterprises Ltd.@1987
3. Candido, James and Phillips. Electrolysis of Water, pp.142-143. Heath Science Connections 9.D.C.Heath Canada Ltd.@1987
4. Rosen, S. Chemistry Workshop 1. Globe Book Company Inc. Englewood Cliffs, New Jersey. @1988
5. Nelson Science 9. Nelson Canada. @1996
6. A Catholic Perspective on the Applications of Science Guiding Principles.

Accommodations

1. Where the student has an individual educational plan, IEP, this activity will be modified to meet the student's needs as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means while written English is developing (spoken English, direct demonstration and pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom and laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in all group and individual activities.
4. For the purpose of providing extensions and enrichment, students will have opportunities to investigate the topics presented here in greater detail. Close collaboration between teacher and student is required to ensure appropriate enrichment opportunities.

Activity #5: Classification of Metals and Nonmetals

Time: 340 minutes

Description

The Periodic Table is an organized table of elements that allows users to identify information quickly and easily. Students will classify elements as metals or nonmetals, recognize that the majority of elements are metals, and realize that metals are located on the left side of the Table while most nonmetals tend to be on the right.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:

The graduate is expected to be: 1d; 2a, b, c, d, e; 3b, c, d, e, f; 4a, b, c, e, f, g; 5a, b, c, d, e, f, g, h; 7a, b, d, h, i, j

Strand: Chemistry

Overall Expectation

At the end of Grade 9, students will: CHV.01, CHV.03

Specific Expectations

Students will: CH1.09 ☆, CH2.01 ☆, CH2.02 ☆, CH2.03 ☆, CH2.04 ☆, CH2.05 ☆, CH2.06 ☆ CH2.07 ☆ CH3.02 ☆.

Planning Notes

- Provide a variety of metals and nonmetals (consult your department safety policies to see which elements are appropriate to include and which should be omitted).
- Students should have access to blank periodic tables where information on various elements can be placed by the student.
- All laboratory activities suggested can be readily found in most science and chemistry text or laboratory manuals; make sure to perform these tests before showing students.
- It is suggested that laboratory tests comparing magnesium and calcium be done only by the teacher.
- Book time for computer use in library and/or computer labs.
- Obtain a class set of atlases or other geographical sources to use when introducing mining of metals.
- The ethical use of the Internet and other information technology sources must be stressed to students and if possible monitored by the teacher.
- The teacher should ensure that various vehicles for student presentation of work are employed throughout this activity .

Prior Knowledge Required

- The student should be able to describe substances as elements or compounds.
- The student should be able to identify and write symbols for elements.

Teaching/Learning Strategies

1. Students classify a variety of elements as metallic or nonmetallic based on qualitative tests, teacher demonstrations and information gathered through other sources such as books, illustrated element chart, Internet, multimedia. The ethical use of the Internet and of other technology sources must be stressed to students and if possible monitored by the teacher. The properties that may be examined are appearance, electrical conductivity, heat conductivity, melting point, lustre and hardness. The teacher should provide students with plenty of examples of both metals and nonmetals. Teachers need to stress to students that the properties they are observing dictate the uses of those elements.
   - Students examine various metals and nonmetals. Using the properties tested, they will classify substances as metals or nonmetals.
   - Students will input the qualitative properties observed onto a periodic table. The students will be directed to design their own data table.
   - Students will submit completed data table (Periodic table).

2. Students examine some of the metals mined in Canada and how they are extracted from their ores. They will also examine the importance of these metals to the Canadian economy and the impact of the industry on society and the environment.
   - Students will research and list the metals mined in Canada and their locations using atlases or other geographical sources supplied by the teacher. The list of metals and their locations are shared with the class.
   - Students are placed in small groups or in pairs and instructed to research one of the metals. The metal may be chosen by the group or by the teacher. Their research should include:
     (a) Where is the metal mined in Canada?
     (b) What main process is used to extract the metal from its ore? (e.g. crushing, separation, roasting, smelting)
     (c) Detail the process of extraction. (e.g. List each of the steps involved in extracting nickel and state whether they are physical or chemical changes. Explain your choice in each case.)
     (d) There are generally two classes of mines, open-pit and underground. How do these mines differ?

     Students should be encouraged to include other information they find interesting to the topic.
   - Through student-teacher conferencing, information gathered by the groups will be assessed for accuracy.
   - Students will share their information with their peers. This may be done as jigsaw, small group or whole group presentations.
   - Students will produce a summary note of their research for their peers. This will be photocopied by the teacher.
   - In small or large groups, students will brainstorm on the following issues:
     (a) environmental concerns of metal mining and extraction
     (b) health issues due to metal mining and extraction
     (c) economic importance of metal mining and extraction in Canada.
- Students in small groups will research one of the above concerns as it affects their local area. They will be asked to be prepared to debate the pros and cons of the issue researched. Students are encouraged to examine the above issues as Catholic Citizens in the global community. Students may be further asked to design and submit a poster or pamphlet detailing the pros and cons of their research. Identify ethical and environmental issues connected with their research topic (Appendix C1-C3).

3. Students may be asked to research a topic related to metals of their choice or one of the following topics. The student's choice must be approved by the teacher. Student research may be presented as a research paper, pamphlet, poster, video presentation and/or skit. Ensure that students use a variety of presentation vehicles throughout this activity.

A. Alloys. Choose one (e.g. carbon in steel, lead-tin in solders, brass, bronze, alloys in "mag" wheels) alloy and answer the following questions:
   (a) What elements are involved in the alloy?
   (b) Give the physical properties of each of the metals in the alloy.
   (c) Give the physical properties of the alloy.
   (d) Show how the properties of the metals in the alloy impact on the overall properties of the alloy.
   (e) What is the effect of producing the alloy on the environment/people?

B. Radioactive Metals. Choose a radioactive metal (e.g. uranium, plutonium) and answer the following questions:
   (a) Who discovered the radioactive metal? Give a brief history.
   (b) What are the physical properties of the radioactive metal? What safety precautions must be noted when using this radioactive metal?
   (c) What are the uses of the radioactive metal (e.g. medical, energy production)?
   (d) How does the use of this radioactive metal impact on the environment? Discuss this from an ethical perspective. (Appendix C1-C3)

C. Dentistry and Alloy Use.
   (a) What happens when you have a cavity?
   (b) What are amalgams?
   (c) What are the pros and cons of using silver amalgams?
   (d) Why must mercury be sealed to prevent the release of mercury vapour?
   (e) Are there other types of substances that can be used to fill a cavity that does not contain mercury? You may wish to speak to a dentist on the benefits/downfalls of other possible filling agents.
   (f) What can you do to ensure that your teeth last a lifetime?
   (g) What chemical in toothpaste kills plaque?
   (h) Why do most toothpastes contain a caution about not letting small children swallow the toothpaste?

Assessment/Evaluation

- Use of roving conference to ensure students are using proper laboratory technique and safety procedures and that observations on the student periodic tables are recorded. The teacher will record this using appropriate checklists and/or rating scales prepared in advance. (CH1.09, CH2.01, CH2.04, CH2.06, CH2.07)
- Students submit their periodic table based on metal/non-metal observations. These will be assessed for knowledge/understanding and communication through the use of a product rubric. (Appendix A3) (CH1.09, CH2.01, CH2.04, CH2.06, CH2.07)
- Students collaborate to inform and be informed on metals and metal mining. Through collaboration students set direction of study, solve problems, recognize relevant information and assess self and peers. This is assessed though the use of a collaborative rubric (Appendix A4). (CH2.02, CH2.03, CH2.05, CH3.02)
- Students produce a student note on metal mining. These will be assessed for knowledge/understanding and communication through the use of a product rubric (Appendix A4). (CH3.02)
- Students will debate ethical issues connected with metal mining. This will be used to assess knowledge/understanding, communication and making connections through the use of a rubric prepared in advance by the teacher. (CH3.02)
- Students will submit a research product on alloys, radioactive metals or dentistry and alloy use. These will be used to assess knowledge/understanding, communication and making connections through the use of a product rubric (Appendix A3). (CH1.09, CH2.02, CH2,03, CH2.04, CH2.05, CH3.02)

- A paper/pencil test will be used to assess the knowledge/understanding of the mining process of metals. (CH1.09, CH2.02, CH3.02).

Resources

1. Illustrated element chart

Accommodations

1. Where the student has an individual educational plan, IEP, this activity will be modified to meet the student's needs as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means while written English is developing (spoken English, direct demonstration and pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom and laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in all group and individual activities.
4. For the purpose of providing extensions and enrichment, students will have opportunities to investigate the topics presented here in greater detail. Close collaboration between teacher and student is required to ensure appropriate enrichment opportunities.

Activity #6: The Periodic Table and the Atom

Time: 225 minutes

Description

Trends in the periodic table have allowed scientists to predict properties of elements. Students will use simple atomic models and experimental observations to illustrate the concept of periodicity.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2a, b, d; 3b, c, d, e, f; 4a, b, c, e, f, g; 5a, b, c, d, e, f, g; 7a, b, j

Strand: Chemistry

Overall Expectations
At the end of grade 9, students will: CHV.01

Specific Expectations
Students will: CH1.04 ☆, CH1.05 ☆,CH1.06 ☆

Planning Notes

- Video on “Chemical Families” is a good overview of elements in families or groups.
- Teacher demonstrations of the properties of calcium, magnesium, carbon and silicon are readily found in most science and chemistry texts or laboratory manuals; practice all demos or experiments before conducting them with students.
- Do not spend much time on the development of atomic theory or on the development of the Bohr - Rutherford model; a simple approach is best.
- One period has been allotted for the summative evaluation of the unit in this activity. The teacher may wish to evaluate the students through the use of pencil/paper test, a culminating project, a laboratory activity design and practicum and/or an extension essay.

Prior Knowledge Required

The student should be able to:
- identify pairs of materials that produce a charge when rubbed together.
- describe and demonstrate how some materials that have been electrically charged or magnetized may either attract or repel materials.
- describe examples of static electricity encountered in everyday activities.
- describe ways in which static electricity can be used safely or avoided.

Teaching/Learning Strategies

1. The teacher may demonstrate various simple experiments using representative elements such as magnesium, calcium, carbon and silicon, to show common trends within a group or family.
    - Teacher may demonstrate simple chemical tests using representative elements.
    - Students view the video " Chemical Families" or any other suitable video to further investigate similarities among elements in a group or family.
    - Students use their observations to identify Groups I through VIII (or 1, 2, 13 to 18) as the Main groups of elements on the Periodic Table.
    - Students are introduced to the term period and recognize that there are 7 periods in the Periodic Table and that each period gives a cross section of the chemical properties from each of the groups.

2. Students, with some direction from the teacher , will examine the Periodic Table and develop the idea that elements in the same family end with the same number of electrons in the outermost shell or orbit.
    - The teacher will introduce the three fundamental particles of the atom, their charges, location and relative mass using simple atomic models.
    - Students will draw Bohr-Rutherford models given the following instructions: maximum number of electrons in the first three orbits are 2, 8, 8 respectively. **DO NOT DRAW BOHR- RUTHERFORD MODELS PAST CALCIUM.** Students may model as a group (i.e. arrange themselves as electrons around a nucleus).
    - Students, through the use of probe questions, will determine that similarities in the chemical properties of the elements of a family result from the family members having the same number of electrons in their outermost shell or orbit.

Assessment/Evaluation

Use of worksheets and/or paper and pencil quiz, students will be assessed for knowledge/understanding of groups and periods in the periodic table, the Bohr-Rutherford models and the determination of chemical properties of elements based on valence electrons. (CH1.04, CH1.05, CH1.06)

Resources

1. Chemical Families video (CHEMSTUDY FILM)

Accommodations

1. Where the student has an individual educational plan, IEP, this activity will be modified to meet the student's needs as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means while written English is developing (spoken English, direct demonstration and pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom and laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in all group and individual activities.
4. For the purpose of providing extensions and enrichment, students will have opportunities to investigate the topics presented here in greater detail. Close collaboration between teacher and

student is required to ensure appropriate enrichment opportunities. In this particular activity students may:

- design and build 3D models of atoms in small groups after understanding the electron orbits. LED's or small "Christmas type" lights may be used in their model to represent the protons and neutrons. **(Possible Science World Idea)**

Unit #2: Physics: Electrical Applications

Time: 27.5 hours

Unit Developers

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Development Date: April 1, 1999.

Unit Description

In this unit students will develop an understanding of static and current electricity. They will build electrical circuits found in everyday life. Students will also analyze the practical uses of electricity and its impact on everyday life. They will practice being collaborative team members, respecting the rights and contributions of others. Through the study of electricity, students will receive a practical lesson in stewardship as they will be encouraged to conserve energy.

Strand(s) & Expectations

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

Strand: 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

Activity Titles (Time + Sequence)

Activity 1	Properties of Static Electricity	150 min
Activity 2	Properties of Current Electricity	75-150 min
Activity 3	Comparing Methods of Electrical Production	300 min
Activity 4	Making and Using Series Circuits	75-150 min
Activity 5	Making and Using Parallel Circuits	100-150 min
Activity 6	Measuring Resistance	75-150 min
Activity 7	Electrical Devices: How do They Work	150 -225 min
Activity 8	Efficiency of Electrical Devices	150 min
Activity 9	Authentic Problem Relating to Electricity	150 min
Activity 10	Careers Relating to Electrical Technology	225-300 min

Unit Planning Notes

This unit emphasizes the flow of ideas from the existence of common electrical phenomena beginning with static electricity, to the production of current electricity and ultimately to practical applications of electricity in common devices. Teachers are required to teach the proper use of electrical meters. It is advisable that overhead demonstration meters are available to show students how to read meters correctly. Alternately, digital multimeters are very easy to read but require increased caution in use since they must be adjusted depending upon their intended use. In order to efficiently plan for Activity 9, the research project into devices that use electricity, and Activity 10, the career exploration assignment, teachers must introduce the parameters of the assignments early

in the unit, particularly if a student presentation will be required. Teachers should collect various old small electrical appliances and related information in order to have available information about the operation of appliances. Teachers should help students become aware of Church documents and the Catholic perspective on the role of work in a person's life, as well as the role of humans in the environment as stewards of the world's resources. Appendix C (A Catholic Perspective on the Applications of Science: Guiding Principles) also provides some guidance with respect to these. Alternatively, this aspect of the unit could be organized into a guided research activity with appropriate teacher/student conferencing. Teachers should also identify instances where students may engage in scientific inquiry/experience that students could include in their "Science World" portfolio. (See Appendix B)

Prior Knowledge Required

In grade 6, students have studied the basic concepts of electricity, including the sources of static electricity and the difference between static and current electricity. Students also designed and constructed simple electrical circuits that transform electricity into other forms of energy; this may require review. The students will also have knowledge of the atomic structure of matter from the unit on Chemistry: Exploring Matter. Knowledge about the correct procedure for identifying and controlling variables is assumed from previous science courses, however it must be placed in the context of electrical problems. Students should also have knowledge of the proper use of the library and the Internet for research work. Review the ethical use of information from information-technologies as required.

Teaching/Learning Strategies

The teaching and learning strategies suggested for use in delivery of this unit include teacher demonstration, student experimentation, collaborative/cooperative groups, library research, student presentations, personal interviews and a variety of independent experiences called "Science World" activities. (See Appendix B)

Assessment/Evaluation

In this unit, student achievement of the expectations is evaluated based on a variety of assessments, tools and strategies. Assessment strategies used include: teacher-student conferences, formal teacher observations, roving conferences, peer conferences, self and peer assessment, pen and paper assessment, student logs, and wrap-up activities. Sample rubrics have been included for the science process, lab product, and generic product which may be adapted by teachers to assess and evaluate students. Rubric A3 was intended to be a framework from which teachers could develop specific rubrics to assess research projects and not to be used "as is." In addition, for summative evaluation, up to one period may been allotted. The teacher may wish to evaluate students through the use of pencil/paper test, a culminating project, a laboratory activity design/practicum and/or extension essay.

Resources

Print

Andrews et al. Science 10 An Introductory Study. Canada: Prentice Hall, 1987.

Candido et. al. Heath Science Connections 10. Canada: D.C. Heath, 1988.

Oxenhorn/Idleson, Pathways in Science, Physics

Friction Rod Kit; Catalogue # 61789 Boreal; 399 Vansickle Rd., St. Catherines, Ont. L2S 3T4; 1-800-387-9393;

Hirsch et al. Science Explorations 10, Toronto: John Wiley & Son, 1987.

Martindale et al. Fundamental of Physics: An Introductory Course. Toronto: D.C. Heath, 1987.

Rosen, S, Science Workshop Series: Physical Science: Volume: Electricity & Magnetism. Cambridge: Prentice Hall Ginn Canada.

Computer Software

A variety of commercially prepared software is available through science suppliers such as VWR, Boreal, Northwest, Fisher and Merlan.

Internet Sites

http://www.aceee.org/
http://EETD.LBL.gov/
http:/www.green-e.org/teacher/index.html
http://solstice.crest.org/index.shtml
http://www.ase.org/educators/lessons/index.htm
http://zebu.uoregon.edu/1998/phys162.html
http://www.est.gov.on.ca/english/en/en_renew.h
tmhttp://www.eren.doe.gov

Videotapes

Static Electricity and Current Electricity. Bill Nye: The Science Guy Series, Magic Lantern(10 Meteor Drive, Toronto, M9W 1A4)

Eureka series from TVO.

Community

Energy Educators of Ontario; 517 College Street, Suite 404; Toronto Ontario; (416) 323-9216

Activity #1: Properties of Static Electricity

Time: 150 Minutes

Description

Through the use of a variety of demonstrations, students will be introduced to static electricity as a natural phenomenon. The teacher and students will carry out a series of small experiments showing common everyday occurrences of static electricity in our lives. These experiences will be linked through a review of the properties of matter, the structure of the atom, and how this relates to our understanding of static electricity. A formal lab requiring students to study the properties of static electricity using a metal leaf electroscope will follow.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2a, b, c; 3b, c, e; 4b; 7a, b, i, j

Strand: Physics

Overall Expectations
At the end of Grade 9, students will: PHV.01

Specific Expectations
Students will: PH1.01, PH1.02, PH2.03 ☆, PH2.04 ☆, PH2.06, PH2.07

Planning Notes

- Where possible, have a variety of common household materials available for experimentation; (combs, pieces of material of various types, balloons, odd pieces of carpeting, etc.)
- A lab station structure would permit students to experience each of a number of situations that can be set up using the materials available.
- Demonstrations should include the use of the Van de Graaff to do the “hair on end” demonstration, a charged rod to cause a stream of water to warp or bend, a charged rod to cause confetti to scatter.
- Suspending pairs of inflated balloons from the ceiling will allow students the opportunity to examine the properties of charge (a form of electroscope).
- Students may wish to do a “Science World” activity based on some of the experiences gained in this activity. Refer to Appendix B.

Prior Knowledge Required

Students should be familiar with the Bohr-Rutherford model of the atom discussed in the Chemistry Strand. Safe laboratory behaviour should be reviewed prior to beginning the activity.

Teaching/Learning Strategies

1. In pre-assigned small groups, students will examine the effects of rubbing two types of materials together. They will relate this to everyday experiences by using common materials such as textiles, household plastic products, combs, balloons and any other material that can be provided. These will be distributed in a station type of set up, allowing all students the opportunity to examine all situations.

2. Students will observe electrostatic discharge using a device such as a Van de Graaff machine or a Wimshurst machine. Students will then discuss this type of discharge and how it relates to the experiences they have gathered in the introductory activity.

- Through careful observation, students discuss how either of the above machines derives a static charge
- Students will make the connection between the static discharge observed in the demonstration and common natural phenomena such as lightning; static discharge after walking on a carpet; and other experiences from #1 above

3. In their groups, students will review the Bohr-Rutherford model of the atom. They will then attempt to explain the origin of electrostatic charge using this model.
   - Through conferencing with each of the groups, the teacher will assist students in developing the idea that charge is a result of either too many or too few electrons
   - Alternatively, students may participate in a role playing activity involving the demonstration of an electric charge as a cap or ball each person possesses and then is passed on so that some people have extra caps or balls and others have a deficiency.
   - For each of the activities they did in #1 above, students will write a short explanation using the movement of electrons as the premise on which they base their understanding of the experiences.
   - Each student will be asked to present their explanation for one of the experiences from #1

4. Static electricity will be related to current electricity using a simple analogy such as the flowing of water.

Assessment/Evaluation

- Students will be assessed during lab activities for inquiry by means of the process rubric. (PH2.04)
- Student explanations from #3 above will be collected and evaluated for knowledge/understanding and proper use of terminology. (PH2.03)
- Group presentations may be evaluated for communication skills using a product assessment rubric (Appendix A3).

Resources

1. William A. Andrews et. al. Science 10 An Introductory Study Prentice Hall 1987 ISBN 0-13-794629-5
2. Hirsch et. al. Science Explorations 10 John Wiley & Son 1987 ISBN 0-471-79705-7
3. Friction Rod Kit; Catalogue # 61789 Boreal; 399 Vansickle Rd., St. Catharines, Ont. L2S 3T4

Accommodations

1. Where the student has an individual educational plan, IEP, this activity will be modified to meet the student's needs as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means while written English is developing (spoken English, direct demonstration and pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom and laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in all group and individual activities.

Activity #2: Properties of Current Electricity

Time: 75-150 minutes

Description:

In this activity, students will be introduced to the concept of current electricity and its properties. Current, potential difference, and resistance will be defined in qualitatively using a water analogy, and quantitatively for the purpose of measuring their values in a circuit.

Strand(s) and Expectations:

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: CGE 2a, b, c, d, e; 3b, c, f; 4a, b, e, f; 5a, e, f, g; 7a, b, i, j

Strand: Physics

Overall Expectations:
At the end of Grade 9, students will: PHV.01, PHV.02

Specific Expectations:
Students will: PH1.03 ☆, PH1.04 ☆, PH2.01 ☆, PH2.06 ☆, PH2.07 ☆

Planning Notes:

- Students will probably grasp the concept of electric current more easily than potential difference. Alternative analogies should be employed as required. The term "voltage" should be introduced as a synonym of potential difference because of its widespread use.
- Remind students of lab safety rules regarding the use of electricity. They should be made aware of the sensitivity and fragility of analog electric meters. If using even low voltage variable power supplies, students should be prompted to zero the adjustment knob before turning the power on, then slowly increasing the power until the bulb(s) begin to glow (not too brightly). Alternatively, combinations of dry cells could be used.
- Circuit lab activities are best performed in pairs on uncluttered benches.
- This activity involves several large group demonstrations. Suitably sized meters should be used for this purpose. Devices able to be projected onto a screen would be ideal.
- Several concepts developed in this activity lend themselves to a “Science World” experience such as special circuits to control multiple devices. **(Possible Science World Idea.)**

Prior Knowledge Required:

- Grade 6 electricity unit specific expectations 07, 10, 12, 13, 14, 15, 16
- Know the difference between static and current electricity in terms of stationary versus moving electrons.
- Lab safety, especially in regard to the use of electricity and electrical devices should be reviewed.

Teaching/Learning Strategies:

1. Students will be introduced to the concepts of current, potential difference, and resistance. This may be done through a series of worksheets/mini-labs or as a whole group activity using a variety of audio/visual delivery methods and analogies. The water analogy for current may be demonstrated at this time.

2. The voltmeter and ammeter will be introduced and discussed as devices that measure potential difference and current respectively. Display a suitably sized device of each type. The schematic symbol for voltmeter and ammeter should be introduced.

3. Students will be instructed in the proper connection of a voltmeter (in parallel) and an ammeter (in series) and how to read each type of device using the appropriate scale. Emphasis will be placed on fact that the polarity of the meter connections must always correspond to the polarity of the source (i.e., positive terminal of a voltmeter connected to the positive side of the component). Fragility of the devices must be emphasized.

4. Students will perform an inquiry based lab activity where they are given an opportunity to build simple circuits using cells or a DC power supply, switch, light bulb, and wires. Students will be given the challenge to make a light as bright or as dull as possible using several cells and one bulb. Students should attempt to measure current and potential difference using a voltmeter and an ammeter at different parts of the circuit.
- Students will submit a lab report detailing their observations of a simple circuit, including their diagrams for their circuit.

5. Schematic symbols for common circuit components will be introduced as a way to simplify circuit diagrams. This may be done as a whole group mini-lesson using a suitable whole group method of delivery with ample use of audio/visual aids.

6. Students will write a short description of their work and the design of the circuit in Strategy #4. In their report they should relate the 'flow of electrons analogy' discussed in #1 above to the components of the circuit they built in this portion of the activity. Each component of the circuit should be described in relation to its function within the context of the analogy used.

7. Students may wish to extend their knowledge by carrying out a related "Science World" activity focusing on multiple dry cells and multiple bulbs with various levels of brightness. **(Possible Science World Idea)**

Assessment/Evaluation

- The process students use to carry out each exercise or lab may be evaluated for inquiry using the lab process rubric (Appendix A1). (PH2.01, PH2.03)
- Student Lab Reports may be collected and assessed/evaluated for knowledge/understanding communications using the lab report rubric (Appendix A2). (PH1.04, PH2.03, PH2.06, PH2.07)
- Student actions during a lab may be assessed for safety using a prepared checklist. (PH2.01)
- Student responses from #6 may be collected and evaluated for knowledge/understanding using a check list. (PH1.03, PH2.04)
- Student use and care of equipment may be assessed/evaluated for inquiry skill using a prepared checklist. (PH1.04, PH2.01, PH2.04)
- If students choose to carry out a related "Science World" experience, this may be assessed/evaluated as a component of a final Portfolio or Journal assignment.

Resources

1. Oxenhorn/Idleson, Pathways in Science, Physics 1
2. Prentice Hall Science, Electricity and Magnetism
3. Heath Science Connections 10
4. Andrews, Science 10

Accommodations

1. Where a student has an IEP, this activity will accommodate the modifications as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means, (spoken English, direct demonstration, pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, classroom/laboratory activities will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in group and individual activities.
4. For the purpose of providing Extensions and Enrichment, students will have opportunities to investigate the topics presented here in greater detail. This would be undertaken in collaboration with the teacher to ensure that the activity is likely to yield useful or interesting information and that it is feasible given the time and resources available. Interested students could extend their knowledge by carrying out appropriate "**Science World**" activities. (Appendix B).

Activity #3: Comparing Methods of Electrical Production

Time: 300 minutes

Description

In this series of activities, students will be given the opportunity to research and present information regarding the production of electrical energy by traditional and alternative methods. The final product of this activity will be in the form of a "User's Manual" for electrical energy generation. Students will be required to produce a print version of their manual for distribution in addition to preparing a bulletin board or other highly visible presentation. In all respects, their final product must reflect the Catholic Church's teachings on respect for the environment and our fellow human beings.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2a, b, c; 3b, c, e; 4b; 5a, e, f, g

Strand: Physics

Overall Expectations
At the end of Grade 9, students will: PHV.03

Specific Expectations
Students will: PH2.05, PH2.06, PH2,07 , PH3.03

Planning Notes

- This activity should be initiated at the beginning of the unit, as it will require considerable time to assemble the final product.
- Library/Computer time should be booked in two blocks of two periods to allow students to make the best use of the time to complete their research or to assemble their work. If the school library is not available, the teacher should collect resources for classroom use.
- Have a variety of sources available for student use. These should include various commercially available CD-ROMS, magazine articles, and community resources such as the local hydro authority or a local alternative energy marketing board/agency.
- As part of the exercise, students will be required to work in a team format with each individual having a specific role and task to accomplish. It is suggested that the teacher pre-assign students

to heterogeneous groups to allow all students to participate equally and contribute completely to the process. Students with IEP considerations will have roles appropriate to modifications and individual accommodation needs.
- The final product will be a "shareable" item, requiring students (with the assistance of the teacher), to make and distribute copies. As such, students should have access to, and be encouraged to use, presentation and word processing software. Where this is not possible, the final product should have a layout that will permit easy duplication for distribution to the class.

Prior Knowledge Required

- An understanding of the collection of written and numerical data for use in a report or essay.
- Research techniques for the Internet and other multimedia systems as well as through conventional print material.
- Appropriate citation techniques such as parenthetical referencing.
- This activity may be conducted as a group activity depending on the scope and depth of resources available.
- Ethical use of the Internet and other information technologies.

Teaching/Learning Strategies

1. Students will choose from the following list of topics and working in groups, prepare a "User's Manual" for their choice of electrical generating system. (Topics: Wind, Solar, Photovoltaic, Hydrogen cell, Tidal, Hydro, Nuclear, Fossil Fuels) The "User's Manual" will be written in a style and manner (with the appropriate use of graphics/drawings) of a typical handbook/guide that one would receive with a new piece of sophisticated equipment, (e.g., stereo, television). The booklet will explain the operation of the generating system using graphics and written instructions wherever appropriate.

2. Within the group, each student will pick one task to complete for their choice of topic. This task may be to prepare the graphics for their manual, prepare written material for the manual or to edit the material prepared. In addition, all students will be required to research an aspect of their choice of topic for the final project. Areas of research will include but are not limited to:
   - physical process of producing power for their choice; (i.e., "how does it work?", turbine, chemical reactions, heat/turbine combinations).
   - cost/efficiency of the system per unit of electricity produced.
   - environmental impact, including pollutants produced, impact on animal/plant life, aesthetics.
   - the ethical implications of their choice of energy production.

3. Students will use a variety of sources to gather their information. Students should have at least one source from each of the categories listed below (depending on availability):
   - Electronic – such as CD-ROM or Internet; both if they are available
   - Print – articles from recent scientific publications such as Discover, The Crucible, Popular Science or other appropriate publication
   - Anecdotal – an interview or survey of a representative from a local power generating authority
   - Print – a review of publications/marketing materials from a local alternative energy provider or expert
   - Print – a review of materials gathered from traditional print sources such as reference texts or books.

4. Students may prepare a bulletin board or other presentation of the information they have collected. This will be set up either in a highly visible part of the school or as part of an "Energy Fair." Students should be able to answer questions put to them about their chosen topic by the "general public."

Assessment/Evaluation

- Each component of the assignment should be assessed independently of all others to allow for individual evaluation. Choice of research source, graphics and the quality of the information gathered and used by an individual student should be assessed for knowledge/understanding and communication using a version of the product assessment rubric (Appendix A3). (PH2.05)
- The final product will be evaluated for knowledge/understanding, communication, and making connections using product assessment rubric A3. (PH2.06, PH2.07)
- Student knowledge/understanding of at least one other method of electric generating system will be evaluated using a traditional paper and pencil test. (PH3.03)
- Peers, other teachers in the school or a combination of both may assess either student presentations or bulletin boards. This may be done using a checklist, rubric or other assessment/evaluation vehicle which should be generated by the teacher along with the students before the presentation.

Resources

1. http://www.aceee.org/
2. http://EETD.LBL.gov/
3. http://www.green-e.org/teacher/index.html
4. http://solstice.crest.org/index.shtml
5. http://www.ase.org/educators/lessons/index.htm
6. http://zebu.uoregon.edu/1998/phys162.html; an internet site which provides a good overview of various forms of alternative energy and many links to other useful web sites.
7. http://www.est.gov.on.ca/english/en/en_renew.html ; government of Ontario Ministry Web site with a review of current/past government initiatives, their goals, costs etc. Also contains links to a variety of other web sites.
8. http://www.eren.doe.gov ; United States Department of Energy Web site with excellent overviews of various Alternative Energy sources and links to institutions and organizations either researching or utilizing various types of energy alternatives.
9. Energy Educators of Ontario; 517 College Street, Suite 404; Toronto Ontario; (416) 323-9216; a source of various publications and print materials dealing specifically with Canadian Energy Issues.
10. Teachers can prepare a research log that allows students to list resources they have accessed in each of the main resource categories listed above.
11. Library resources
12. Multimedia CD ROM available from a variety of Scientific Supply houses
13. Use of Multimedia presentation tool should be encouraged wherever possible. E.g. Microsoft PowerPoint/ Lotus Freelance Graphics etc.
14. The Church's teaching on the environment

Accommodations

1. Where a student has an IEP, this activity will accommodate the modifications as outlined in the plan.
2. For ESL/D, students will have opportunities to demonstrate their learning by alternative means, (spoken English, direct demonstration, pictorial representation). At the same time, instruction in written, science-specific language will continue.
3. For students with physical or learning impairments, roles and duties will be modified to permit participation regardless of the impairment. Where possible, peers will be encouraged to assist the student to permit participation in group and individual activities.

4. For the purpose of providing Extensions and Enrichment, students will have opportunities to investigate the topics presented here in greater detail. This would be undertaken in collaboration with the teacher to ensure that the activity is likely to yield useful or interesting information and that it is feasible given the time and resources available. Interested students could extend their knowledge by carrying out appropriate "Science World" activities, (Appendix B). An example may be to create a working model of their choice of power generation system. **(Possible Science World Idea)**

Activity #4: Making and Using Series Circuits

Time: 75 - 150 minutes

Description

Through experimental investigation, the student will gain an understanding in how series circuits are connected and some of their quantitative properties. By measuring the output voltage and output current of loads (light bulbs) connected in series, the student will be able to communicate the effect of more loads added to a circuit. Students will be expected to draw schematic diagrams using pencil and ruler.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2b, c; 3c; 4a, b, d, e, f; 5a, b, e, f, g; 7b, j

Strand: Physics

Overall Expectations
At the end of Grade 9, students will: PHV.02

Specific Expectations
Students will: PH1.04 ☆, PH2.01 ☆, PH2.04 ☆, PH2.06 ☆, PH2.07 ☆, PH2.08 ☆

Planning Notes

- Circuit symbols to be reviewed (e.g. switch, cell, wire and light bulb)
- Connecting the symbols together in a schematic diagram. Use real equipment or accurate pictorial diagrams if possible.
- Ruler drawings must be emphasized.
- Students must be taught the use of electrical meters (voltmeter and ammeter).

Prior Knowledge Required

- Completion of Activity #2

Teaching/Learning Strategies

1. Students should review the following points:
   - how to connect or hook up a circuit using standard lab equipment
   - the units of measurement for each meter
   - the settings or adjustments to be made with the meter dials
   - how each meter is to be placed or used in the circuit
   - how the data should be recorded
   - how the numerical values can be formulated into a mathematical relationship.

2. Students will be given several light bulbs and will be asked to connect them in such a way as to show decreasing brightness. Students should select an appropriate way to communicate their connection to others. Students should measure the voltage and current in various parts of the circuit in order to identify a pattern.

3. Teachers will review with the students diagrams, both pictorial or schematic, of series circuits with 2 or 3 loads:

- Students to draw and interpret circuit diagrams with similar and/or different loads.

Assessment/Evaluation

- The teacher observes the activity performed in Strategy 2 for inquiry using a checklist produced by the teacher. The items to be observed and assessed are: the student obtaining the appropriate lab materials, the care of assembly of the required circuit, making the necessary meter readings, recording and collecting of data and the proper returning of equipment to its appropriate place in the classroom (PH1.04, PH2.04, PH2.06)
- The teacher assesses the knowledge/understanding of the students concerning drawing a circuit, using symbols, given the electrical devices and how these devices are to be connected using a pen and paper test. (PH2.08)
- The teacher will assess the knowledge/understanding and communication of the lab report by using product rubric (Appendix A2). (PH2.07)

Resources

1. Science 10 An Introductory Study: Andrews et. al. Prentice Hall 1987
2. Heath Science Connections 10: Candido et. al. D.C. Heath, 1988, Canada
3. Science Workshop Series: Physical Science: Volume: Electricity & Magnetism Seymour Rosen
4. Teacher created activity sheet or as found in the grade nine text book.
5. Various webs sites such as The Virtual Laboratory (http://physicsweb.org/TIPTOP/VlAB/) and use the necessary applets to reinforce this activity.

Accommodations

1. Where the student has an IEP, this activity will accommodate the modification(s) as outlined in the IEP plan.
2. ESL/D students will have opportunities to demonstrate their learning by alternate means while written English is developing. At the same time, instruction in written, science-specific language must continue.
3. Classroom/laboratory facilities will be modified to permit participation, regardless of impairment, in group and individual activities. Where possible, peers will be encouraged to assist in these accommodations.

Activity #5: Making and Using Parallel Circuits

Time: 100 -150 minutes

Description

Through experimental investigation, the student will gain an understanding of how parallel circuits are connected, some quantitative properties and how this type differs from series circuits (Activity #4). By measuring the output voltage and output current of loads (light bulbs) connected in parallel, the student will communicate the effect of adding more loads (light bulbs) to a circuit. Students will be expected to draw schematic diagrams using pencil and ruler. Household wiring will be discussed in the context of series and parallel circuits with reference to the terms: hot wire, fuse or circuit breaker, ground wire, 120 volt circuit versus 240 volt circuit.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:

The graduate is expected to be: 2b, c; 3c; 4a, b, d, e, f; 5a, b, e, f, g; 7b, j

Strand: Physics

Overall Expectations

At the end of Grade 9, students will: PHV.02

Specific Expectations

Students will: PH1.04 ☆, PH2.01 ☆, PH2.04 ☆, PH2.06 ☆, PH2.08 ☆, PH3.01 ☆

Planning Notes

- Use electrical demo kits where possible
- Have the students do a visual inspection of the wiring in their own house especially the main circuit panel (alternately, a possible tour of the school electrical room); a report may be written on the student's inspection

Prior Knowledge Required

- Construction of series circuits.

Teaching/Learning Strategies

1. Students should review the following points leading up to circuit assembly and quantitative measurements :
   - how to connect or hook up a circuit using standard lab equipment
   - the units measured by each meter
   - the settings or adjustments to be made with the meter dials
   - how each meter is to be placed or used in the circuit
   - how should the data be recorded
   - how the numerical values can be formulated into a mathematical relationship.

2. Students will be given several light bulbs and will be asked to predict the brightness of each as more light bulbs are connected in parallel. Students will then compare their observations to those from the previous activity.

3. The teacher should review pictorial or schematic circuit diagrams.
   - Students should draw and interpret circuit diagrams; cue cards may be used to assist in developing schematic diagrams.

4. The teacher should discuss with the students:
   - why a household is wired in parallel and not in series
   - why certain devices throughout the household are wired in series; what they are and why they are wired in this manner
   - how to view and analyze electrical blueprints
   - the wiring of a model house using appropriate electrical fixtures.

5. Students may explore specific circuits such as a household alarm or explain why a fuse blows or a circuit breaker disconnects. **(Possible Science World Idea)**

Assessment/Evaluation

- The teacher observes the activity performed in Strategy 2 for inquiry using a checklist produced by the teacher. The items to be observed and assessed are: the student obtaining the appropriate lab materials, the care of assembly of the required circuit, making the necessary meter readings, recording and collecting of data and the proper returning of equipment to its appropriate place in the classroom (PH1.04, PH2.04, PH2.06)
- The teacher assesses the knowledge/understanding of the students concerning drawing a circuit, using symbols, given the electrical devices and how these devices are to be connected in the home using a pen and paper test. (PH2.08, PH3.01)
- The teacher will assess the knowledge/understanding and communication of the lab report by using product rubric (Appendix A2). (PH2.07)

Resources

1. Science 10 An Introductory Study: Andrews et. al. Prentice Hall 1987
2. Heath Science Connections 10: Candido et. al. D.C. Heath, 1988, Canada
3. Science Workshop Series: Physical Science: Volume: Electricity & Magnetism Seymour Rosen
4. Science: Ideas and Applications 10: Finucane, Lang, John Wiley & Sons, 1998
5. Teacher created activity sheet or as found in the grade nine text book.
6. Various webs sites such as The Virtual Laboratory (http://physicsweb.org/TIPTOP/VlAB/) and use the necessary applets to reinforce this activity.
7. Any household wiring text or brochures that, for example, would be available at a hardware store or building centre.

Accommodations

1. Where the student has an IEP, this activity will accommodate the modification(s) as outlined in the IEP plan.
2. ESL/D students will have opportunities to demonstrate their learning by alternate means while written English is developing. At the same time, instruction in written, science-specific language must continue.
3. Classroom/laboratory facilities will be modified to permit participation, regardless of impairment, in group and individual activities. Where possible, peers will be encouraged to assist in these accommodations.

Activity #6: Measuring Resistance

Time: 75-150 minutes

Description

Through experimental investigation, the student will gain an understanding of the relationship between electric current, potential difference, and resistance. They will measure the potential difference and the current in a simple series circuit for an ohmic resistor and plot a graph of the data in order to see that the resistance is the slope of the graph. Simple problems involving the relationship V=IR will be solved mathematically.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2b, c; 3c; 4a, b, d, e, f; 5a, f, g; 7b, j

Strand: Physics

Overall Expectations
At the end of grade 9, students will: PHV.01

Specific Expectations
Students will: PH1.03, PH1.04, PH1.05, PH1.06 ☆, PH2.06 ☆, PH2.07 ☆, PH2.09 ☆

Planning Notes

- The use of the electrical meters was just completed as part of the previous activities. It would be convenient to use digital meters if possible for their accuracy and ease of reading. Two meters for each group would be convenient to avoid the need to change the configuration of the circuit. However, one may be used if that is all that is available.
- The electrical symbol for resistance should be introduced as part of the activity.
- Use only ohmic resistors (not light bulbs) in order that the results will be linear.
- Students should come to know that as the resistance increases in a circuit the current decreases, and as the resistance decreases the current increases. The concept for the relationship among these quantities will be explained by means of a water analogy, where the potential difference is the water pump, the current is the water flow and the resistance is the opposition to the flow of water due to restrictions of the diameter of the water pipe.

Prior Knowledge Required

- The knowledge of how to connect simple electrical circuit based upon pictorial or schematic diagrams.
- The proper use of voltmeters in parallel and ammeters in series must be emphasized.
- The production of line graphs and the determination of their slopes either by hand or from computer database or spreadsheet programs.
- The solution of simple linear equations.

Teaching/Learning Strategies

1. Students will be given several resistors and asked to predict and then measure the resulting current with several different potential differences:
   - The students will plot a line graph of potential difference versus current.
   - The students will be asked to identify a pattern to the graph (a straight line that has a positive slope).
   - The students will be asked to identify a pattern to the relationship between the resistance and the current (larger resistance, smaller current, etc.).

2. The teacher will verify the results and introduce the equation V=IR.
   - The teacher will define the unit of resistance as the "ohm" (3) when the potential difference is in volts and the current is in amperes.
   - Several examples of solving the equation for each unknown given the other two will be worked out with student input.
   - The students will practise solving similar problems, working in groups.

3. The teacher will summarize the behaviour of electrical circuits with regards to resistance, potential difference and current by means of a water analogy.

4. Students may explore the operation of a dimmer switch. **(Possible Science World Idea)**

Assessment/Evaluation

- The results of the experiment relating potential difference and current should be collected and assessed for inquiry and communication:
- are the results within the accuracy range of the resistor (usually 5%or 10%)?
- is the graph a straight line? (PH2.09)
- can the students correctly relate current and potential difference? (PH1.06)
- The teacher may assess the written lab report for knowledge/understanding and communication using the lab product rubric (Appendix A2).
- The teacher can assess the students' knowledge/understanding of the relationship among resistance, potential difference and current by means of a pen and paper test:
  - Can students successfully use the equation V=IR to solve for one of the variables if the other two are given? (PH1.08)
  - Can students use the water analogy to explain the concept of resistance in an electrical circuit?
- The teacher can assess the students' knowledge/understanding of the effect of resistance in series and parallel by means of a performance task in which students are asked to reduce or increase the resistance in a given circuit by adding an additional resistor. (PH1.05)

Resources

1. Science Workshop Series: Physical Science: Volume: Electricity & Magnetism Seymour Rosen Prentice Hall Ginn, Cambridge, Ontario
2. Teacher created activity sheet or as found in the grade nine text book.
3. Various webs sites such as The Virtual Laboratory (http://physicsweb.org/TIPTOP/VlAB/) and use the necessary applets to reinforce this activity.

Accommodations

1. Where the student has an IEP, this activity will accommodate the modification(s) as outlined in the IEP plan.
2. ESL/D students will have opportunities to demonstrate their learning by alternate means while written English is developing. At the same time, instruction in written, science-specific language must continue.

3. Classroom/laboratory facilities will be modified to permit participation, regardless of impairment, in group and individual activities. Where possible, peers will be encouraged to assist in these accommodations.

Activity # 7: Electrical Devices: How do they work?

Time: 150 - 225 minutes

Description

The students will brainstorm the energy transformations that occur in common electrical devices. For example, electricity may be used to produce heat, light, sound, motion, magnetism, etc. The student will be asked to select a device that they wish to research and then explain how the device works and present the results of their research to the class in one of several ways; a poster, a video, a demonstration presentation etc. A cooperative lesson could also be used using a jig saw format.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2b, c; 3c; 4a, b, d, e, f; 5a, f, g; 7b, j

Strand: Physics

Overall Expectations
At the end of grade 9, students will: PHV.03

Specific Expectations
Students will: PH2.03, PH2.04, PH2.05 ☆,PH2.07, PH3.04 ☆

Planning Notes

- Teachers should collect various resources such as books or CD-ROM sources of information about "The Ways Things Work". Relevant Internet sites should also be researched in order to help give students a start on their research.
- Various electrical devices should be available in the class for students to examine.
- Students should be warned about the dangers of taking certain appliances apart and that they should never be operated when they are open for inspection.
- Students should be warned about the ethics of integrity and that there are consequences for plagiarism in collecting information.

Prior Knowledge Required

- Students should know how to find books and other resources in a library.
- Students should know how to use CD-ROM sources of information.
- Students should know how to conduct an the Internet search.
- Students should know how to properly reference the information that they are using.

Teaching/Learning Strategies

1. Students will examine several electrical appliances and determine, with the guidance of the teacher, what kind of energy transformation occurs in the device.

2. Students will select a particular device that they wish to research after they have had time to consider their own sources of information. A mini lesson can be prepared and presented to the class

3. The teacher will arrange at least one library or computer lab research period to give students an opportunity to collect some preliminary information. If the school library is not available, the teacher must collect resources for use in the classroom.

4. Students should be asked to reflect on the wise use of electricity. Ontarians use between 50 to 150 kWh of energy daily. In some parts of the world this may represent a weekly or monthly consumption. Students should relate the wise use of their selected device and how it should be used to promote energy conservation.

5. Students may wish to research the workings of additional devices and present them as a poster or pamphlet. **(Possible Science World Idea)**

Assessment/Evaluation

- The teacher will assess the presentation by the student for knowledge/understanding, communications and making connections by means of an adaptation of the product assessment rubric (Appendix 3) (PH2.05, PH3.04)

Resources

(a) The Way Things Work: Macaulay, D., Houghton Mifflin 1988, Boston
(b) How Things Work Editor of Consumer Guide, Publications International, Ltd, 1990, Lincolnwood, Illinois USA

Accommodations

1. Where the student has an IEP, this activity will accommodate the modification(s) as outlined in the IEP plan.
2. ESL/D students will have opportunities to demonstrate their learning by alternate means while written English is developing. At the same time, instruction in written, science-specific language must continue.
3. Classroom/laboratory facilities will be modified to permit participation, regardless of impairment, in group and individual activities. Where possible, peers will be encouraged to assist in these accommodations.

Activity # 8: The Efficiency of Electrical Devices or Appliances

Time: 150 minutes

Description

The teacher will introduce the relationship between energy output and energy input as a measure of the efficiency of the transformation of one form of energy into another. Then through experimental investigation, the student will be asked to quantitatively determine the percent efficiency of an electrical device that converts electrical energy into heat energy such as in an electric hot plate or kettle. Other examples will be discussed such as the conversion of electrical energy into sound energy or light energy.

Students will be expected to perform mathematical calculations involving the relationship: percent efficiency = (energy output / energy input) x 100%.

Strand and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2b, c; 3c; 4a, b, d, e, f; 5a, f, g; 7b, j

Strand: Physics

Overall Expectations
At the end of grade 9, students will: PHV.03

Specific Expectations
Students will: PH1.07 ☆, PH2.01, PH2.06, PH2.07 ☆.

Planning Notes

- Teachers should collect Energy Guide information about appliances in order that they have samples of energy consumption available for students to discuss.
- An electrical kettle and other electrical devices should be available in the class in order that data about energy consumption may be collected.
- Digital electronic balances are best in order to precisely measure the mass of the water in the experiment.
- Care should be taken when measuring the final temperature of the water inside an electric kettle. If the thermometer comes in contact with a hot element the thermometer may break. It is safer to use a hotplate and beaker combination although the efficiency may not be as great.

Prior Knowledge Required

- Students have studied heat in grade 7, however few students know the equation for the heat gained or lost by a substance as $E=mc\Delta T$ or as $Q=mc\Delta T$.
- Students have studied mechanical efficiency in grade eight, however not all students may know the equation for the efficiency of an energy conversion as (energy output/energy input) x 100%
- Students should be aware of the information contained on the identification plate of a device, usually the potential difference, the power rating or the electrical current. Students may not be aware of the fact that the power is the product of the potential difference and the current ($P=VI$) or that Energy is the product of the power and the time item is used ($E=P\Delta t$)
- Students should be able to solve simple equations.

Teaching/Learning Strategies

1. Students will examine several electrical appliances, determine the information available on the identification plate, and record it in their notebook or science journal:
   - the electrical potential difference required, the current used, the resistance of the device, and the power of the device.

2. The student will investigate and explain the relationship among the potential difference, the elapsed time and the energy consumed by an electrical device, as well as the relationship among the power, the potential difference and the current:
   - $E = P\Delta t$ and $P = VI$.
   - Students will perform several sample calculations using this relationship.

3. The teacher will review the relationship for efficiency of the energy transformation
   - The students will collect data experimentally to determine the efficiency of a kettle or hotplate using the appropriate equation.
   - The students may be asked to produce a complete lab report of the activity.
   - The teacher will review other examples of the efficiency of the energy transformation.
   - The students will use this equation to determine the efficiency of other devices, given the energy input and output.

4. Students may attempt to determine the efficiency of other devices such as the gravitational energy produced by an electric motor in lifting an object compared to the electrical energy it needs to operate. **(Possible Science World Idea)**

Assessment/Evaluation

- Student ability to read the information from the name plate will be assessed orally.
- The teacher may make a formal observation for inquiry using a modification of the process rubric (Appendix A1). Items to be observed include: use of appropriate lab materials, care of assembly and the proper returning of equipment to its appropriate place in the classroom.
- The teacher assesses the recording and collecting of data in an organized chart for communication by means of observation and individual conferences.
- By means of a pen and paper test (PH1.07), the teacher will assess for knowledge/understanding the ability of students to:
  - calculate power, given potential difference and current.
  - calculate energy, given power and time used.
  - calculate efficiency, given energy output and energy input.
- The teacher will assess the written lab report for inquiry, knowledge/understanding, and communication using lab product rubric (Appendix 2). (PH2.07)

Resources

1. Fundamentals of Physics: An Introductory Course: Martindale et. al. D.C. Heath 1987, Toronto
2. Teacher created activity sheet or as found in the grade nine text book.
3. Science: Ideas and Applications 10 Finucane and Lang, John Wiley & Sons
4. Various webs sites such as The Virtual Laboratory (http://physicsweb.org/TIPTOP/VlAB/) and use the necessary applets to reinforce this activity.

Accommodations

1. Where the student has an IEP, this activity will accommodate the modification(s) as outlined in the IEP plan.
2. ESL/D students will have opportunities to demonstrate their learning by alternate means while written English is developing. At the same time, instruction in written, science-specific language must continue.
3. Classroom/laboratory facilities will be modified to permit participation, regardless of impairment, in group and individual activities. Where possible, peers will be encouraged to assist in these accommodations.

Activity #9: Authentic Problem Relating to Electricity

Time: 150 minutes

Description

In this activity, students will be given an opportunity to use the knowledge and skills learned in previous activities to solve practical problems involving electric circuits, and relate the solutions they develop to real-world situations.

Strand(s) and Expectations:

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: a,b,c,d,e; 3b,c,f; 4a,b,e,f; 5a,e,f,g; 7i

Strand: Physics

Overall Expectations
At the end of grade 9, students will: PHV.01, PHV.02, PHV.03

Specific Expectations
Students will: PH2.01, PH2.02☆, PH2.08☆, PH2.09☆, PH3.02☆

Planning Notes

- Remind students of lab safety rules regarding the use of electricity. When using low voltage variable power supplies, they should be prompted to zero the adjustment knob before turning the power on, then slowly increasing the power until the bulb(s) begin to glow (not too brightly).
- Students will be using a variety of switches in the laboratory activity. Teachers should explain the difference between single pole single throw (SPST) and single pole double throw (SPDT) switches and demonstrate examples of knife switches of these two types. Schematic symbols for these types of switches will be introduced.

Prior Knowledge Required

- grade 6 electricity unit specific expectations 07, 10, 12, 13, 14, 15, 16
- simple, parallel, and series circuits

Teaching/Learning Strategies

1. Students will participate in a problem solving laboratory-based activity entitled "The Double Light Switching Puzzle". As a pre-lab activity, the teacher will lead the students in a discussion regarding the problem they will be solving; the materials they will be given to help solve it; and the group structure and format that will be used to organize and carry out their assigned task.

2. Students will break into working groups of 2 to 4. They will brainstorm on paper possible solutions to the problem and select the most promising hypothesis. The teacher will check their plans for safety.

3. Work groups will be provided with an assortment of wires, light bulbs, switches, and a low voltage DC power supply or cells and holders. After checking with the teacher, they will attempt their chosen circuit and report on its success or failure. If the circuit fails to solve the stated problem, students will re-arrange their circuit designs in an effort to achieve success. The teacher should provide assistance where necessary.

4. Students (alone or as a group), will submit a report, and verbally share their solutions with the class. A conclusion statement that includes a diagrammatic or written explanation of the pathways taken by the current to achieve the outcome that solves the problem should be included. The report should end with a section called "connections" where students provide several practical uses of this kind of circuitry in the "real" world.

Assessment/Evaluation

- This activity will be assessed for inquiry, knowledge/understanding, communication and making connections by means of a rubric based upon product assessment rubric (Appendix A3). This rubric should be developed before the activity with teacher and student cooperation. (PH2.02, PH2.08, PH2.09, PH3.02)

Accommodations

1. Where the student has an IEP, this activity will accommodate the modification(s) as outlined in the IEP plan.
2. ESL/D students will have opportunities to demonstrate their learning by alternate means while written English is developing. At the same time, instruction in written, science-specific language must continue.
3. Classroom/laboratory facilities will be modified to permit participation, regardless of impairment, in group and individual activities. Where possible, peers will be encouraged to assist in these accommodations.

Activity # 10: Careers Relating to Electrical Technology

Time: 250-300 minutes

Description

Students will gain an interest in Electrical Technology through an introduction to career opportunities. The student will be exposed to different career placements that require knowledge of electric circuitry. Through this activity students will gain further respect for the dignity of all occupations and the value of all workers. This activity must be introduced early in the unit and the time devoted to it should be spread out to allow time for research.

Strand(s) and Expectations

Ontario Catholic School Graduate Expectations:
The graduate is expected to be: 2b, c, e; 3c; 4a, b, d, e, f, g; 5a, b, e, f, g, h; 7b, j

Strand: Physics

Overall Expectations
At the end of grade 9, students will: PHV.03

Specific Expectations
Students will: PH2.05, PH3.05 ☆

Planning Notes

- Collect pamphlets on technology careers/programs from apprenticeship and college/university sources.
- Students may be assigned a college or university to discover where there are post secondary electrical technology programs.
- Each listed career has its own specific descriptor, with example titles (job classifications) classified in each unit group. Main duties to be performed and employment requirements are listed for each unit.

Prior Knowledge Required

- none

Teaching/Learning Strategies

1. Brainstorming - Students try to generate initial careers or job activities that require electrical knowledge or skills. Ideas thrown up on a “Big Board” for peer critiquing. Each idea can be looked at for it’s own uniqueness. Teacher can then supplement list with above given career listings and college, apprenticeship and university placement information. This should be done early in the unit.

2. A portfolio - developed in which the student demonstrates an ability to handle and collect relevant career related material and apply his/her knowledge to process this information which has a very “real-world” application. This should be an on-going activity in the unit. The student should keep a log or record of their work on this activity in a portfolio.

3. The Interview - Students should be encouraged to interview individuals who are in the above listed careers to gain a first hand experience as to what this job entails. This may be done at any time throughout the unit.

4. Case Study - Students will select career topics. They then investigate each career under headings such as; necessary education required, nature of the work, working conditions, employment advancement opportunities, remuneration and related occupations. The case study can be either a small group project or on an individual basis. Co-op students in the school could be used as “experts” . Apprentices affiliated with the school would also provide good role models and invaluable resource information.

5. Report/Presentation - The student presentation could be in the form of a company recruiting commercial.

Assessment/Evaluation

- Teachers should assess the students time on task in order to evaluate their inquiry skills by reviewing the student logs included in the portfolio, as well as by means of individual student-teacher conferences.
- Teachers should assess the final written report, presentation and/or portfolio for knowledge/understanding and communication skills by means of a product assessment rubric based upon Appendix A3. This rubric should be created at the start of the activity by student/teacher cooperation.

Resources

1. Guidance Centre Career Monographs "Electronic Engineering Technologist" 1991 Guidance Centre, OISE
2. National Occupational Classification, Occupational Descriptions Series 7241 to 7247
3. Internet Sites which can be made assessable through the Guidance Department

Accommodations

1. Where the student has an IEP, this activity will accommodate the modification(s) as outlined in the IEP plan.
2. ESL/D students will have opportunities to demonstrate their learning by alternate means while written English is developing. At the same time, instruction in written, science-specific language must continue.
3. Classroom/laboratory facilities will be modified to permit participation, regardless of impairment, in group and individual activities. Where possible, peers will be encouraged to assist in these accommodations.

Appendix A1: Process Rubric

CATEGORY	CRITERION	LEVEL 1	LEVEL 2	LEVEL 3 (Provincial Standard)	LEVEL 4
Inquiry	Planning	• does not demonstrate an understanding of the problem • no preparation is attempted or the preparation is incoherent or unworkable • no controls and variables identified	• demonstrates a partial understanding of the problem • preparation is limited in appropriateness and completeness • some controls and variables identified	• demonstrates a basic understanding of the problem • preparation is complete and appropriate for the activity • most controls and variables identified	• demonstrates a thorough understanding of the problem • preparation is clear, complete and appropriate • all controls and variables identified
	Personal Technical Skill	• limited competence	• moderate competence	• considerable competence	• high degree of competence
	Safety and/or Equipment Care	• safety rules broken • careless use of equipment	• safety compromised • some mishandling or misuse of equipment	• safety rules followed adequately • careful use of equipment	• extra safety practiced • extra care of equipment exercised
	Group Skills	• poor group-work skills • little contribution	• moderate group-work skills • moderate contribution	• good group-work skills • good contribution	• excellent group-work skills • excellent contribution
OCSGE	Catholicity	• lacks respect for the dignity and welfare of others	• occasionally demonstrates respect for the dignity and welfare of others	• adequately demonstrates respect for the dignity and welfare of others	• selflessly strives to respect and affirm the rights and dignity of others

Appendix A2: Lab Product Rubric

CATEGORY	CRITERION	LEVEL 1	LEVEL 2	LEVEL 3 (Provincial Standard)	LEVEL 4
Knowledge and Understanding	Hypothesis Reflects Theoretical Information	Used terms and ideas but did so inappropriately Demonstrated limited understanding Infrequently transferred simple concepts to new contexts	Used some terms and ideas appropriately Demonstrated only some understanding Sometimes transferred simple concepts to new contexts	Used terms and ideas appropriately Demonstrated considerable understanding Able to extend simple concepts and some complex concepts in new contexts	Routinely used terms and ideas appropriately Demonstrated a thorough understanding Able to extend simple and complex concepts to new contexts.
	Used prior knowledge to answer discussion questions				
	Work demonstrates an understanding of the concept(s) being investigated				
Inquiry	Application of the skills and strategies of scientific inquiry	Applies few of the skills and strategies of scientific activity	Applies some of the skills and strategies of scientific inquiry	Applies most of the skills and strategies of scientific inquiry	Applies all or almost all of the skills and strategies of scientific inquiry
Communication	Used the proper format for the lab report	Had a few elements of the criterion but did not do so clearly or precisely	Use of terminology evident but not necessarily accurate or appropriate	Uses terminology and symbols appropriately although does make the occasional error or omission	Uses terminology and symbols appropriately and at all times.
	Used the proper units for all measured quantities				
	Used the appropriate presentation format for data				
Making Connections					

Appendix A3: Product Assessment Rubric

CRITERION	LEVEL 1	LEVEL 2	LEVEL 3 (Provincial Standard)	LEVEL 4
Knowledge and Understanding				
Accuracy of description of topic	• Description of concepts is rudimentary • Very few summaries in the student's own words • Inappropriate use of terms and language • Information predominantly from one source	• Demonstrates some understanding of concepts. • Evidence of summarization and encapsulation of ideas and concepts • Terms and language reflect some understanding • Information from at least two sources	• Demonstrates good understanding of concepts • Summarizes information from a source • Good use of terminology and language • Draws on multiple sources in the development of an idea or concept	• Demonstrates thorough understanding of the concepts • Summarizes all information • Use of terminology reflecting a thorough understanding of the concept • Combines information from multiple sources on an idea or concept
Completeness of topic analysis	• Work demonstrates a limited review of the information available. • Work does not analyze concepts in depth • Facts or data not used to support ideas or concepts • Is unable to make links between two aspects of a topic	• Demonstrates a greater analysis of the information • Some analysis of concepts or ideas is evident • Minimal facts or data are used to support the topic or analysis • Is sometimes able to make links between two aspects of a topic	• Demonstrates a good review of the relevant facts • Good analysis of the concepts or ideas • Uses sufficient facts and data to support each topic or analysis • Is able to make links between two aspects of the topic	• Demonstrates a thorough understanding of the relevant facts or data • Uses a large number of facts or pieces of data to support the topic or analysis • Is continuously linking facts from one aspect of the topic with the next to provide a continuum in the analysis
Comparisons of chosen topic to related ideas	• Does not relate the topic to other areas of relevance • Work reflects a limited perspective of the impact of the topic on society and the environment	• Mention is made of at least one possible link/influence between the topic and another area of relevance. • Demonstrates some perspective of the impact of the topic on society or the environment	• Demonstrates an understanding of the at least two relationships that exist between the topic and other areas of relevance • Discusses the impact of the chosen topic on at least one aspect of society or the environment, (e.g. social, economic, pollution etc.)	• Presents a thorough discussion of at least two relationships/impacts of the topic and other areas of relevance • Demonstrates a thorough understanding of the relationships between the chosen topic and other aspects of society and/or the environment

Discussion of secondary concepts/issues	• Does not discuss secondary issues. • Demonstrates limited awareness of relevant secondary issues • Does not link the concepts within the topic to other ancillary topics or ideas	• Demonstrates some understanding of secondary issues • Makes mention of at least one secondary issue • Demonstrates some awareness of the links between at least one concept within the topic and one other ancillary topic or idea	• Demonstrates considerable understanding of secondary issues related to the topic • Discusses at least one secondary issue • Discusses the links between at least one concept within the topic and one other ancillary topic or idea	• Demonstrates a thorough understanding of secondary issues related to the topic • Discusses at least two secondary issues thoroughly • Makes the link between specific concepts within the topic and specific ancillary topics or ideas
Review of Church teachings on the topic	• Demonstrates a limited understanding of Church teachings with respect to the topic • Makes reference to Moral/Ethical issues with no reference to the teachings of the Church • Demonstrates limited understanding of the links between the teachings of the Catholic Church and the issues in the topic.	• Demonstrates some understanding of Church teachings. • Makes at least one reference to a specific Scriptural or encyclical teachings • Demonstrates some understanding of the links between the teachings of the Catholic Church and the issues discussed in the topic	• Demonstrates a good understanding of Church teachings • Makes at least 3 references to specific Scriptural or encyclical teachings • Where appropriate, links at least one concept/issue in the topic to the teachings of the Catholic Church	• Demonstrates a thorough understanding of Church teachings. • Concepts/issues of the topic are discussed with specific reference to the teachings of the Catholic Church • Where appropriate, links are made between all relevant issues/concepts and the Church's teachings.
Use of diagrams, charts and graphics	• Demonstrates limited appropriate use of diagrams charts or graphics • Diagrams, charts or graphics serve a decorative purpose only	• Demonstrates appropriate use of diagrams, charts or graphics. • Diagrams, charts or graphics are used to enhance a point or concept	• Demonstrates a good understanding of the use of diagrams, charts and graphics to illustrate/reinforce a point or concept • Uses diagrams, charts or graphics to support concepts and to explain ideas • Makes reference to diagrams charts or graphics in explaining a point or concept	• Demonstrates a thorough understanding of the use of diagrams, charts and graphics in the elaboration of ideas and the enhancement of a product • Uses diagrams, charts and graphics to explain/elaborate and reinforce ideas and concepts when necessary • Makes reference to diagrams, charts or graphics throughout the product
Inquiry				

Use of Internet Resources	• Demonstrates limited use of the Internet as a source of information • Uses limited Internet references - some may be inappropriate • Uses "cut and paste" rather than summary and reference	• Demonstrates some use of the Internet as a source of information • Uses some appropriate Internet references • Demonstrates some summarization of information with appropriate referencing	• Demonstrates a good use of the Internet as a source of Information • Uses sufficient and appropriate Internet references • Demonstrates good summarization of information and cross referencing of information	• Demonstrates a thorough understanding of the Internet as a source of Information • Uses extensive and appropriate Internet References • Demonstrates complete summarization of information with extensive cross-referencing of information
Use of other electronic media	• Demonstrates limited use of on-line or CD-ROM sources • Uses Encyclopedic CD-ROM sources • Demonstrates limited understanding of the appropriateness of material	• Demonstrates some use of on- line or CD-ROM sources such as SIRS or similar research tool • Uses Encyclopedic as well as subject specific CD-ROM sources • Demonstrates some understanding of the appropriateness of material	• Demonstrates good use of on-line or CD-ROM sources • Uses a variety of on-line tools and sources/materials • Demonstrates a good understanding of the appropriateness of material	• Demonstrates a thorough use of on-line or CD-ROM sources • Uses a wide variety of on-line tools and sources/materials • Demonstrates thorough understanding of the appropriateness of material
Use of traditional research tools (books, articles)	• Demonstrates a limited understanding of research techniques using traditional sources • Demonstrates a limited understanding of the use of linking information from two or more sources to support a concept or idea	• Demonstrates some understanding of research techniques using traditional sources, (subject search) • Demonstrates some linkage between sources to support a concept or idea	• Demonstrates a good understanding of research techniques. • Demonstrates good linkage between sources in support of an idea or concept.	• Demonstrates a thorough understanding of research techniques. • Demonstrates extensive linkage between sources to support a concept or idea
Communication				

Product organized according to a discernable outline	• Demonstrates a limited understanding of the use of an outline • Product is not coherent or organized in a topical manner • Related concepts are disjointed • Demonstrates no 'flow' from one concept to the next	• Demonstrates some understanding of the use of an outline • Product is organized according to an outline. • Related concepts are grouped together • The flow from one group to the next is not coherent	• Demonstrates a good understanding of the use of outlines to organize material • Product is organized and coherent • Topics are grouped according to the discernable links between them • Flow from one concept to the next is coherent	• Demonstrates a thorough understanding of the use of outlines in organizing both research and product • Product is organized and coherent • Topics within a sub-group are related • Each topic group leads logically into the next.
Making Connections	Use this to develop specific criteria relating the topic to the discussions in class or in society.			

Appendix A4: Collaborative Rubric

Group/Self/Teacher Rating Scale for Group Skills

Circle the number that best demonstrates the behaviour as outlined below.

1 = rarely
2 = seldom
3 = usually
4 = always

	Your Name	Peer Name	Peer Name	Peer Name
STAYED ON TASK _ not easily distracted _ contributed actively _ seen researching, note-taking	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
ACTIVELY LISTENED _ eye to eye contact _ attentive facial expression _ asked for clarifications _ hear one voice at a time	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
FOLLOWED ASSIGNED ROLES _ facilitator _ motivator _ recorder _ task master	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
WORKED COOPERATIVELY _ offered opinions politely _ kept a positive attitude _ accepting of others' ideas _ respected principles of brainstorming	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
COMPLETED THEIR FAIR SHARE OF THE WORK	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

GROUP ROLES & DESCRIPTIONS

Facilitator:	Ensures that everyone understands the work in progress. Keeps the group moving towards the accomplished goal.
Recorder:	Writes and pulls together the conclusions of the group so that they can be presented coherently.
Motivator:	Provides support to the members of the group so that they are more enthused about their participation. Makes helpful suggestions.
Task Master:	Keeps the group focussed on the task and monitors the time.

Appendix B: Science World

A Personal Journey Through The World of Science

Science World is an individualized, interdisciplinary, project-based activity that allows students to relate and extend scientific and technological concepts learned in class to everyday life. It will give them an opportunity to explore science beyond the classroom and receive credit for personal activities, interests, and hobbies they may already be engaged in outside the school environment or in departments other than science. Students should keep a log or a student journal to keep track of new words, data from class experiences that may be extended and a record of activities that have been completed.

Students will engage in Science World projects throughout the course. Teachers will provide the necessary student-friendly outlines and guides suggesting possible Science World activities in all units of the course. Students will be free to choose the activities they would like to work on. They will also be given the option to design and perform their own Science World project. The products of their effort will be placed in a personal Science World portfolio. Process and product will be assessed and evaluated according to suitable teacher-developed marking schemes and assessment rubrics (see Appendices A1, A2, and A3 in this document for samples).

Teachers will establish policies regarding timelines available for the design, development, and submission of final products. Flexibility is important in this regard. Students should be allowed to put forth their best effort---not one compromised by unreasonable time constraints (with the provision that projects commenced late in the school year need to be started at a suitable time to ensure completion). Student self-pacing must be encouraged. Teachers must also assist in arranging and scheduling dates, times, and places for staging certain events or large and small group presentations (as Science World extends to other courses, this could become a department-wide activity).

Teachers will assist students develop effective time-management skills, select group members where necessary, and select activities that suit their interests and abilities. They will facilitate the search for required materials and equipment; the search for reference materials; and the search for suitable community-based resources. Teachers must not exert excessive control over the selection, design, or perform/create aspects of the projects. Science World must remain an exclusively student- centered activity.

Science World structure and content may be modified to suit local school conditions, extended community profile, and student population characteristics as well as any possible limitations on the availability of resources.

The present version of Science World allows students to select from five different classes of activities; each assigned a different number of points (these could be adjusted by an individual teacher for a particular school):

1. Mini Explores: These are relatively short projects that are meant to be fun, interesting, and challenging. A sample Mini Explore Guide is found at the end of this appendix. Teachers will be expected to develop others. (10 Points)

2. Major Explores: These are formal science fair projects involving in-depth study done over a longer period of time. They usually require the design and performance of a single laboratory-based research project that usually requires a detailed written report and a project board. (30 Points)

3. School Clubs: Students may obtain Science World credit by joining and making a significant contribution to certain school clubs and associations that have a significant science or technology content. Examples would include audio-visual and stage lighting technicians for school productions, math club, science club and debating club (if science or technology concerns are debated). (10 Points)

4. Da Vinci's Dilemma or Science Olympics: This would be a large group activity organized in a "Science Olympics" format and taking place over a number of days. Groups of students would compete against one another on challenging problem-solving activities that involve elements of science, technology, art, and mathematics. (20 Points)

5. Major School Field Trips: Various school clubs and associations may from time-to-time organize major (overnight) excursions to distant locations of interest. Some of these may have enough of a science or technology component to qualify for Science World credit. Alternatively, the science department could arrange such an excursion. (20 Points)

In order to complete Science World, students will have to accumulate a particular number of points (e.g. 30) by the end of the school year or semester. Since different classes of activities involve differing amounts of time and effort, a reasonable combination of activities must be selected by students for credit.

Sample Mini Explore Guide

1. **Explain the role male hormones play in the development of "Male pattern Baldness."** 2-3 page report including caused, treatments and possible cures, diagrams, photos, print and internet references. (Biology Unit)

2. **Create a photo album of the moon's phases.** Portfolio of 6-8 photographs of different phases of the moon. The photos must be properly labelled and placed in plastic protectors. (Earth/Space Unit)

3. **Create a Science Board Game.** The game must illustrate a theme, or principle learned in the course. It must have "play-value" and should be artistic and colourful. It should "make sense" and teach as one plays. (Any Unit)

4. **Design and Build a Science Mobile.** The mobile must be light-weight, colourful, and illustrate one of the themes, concepts, or principles learned in the course. (Any Unit)

5. **Write a Science Poem.** The poem must be a rhyming poem composed of a minimum of 4 stanzas containing no less than 4 lines each, or 3 different limericks. The poem or limericks must be original and must explain a science concept or principle learned in the course. (Any Unit)

6. **Build a Solar System Model.** The model must include the sun and the nine planets. Each component must be shaped and coloured to look as realistic as possible. They must also be sized to scale. (Earth/Space Unit)

7. **Produce a Video Clip or Computer Simulation.** You may use video or computer animation and special effects techniques to produce a product that illustrates a scientific principle or concept learned in the course. Audio is optional. (Any Unit)

8. **Construct a Radio that Works.** The radio must be "home-made", not store-bought. Plans may be obtained from the internet or popular science magazines. (Physics Unit)

9. **Participate in the Science Scavenger Hunt.** Groups of students will compete with one another amassing a list of interesting and unusual "sciencey" items that need to be retrieved over a number of days. The list should include esoteric, cryptic items that require some research to identify). (Any Unit)

Appendix C1: A Catholic Perspective on the Applications of Science: Guiding Principles (Teacher)

Stewardship

The biblical story of creation is a revelation of the goodness of all creation. Humankind, as the culminating act in the first creation story, was given dominion over creation. To be given dominion over creation was to be given dominion over the goodness of creation. The human person, the pinnacle of creation, was to exercise this responsibility in a manner that respected the **integrity** (order, substance, goodness, love, life, spirit and soul) of all that was created. The role that humankind assumed, in order to safeguard the integrity of creation, was that of a **steward**. A steward is a caretaker. All human persons are called to tend to the created world with the wisdom of the divine Steward. The divine Steward is the creator of life and people are the custodians of that life. Science and technology, in their methods and applications must safeguard the integrity of life.

Environment

The environment is the contact point between the implicit order of the universe and the physical substance of life. The environment exists in delicate harmony at the junction of order and substance. The **Providence** of God (God's plan and care for the universe) is most evident at this juncture. Life is inextricably rooted in the environment. Destruction of the environment threatens the delicate balance of life. The human and personal call to stewardship requires that safeguards be placed on the environment in order to protect the integrity of life.

Resources

The resources of the earth have been created in order to promote the welfare of all life. Resources by their nature are limited in their availability and renewability. The resources of the earth are part of the established order of the universe and as such serve a role in the maintenance of life on this planet. Humankind in exercising stewardship must use the resources of the earth in such a way as to promote the welfare of all life, while at the same time not jeopardizing the order of life. It must also be recognized that the resources of the earth are to be used to promote the **greater good** of all humankind.

The extraction of resources from the earth must be done in the least environmentally intrusive manner possible. It would also be consistent with good stewardship to regenerate the areas damaged by the processes of extraction. In the processing of various resources safeguards must be in place to minimize damage to the environment by the waste products. It is also incumbent upon employers to safeguard the health and welfare of all workers involved in the extraction and processing of metals and minerals. To ignore these measures would be to deny the **dignity** and value of the human person and to place a higher priority on capital than labour.

Energy

Energy is a necessary commodity for life. Energy must be used to promote the greater good of all life. It must be made available for the fundamental needs of all humanity. Many forms of energy are not renewable. Other forms, while potentially unlimited, carry with them a high environmental cost. Some forms, while not economically viable, are environmentally sustainable. Good stewardship requires that consumption, cost, environmental disintegration and sustainabilty all be considered in making decisions about which forms of energy would best serve the economic, environmental and human needs of the planet. It would also encourage students to envision a world in which consumption, cost, and the environment existed in a sustainable relationship. Once again, the health and safety of workers employed in energy research, transformation or transmission must take a higher priority than considerations for maximizing capital gain.

Economy

All economic systems rely on the goods of the earth in order to function. The Creator is the source of all the **goods of the earth** and has created them to help **sustain life**. Economic systems which reflect the Providential order of the universe will provide for the needs of all of God's

creations. Economic systems that are driven by unbridled personal gain or Godless purpose will lead to exacerbated social inequalities and/or social disintegration.

The **human person and the natural environment** must be at the centre of all economic life. The economy must be placed at the service of the people of God . An economy that finds its purpose in the service of people, will provide opportunities for all members of its society to live according to the plan of God and to grow in **holiness** (wholeness). A humanizing economy will see work as a basic human right. People will not be treated as units of productivity. Wages will not be determined by market forces alone. The interests of individuals will be bridled by the greater common good. Resources will be used for the creation of life-giving communities. The environment will be treated as integral to the life of the community.

Appendix C2: A Catholic Perspective on the Applications of Science: Guiding Principles (Student)

In the story of creation (Genesis 1-2:4) we read that it was God who created the universe. This belief, that we all share as Christians, compels us to look at life in a special way. We see that the entire universe is part of God's larger plan (**Providence**) for our salvation. It also means that all of creation shares in the meaning and purpose of God's plan. God made the **human person** the pinnacle of creation. We read, in the Bible, (Genesis 2:7) that God breathed life-giving breath into humanity. This life-giving breath was the spirit of the Creator. We, as human persons, were created in the image of God. We were given special responsibilities as a result of being given some of the gifts of the Creator. We were to use our gifts of spirit, love, sexuality, intellect, will, imagination and creativity to sustain the life of the planet. When we do so we act with **integrity**. We read in the Bible (Genesis 1:28) that all of humanity was given dominion over life. We were to act as **stewards** (caretakers) of all of creation. To be stewards we had to act in a way that would ensure the survival of life on the planet. When we act in this manner we sustain the **goodness** of creation.

We read in the Bible (Genesis 3) the story of our human weakness. We were given **free will** by our Creator. When we make our own individual interests more important than the **good** of others then we loose our integrity (**disintegration**). In this state we are subject to sin and as we see in the story of Cain and Abel (Genesis 4:1-12), jealousy and anger bring death (loss of wholeness) into our lives.

Science and technology are fruits of the human intellect. Advances in both science and technology have done much to further our understanding of the world in which we live. As students of science, we cannot help but marvel with **wonder and awe** (gifts of the Holy Spirit) at the miraculous nature of the universe. As stewards of the earth, we must make sure that both science and technology work to enhance life on the planet. We now know how **interdependent** the inanimate (non- living) and animate (living) parts of the biosphere are. As caretakers, we must recognize that the exploitation of resources endangers the delicate balance of life. It is our responsibility to make sure that when we extract minerals and metals from the earth that we do not destroy the local ecosystem. We must also be aware that the by-products (pollutants) of our industrial processes pose a significant threat to life. We must safeguard the local and global environments from the toxic effects of pollutants.

As human persons, we have a special obligation to other people in the world (**solidarity)**. In the story of Cain and Abel (Genesis 4:9) we hear the question **Am I my brother's/sister's keeper?** The answer is a resounding yes. We must make sure that we ask certain questions each time we are deciding on the value of an application of science. How will this contribute to the **greater good** of humanity? How will this benefit the **poor?** Does this threaten the **life-sustaining** capacity of the earth?

Appendix C3: References

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