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*Public and Catholic District School Board Writing Partnerships*

Locally Developed Compulsory Credit Course

# Course Profile

## **Science**

Grade 9

SNC1L

• *for teachers by teachers*

This sample course of study was prepared for teachers to use in meeting local classroom needs, as appropriate. This is not a mandated approach to the teaching of the course. It may be used in its entirety, in part, or adapted.

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## Course Overview

### Locally Developed Compulsory Credit Course: Science, Grade 9, SNC1L

#### Course Description

This course emphasizes reinforcing and strengthening science-related knowledge and skills, including scientific inquiry, critical thinking, and the relationship between science, society, and the environment, to prepare students for success in everyday life, in the workplace, and in the Grade 11 Science Workplace Preparation course.

Students explore a range of topics, including science in daily life, properties of common materials, life-sustaining processes in simple and complex organisms, and electrical circuits.

Students have the opportunity to extend mathematical and scientific process skills and to continue developing their skills in reading, writing, and oral language through relevant and practical science activities.

#### How This Course Supports the Catholic School Graduate Expectations

The study of science helps students learn to be reflective, critical, and creative thinkers, as well as discerning believers who can apply their knowledge in the spirit of social justice to the world around them. Throughout this course, students are challenged to examine themselves and their role in the classroom and beyond. Students are continually challenged to make decisions in light of Gospel values and Church teachings, to take action, to make an impact, and to change things for the greater good. The study of science teaches students to be collaborative contributors to an interdependent team, respecting the rights, responsibilities, and contributions of others. Throughout the course, students are given continual opportunities to experience success, allowing them to build self-confidence in their own abilities to solve problems and deal with authentic situations. These experiences allow students to continually consider and reflect on the role of science in the workplace, and to learn to find meaning, dignity, fulfillment, and vocation in the work they do.

#### Course Notes

- This Course Profile is a sample course of study that teachers can use in its entirety, in part, or adapt to meet the specific needs of students in their classrooms.
- Students examine personal and workplace situations with an emphasis on learning how to protect their health and safety, as well as the health and safety of those around them. Expectations from the Unit 1: Scientific Inquiry: Science in Daily Life are integrated throughout each unit, since these form the core set of knowledge and skills in this course.
- Learners arrive with a wide range of scientific knowledge and skills gained in previous courses and other experiences. The activities in Unit 1 are designed to assess this range of scientific knowledge and skills to identify the scientific inquiry skills that students need to develop and/or extend in order to have a solid foundation for learning the concepts and skills presented in subsequent units. The units that follow address the specific concepts and skills related to the subjects Physics, Biology, and Chemistry.
- Throughout the units, students focus on specific social skills such as collaboration, appropriate language in conversations, and respect for other opinions as they engage in the tasks. A different skill is integrated into their work for the day. Teachers decide how to introduce this social skill and determine how students are expected to track their use of it. At the end of the activity, students reflect on how well they did.

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- Expectations are clustered into units based on common themes. Each unit is subdivided into multiple clusters of expectations. Some expectations appear several times so that students have multiple opportunities to meet the expectation and demonstrate their achievement.
  - Unit 5: Making Personal Decisions represents the final thirty percent evaluation. Students should be introduced to the final task well before it is begun, and some of the preparation for the final task should take place during the other units. Each unit provides practice to prepare students in some aspect of the final task and at the end of the course. In particular, the first three activities of Unit 5 actually occur while Unit 4: Chemistry: Properties of Common Materials is still underway. Please see the Planning Notes in Unit 4 for suggestions about when to introduce these activities.
  - Teaching/learning activities are designed with the nature of the adolescent learner in mind. Emphasis is placed on providing opportunities for students to experience success; to engage in hands-on, practical, and relevant activities; to develop and practise Essential Skills; to be reflective about their learning; and to be well supported in their efforts to learn and grow.
  - Literacy strategies are embedded throughout the Course Profile to help students gather, interpret, and integrate information; communicate effectively in a variety of forms; and use before-, during-, and after-reading strategies to improve reading comprehension of scientific and technical texts. Forms of Communication include oral, written, and graphical, with a particular emphasis on oral communication as the precursor to the further development of reading and writing skills. See Appendix A: Strategies for Literacy Connections in the Science Classroom.
  - Mathematical literacy is an important component of science education and has been included, where appropriate. Skills such as estimating and measurement, gathering and analysing numerical data, reading and understanding of graphs and graphical material, problem solving, and inquiry are of particular importance.
  - Activities are designed to allow students to practise the Essential Skills that they require for success in the workplace, e.g., they work with the types of documents they may use in the workplace. The Resources list provides suggestions of sources for these authentic documents.
  - Wherever possible, opportunities to provide student choices based on personal interest should be incorporated into the activities. Possible strategies to assist students in identifying areas of personal interest and in making appropriate choices are included in individual activities, where appropriate.

## **Health and Safety**

Teachers are responsible for ensuring the safety of students during classroom activities and for teaching students to assume responsibility for their own and others' safety. They must model safe practices and communicate safety expectations to students in accordance with school board and ministry policies. This concern for safety in science requires that students demonstrate:

- knowledge about the materials, tools, processes, and procedures used in science;
- skill in performing tasks in the laboratory;
- knowledge about health and safety concerns and about the care of living things (plants and animals) that are brought into the classroom;
- concern for the health and safety of self and others.

Students demonstrate the knowledge, skills, and habits of mind required for safe involvement in science when they, for example:

- maintain a well-organized and uncluttered work space;
- carefully follow the instructions and example of the teacher;
- identify possible health and safety concerns;
- follow established safety procedures;
- suggest and implement appropriate safety procedures in new situations;
- comply with Workplace Hazardous Materials Information System (WHMIS) legislation.

The health and safety of teachers and students must be of paramount importance when conducting laboratory activities. Teachers must provide specific instructions and cautions regarding the safe handling, storage, and disposal of materials and safe handling and storage of equipment used in each activity. See *Stay Safe*, the STAO safety booklet for suitable safety rules for students.

## Units: Titles & Time

Unit 1	Scientific Inquiry: Science in Daily Life	15 hours
Unit 2	Biology: Staying Alive	25 hours
Unit 3	Physics: Electrical Circuits	25 hours
Unit 4	Chemistry: Properties of Common Materials	25 hours
Unit 5	Making Personal Decisions	20 hours

## Unit Overviews

### Unit 1: Scientific Inquiry: Science in Daily Life

**Time:** 15 hours

#### Unit Description

Through study of science and its processes, students can acquire a valuable perspective on the workplace and everyday life. They use critical thinking and inquiry skills that include generating questions and being able to answer those questions experimentally with an understanding of the factors that might affect experimental results; the concept of a fair test. In addition, students learn to use common laboratory tools appropriately and safely and to make connections with how tools used in science are also used in daily life.

As students perform two simple experiments, they analyse the factors that affect the results of the experiments, change one factor, and observe the changes in the results. Students are introduced to a discrepant event, for which they brainstorm and analyse questions as: testable by experiment, answerable by research, or not answerable scientifically. They further analyse the testable questions for practicality. Students are introduced to General Lab Safety Rules preparatory to their acquiring a Handling Lab Equipment Part 1 Licence. Students devise a fair test method of comparing the bouncibility of a variety of sports balls and write a procedure for their method. They collect results and create bar graphs, which they use to discuss the materials and uses of the particular balls. They write a paragraph on the connection of science to everyday life.

In the final activity, students pose and analyse simple questions of personal choice, plan fair test methods, and conduct experiments to answer the questions and present their results.

#### Unit Overview Chart

Activity	Learning Expectations	Assessment Categories	Focus
1.1 Introduction to the Fair Test	SILV.01, .02, SIL1.02, 2.02, 2.04, 2.05 CGE5a	Knowledge/ Understanding Inquiry	Manipulating experimental factors to affect a specific result
1.2 Asking Questions	SILV.01, .02, .03, SIL1.01, 2.01, 2.03, 2.06, 3.02 CGE3c	Knowledge/ Understanding Inquiry Making Connections	Experimental questions and safe laboratory investigations

Activity	Learning Expectations	Assessment Categories	Focus
1.3 Applying Inquiry to Daily Life	SILV.01, 02, .03, SIL1.01, 2.02, 2.03, 2.04, 2.06, 3.03  CGE2c, 2d, 5b	Knowledge/ Understanding Inquiry Communication Making Connections	Designing and conducting a fair test
1.4 Investigating a Testable Question	SILV.01, .02, .03, SIL1.02, 2.01, 2.02, 2.03, 2.04, 2.05, 2.06, 3.01, 3.02  CGE2c	Knowledge/ Understanding Inquiry Communication Making Connections	Investigating testable questions

## Unit 2 Biology: Staying Alive

**Time:** 25 hours

### Unit Description

This unit connects life-sustaining processes and systems to procedures important for personal safety in the workplace, the home, and everyday life. The skill emphasis is on the development of testable questions.

Students review the concept of life-sustaining processes while reinforcing the skills of observation, data collection, and communication. They pose questions and investigate simple life processes. Students expand their knowledge of the structures and systems required for these life-sustaining processes. The activities, including a safe dissection or simulation, build on an understanding that structures work together in organized systems to support life. Students connect this understanding to their personal lives and future work experiences. They identify the characteristics of a safe workplace and choose personal protective equipment appropriately. They build on Essential Skills needed in the workplace: document use, finding information, and decision making.

### Unit Overview Chart

Activity	Learning Expectations	Assessment Categories	Focus
2.1 Life-Sustaining Processes	BSAV.01, .02, BSA1.01, 2.01, 2.02, 2.04, 2.05 SILV.02, SIL2.01  CGE2c, 3c, 5a, 7i	Knowledge/ Understanding Inquiry Communication	Developing skills in microscope use and questioning; examining life-sustaining processes
2.2 Interconnected Systems	BSAV.01, .02, .03, BSA1.02, 1.03, 2.02, 2.03, 2.04, 2.05, 3.01 SILV.01, .02, SIL1.01, 2.03, 2.04, 2.05, 2.06  CGE4f	Knowledge/ Understanding Inquiry Communication	Dissection skills, structures, and systems required for life-sustaining processes
2.3 Personal Safety	BSAV.02, .03, BSA2.04, 2.05, 3.01, 3.02 SILV.01, .02, .03, SIL1.01, 2.05, 3.03  CGE2c, 7j	Knowledge/ Understanding Inquiry Communication Making Connections	Personal safety in the workplace

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### Unit 3: Physics: Electrical Circuits

**Time:** 25 hours

#### Unit Description

Students are made aware of the practical uses of electrical circuits in their daily lives. They develop an understanding of current electricity and the role it plays in everyday life. The scientific skill emphasis is on gathering, organizing, and working with qualitative and quantitative data.

Students investigate how the components of circuits work together and build simple circuits that model everyday circuits. They collect data as they measure current and potential difference in various circuits and relate this understanding to everyday electrical devices in circuits. Using a variety of household and workplace devices, they develop a logical checklist for troubleshooting electrical devices.

Safety, experimentation, literacy, and collaboration are integral components of the activities. Students build on the following Essential Skills needed in the workplace: oral and written communication; document use; and thinking skills, including problem solving and decision making.

#### Unit Overview Chart

Activity	Learning Expectations	Assessment Categories	Focus
3.1 Introduction to Electric Circuits	PECV.01, .02, .03, PEC1.01, 1.02, 1.03, 1.04, 2.03, 2.04, 3.01 SILV.02, SIL2.03, 2.04  CGE2b, 2d, 3c, 5a	Inquiry Making Connections	Introduction to electrical terms and the building of circuits
3.2 Building a Common Electrical Device	PECV.01, .02, PEC1.01, 1.02, 1.03, 1.04, 2.03 SILV.02, SIL2.03, 2.04  CGE2b, 2d, 3c	Knowledge/ Understanding Inquiry	Building an everyday electrical device from a circuit diagram
3.3 Properties of Series and Parallel Circuits	PECV.01, .02, PEC1.01, 1.04, 2.01, 2.02, 2.03, 2.04, 2.06 SILV.02, SIL2.03, 2.04, 2.05, 2.06  CGE2b, 2d, 3c, 5a	Knowledge/ Understanding Inquiry Communication	The properties of series and parallel circuits
3.4 Troubleshooting Electrical Devices	PECV.01, 02, .03, PEC1.02, 1.03, 2.05, 3.01, 3.02 SILV.01, .02, .03, SIL1.02, 2.04, 3.03  CGE2b, 2d, 3c	Inquiry Communication Making Connections	Safety precautions and troubleshooting for electrical appliances

### Unit 4: Chemistry: Properties of Common Materials

**Time:** 25 hours

#### Unit Description

Students are made aware that both hazardous and non-hazardous materials surround them in their home, school, and workplace environments and that making decisions about the safe use, handling, and disposal of these materials is an important life skill. The skill emphasis is on inquiry, drawing conclusions, and making decisions based on data. Students develop an understanding of the importance of Household Hazardous Product symbols (HHPs) and Workplace Hazardous Materials Information System (WHMIS) symbols and of following safe procedures when handling common materials.

By designing and conducting laboratory investigations, they gain an understanding of the physical and chemical properties of various common materials and decide on how they can refine their investigation. Students plan and conduct a safe investigation of two similar materials and recommend the best material for a specified purpose based on its physical and chemical properties. Students practise and refine their literacy and communication skills. The Essential Skills needed in the workplace are problem solving, decision making, and writing. Activities from Unit 5: Making Personal Decisions are interspersed in this unit to permit the preliminary work required for the final task.

### Unit Overview Chart

Activity	Learning Expectations	Assessment Categories	Focus
4.1 Safety First	CPMV.01, CPM1.01, 1.02  CGE5f, 7i, 7j	Knowledge/ Understanding Communication	Materials safety
4.2 Describing Materials (Physical and Chemical Properties)	CPMV.01, .02, .03, CPM1.03, 1.04, 1.05, 2.02, 2.03, 3.01, 3.02 SILV.02, SIL2.03, 2.04  CGE3c, 5f, 7i, 7j	Knowledge/ Understanding Inquiry Communication Making Connections	Physical and chemical properties of materials
4.3 Chemicals in the Workplace	CPMV.01, .02, CPM1.03, 1.04, 1.05, 2.02, 2.03 SILV.02, SIL2.03, 2.04  CGE3b, 3c, 5f, 7j	Inquiry	Chemical safety in the workplace
4.4 The Best Material for the Job	CPMV.02, .03, CPM2.01, 2.02, 2.03, 2.04, 3.01, 3.02, 3.03 SILV.02, .03, SIL2.03, 2.04, 2.05, 2.06, 3.02, 3.03  CGE2b, 3b, 3c, 5f, 7j	Inquiry Communication Making Connections	Planning and conducting an investigation, collecting data, analysing results, and making recommendations

## Unit 5: Making Personal Decisions

**Time:** 20 hours

### Unit Description

Students demonstrate the laboratory and technical inquiry skills, communication skills, and the concept of “fair test” that they developed throughout the course. By investigating a personally chosen topic, students collect qualitative and quantitative data through scientific investigations, research a product of their choice, and provide a recommendation for choosing a product.

Students use existing product comparisons to review questioning skills for decision making. They submit a proposal outlining the questions they plan to test and focus on the design of the personal investigation. Students carry out their investigation, evaluate and refine their investigation, and make recommendations. They summarize their investigations and recommendations in a report. Throughout the process, they self-assess and receive teacher and peer feedback to improve their final product.

## Unit Overview Chart

Activity	Learning Expectations	Assessment Categories	Focus
5.1 Finding Information: The Questioning Consumer	SILV.02, SIL1.01, 2.01 BSAV.02, BSA2.04 PECV.02, PEC2.05  CGE2d, 2e, 3c	Knowledge/ Understanding Communication	Formulating questions, examining product comparison reports
5.2 Decision Making: The Question and Proposal	SILV.02, .03, SIL2.01, 3.01  CGE2b, 2c, 2d, 5d	Inquiry Communication Making Connections	Pose questions of personal interest and analyse for reasonability, safety, expense, etc.; create and submit a proposal
5.3 Planning the Investigation	SILV.01, 02, SIL1.02, 2.02 BSAV.03, BSA3.01, 3.02  CGE2c, 2d, 3c, 4f	Knowledge/ Understanding Inquiry Communication Making Connections	Plan and design an investigation, including safety checklist; submit design and rationale
5.4 Conducting the Investigation	SILV.02, SIL 2.03, 2.04, 2.06 CPMV.02, CPM2.02, 2.03  CGE4f	Inquiry Communication	Conduct investigation, record data and observations
5.5 Evaluating the Evidence	SILV.01, .02, .03, SIL1.02, 2.05, 3.02, 3.03  CGE4b, 5a, 5f, 5g	Knowledge/ Understanding Inquiry Making Connections	Interpret data, draw conclusions, evaluate and refine investigation in order to make recommendations
5.6 Preparing the Product Comparison Report	SILV.02, SIL2.06 BSAV.02, BSA2.05 CPMV.02, .03, CPM2.04, 3.03  CGE4f, 5g	Communication Making Connections	Summarize and justify investigation and recommendations in a report

## Teaching/Learning Strategies

The goal of this course is to develop conceptual understanding of scientific principles and relationships by fostering a safe and inviting classroom where students gain confidence in their abilities and experience success. Many of the suggested teaching and learning strategies assist in the development of routines, provide opportunities for feedback and reflection, and aid students in gaining a repertoire of essential skills and knowledge.

Strategies include:

- The use of flexible groupings
- Opportunities for talk and discussion
- Practical, relevant, authentic tasks
- Interactive, hands-on activities
- A focus on personal safety and the safe use of scientific tools and equipment
- The use of manipulatives and models
- Opportunities for metacognition and reflection

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- Expanding the learning environment beyond the classroom
  - A focus on skill development
  - Inquiry problem-based learning
  - Age- and skill-level-appropriate resources – print, electronic, community
  - The use of scaffolded supports
  - Assignments based on personal choice
  - Ample opportunities for practice with feedback
  - The use of portfolios to collect and organize student work
  - The use of Operator’s Licences to track skill development
  - The use of authentic workplace documents and experiences
  - Collection, organization, presentation, and analysis of data using a variety of presentation formats

## **Assessment & Evaluation of Student Achievement**

Seventy percent of the grade will be based on assessments and evaluations conducted throughout the course. Thirty percent of the grade will be based on a final evaluation as defined in *The Ontario Curriculum Grades 9 to 12 Program Planning and Assessment 2000*. The term assessment refers to feedback that is provided to students to improve their learning. The term evaluation refers to data that will be used by the teacher to determine a student’s report card grade. In Units 1 through 4, evaluation refers to data that the teacher uses to determine the seventy percent of this grade assigned to course work. The evaluations referred to in Unit 5: Making Personal Decisions together form the final thirty percent of a student’s report card grade.

*In each unit, there are extensive supports given for assessing and evaluating student learning during the activities. Throughout each stage of the activities, there are suggestions for providing immediate and ongoing feedback to move students forward in their learning. Teachers are encouraged to use their professional judgement and their knowledge of the students in selecting opportunities, strategies, and tools for this process.*

The Course Profile is structured around assessments that allow students to develop and demonstrate personal growth. Diagnostic assessment forms the major focus of Unit 1 and is incorporated into the beginning of Units 3 and 4. There are opportunities for frequent, on-going feedback to students throughout the course from a range of self-, peer, and teacher assessments that are built into the activities. To build in success and to make the tasks more manageable, a performance task is suggested for each activity. The performance tasks provide practice in the components that must be demonstrated in the final thirty percent evaluation represented by Unit 5: Making Personal Decisions.

Throughout the course, students have an opportunity to practise the skills needed for the tasks in Unit 5.

In Unit 1: Scientific Inquiry: Science in Daily Life, students develop skills in gathering data, formulating testable questions, and drawing conclusions from data. Although all skills are necessary in each unit, one of each of these skills is emphasized in Units 2 through 4. The units are designed so that students experience a logical progression of these skills. In the Biology unit, the skill emphasis is on formulating testable questions. In the Physics unit, the skill emphasis is on data collection and organization. In the Chemistry unit, the skill emphasis is on drawing conclusions and making decisions based on data. Since each skill builds on previous skills, teaching these units in this order is suggested to best support student learning.

In Unit 5: Making Personal Decisions the evaluation takes the form of a series of activities, which are performed toward the end of the course. Each activity contains a rehearsal, where students take time to review their knowledge and skills and receive feedback, followed by a task that is evaluated. The data collected through these evaluations forms the final thirty percent evaluation for this course. The first three of these activities take place while Unit Four: Chemistry: Properties of Everyday Materials is still in progress, to provide students the time they need to achieve success in their final evaluation.

A theme running throughout the assessment of the LDCC Grade 9 Science course is demonstrating mastery of the use of specific tools, or skill sets, e.g., the use of WHMIS symbols. To make connections to the workplace skills students earn an Operator’s Licence in each area – Electric Circuit Operation; General Lab Safety; Handling Lab Equipment; Microscope Operation; Use, Storage and Disposal of Chemicals. These licences might be collected in a portfolio so that students can see the development of their skills throughout the course and could be used as evidence that they have mastered the skills. In each unit, a minimum of one Licence is required. Students can earn a Licence when a minimum of Level 3 achievement is demonstrated. Where appropriate, e.g., WHMIS, where the industry standard is 100% achievement, this minimum achievement can be modified. Students who are unsuccessful in obtaining their Licence on the first attempt should be given additional opportunities to earn a Licence as their skills progress.

Students will maintain a personal portfolio. Decide on the format, sections, and methods of storing the student portfolio. In addition to tracking academic achievement, students may also keep a learning skills tracking sheet in their portfolio to record their successes in individual and group work. Information on learning preferences and styles, student reflections, and all Licences are included in the portfolio. Suggestions for inclusion of items in the portfolio occur within the teaching/learning strategies for various activities.

### Building an Effective Rubric

- Determine a cluster of expectations to be assessed and/or evaluated.
- Decide how the students will be expected to demonstrate achievement of these expectations (i.e., build a performance task).
- Connect the selected expectations to one or more of the Achievement Chart categories. **Note:** The verb is often an indicator for connecting the expectation to a particular category.
- Develop criteria for each expectation that identify the aspects of student performance that are to be assessed and/or evaluated (i.e., the “look fors”).
- Indicate the required characteristic for each criteria (e.g., clear, effective, accurate, appropriate).
- Provide qualifiers for each of the four levels of achievement (i.e., limited, some, considerable, high degree).

### Accommodations

Accommodations refer to the teaching strategies, supports, and/or services that are required in order for a student to access the curriculum and demonstrate learning: **Instructional Accommodations** refer to changes in teaching strategies that allow the student to access the curriculum. **Environmental Accommodations** refer to changes that are required to the classroom and/or school environment. **Assessment Accommodations** refer to changes that are required in order for the student to demonstrate learning. Because of the wide range of students in these courses, a range of accommodations needs to be planned for and provided to students. Students who have an IEP are entitled to the accommodations specified in these plans.

#### Examples of Accommodations

Instructional Accommodations	Environmental Accommodations	Assessment Accommodations
<ul style="list-style-type: none"> <li>• Buddy/peer tutoring</li> <li>• Note-taking assistance</li> <li>• Duplicated notes</li> <li>• Contracts</li> <li>• Reinforcement incentives</li> <li>• High structure</li> </ul>	<ul style="list-style-type: none"> <li>• Alternative workspace</li> <li>• Strategic seating</li> <li>• Instructor proximity</li> <li>• Reduced audio/visual stimuli</li> <li>• Study carrel</li> <li>• Minimize background noise</li> </ul>	<ul style="list-style-type: none"> <li>• Extended time limits</li> <li>• Verbatim scribing</li> <li>• Oral responses, including audiotapes</li> <li>• Alternative settings</li> <li>• Increased breaks</li> </ul>

Instructional Accommodations	Environmental Accommodations	Assessment Accommodations
<ul style="list-style-type: none"> <li>• Partnering</li> <li>• Readiness grouping</li> <li>• Augmentative and alternative communications systems</li> <li>• Assistive technology, such as text-to-speech software</li> <li>• Graphic organizers</li> <li>• Non-verbal signals</li> <li>• Organization coaching</li> <li>• Time-management aids</li> <li>• Mind maps</li> <li>• Increased breaks</li> <li>• Concrete/hands-on material</li> <li>• Manipulatives</li> <li>• Tactile tracing strategies</li> <li>• Gesture cues</li> <li>• Dramatizing information</li> <li>• Visual cueing</li> <li>• Large size font</li> <li>• Tracking sheets</li> <li>• Colour cues</li> <li>• Reduced/uncluttered format</li> <li>• Computer options</li> <li>• Spatially-cued formats</li> <li>• Repeat information</li> <li>• Reword/rephrase information</li> <li>• Allow processing time</li> <li>• Word retrieval prompts</li> <li>• Taped texts</li> <li>• The use of pictures to illustrate scientific terms</li> </ul>	<ul style="list-style-type: none"> <li>• Quiet setting</li> <li>• Use of headphones</li> <li>• Special lighting</li> <li>• Assistive devices or adaptive equipment</li> <li>• The use of large-scale models and/or manipulatives</li> </ul>	<ul style="list-style-type: none"> <li>• Assistive devices or adaptive equipment</li> <li>• Prompts to return student's attention to task</li> <li>• Augmentative and alternative communications systems</li> <li>• Assistive technology, such as speech-to-text software</li> <li>• Large size font</li> <li>• Colour cues</li> <li>• Reduced/uncluttered format</li> <li>• Computer options</li> <li>• Processing time allowed</li> <li>• The use of large-scale models and/or manipulatives</li> </ul>

Adapted from: OSSLC Course Profile, Grade 12 Open (OLC4O), 2003

## Resources

The URLs for the websites were verified by the writers prior to publication. Given the frequency with which these designations change, teachers should always verify the websites prior to assigning them for student use.

Units in this Course Profile make reference to the use of specific texts, magazines, films, videos, and websites. Teachers need to consult their board policies regarding use of any copyrighted materials. Before reproducing materials for student use from printed publication, teachers need to ensure that their board has a Cancopy licence and that this licence covers the resources they wish to use. Before screening videos/films with their students, teachers need to ensure that their board/school has obtained the appropriate public performance videocassette licence from an authorized distributor, e.g., Audio Cine Films Inc. Teachers are reminded that much of the material on the Internet is protected by copyright. The copyright is usually owned by the person or organization that created the work. Reproduction of any work or substantial part of any work on the Internet is not allowed without the permission of the owner.

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## Science Resources

### Print

Haduch, Bill. *Science Fair Success Secrets*. New York: Dutton Children's Books, 2002. ISBN 0-525-46534-0

Plumb, Donald, Bob Ritter, Edward James, and Alan Hirsch. *Nelson Science 9*. Toronto: Nelson Thomson Learning, 1999. ISBN 0176120327

Sci-Tech Ontario. *Real Science: Using projects to engage students and meet the goals of the Ontario Curriculum, Grades 9 to 12*. First Edition. Ontario: Sci-Tech Ontario, 2003.

Wolfe, Elgin. SCIENCEPOWER 9™. Toronto: McGraw-Hill Ryerson Limited, 1999. ISBN 0075603616

### Software

*Smart Ideas*. Ministry-licenced OSAPAC – Graphic organizers

*TABS Plus*. Computer program that designs and prints out nets (blueprints) to design and build three-dimensional shapes of your choice

### Websites

Access Excellence – [www.accessexcellence.org](http://www.accessexcellence.org)

American Chemical Society – [www.chemistry.org](http://www.chemistry.org)

Bill Nye the Science Guy – [www.nyelabs.com](http://www.nyelabs.com)

Centre for Environmental Education Web Resources – <http://weblinks.schoolsgogreen.org>

Cleaner and Greener: An Energy and Environment Program – [www.cleanerandgreener.org](http://www.cleanerandgreener.org)

Community Learning Network – [www.cln.org](http://www.cln.org)

David Suzuki Foundation – [www.davidsuzuki.org](http://www.davidsuzuki.org)

Discovery.com – <http://www.discovery.com>

Green Teacher – [www.greenteacher.com](http://www.greenteacher.com)

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– <http://www.accesswave.ca/~hgunn/computedu/sciencerubrics.htm>

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Essential Skills – [www15.hrdc-drhc.gc.ca](http://www15.hrdc-drhc.gc.ca)

Live Safe! Work Smart! – [www.livesafeworksmart.net](http://www.livesafeworksmart.net)

TOWES (Test of Workplace Essential Skills) Project – [www.towes.com](http://www.towes.com)

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#### Print

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– [http://www.vatican.va/archive/hist\\_councils/ii\\_vatican\\_council/](http://www.vatican.va/archive/hist_councils/ii_vatican_council/)

Gaudium et Spes

– [http://www.vatican.va/archive/hist\\_councils/ii\\_vatican\\_council/documents/vat-ii\\_cons\\_19651207\\_gaudium-et-spes\\_en.html](http://www.vatican.va/archive/hist_councils/ii_vatican_council/documents/vat-ii_cons_19651207_gaudium-et-spes_en.html)

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## Appendix A: Strategies for Literacy Connections in the Science Classroom

The following strategies are suggestions that science teachers can use to support students in building on their oral communication, reading, and writing skills.

### Oral Communication

We learn language – its words, structure, and meanings – orally. Students may need to hear the correct terminology and phrasings many times before they comprehend meaning, or are able to use words and phrases themselves in conversation.

To assist students in gaining skills in oral language as they engage in meaningful conversation about science, teachers can:

- model correct scientific terminology;
- stage conversations that require students to use scientific terminology and engage in critical thinking (*Think Literacy*, pp. 151-186).

### Questioning

Many questions asked of science students are directly stated in text. Answering indirect questions requires students to combine their prior knowledge with information from the text. Students should be able to connect their personal lives to the text they are reading in Science.

- Science teachers can use questions requiring students:
  - to understand direct ideas and information;
  - to understand indirect ideas and information; and
  - to make connections between personal experience and the reading
- Science teachers can teach students to infer (*Think Literacy*, pp. 40-43; Beers, pp. 165-171);
- Science teachers can model and have students use a strategy such as The Question-Answer Relationship Strategy to understand questions asked and to pose questions for others (Sejnost and Thiese, pp. 13-16; Barton and Jordan, pp. 117-119).

### Reading

The purpose often determines how a reader approaches a text, e.g., in some cases, they need to skim and pick out only key words; in other cases, they may need to understand a small portion of the text thoroughly.

In the workplace and at home, students read informational and graphical text containing technical terms. In the science classroom, there are multiple ways to engage students in reading for information, reading to challenge thinking, and reading to consolidate learning

Science teachers can:

- give students a purpose for the assigned reading and ask them to suggest the strategy they will use;
- teach students to define their own purpose for reading by modelling, e.g., turn headings into questions that will be answered in the text; skim text and predict questions the text might answer.

### Before-, During-, and After-Reading Strategies

Students can develop a number of before-, during-, and after-reading strategies as they interact with texts in Science. To prepare for reading, students can skim for terminology, text features, and structure; recall prior knowledge to connect to the text; and determine a purpose for reading. During reading, they engage with the text. After reading, they reflect, connect the text to their own lives, and review to consolidate their learning. Most of the references are structured around these three important stages of reading.

## Appendix A: Strategies for Literacy Connections in the Science Classroom (continued)

Some examples follow:

	<b>Teaching Strategies</b>	<b>Student Strategies</b>
<b>Before Reading</b>	<ul style="list-style-type: none"> <li>• Anticipation Guide</li> <li>• Word Sorts, Games</li> <li>• Set Purpose</li> <li>• Know/Want to Know/Learned Chart (KWL), Directed Reading/Thinking Activity (DR/TA)</li> <li>• Vocabulary Development</li> <li>• Graphic Organizer</li> <li>• Group Discussion</li> </ul>	<ul style="list-style-type: none"> <li>• Turn headings into questions</li> <li>• Skim for unfamiliar terminology to look up, text features, signal words for patterns</li> <li>• Think about prior knowledge</li> <li>• Set purpose (KWL)</li> </ul>
<b>During Reading</b>	<ul style="list-style-type: none"> <li>• Pair Reading</li> <li>• Anticipation Guide</li> <li>• Graphic Organizer</li> <li>• Vocabulary Development</li> <li>• KWL, DR/TA</li> </ul>	<ul style="list-style-type: none"> <li>• Engage with text</li> <li>• Answer/ask questions</li> <li>• Think aloud</li> <li>• Complete graphic organizer</li> <li>• KWL</li> </ul>
<b>After Reading</b>	<ul style="list-style-type: none"> <li>• Question-Answer Relationships (QAR)</li> <li>• Group Response/Debate Activity</li> <li>• Discussion</li> <li>• KWL, DR/TA</li> </ul>	<ul style="list-style-type: none"> <li>• Reflect, Reread, Retell</li> <li>• Complete learning log</li> <li>• Think about how text connects to self</li> <li>• KWL</li> </ul>

Sources: Barton and Jordan; Burke, Klemp and Schwartz; *Think Literacy*.

### Technical Terminology

Scientific or technical terms often pose difficulty for learners because:

- technical terms are not used frequently in everyday language;
- terms may not be understood easily from context;
- some words may have different meanings in science as opposed to everyday language;
- the terms used in the workplace may be different from those used in science.

Research indicates that we must hear words at least six times in context before we can determine and recall its meaning. Some terms are critical and require a deep understanding to comprehend text. Students may require only a surface understanding of other technical terms and still be able to read and extract meaning.

Science teachers can:

- identify a small number of critical terms for each unit and work with them frequently using a variety of strategies, e.g., word webs;
- select terminology in a text that may be problematic for students;
- provide glossaries with clear explanations of terms;
- post key terminology in the classroom, e.g., word walls, word trees: include pictures and labels;
- teach students how to recognize when terminology is a block to reading, and use strategies to help themselves.

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## Appendix A: Strategies for Literacy Connections in the Science Classroom (continued)

### 1. Predict the Meaning of Unfamiliar Words Encountered in Text

In scientific or informational texts, students can look for clues such as:

- definitions enclosed in parentheses;
- bold words indicating a glossary entry;
- italics indicating a definition may be located elsewhere;
- definitions/explanations in footnotes;
- definitions/explanations in graphs and charts or pictures;
- definitions, examples, descriptions, clarification, comparisons, and elaborations within the text following the new word itself (Allen, 1999; Beers; *Think Literacy*, pp. 34-39);
- using prefixes, suffixes, and roots to predict the meaning of words (Allen, 1999; Beers, Burke, Klemp and Schwartz, pp. 758-765).

### 2. Reflect on How Well They Know the Words

Students can:

- work in groups with a list of words they work through together as they read a passage;
- respond to a list of words using a strategy such as the 1, 2, 3 method: 1) Words I am very familiar with; 2) Words I have heard before and think I know the meanings of; 3) Words I have never heard before. This is useful as a diagnostic before-reading exercise and then at the end of a unit, students may discuss vocabulary and update their numbers;
- use a Knowledge Chart. Before reading they fill in what they know about a critical scientific term. After reading, they fill in what they learned about the term and complete a graphic organizer to consolidate the learning.

### 3. Work with Words in a Collective Sense

To reinforce their understanding of technical terms, students can:

- solve word puzzles and games that use the technical terms needed for the unit;
- group technical vocabulary into categories, e.g., units, quantities, or sort them using a Venn diagram (Barton and Jordan);
- create and refine concept maps and use them as organizers for the words contained in a unit (Barton and Jordan, 2001; *Think Literacy*, 2003; Bennett and Rolheiser, 2001; Strong et al., 2002);
- complete statements by selecting recently learned terminology for the blank spaces, and justify their response.

### 4. Graphic Organizers

These organizers help students construct layers of understanding about the critical term or series of terms they are studying.

Examples:

- Semantic Feature Analysis
- Semantic Mapping
- The Frayer Model
- Concept of Definition
- Analogies: Similarities and Differences Chart
- Four-Dimensional Study
- Content-Context Experience
- Concept Ladder

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## Appendix A: Strategies for Literacy Connections in the Science Classroom (continued)

- Vocabulary Graphics (a student-prepared card with the word and its definition in the centre and in each of the four corners: an antonym, a synonym, a sentence, and an illustration)

### 5. Matching Text to the Reading Level of the Learner

To help students understand the meaning of terms and their use, it is important to provide clear, coherent, and short reading passages.

Science teachers can:

- select resources at various readability levels, e.g., newspapers and magazine articles, Internet;
- provide resources in which information is usually presented with minimal text;
- use informational text in which scientific terminology is defined where it is used, rather than in an end-of-book glossary.

### Text Features and Structures

Students whose early reading concentrated on narrative fiction may not have been introduced to the patterns of text that are used in science (Strong et al., pp. 24-27). When students are familiar with the structures and can recognize them using clue words, they can use them to construct meaning. Graphic organizers capture these patterns visually. Text features, including parentheses, bold-faced and italic type, and headings with various font sizes can all be used as clues to meaning.

Science teachers can:

- teach students to preview a textbook (*Think Literacy*, pp. 8-10);
- teach students to analyse text features (*Think Literacy*, pp. 12-13);
- provide students with graphic organizers to collect notes from reading (Strong et al., pp. 4-14);
- have students find organization patterns in text using signal words (*Think Literacy*, pp. 16-19, 24-28).

### Graphic Text

In Science, information can be meaningfully presented to students in visual images, charts, graphs, and maps.

Science teachers can help students interpret charts and graphs by:

- looking at the heading and predicting the axes or column headings;
- looking at the axes and headings and predicting what the graph will look like, or predicting whether the numbers will go up or down in a particular column or row.

### Writing

Students write for many purposes in the Science classroom. They construct meaning and impart their findings from scientific research and investigations, e.g., using technology, charts, graphs, and templates.

In the workplace and in everyday life, students use similar forms of writing to convey information, e.g., instructions, graphic organizers, sequential lists.

Science teachers can help students:

- use charts, graphs, and other graphic organizers, e.g., Venn diagrams, flow charts, fish bone, or concept maps to display and organize scientific data and concepts (*Think Literacy*, pp. 108-109, *Beyond Monet*, pp. 280-283);
- construct logical and sequential procedures and instructions used in conducting scientific research and investigations (*Think Literacy*, pp. 142-143);
- learn how to structure scientific reports and explanations (*Think Literacy*, pp. 144-149, *Beyond Monet*, p. 252).

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Appendix B: Sample Operator's Licence Tracking Form

**Grade 9 Science**

**Licence Tracking Form**

**This certifies that**

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**has completed the requirements to earn the licences identified below**

<b>Licence</b>	<b>Date Earned</b>	<b>Inspector's Initials</b>	<b>Official Seal</b>
<b>Electric Circuit Operator (part 1)</b>			
<b>Electric Circuit Operator (part 2)</b>			
<b>General Lab Safety</b>			
<b>Handling Lab Equipment (part 1)</b>			
<b>Handling Lab Equipment (part 2)</b>			
<b>Microscope Operator</b>			
<b>Use, Storage, and Disposal of Chemicals</b>			

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## **Coded Expectations, Locally Developed Compulsory Credit Course, Science, Grade 9, SNC1L**

### **Scientific Inquiry: Science in Daily Life**

#### **Overall Expectations**

**By the end of this course, students will:**

**SILV.01** • illustrate how science is a part of daily life;

**SILV.02** • use appropriate scientific skills, tools, and safety procedures to investigate problems;

**SILV.03** • examine the connections between science and activities in daily life.

#### **Specific Expectations**

##### **Understanding Basic Concepts**

**By the end of this course, students will:**

**SIL1.01** – describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life (e.g., microscopes and balances, the use of statistical evidence to make decisions);

**SIL1.02** – explain the importance of a “fair test” for troubleshooting and testing everyday science problems (e.g., diagnosing computer problems, repairing automobiles, testing faulty electrical circuits, determining safety of consumer products).

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

**By the end of this course, students will:**

**SIL2.01** – formulate questions about problems or issues that can be scientifically tested (e.g., Which paper airplane flies the farthest or fastest? Which metal retains more heat? Which colour/brand of hair dye lasts the longest? Which pair of sunglasses are the best filters of the sun’s rays? Which location enables us to see the stars most clearly at night?);

**SIL2.02** – plan, conduct, and refine simple investigations to answer student-generated questions;

**SIL2.03** – conduct investigations safely, using appropriate lab equipment (e.g., use scales, rulers, voltmeter/ammeter, stopwatch for making measurements);

**SIL2.04** – observe and record data, using a variety of formats (e.g., diagrams, data tables, webs, graphic organizers, using computers, as appropriate) including the use of SI units, where appropriate;

**SIL2.05** – assess data to make inferences and conclusions and to answer questions and refine procedures;

**SIL2.06** – communicate plans, observations, and results using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate (e.g., tables, charts, journals, using a variety of technologies).

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

**By the end of this course, students will:**

**SIL3.01** – develop and investigate research questions about an everyday science-related topic of personal interest (e.g., Which skateboard wheels are the fastest? Which snack bar is the most nutritious? Which ball retains its bounce the longest, or bounces the highest? Which light bulbs last the longest? What paper towel is the most absorbent? What effect do the sun’s patterns have on the activities in my community?);

**SIL3.02** – evaluate the investigation of the topic they selected and suggest possible refinements;

**SIL3.03** – demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process skills (e.g., sampling, researching, recording).

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## Chemistry: Properties of Common Materials

### Overall Expectations

**By the end of this course, students will:**

- CPMV.01** • explain the characteristics and classification of common materials, using appropriate scientific terminology;
- CPMV.02** • investigate the physical and chemical properties of common materials through laboratory activities;
- CPMV.03** • analyse how the use of various materials is based on their physical and chemical properties.

### Specific Expectations

#### Understanding Basic Concepts

**By the end of this course, students will:**

- CPM1.01** – recognize the symbols used to classify hazardous materials at home and in the workplace (HHPs, WHMIS);
- CPM1.02** – outline the hazards of common materials (e.g., bleach, drain cleaner, burning plastics) associated with safe and unsafe use;
- CPM1.03** – explain the characteristics of pure substances and mixtures, using appropriate scientific terminology;
- CPM1.04** – describe the physical properties (e.g., texture, lustre, solubility, clarity, colour, state, electrical conductivity) of common materials (e.g., paints, solvents, metals), using appropriate scientific terminology;
- CPM1.05** – describe the chemical properties (e.g., flammability, reactivity, reaction in water, reaction in acids, reaction with pH test strips) of common materials (e.g., paints, solvents, metals), using appropriate scientific terminology.

#### Developing Skills of Inquiry and Communication

**By the end of this course, students will:**

- CPM2.01** – plan and conduct investigations on the physical and chemical properties of substances, using lab equipment and materials safely and accurately (e.g., test metals to observe state, appearance, strength, flexibility, heat, and electrical conductivity; test materials for their reaction with acids, water, salt solutions);
- CPM2.02** – use appropriate laboratory safety and disposal procedures while conducting investigations (e.g., wear safety glasses, practise orderliness and cleanliness, follow WHMIS guidelines and emergency procedures, use proper procedures for handling and disposal);
- CPM2.03** – organize and record the observations of the investigations, using appropriate formats (e.g., charts, tables, diagrams, graphs, science journals);
- CPM2.04** – interpret and communicate the results of investigations (e.g., classify the materials tested, write conclusions).

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

**By the end of this course, students will:**

- CPM3.01** – investigate the physical and chemical properties of the component materials of two similar products (e.g., hair mousse, toothpastes, skateboards, backpacks, running shoes, building materials, electrical materials);
- CPM3.02** – compare the physical and chemical properties of the materials investigated and relate these properties to how they are used (e.g., the flexibility and strength of wood and carbon fibre to their use in hockey sticks; heat conductivity in metals to their use in pots and pans; solubility of materials to their use in make-up);

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**CPM3.03** – present a recommendation (e.g., oral presentation, product label, product information sheet, annotated diagram, advertisement), based on the results of the investigation and the research of the product, appropriate for someone interested in using the product (e.g., hairstylist, hockey player, sportswear manufacturer, welder).

## **Biology: Staying Alive**

### **Overall Expectations**

**By the end of this course, students will:**

**BSAV.01** • explain the systems and processes required by simple and complex organisms to sustain life;

**BSAV.02** • investigate, through laboratory activities, the processes which simple and complex organisms use to sustain life;

**BSAV.03** • analyse how personal health and safety in everyday life and in the workplace are protected through the proper use of equipment and safety practices.

### **Specific Expectations**

#### **Understanding Basic Concepts**

**By the end of this course, students will:**

**BSA1.01** – describe the basic life-sustaining processes of organisms, including single-celled and complex organisms (e.g., ingestion of food, waste removal, gas exchange, material transport, response to environmental stimuli, reproduction), using appropriate scientific vocabulary;

**BSA1.02** – relate structures involved in life-sustaining processes to their function (e.g., nucleus and reproduction, membranes and diffusion, components of respiratory system to gas exchange);

**BSA1.03** – outline how a complex organism functions through the basic interactions between organ systems (e.g., connection between respiratory and circulatory system in animals, between roots and leaves in plants).

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

**By the end of this course, students will:**

**BSA2.01** – formulate questions and plan simple experiments to investigate how simple and complex organisms respond to environmental stimuli (e.g., earthworm responses to light, plant response to gravity or light, mimosa plant response to touch, Euglena response to light, eye response to light, production of saliva);

**BSA2.02** – make accurate observations of structures, using microscopes, and relate them to functions of systems and processes of simple and complex organisms (e.g., feeding behaviour of protists, circulatory system of Daphnia, budding of yeast cells, chloroplasts in plant cells, breathing in fish);

**BSA2.03** – examine the relationship between the circulatory, respiratory, and digestive systems in complex organisms by performing dissections or using a computer-simulated dissection (e.g., earthworm, fish, grasshopper, frog);

**BSA2.04** – extract and interpret information from a variety of sources (e.g., informational texts, lab instructions, Internet, electronic databases);

**BSA2.05** – communicate observations, interpretation of results, and information through appropriate formats (e.g., diagrams, graphs, group discussions, and written work).

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

### By the end of this course, students will:

**BSA3.01** – analyse how specific equipment and safe practices are used to protect personal health and safety at home and in the workplace (e.g., how protective gloves prevent absorption of harmful chemicals into the circulatory system; how controlling the growth or removing harmful microbes from food by refrigeration or cooking protects against ingestion of harmful bacteria; how a space suit/scuba gear support the respiratory system);

**BSA3.02** – examine case studies of common workplace environments to develop a checklist of safety practices necessary to sustain systems and processes critical to life (e.g., safety practices when spray painting, preparing food, working in an auto shop, applying pesticides, working in a mine).

## Physics: Electrical Circuits

### Overall Expectations

By the end of this course, students will:

**PECV.01** • describe the characteristics of electrical circuits;

**PECV.02** • investigate simple electrical circuits, using safe practices;

**PECV.03** • analyse the practical uses of electrical circuits and their impact on daily life.

### Specific Expectations

#### Understanding Basic Concepts

By the end of this course, students will:

**PEC1.01** – use scientific terminology during investigations to describe basic electrical concepts and related units of measure (e.g., current – ampere, potential difference – volts, source, load, open and closed circuit, conductor, insulator);

**PEC1.02** – demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits (e.g., heat, light, motion);

**PEC1.03** – identify how household and workplace electrical devices operate by converting energy to another form (e.g., electrical energy to light energy in a bulb, flashlight; electrical energy to heat energy in a stove, electric heater, and heat lamps; chemical energy to electrical energy in a battery; electrical energy to motion in a power saw and analog watch);

**PEC1.04** – use a variety of symbols to represent different components in electrical circuits (e.g., ammeter, wire, switch, power source, load, voltmeter).

#### Developing Skills of Inquiry and Communication

By the end of this course, students will:

**PEC2.01** – formulate scientific questions about circuits and create a simple plan to carry out an investigation, including safety procedures (e.g., How do series and parallel circuit of bulbs work differently? What is the effect of increasing the number of batteries in series or parallel in a circuit? How can a circuit be turned off at two different locations? What is the effect of increasing the number of loads in a circuit?);

**PEC2.02** – design, build, and test an electrical circuit to investigate the chosen question, using appropriate safety procedures;

**PEC2.03** – conduct investigations, using electrical materials, tools, and equipment safely;

**PEC2.04** – measure and record the current and potential difference in simple circuits through the safe and proper use of an ammeter and a voltmeter;

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**PEC2.05** – extract and interpret information from instructions and manuals for circuits and electrical devices (e.g., explain a circuit diagram to a peer);

**PEC2.06** – communicate plans and results of investigations about electrical circuits, using a variety of oral, written, and graphic formats.

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

**By the end of this course students will:**

**PEC3.01** – identify circuits and their components in household and workplace settings (e.g., fuses, circuit breakers, switches, loads in appliances, electronic equipment, household wiring, handheld tools);

**PEC3.02** – develop a logical checklist to troubleshoot an electrical device of personal choice (e.g., CD or DVD player, hair dryer or curling iron, VCR, electric floor cleaner, electronic balance, calculator, toaster, flashlight, electric drill).

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## Ontario Catholic School Graduate Expectations

The graduate is expected to be:

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

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

### An Effective Communicator who

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

### A Reflective and Creative Thinker who

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

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

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

**A Collaborative Contributor** who

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

**A Caring Family Member** who

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

**A Responsible Citizen** who

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

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## Unit 1: Scientific Inquiry: Science in Daily Life

**Time:** 15 hours

### Unit Description

Through study of science and its processes, students can acquire a valuable perspective to the workplace and everyday life. They use critical thinking and inquiry skills that include generating questions and being able to answer those questions experimentally with an understanding of the factors that might affect experimental results; the concept of a fair test. In addition, students learn to use common laboratory tools appropriately and safely and to make connections with how tools used in science are also used in daily life.

As students perform two simple experiments, they analyse the factors that affect the results of the experiments, change one factor, and observe the changes in the results. Students are introduced to a discrepant event, for which they brainstorm and analyse questions as: testable by experiment, answerable by research, or not answerable scientifically. They further analyse the testable questions for practicality. Students are introduced to General Lab Safety Rules preparatory to their acquiring a Handling Lab Equipment Part 1 Licence. Students devise a fair test method of comparing the bouncibility of a variety of sports balls and write a procedure for their method. They collect results and create bar graphs, which they use to discuss the materials and uses of the particular balls. They write a paragraph on the connection of science to everyday life.

In the final activity, students pose and analyse simple questions of personal choice, plan fair test methods, and conduct experiments to answer the questions and present their results.

### Unit Synopsis Chart

Activity/ Time	Learning Expectations	Assessment & Evaluation Categories, Tasks, and Tools	Tasks
1.1 Introduction to the Fair Test  2.5 hours	SILV.01, .02, SIL1.02, 2.02, 2.04, 2.05  CGE5a	1.1.1: Student performance is assessed diagnostically for Knowledge/Understanding and Inquiry.  1.1.2: Student performance is assessed diagnostically for Knowledge/Understanding.	Students: <ul style="list-style-type: none"><li>• perform a simple experiment and investigate the factors affecting the results;</li><li>• manipulate a single factor to effect the specific result of winning a competition.</li></ul>
1.2 Asking Questions  2.5 hours	SILV.01, .02, .03, SIL1.01, 2.01, 2.03, 2.06, 3.02  CGE3c	1.2.1: Analysis of questions is assessed for Inquiry using a checklist.  1.2.2: Lab Performance is assessed for Inquiry using a rubric; Lab Plans are self-assessed using reflection questions.	Students: <ul style="list-style-type: none"><li>• brainstorm questions;</li><li>• classify questions;</li><li>• analyse testable questions;</li><li>• safely conduct a laboratory investigation using simple labware.</li></ul>
1.3 Science Inquiry Everyday Life  2.5 hours	SILV.01, .02, .03, SIL1.01, 2.02, 2.03, 2.04, 2.06, 3.03  CGE2c, 2d, 5b	1.3.1: The written procedure is assessed for Knowledge/ Understanding, Communication, and Inquiry through peer feedback; the paragraph is diagnostically assessed for Knowledge/Understanding, Communication, and Making Connections using a checklist.	Students: <ul style="list-style-type: none"><li>• devise and write a procedure for a fair test;</li><li>• conduct an experiment;</li><li>• record information and present it using a chart and a bar graph;</li><li>• write a reflective paragraph on the connection of science processes to daily life.</li></ul>

Activity/ Time	Learning Expectations	Assessment & Evaluation Categories, Tasks, and Tools	Tasks
1.4 Investigating a Testable Question  7.5 hours	SILV.01, .02, .03, SIL1.02, 2.01, 2.02, 2.03, 2.04, 2.05, 2.06, 3.01, 3.02  CGE2c	1.4.1: Students' questions and their instructions for Fair Test are evaluated for Knowledge/ Understanding, Inquiry, and Making Connections using a rubric.  1.4.2: Student performance is assessed for Inquiry Skills using a checklist; student performance is assessed for Communication Skills using a diagnostic tool.	Students:  • select a simple testable question; design a simple experiment with an understanding of the concept of fair test and safety awareness; • conduct an investigation and record results; • communicate the results of the experiment.

## Activity 1.1: Introduction to the Fair Test

**Time** 2.5 hours

### Description

Working collaboratively, students investigate simple experiments and analyse the factors that affect changes in the results of the experiments. They participate in a teacher-led investigation in which they examine the factors that affect the results of the experiment. Students share their likes and dislikes as they contribute to a bulletin board on class interests and hobbies that can be related to science.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE5a - works effectively as an interdependent team member

**Strand(s):** Scientific Inquiry: Science in Daily Life

#### Overall Expectations

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

#### Specific Expectations

SIL1.02 - explain the importance of a “fair test” for troubleshooting and testing everyday science problems;

SIL2.02 - plan, conduct, and refine simple investigations to answer student-generated questions;

SIL2.04 - observe and record data, using a variety of formats including the use of SI units where appropriate;

SIL2.05 - assess data to make inferences and conclusions and to answer questions and refine procedures.

### Prior Knowledge & Skills

- Basic literacy and numeracy skills

### Planning Notes

- Teachers should familiarize themselves with the role the Essential Skills play in the jobs that students have in the community workplace. See website for Essential Skills [www.15.hrhc-drhc.gc.ca](http://www.15.hrhc-drhc.gc.ca)

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### 1.1.1 Flip Floppers

- Make copies of the student sheet Flip-Floppers (Appendix 1.1.1).
- Prepare the graphic organizer Flip-Flopper Factors to discuss the nature of fair test comparisons and how to control these results so you can have fair comparisons. In science, the word *variable(s)* is frequently used; it is used here to mean factors which affect results, to avoid confusion with workplace terms.
- Prepare Guiding Questions Template (Appendix 1.1.3) for the portfolio.
- Prepare questionnaires for likes and dislikes, hobbies, and interests.

### 1.1.2 Pop-Can Wanderers

- Make copies of Pop-Can Wanderers (Appendix 1.1.4).
- Make arrangements for a larger space for students to obtain results, e.g., outside, in the gym.
- Prepare a bulletin board to post commonalities among students' interests and hobbies and their experiences with science in their daily lives.

## Teaching/Learning Strategies

### 1.1.1 Introduction to Fair Test

- The teacher groups students, and they introduce themselves in their group.
- Working in pairs, students perform a simple experiment (see Appendix 1.1.1). **Safety Note:** Students must wear safety glasses as elastic bands may break due to stress.
- The teacher prompts students with a question such as: Which Flip Flopper stopped on top?
- Using a graphic organizer, the teacher leads a discussion as to which factors can effect results (see Appendix 1.1.2: Flip-Flopper Factors).
- Students repeat the experiment changing only one factor at a time and maintain a record of their results.
- The teacher introduces the portfolio and distributes the Guiding Questions Template for preparing scientific reports (Appendix 1.1.3).
- Students share their results with another pair of students, using the guiding questions.
- Students reflect on the task by discussing what they liked and didn't like about the activity, in their original pair grouping.
- The teacher assesses the students' learning and social skills as they work at the task.

### Introducing the End-of-Unit Task

- Following a teacher-led discussion on learning preferences, students complete a personal interest sheet that the class can use to generate testable questions.
- The teacher introduces the end-of-unit task and the purpose of the bulletin board.
- Students begin to list questions about their hobbies or interests in their portfolio and post them on the bulletin board.

### 1.1.2 Fair Test Competition

- The teacher introduces a second simple experiment (see Appendix 1.1.4:) and directs students to look at different factors that can be changed to make their device go the fastest, the farthest, or the straightest.
- Students work in groups of four to share their likes and dislikes and establish a name for their team.
- Working within a given time frame, the groups adjust the device to improve results, test the device, and record the changes and the results of those changes on a simple T-chart, e.g., What Was Changed, The Result)
- Students write point-form notes using the Guiding Questions Template (see Appendix 1.1.3).

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## Assessment & Evaluation of Student Achievement

See *Assessment & Evaluation of Student Achievement in Overview*, p. 8.

- In activity 1.1.1, the teacher assesses student performance for Knowledge/Understanding and Inquiry using anecdotal records.

### Resources

#### Science Resources

##### Print

Cavaness, Diane, “SPF30: Exposing Your Students to Science Inquiry.” *Science Scope*, 27:14 (May, 2004).

Haduch, Bill. *Science Fair Success Secrets*. New York: Dutton Children’s Books, 2002. ISBN 0-525-46534-0

Sci-Tech Ontario. *Real Science: Using projects to engage students and meet the goals of the Ontario Curriculum, Grades 9 to 12*. First Edition. Ontario: Sci-Tech Ontario, 2003.

##### Websites

Science.ca – [www.science.ca/home.php](http://www.science.ca/home.php)

Science Teachers’ Association of Ontario – [www.stao.org](http://www.stao.org)

Sci-Tech Ontario – [www.scitechontario.org](http://www.scitechontario.org)

#### Teaching and Learning Resources

##### Print

Bennett, Barrie and Carol Rolheiser. *Beyond Monet*. Toronto, ON: Bookation, 2001. ISBN 0969538839

Gregory, Gayle H. and Carolyn Chapman. *Differentiated Instructional Strategies: One Size Doesn’t Fit All*. Thousand Oaks, CA: Corwin, 2002. ISBN 0761945512

Lewe, Glenda and Carol D. MacLeod. *Step Into the World of Workplace Learning: A Collection of Authentic Workplace Materials*. Scarborough, ON: Nelson, 2001. ISBN 0176085718

Rogers, Spence. *Teaching Tips: 105 Ways to Increase Motivation and Learning*. Evergreen, CO: Peak Learning Systems, Inc., 1999-2001.

Silver, H., R. W. Strong, and M. J. Perini. *So Each May Learn: Integrating Learning Styles and Multiple Intelligences*. Alexandria, VA: ASCD, 2000. ISBN 0871203871

Sousa, David A. *How the Special Needs Brain Learns*. Thousand Oaks, CA: Corwin Press, Inc., 2001.

#### Resources for Catholic Teachers

##### Websites

Ontario Catholic Curriculum Cooperative – <http://www.eoccc.org>

##### CD ROMs

*Curriculum Support for Catholic Schools*. Eastern Ontario Catholic Curriculum Cooperative, 2002.

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## Appendix 1.1.1: Flip-Floppers

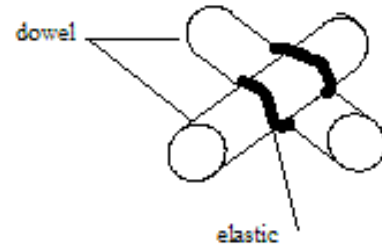
### Making the Flip-Flopper

#### Materials Needed:

- clothes peg
- markers
- pencil
- dowel

#### Instructions

1. Place an elastic band on the desk.
2. Place one flopper across the elastic.
3. Hold up both ends of the elastic and slide the second flopper through each end of the elastic.
4. Mark each flopper with a different colour.



#### Using the Flip-Flopper

**Safety Caution:** Wear safety goggles when using the flip-flopper, as elastics may break. Do not over tighten.

1. Working in pairs, decide what you are testing.
2. Wind the Flip-Flopper, place it on the desk, and release it.
3. Record the position of the Flip-Flopper when it stops – one part on top of the other, side by side, one part ahead of the other.
4. Wind up and release the Flip-Flopper 10 times.
5. Record its stopping position each time.

#### Which Factors Affect Flip-Floppers?

1. Use the sheet Flip-Flopper Factors (Appendix 1.1.2) to make a list of all the things that could be changed about the device. These are called **factors**.
2. Make one change and test your Flip-Flopper 10 more times. Make sure that **all factors are kept the same each time**.
3. Record the change and the results.
4. Which flopper met the test best? **State your evidence** by using numbers in your answer.

#### The Flip-Flopper Fair Test

The goal is to see if you can change the results from last time.

1. Use the Flip-Flopper Factors sheet to choose one factor that you want to change. Decide how you are going to change that factor.

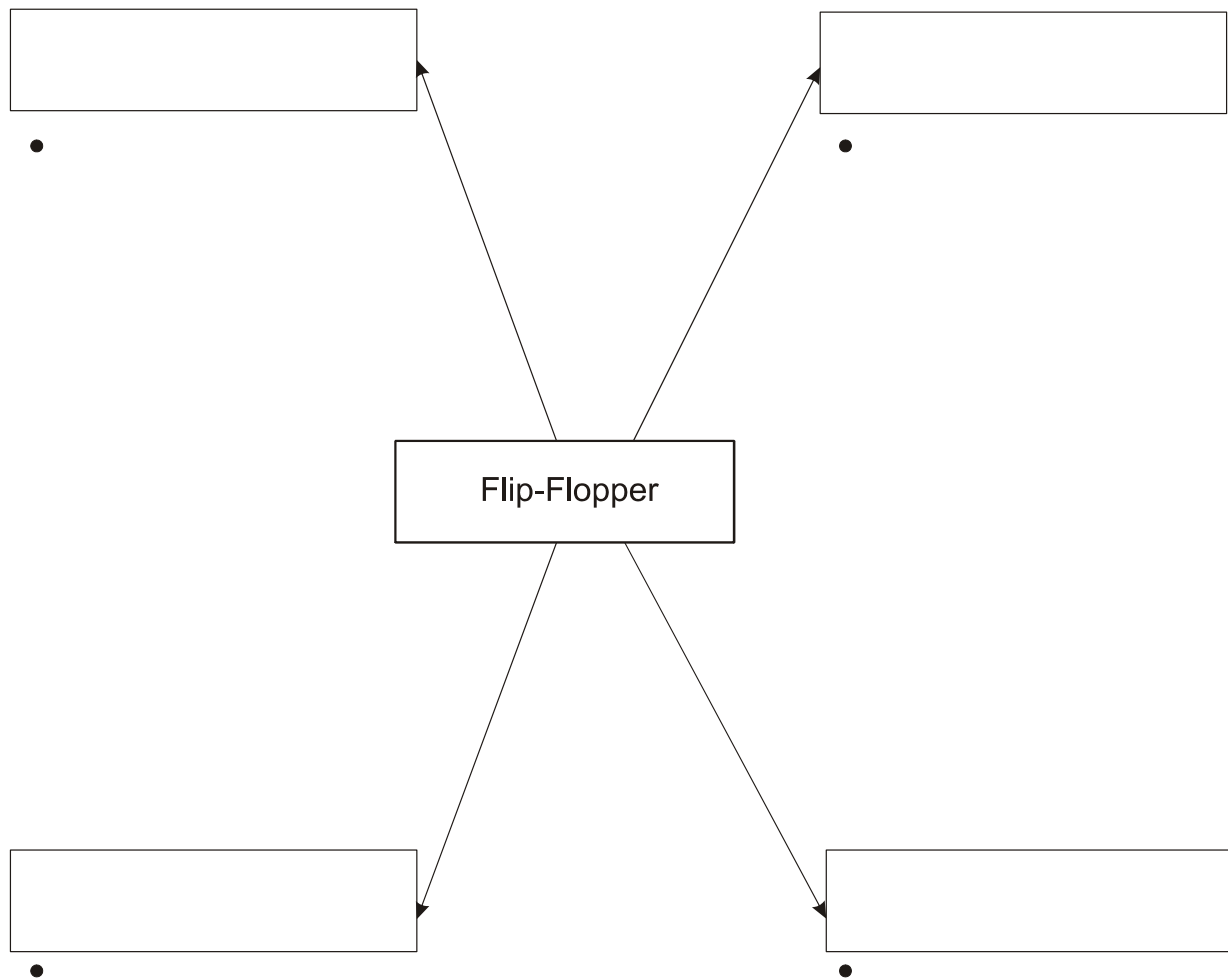
All other factors must be kept the same each time you wind and release your Flip-Flopper.

2. Wind and release your Flip-Flopper 10 more times.
3. **Record** the factor you changed and the results.
4. Did changing your factor affect the results? **State your evidence**.

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## Appendix 1.1.2: Flip-Flopper Factors

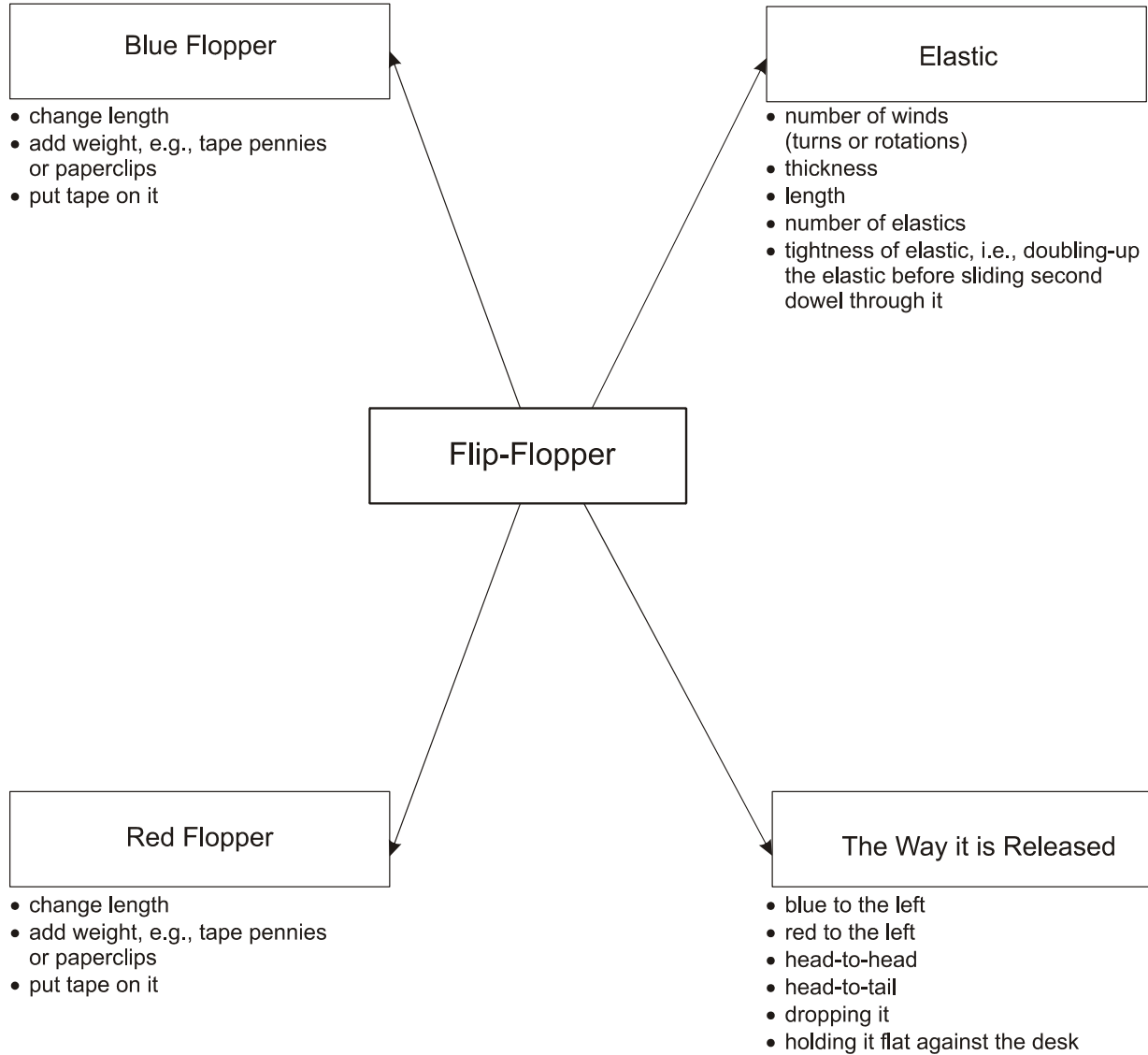
1. Use this graphic organizer to identify the factors that may affect the results of your experiment.
2. In the centre rectangle, put the name of your device, e.g., Flip-Flopper.
3. In each of the surrounding rectangles, name one of the parts that make up that device.
4. Below each of the rectangles, list all the ways that part can be changed. These are the factors that can affect the results of your fair test.
6. Once your lists are complete, circle one factor with which you want to work.
7. Decide how you are going to change that factor.



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## Appendix 1.1.2: Flip-Flopper Factors (continued)

### Flip-Flopper Factors – sample





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## Appendix 1.1.4: Pop-Can Wanderers

### Making the Pop-Can Wanderer

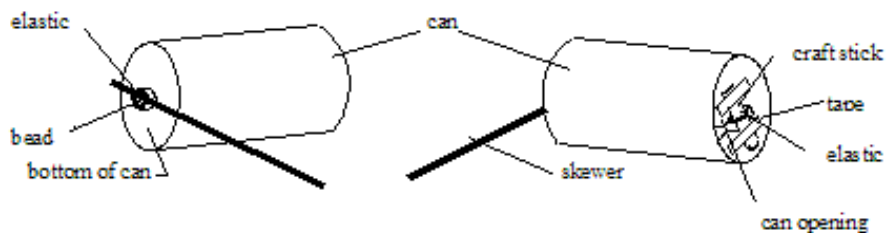
#### Materials needed

- 1 pop can with nail hole punched into the centre of the bottom
- 1 bead, large enough to protrude beyond the edge of the can when sitting in the nail hole
- 1 elastic band
- 1 skewer or thin dowel
- piece of wooden craft stick
- tape
- 1 paper clip bent to form a hook (to help pull elastic through can)

#### Instructions

**Safety Caution:** Wear safety goggles when making and using the Pop-Can Wanderer, as elastics may break. Do not over tighten.

1. Slide one end of the elastic band through the hole in the bead.
2. Slide one end of the skewer through the loop of elastic sticking out of the bead. Pull snugly.
3. Slide the other end of the elastic through the nail hole in the bottom of the can.
4. Reach into the can opening with the paper clip and "hook" the elastic.
5. Pull the end of the elastic band through the opening and place the piece of wooden craft stick through the loop. This is to keep the elastic band from going back inside the can.
6. Tape the wooden craft stick to the can.



#### Using the Pop-Can Wanderer

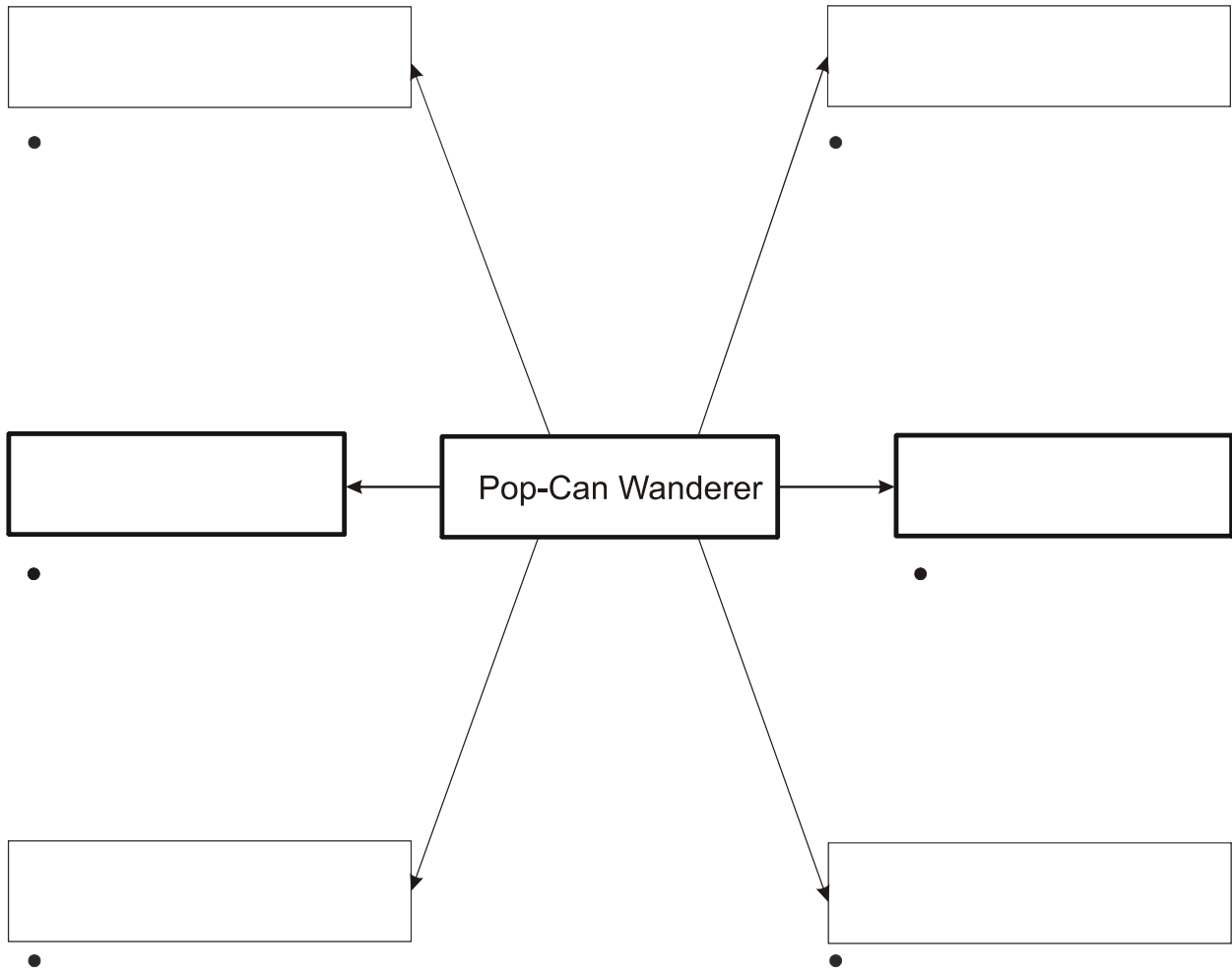
1. Wind the Pop-Can Wanderer, put it on the floor, and release it.
2. Make an observation on the movement of the Wanderer.
3. Adjust the Wanderer by changing one factor.
4. Test the Wanderer 10 more times.
5. Record the change and the results of your test.
6. Using the Guiding Questions, write a summary of your observations.

#### Possible Challenges

- Which goes fastest? Which factors cause the Wanderer to go faster?
- Which goes farthest? Which factors cause the Wanderer to go farther?
- Which goes straightest? Which factors cause the Wanderer to go straighter?
- Which stops closest to a particular target?

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**Appendix 1.1.4: Pop-Can Wanderers (continued)**



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## Activity 1.2: Asking Questions

**Time:** 2.5 hours

### Description

A discrepant event, such as the absorption of a large amount of water by a small amount of a super-absorbent polymer found in many household and workplace items, serves as an invitation to generate questions about the product. Students sort the questions into those testable by experiment, those answerable by research, and those not answerable by science. They further analyse testable questions using a Question Practicality Template that has a similar framework to the one used in the final unit. In pairs, they answer a class-created question, share results with another pair, and assess their method and results in a reflection.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems.

**Strand(s):** Science Inquiry: Science in Daily Life.

#### Overall Expectations

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life:

#### Specific Expectations

SIL1.01 - describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life;

SIL2.01 - formulate questions about problems or issues that can be scientifically tested;

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.06 - communicate plans, observations, and results, using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate;

SIL3.02 - evaluate the investigation of the topic they selected and suggest possible refinements.

### Prior Knowledge & Skills

- Literacy and numeracy skills, including oral language
- Understanding of the concept of “fair test”

### Planning Notes

- Consult board, school, or department requirements for safety in the science classroom. The policy may require that students and parents sign a list of safety rules or a letter before beginning the experimental part of the course. See *Stay Safe*, the STAO safety booklet, which has a suitable list of safety rules for students.
- Purchase a super-absorbent polymer such as Super Gel and distribute in small packages of equal mass.
- Make safety glasses and eye wash stations available.
- Bring in examples of super-absorbents in daily life – diapers, spill pillows for hazardous waste, “grow” dinosaurs for children, etc., as well as pictures.
- Begin the “Science in Daily Life” bulletin board with examples so that students have visual images on a constant basis.
- Begin a word wall with pictures of the equipment and glassware to be used.

- 
- Prepare sheets for Equipment additions to the Portfolio: Name, Picture, Purpose, Safe Use.
  - Prepare an overhead with the DOVE technique for brainstorming:  
Defer judgement – accept all ideas, list everything, evaluate later.  
Opt for original and off-beat – anything goes, especially different and crazy ideas.  
Vast numbers of ideas are best – get as many ideas, the more the better.  
Expand by association – piggyback off each other’s ideas.
  - Start an observation tracking sheet for student performance. Much of the assessment and evaluation will be able to be done from performance rather than by pencil-and-paper tasks.
  - Encourage students to bring in scientific questions about their interests and hobbies. They begin a page in their portfolio to generate scientific questions of personal interest for future use.

## Teaching/Learning Strategies

### 1.2.1 Generating and Analysing Questions

- By using a demonstration that involves the use of the super-absorbent found in diapers (see "Tricky Science" in Resources), the teacher introduces a discrepant event with humour.
- Challenge students to brainstorm at least 20 questions using the DOVE technique either in small groups or as a whole class.
- The teacher leads a discussion on whether questions are testable by experiment, researchable, or are not able to be answered scientifically.
- In groups, students sort questions. Pairs of students regroup to compare their sorts.
- The teacher circulates to assess whether further discussion is required.
- Introduce students to the Question Practicality Template (Appendix 1.2.1). Students add a copy of the template to their portfolio and place one on the Hobbies and Interests bulletin board.
- In small groups, students use a teacher-devised question that does not meet one of the criteria. They use the Question Practicality Template to analyse the question.
- Group members take on specific tasks for this activity: one is the recorder, one the time keeper, one the spokesperson, and one the materials manager. The spokesperson shares the analyses leading to a class discussion.
- The teacher gives students a short list of questions that they must analyse individually.

### 1.2.2 How Much Will It Absorb?

- The teacher leads a class discussion revisiting the testable questions using the concepts developed in the Question Practicality Template. Guided by the teacher, students select the testable question, e.g., How much water will the super-absorbent absorb? The teacher leads a discussion of the appropriate equipment, e.g., graduated cylinder, beaker, balance, to use for the experiment.
- Post pictures of the equipment with names and locations clearly on the walls in a word wall.
- Students begin an Equipment List in their portfolio that includes Name, Picture, Purpose, and Safe use of each piece of equipment they use.
- Introduce students to Lab Safety Rules. The teacher can issue the Handling Lab Equipment Part 1 Licence, which they can put into their portfolio. They identify safety equipment available in the room, e.g., eye wash stations.
- Introduce students to the thinking/inquiry skills that will be used to observe their performance throughout the course (Appendix 1.2.2: Student Lab Performance).
- In groups, students develop a plan to test the question developed above, using either mass or volume. The plan must include safety concerns, e.g., wearing safety glasses.
- Using the same amount of super-absorbent polymer, students work in groups to conduct the investigation and keep simple observations.

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- The teacher observes student performance, assisting as required.
  - Students compare results with other groups, using the same technique (mass or volume). They compare their plans and results using Appendix 1.1.3: Guiding Questions Template.
  - Groups then re-assess their plans and results. They complete a report using the Guiding Questions Template and list the improvements they would make if they were to do the experiment again. The teacher provides feedback.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 1.2.1, the analysis of questions is assessed for Inquiry using a checklist (Met, Not Yet Met Criteria).
- In activity 1.2.2, the lab performance is assessed for Inquiry using a rubric.
- In activity 1.2.2, the lab plans are self-assessed using reflection questions.

### **Resources**

#### **Science Resources**

##### Print

Steward, Mike. "Tricky Science." *Science Scope*, 28:1 (September, 2004).

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## Appendix 1.2.1: Question Practicality Template

Criteria	Yes/No	Comment: reasons for this decision
Is the question testable by doing an experiment in class?		
Is it safe? What precautions are needed?		
Are there costs associated with the experiment?		
Are materials readily available?		
Can the experiment be done in the time available?		
Other areas of concern:		

## Appendix 1.2.2: Student Lab Performance

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Inquiry</b> Use lab equipment and materials	- uses lab material and equipment with limited accuracy	- uses lab material and equipment with some accuracy	- uses lab material and equipment with considerable accuracy	- uses lab material and equipment with thorough accuracy
Follow procedures using necessary safety precautions	- follows procedure using necessary safety precautions with limited effectiveness	- follows procedure using necessary safety precautions with some effectiveness	- follows procedure using necessary safety precautions with considerable effectiveness	- follows procedure using necessary safety precautions with a high degree of effectiveness
Make observations	- makes observations with limited accuracy and effectiveness	- makes observations with some accuracy and effectiveness	- makes observations with considerable accuracy and effectiveness	- makes observations with a high degree of accuracy and effectiveness
Dispose of materials and clean workstation	- disposes of materials and cleans workstation with limited effectiveness	- disposes of materials and cleans workstation with some effectiveness	- disposes of materials and cleans workstation with considerable effectiveness	- disposes of materials and cleans workstation with a high degree of effectiveness

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

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## Activity 1.3: Science Inquiry in Everyday Life

**Time:** 2.5 hours

### Description

Students make a bouncing ball from a polymer and devise a fair test for comparing the bounciness of different sports balls. Students experience the need for giving clear instructions in a one-way communication activity. Working in pairs, they devise a comparison test and share their instructions with others who test them. The class chooses one method that all students use to collect the data. Students prepare charts and connect the data collected with the use of the ball and the way it is made. They write a paragraph connecting science processes with everyday life.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2c - presents information and ideas clearly and honestly and with sensitivity to others;

CGE2d - writes and speaks fluently one or both of Canada's official languages;

CGE5b - understands and uses written materials effectively.

**Strand(s):** Science Inquiry: Science in Daily Life

#### Overall Expectations

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life.

#### Specific Expectations

SIL1.01 - describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life;

SIL2.02 - plan, conduct, and refine simple investigations to answer student-generated questions;

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate;

SIL2.06 - communicate plans, observations, and results using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate;

SIL3.03 - demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process.

### Prior Knowledge & Skills

- Safe use of equipment
- Use of spreadsheet and charting

### Planning Notes

#### 1.3.1 Bouncy Balls

- Prepare equal volumes of white glue and water as Solution One.
- Prepare equal volumes of detergent (preferably powder) and water as Solution Two.
- Make some bouncy balls in advance to test out a suitable method for students to use. (Add drops of Solution Two to about 2 mL of Solution One until it begins to pull away into a ball. Then add further drops of Solution Two until the desired bounciness is reached.)
- Locate metre sticks, measuring tapes, range meters, etc.
- Gather an assortment of sports balls.

- 
- Prepare simple diagrams for students to use during the one-way communication activity.
  - If students are to prepare bar graphs using the computer, book a computer lab and assess the level of student expertise in advance.
  - Prepare criteria and sentence stems for students to use during peer assessment, e.g.,
    - Two things that worked well in the experimental plan are...
    - Two things I would have changed are...

## **Teaching/Learning Strategies**

### **1.3.1 Bouncy Balls**

- The teacher introduces the activity and outlines any safety concerns. (Students must wear safety glasses.)
- In pairs, students add a prepared solution of detergent and water to a prepared solution of water and glue to get the best combination for the best consistency to make a ball that will bounce.
- The teacher directs students to answer the question: What combination of prepared solutions produces the ball with the best bounce? The teacher guides discussion of what best means.
- Using one of the bouncy balls, they test a number of different ways to determine which ball bounces the highest.
- Students participate in a class discussion of their discoveries of measuring the height of bounce and what factors might affect it.
- Students select three sports balls, (e.g., volleyball, basketball, tennis ball, golf ball, soccer ball, ping pong ball, football, rugby ball, dollar store varieties of balls) to compare for bounce.
- The teacher introduces a one-way communication activity to give students experience in writing instructions before they develop a plan for an experiment. While looking at a sample diagram, one student (the instructor) gives verbal instructions to the other (the recorder who can't see the diagram) about how to construct it. The pair discusses and compares the recorder's diagram with the instructor's instructions. Students switch places and use another diagram.
- In pairs, students write out a plan for their fair test, explaining how they keep all factors constant to compare the bounciness of the balls, and they prepare a T-chart for data collection (Appendix 1.3.1).
- They exchange their plan with another pair of students who try out the plans and give feedback, using the criteria provided and prompts from the teacher.
- The class chooses the plan that will produce the best results.
- In pairs, students compare how well the balls bounce based on their construction and their utility.
- As a class, prepare a chart of the collected data.
- Individually, students prepare a bar graph and a model chart for their portfolio.
- As a class, students prepare more questions about hobbies and interests and are encouraged to bring in examples of science in everyday life for the bulletin boards.
- Students write a one-paragraph reflection in their portfolio on how these skills might apply in everyday life.

## **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 1.3.1, the written procedure is peer assessed for Knowledge/Understanding, Communication, and Inquiry through peer feedback.
- In activity 1.3.1, the paragraph is diagnostically assessed for Knowledge/Understanding, Communication, and Making Connections, using a checklist.

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## Resources

### Science Resources

#### Print

*Wonder Science*, 14:3 (Fall 1999).

#### Websites

The American Chemical Society – [www.acs.org](http://www.acs.org)

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### Appendix 1.3.1: Student Planning: A Fair Test

Criteria	Yes/No	Changes I can make
My plan has enough details to make it a fair test.		
My plan includes a list of all the materials I need for the experiment.		
My plan explains how I will gather the data.		
My data tables are appropriate for recording the data.		
My procedure for conducting the experiment is clear and in logical steps.		
My safety checklist addresses necessary safety procedures for the experiment.		

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## Activity 1.4: Investigating a Testable Question

Time: 7.5 hours

### Description

Students select three questions from their portfolio for peer analysis. With the feedback, students choose one of the questions to analyse thoroughly and write instructions for an experiment to answer the question using a fair test. Students choose a question approved by the teacher to produce a set of instructions that are followed by a Workplace Solutions Team. They record data and choose a format to present their results to another team.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2c - presents information and ideas clearly and honestly and with sensitivity to others.

**Strand(s):** Science Inquiry: Science in Daily Life

#### Overall Expectations

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life.

#### Specific Expectations

SIL1.02 - explain the importance of a “fair test” for troubleshooting and testing everyday science problems;

SIL2.01 - formulate questions about problems or issues that can be scientifically tested;

SIL2.02 - plan, conduct, and refine simple investigations to answer student-generated questions;

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate;

SIL2.05 - assess data to make inferences and conclusions and to answer questions and refine procedures;

SIL2.06 - communicate plans, observations, and results using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate;

SIL3.01 - develop and investigate research questions about an everyday science-related topic of personal interest;

SIL3.02 - evaluate the investigation of the topic they selected and suggest possible refinements.

### Prior Knowledge & Skills

- An understanding of the concept of a fair test developed in previous activities
- Knowledge of how to write instructions, as in previous activity
- Safe use of equipment, as in previous activity
- Understanding of presentation skills in mode required

### Planning Notes

- Students can be regrouped according to interests after the first part of this activity. Students may also be grouped according to their skill levels.
- The experiments students devise should be able to be completed in a class period. Students should be informed ahead of time that they will be doing a similar activity in Unit 5: Making Personal Decisions, where they will be able to work with more advanced science tools.

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- Teachers may wish to stagger the experimental part of the activity so that only half the class is experimenting while the other half is either working on the previous activity or preparing the presentation.

## **Teaching/Learning Strategies**

### 1.4.1 Questioning and Planning

- Working with a partner, students exchange three questions chosen from the list they have in their portfolio.
- The partner analyses the three questions using Appendix 1.2.1: Question Practicality Template.
- Based on their partner's analysis, the student chooses one of the questions for further study.
- Individually, students use the feedback to complete their own Question Practicality Template for their question, adding their own comments. They write instructions to answer their question clearly, explaining what factors they must consider for a fair test and what factors they must consider for safety.
- Students submit the Question Practicality Template and instructions to the teacher for approval and evaluation.

### 1.4.2 Conducting, Recording, and Presenting

- In groups, students choose which experiment they wish to pursue from the approved instructions. The team assumes the role of the Workplace Solutions Team and conducts the experiment, recording data on a T-chart.
- Two Workplace Solution Teams work together. Each team presents its results to another team. Formats might include electronic presentation, role play, oral, written, poster, or radio/video presentation.
- Teams re-sort into groups of four, each containing two members of the original teams. Students retell what they heard during the presentation. Original presenters give feedback as to the accuracy of the retelling. Both teams discuss what aspects of the presentations worked and what aspects could be improved.
- Students write an individual reflection in their portfolio on the process and the utility of scientific inquiry in the everyday world.

## **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 1.1.1, the teacher assesses student performance for Knowledge/Understanding and Inquiry, using anecdotal records
- In activity 1.1.2, the teacher assesses students' problem-solving skills during the performance.

## **Resources**

### **Resources for Catholic Teachers**

#### CD-ROMs

*Curriculum Support for Catholic Schools.* Eastern Ontario Catholic Curriculum Cooperative, 2002.

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## Unit 2 Biology: Staying Alive

Time: 25 hours

### Unit Description

This unit connects life-sustaining processes and systems to procedures important for personal safety in the workplace, the home, and everyday life. The skill emphasis is on the development of testable questions. Students review the concept of life-sustaining processes while reinforcing the skills of observation, data collection, and communication. They pose questions and investigate simple life processes. Students expand their knowledge of the structures and systems required for these life-sustaining processes. The activities, including a safe dissection or simulation, build on an understanding that structures work together in organized systems to support life. Students connect this understanding to their personal lives and future work experiences. They identify the characteristics of a safe workplace and choose personal protective equipment appropriately. They build on Essential Skills needed in the workplace: document use, finding information, and decision making.

### Unit Synopsis Chart

Activity/ Time	Learning Expectations	Assessment Evaluation Categories, Tasks, and Tools	Tasks
2.1 Life- Sustaining Processes  12 hours	BSAV.01, .02, BSA1.01, 2.01, 2.02, 2.04, 2.05 SILV.02, SIL2.01  CGE2c, 3c, 5a, 7i	2.1.1: Student answers are diagnostically assessed for Knowledge/Understanding. 2.1.2: Data table is assessed for Inquiry using a checklist. 2.1.2: Major life-sustaining processes are evaluated for Knowledge/Understanding using an oral test. 2.1.3: Microscope use and slide preparation are evaluated for Inquiry and Knowledge/ Understanding using a checklist. 2.1.3: Formal lab drawing is assessed for Inquiry and Communication using a checklist.	Students: <ul style="list-style-type: none"><li>• review questioning skills;</li><li>• observe earthworm responses to stimuli;</li><li>• record observations;</li><li>• add to glossary of terms;</li><li>• earn Microscope Operator's Licences;</li><li>• examine live specimens and prepared slide using a microscope;</li><li>• draw formal lab drawings.</li></ul>

Activity/ Time	Learning Expectations	Assessment Evaluation Categories, Tasks, and Tools	Tasks
2.2 Interconnected Systems  10 hours	BSAV.01, .02, .03, BSA1.02, 1.03, 2.02, 2.03, 2.04, 2.05, 3.01 SILV.01, .02, SIL1.01, 2.03, 2.04, 2.05, 2.06  CGE4f	2.2.1: Safe and proper use of dissecting tools are assessed, then evaluated for Inquiry and Communication using a checklist. 2.2.2: Formal Lab drawings are assessed for Inquiry and Communication using a rubric. 2.2.3: Venn diagrams are assessed for Knowledge/ Understanding and Communication using teacher feedback. 2.2.4: Selection and justification of found objects for the model are assessed for Knowledge/ Understanding using a rubric. 2.2.5: Major life systems are evaluated for Knowledge/ Understanding, using a written test and labelling of a diagram.	Students: <ul style="list-style-type: none"> <li>• learn about dissecting tools and their safe use under teacher direction;</li> <li>• earn Dissecting Licence;</li> <li>• use dissection guides as reference;</li> <li>• learn to draw formal lab drawings as a tool for reporting observations;</li> <li>• dissect earthworms and frogs observing close connection of major systems, drawing diagrams;</li> <li>• orally dialogue with other students to compare one organism's system with a human system;</li> <li>• complete a Venn diagram to compare one system within a frog, earthworm, and human;</li> <li>• construct a model to illustrate major systems.</li> </ul>
2.3 Personal Safety  3 hours	BSAV.02, .03, BSA2.04, 2.05, 3.01, 3.02 SILV.01, .02, .03, SIL1.01, 2.05, 3.03  CGE2c, 7j	2.3: Graphic organizer is assessed for Knowledge/ Understanding, Inquiry, and Making Connections using a checklist. 2.3: Poster is evaluated for Communication and Making Connections using a rubric.	Students: <ul style="list-style-type: none"> <li>• research job hazards from HRSDC information with teacher assistance;</li> <li>• relate each hazard to life-sustaining processes being threatened;</li> <li>• design a poster promoting use of safety equipment for that hazard.</li> </ul>

## Activity 2.1: Life-Sustaining Processes

**Time:** 12 hours

### Description

In a group brainstorming session, students review some of the major life-sustaining processes and develop a list of terms to mount on a word wall and add to their portfolios. Students investigate how earthworms react to various stimuli and develop a concept map relating these behaviours to life-sustaining processes. They learn how to use a microscope correctly and make simple slides. Students use these skills to observe and record the observations from prepared slides and live microscopic specimens. Students will use these skills in their observations and data collection in Unit 5: Making Personal Decisions.

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## **Strand(s) & Learning Expectations**

### **Ontario Catholic School Graduation Expectations**

CGE2b - reads, understands and uses written materials effectively;  
CGE2d - writes and speaks fluently one or both of Canada's official languages;  
CGE5a - works effectively as an interdependent team member;  
CGE7i- respects the environment and uses resources wisely.

**Strand(s):** Scientific Inquiry: Science in Daily Life; Biology: Staying Alive

### **Overall Expectations**

BSAV.01 - explain the systems and processes required by simple and complex organisms to sustain life;  
BSAV.02 - investigate, through laboratory activities, the processes which simple and complex organisms use to sustain life;  
SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

### **Specific Expectations**

BSA1.01 - describe the basic life-sustaining processes of organisms, including single celled and complex organisms;  
BSA2.01 - formulate questions and develop simple experiments to investigate how simple and complex organisms respond to environmental stimuli;  
BSA2.02 - make accurate observations of structures, using microscopes, and relate them to functions of systems and processes of simple and complex organisms;  
BSA2.04 - extract and interpret information from a variety of sources;  
BSA2.05 - communicate observations, interpretation of results, and information through appropriate formats;  
SIL2.01 - formulate questions about problems or issues that can be scientifically tested.

### **Prior Knowledge & Skills**

- The ability to formulate and classify different types of questions
- Ability to organize collected data in tables
- Experience observing and recording the location of the safety equipment in the classroom

### **Planning Notes**

- This activity develops the students' questioning skills in preparation for Unit 5: Making Personal Decisions.
- Prepare a labelled diagram of the light microscope for student reference.
- Check prepared slides before use for damage.
- Gather video and/or written resources so students can review major systems for Quiz Show Game.
- Order or locate live specimens (earthworms, protists).
- Start yeast culture several hours before observation.
- Collect large pieces of cardboard, lights, sandpaper, etc., for worm experiment.
- Arrange a garden or worm-friendly location for the return of the worms to nature.

### **Teaching/Learning Strategies**

#### **2.1.1 Systems Quiz Show Game**

- As a class, students brainstorm possible answers to the question: What do you need to stay alive?
- Students develop a list of life-sustaining processes. The teacher assists with terminology and adds characteristics of other types of organisms, e.g., plants.
- Students add the new vocabulary words to a class word wall and to the glossary of terms in their portfolios.

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- In small groups, students focus on one system, e.g., circulatory, nervous, digestive, excretion, reproduction, respiratory, and use the information and ideas from the brainstorming session, the word wall, class discussions, and other resources to develop questions and answers for a quiz show game.
  - The class reviews the systems by playing the game as a class.

#### 2.1.2 Worm Olympics

- As a class, students generate possible answers to the question: Why don't we find earthworms crawling around on the grass? They use these answers to design testable questions.
- With teacher guidance, students design an experiment to observe the response of earthworms to a variety of stimuli, e.g., wet/dry, smooth/rough, dark/light, up-slope/down-slope, avoiding any which may be harmful to the worms, e.g., strong acids or bases, prolonged dry periods.
- In small groups, students perform the experiment, making careful observations and recording these in data tables of their design.
- Using their observations, the class develops a profile of the conditions "preferred" by earthworms.
- The teacher uses this as a springboard to discuss other life processes and how response to stimuli relates to the students, e.g., you eat when you are hungry.

#### 2.1.3 Microscopic Observation of Structures Associated with Life Processes

- The teacher demonstrates how to use a microscope correctly and how to prepare wet-mount slides.
- Students demonstrate these skills to earn a Microscope Operator's Licence, which they add to their portfolios.
- Students label the diagram of a microscope and add this to their portfolios for reference.
- Through instruction, demonstrations, or samples, students learn how to make formal lab drawings, as another means of presenting observations.
- Using prepared slides, e.g., mitosis in whitefish eggs or root tip, plant cells showing chloroplast, students observe structures related to life-sustaining processes and make simple slides of live material, e.g., budding yeast, onion membrane, feeding Amoeba or Paramecium.
- Students draw formal lab drawings of their observations.
- Students write a paragraph describing what they observed in each case. A partner identifies what was observed from the description. The students improve their descriptions, if necessary, after feedback from the partner, e.g., a student statement of "a small, light brown circle had a smaller circle stuck to it," would be answered with "yeast budding."

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 2.1.1, student answers about systems are diagnostically assessed for Knowledge/Understanding.
- In activity 2.1.2, the data table organization is assessed for Inquiry using a checklist, and the student's Knowledge/Understanding of major life-sustaining processes is evaluated using an oral test.
- In activity 2.1.3, microscope use and slide preparation are evaluated for inquiry. Students gain a Microscope Operator's Licence.
- Formal lab drawing is assessed and evaluated for Inquiry using a checklist.

### **Resources**

- Microscope diagrams are available in blackline master sets available from many publishers.
- Prepared microscope slides are available from most scientific supply companies and may be in the school; the teacher is encouraged to ask the Biology teacher(s).

#### CD-ROMs

*Curriculum Support for Catholic Schools.* Eastern Ontario Catholic Curriculum Cooperative, 2002.

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## Activity 2.2: Interconnected Systems

**Time:** 10 hours

### Description

Students learn the safe use of simple dissecting tools and select the correct tool for completing their task. Students carry out dissections or computer-simulated dissections and practise lab drawing skills to gain an appreciation of the connections between major body systems. They construct a model to reinforce their understanding of the systems.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduation Expectations

CGE4f - applies effective communication, decision-making, problem-solving, time and resource management skills.

**Strand(s):** Scientific Inquiry: Science in Daily Life; Biology: Staying Alive

#### Overall Expectations

BSAV.01 - explain the systems and processes required by simple and complex organisms to sustain life;  
BSAV.02 - investigate, through laboratory activities, the processes which simple and complex organisms use to sustain life;

BSAV.03 - analyse how personal health and safety in everyday life and in the workplace are protected through the proper use of equipment and safety practices;

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

#### Specific Expectations

BSA1.02 - relate structures involved in life-sustaining processes to their function;

BSA1.03 - outline how a complex organism functions through the basic interactions between organ systems;

BSA2.02 - make accurate observations of structures, using microscopes, and relate them to functions of systems and processes of simple and complex organisms;

BSA2.03 - examine the relationship between the circulatory, respiratory, and digestive systems in complex organisms by performing dissections or using a computer-simulated dissection;

BSA2.04 - extract and interpret information from a variety of sources;

BSA2.05 - communicate observations, interpretation of results, and information through appropriate formats;

BSA3.01 - analyse how specific equipment and safe practices are used to protect personal health and safety at home and in the workplace;

SIL1.01 - describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life;

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate;

SIL2.05 - assess data to make inferences and conclusions and to answer questions and refine procedures;

SIL2.06 - communicate plans, observations, and results, using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate.

### Prior Knowledge & Skills

- Familiarity with making formal lab drawings to present observations
- Knowledge of human systems from previous grades
- Use of graphic organizers – Venn diagrams

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## Planning Notes

- This activity provides the students with an alternate method of presenting observations, which may be used in the final evaluation. Students may wish to include this activity in their portfolio for future reference.
- The teacher may wish to expand the concept of dissection to include the idea of taking something apart to see how it works. This is pursued in Unit 3: Physics: Electrical Circuits.
- Make cards for the Matching Cards Activity.
- Students may need further direction on how to draw and label a Venn diagram to compare one system of three different organisms (earthworm, frog, and humans). One suggestion is to have them use different coloured markers.
- As a memory device, have students think of a common object that reminds them of each structure observed, e.g., the stomach is like a balloon. This will also help in preparation for activity 2.2.4.
- The teacher collects found objects for model making.
- For dissection activities, cultural and personal perspectives must be respected, and alternative experiences should be available to the students.

## Teaching/Learning Strategies

### 2.2.1 Dissecting Safely

- In a teacher-directed lesson, students learn the safe and proper use of the tools and procedures involved in a dissection and have a discussion about respect for living things.
- Students complete a safety test to obtain their Dissection Licence. (Appendix B: Sample Operator's Licence Tracking Form)

### 2.2.2 Dissections

- In groups, students refer to the dissection guides as they dissect an earthworm with teacher supervision. The focus for the dissection is the relationships between the major organ systems.
- Students draw formal lab drawings of their observations, showing the close relationship of major systems, e.g., circulatory, digestive, nervous.
- Students conduct a dissection of a frog following the same procedure.

### 2.2.3 Relating to Human Systems

- The teacher organizes the class into pairs. Each student is given a card that has either an organ or a system listed. Students find another student with a card that matches the organ to the system. The teacher then uses the Numbered Heads strategy to assign an organism to each pair.
- Students orally dialogue with their partner about the differences and similarities of the system of their organism to that of a human system.
- Students find another pair of students discussing the same system, with a different organism. They discuss the differences and similarities between the frog, earthworm, and human systems and record their discussions of one system on a Venn diagram showing all three organisms.
- Rotate the Venn diagrams from one group to another so students can see other systems and add to the Venn diagrams using a different coloured marker. Post the Venn diagrams for reference during the next sub-activity.

### 2.2.4 A Systems Model

- Students review their diagrams from the dissection activities and consider what common objects remind them of the structures they observed.
- Each student chooses two of the major systems studied and makes a list of the major organs within that system. Students identify the common object that reminded them of the organ and provide an explanation of what property or characteristic of the object reminded them of that organ.

- 
- Students use “found objects” to make a three-dimensional model of any two of the systems they have observed. Objects used should reflect the nature or structure of the organ modelled, e.g., a vacuum-cleaner hose for a trachea, a balloon for a stomach. Students label the model of the two systems, showing how they are closely connected.
  - Students share their models with the class through an oral presentation or gallery walk.
  - The teacher leads a class discussion about the common features of each model.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 2.2.1 the safe and proper use of dissecting tools is assessed, using a checklist.
- In activity 2.2.2, formal lab drawings are assessed for Inquiry, using a rubric.
- In activity 2.2.3, the Venn diagrams are assessed for Knowledge/Understanding and Communication, using teacher feedback.
- In activity 2.2.4, the selection and justification of found objects for the model are assessed for Knowledge/Understanding, using a rubric. The Knowledge/Understanding of major systems is evaluated, using a written test and a labelled diagram.

### **Resources**

#### **Literacy Resources**

##### Print

Bennett, Barrie and Carol Rolheiser. *Beyond Monet*. Toronto, ON: Bookation, 2001. ISBN 0969538839

#### **Science Resources**

##### Print

Dissection guides are available from many scientific supply companies.

##### Websites

Several sources are available for digital dissection; some of these are:

- <http://biology.about.com/cs/dissections>
- [www.pcrm.org.resch/anexp/dissection\\_alternatives.html](http://www.pcrm.org.resch/anexp/dissection_alternatives.html)
- [www.digitalfrog.com](http://www.digitalfrog.com)
- [www.neotek.com](http://www.neotek.com)
- [www.venturaes.com](http://www.venturaes.com)

#### **Resources for Catholic Teachers**

##### Websites

Faith and the Common Good – <http://www.faith-commongood.net>

##### CD-ROMs

*Curriculum Support for Catholic Schools*. Eastern Ontario Catholic Curriculum Cooperative, 2002.

## Appendix 2.2.2: Sample Rubric for Biological Diagrams

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Communication</b> of information - Clarity of the lab drawing	- the major organ systems are drawn with limited clarity	- the major organ systems are drawn with moderate clarity	- the major organ systems are drawn with considerable clarity	- the major organ systems are drawn with a high degree of clarity
<b>Communication</b> of information - Precision of the lab drawing	- the major organ systems are drawn with limited precision	- the major organ systems are drawn with moderate precision	- the major organ systems are drawn with considerable precision	- the major organ systems are drawn with a high degree of precision
<b>Communication</b> Use of scientific terminology - Labelling of major organ systems	- the major organ systems are labelled with limited accuracy	- the major organ systems are labelled with some accuracy	- the major organ systems are labelled with considerable accuracy	- the major organ systems are labelled with a high degree of accuracy
<b>Inquiry Application</b> of the skills and strategies of scientific inquiry - Recording observations from the dissection	- the organization of the data from each organ system is recorded with limited accuracy	- the organization of the data from each organ system is recorded with some accuracy	- the organization of the data from each organ system is recorded with considerable accuracy	- the organization of the data from each organ system is recorded with thorough accuracy

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

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## Activity 2.3: Personal Safety

**Time:** 3 hours

### Description

Students investigate some of the potential safety hazards associated with careers they may be considering, or with their current jobs, and relate these hazards to the life-sustaining processes that may be affected. They choose a way to promote use of safety equipment designed to protect the worker.

### Strand(s) and Learning Expectations

#### Ontario Catholic School Graduation Expectations

CGE2c - presents information and ideas clearly and honestly and with sensitivity to others;

CGE7j - contributes to the common good.

**Strand(s):** Science Inquiry: Science in Daily Life; Biology: Staying Alive

#### Overall Expectations

BSAV.02 - investigate, through laboratory activities, the processes which simple and complex organisms use to sustain life;

BSAV.03 - analyse how personal health and safety in everyday life and in the workplace are protected through the proper use of equipment and safety practices;

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life.

#### Specific Expectations

BSA2.04 - extract and interpret information from a variety of sources;

BSA2.05 - communicate observations, interpretation of results, and information through appropriate formats;

BSA3.01 - analyse how specific equipment and safe practices are used to protect personal health and safety at home and in the workplace;

BSA3.02 - examine case studies of common workplace environments to develop a checklist of safety practices necessary to sustain systems and processes critical to life;

SIL1.01 - describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life;

SIL2.05 - assess data to make inferences and conclusions and to answer questions and refine procedures;

SIL3.03 - demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process skills.

### Prior Knowledge & Skills

- Knowledge of structures associated with life-sustaining processes
- Understanding of the close relationships between organs involved in life-sustaining processes

### Planning Notes

- The teacher should become familiar with the Human Resources and Skills Development Canada (HRSDC) website for specific career information (see Resources).
- Book the computer lab or library/resource centre for student access to the HRSDC website. Alternatively, teachers could print selections in advance for student use in the classroom.

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## Teaching/Learning Strategies

- Students identify a current job or a future career that they may be considering. The teacher provides guidance in making this choice, keeping in mind that the task is not careers, but safety in the workplace.
- Using the HRSDC website, or the Essential Skills Profiles, students identify the safety concerns associated with the careers, and the life-sustaining process(es) potentially threatened by each job hazard. Students present this information using a graphic organizer.
- Students select one piece of safety equipment used to protect against one of the job hazards identified and design a poster promoting use of that piece of equipment in the workplace, stressing which important life-sustaining process is being protected.

## Assessment & Evaluation of Student Achievement

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 2.3, the graphic organizer is assessed for Knowledge/Understanding, Inquiry, and Making Connections, using a checklist.
- The poster is evaluated for Communication and Making Connections, using a rubric.

## Resources

### Science Resources

#### Websites

Human Resources and Skills Development Canada  
– [www15.hrdc-drhc.gc.ca/English/general/home\\_e.asp](http://www15.hrdc-drhc.gc.ca/English/general/home_e.asp)

### Resources for Catholic Teachers

#### Websites

Faith and the Common Good – <http://www.faith-commongood.net>

## Unit 3: Physics: Electrical Circuits

Time: 25 hours

### Unit Description

Students are made aware of the practical uses of electrical circuits in their daily lives. They develop an understanding of current electricity and the role it plays in everyday life. The scientific skill emphasis is on gathering, organizing, and working with qualitative and quantitative data.

Students investigate how the components of circuits work together and build simple circuits that model everyday circuits. They collect data as they measure current and potential difference in various circuits and relate this understanding to everyday electrical devices in circuits. Using a variety of household and workplace devices, they develop a logical checklist for troubleshooting electrical devices.

Safety, experimentation, literacy, and collaboration are integral components of the activities. Students build on the following Essential Skills needed in the workplace: oral and written communication; document use; and thinking skills, including problem solving and decision making.

### Unit Synopsis Chart

Activity/Time	Learning Expectations	Assessment and Evaluation Categories, Tasks, and Tools	Tasks
3.1 Introduction to Electric Circuits  10 hours	PECV.01, .02, .03, PEC1.01, 1.02, 1.03, 1.04, 2.03, 2.04, 3.01 SILV.02, SIL2.03, 2.04  CGE2b, 2d, 3c, 5a	3.1.1: Map of classroom and written reflection are assessed for Making Connections using a checklist.	Students: <ul style="list-style-type: none"><li>• review prior knowledge of electricity;</li><li>• identify the components of electrical circuits and their functions;</li><li>• build circuits and measure current and voltage;</li><li>• obtain Electric Circuit Operator Licence.</li></ul>
3.2 Building a Common Electrical Device  2 hours	PECV.01, .02, PEC1.01, 1.02, 1.03, 1.04, 2.03 SILV.02, SIL2.03, 2.04  CGE2b, 2d, 3c	3.2: Lab skills are self-assessed for Inquiry using a checklist. 3.2: Explanation of components of a circuit is evaluated for Knowledge/Understanding using a rubric.	• Students: <ul style="list-style-type: none"><li>• build an everyday electric circuit from a circuit diagram.</li></ul>
3.3 Properties of Series and Parallel Circuits  6 hours	PECV.01, .02, PEC1.01, 1.04, 2.01, 2.02, 2.03, 2.04, 2.06 SILV.02, SIL2.03, 2.04, 2.05, 2.06  CGE2b, 2d, 3c, 5a	3.3.1: Data tables are peer assessed for Inquiry and Communication using a checklist. 3.3.1: Data tables and experimental data are evaluated for Inquiry and Communication using a rubric. 3.3.1: Properties of series and parallel circuits are evaluated for Knowledge/Understanding using a quiz. 3.3.2: Problem solving and lab skills are evaluated for Inquiry and Communication using a rubric.	Students: <ul style="list-style-type: none"><li>• identify the properties of series and parallel circuits through an investigation;</li><li>• create a graphic organizer on the properties of series and parallel circuits;</li><li>• design an electric circuit.</li></ul>

Activity/Time	Learning Expectations	Assessment and Evaluation Categories, Tasks, and Tools	Tasks
3.4 Troubleshooting Electrical Devices  7 hours	PECV.01, .02, .03, PEC1.02, 1.03, 2.05, 3.01, 3.02 SILV.01, .02, .03, SIL1.02, 2.04, 3.03  CGE2b, 2d, 3c	3.4.1: Safety poster is evaluated for Inquiry and Communication using a rubric. 3.4.2: Troubleshooting procedure is evaluated for Making Connections using a rubric.	Students: <ul style="list-style-type: none"> <li>• read appliance manuals;</li> <li>• identify safety precautions associated with the use of electrical appliances;</li> <li>• determine how to troubleshoot faulty appliances;</li> <li>• prepare a list of steps to be followed when troubleshooting an appliance of personal interest.</li> </ul>

### Activity 3.1: Introduction to Electric Circuits

**Time:** 10 hours

#### Description

Students work with electric circuits during a series of hands-on activities, with a focus on laboratory skill development. Students recognize electric circuits used in their everyday lives and learn how the components of an electric circuit convert electrical energy into other forms of usable energy. With an emphasis on safety, students build electric circuits and connect and read meters in an electric circuit.

#### Strands & Learning Expectations

##### Ontario Catholic School Graduate Expectations

CGE2b - reads, understands and uses written materials effectively;  
 CGE2d - writes and speaks fluently one or both of Canada's official languages;  
 CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;  
 CGE5a - works effectively as an interdependent team member.

**Strand(s):** Physics: Electrical Circuits; Scientific Inquiry: Science in Daily Life

##### Overall Expectations

PECV.01 - describe the characteristics of electrical circuits;  
 PECV.02 - investigate simple electrical circuits, using safe practices;  
 PECV.03 - analyse the practical uses of electrical circuits and their impact on daily life;  
 SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

##### Specific Expectations

PEC1.01 - use scientific terminology during investigations to describe basic electrical concepts and related units of measure;  
 PEC1.02 - demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits;  
 PEC1.03 - identify how household and workplace electric devices operate by converting energy to another form;  
 PEC1.04 - use a variety of symbols to represent different components in electrical circuits;  
 PEC2.03 - conduct investigations, using electrical materials, tools, and equipment safely;  
 PEC2.04 - measure and record the current and potential difference in simple circuits through the safe and proper use of an ammeter and a voltmeter;

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PEC3.01 - identify circuits and their components in household and workplace settings;  
SIL2.03 - conduct investigations safely, using appropriate lab equipment;  
SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate.

### **Prior Knowledge & Skills**

- Experience conducting laboratory investigations safely (Grade 6)
- An understanding that electrical energy can be transformed into other forms of energy
- Practice designing and constructing a variety of electrical circuits

### **Planning Notes**

- Gather various electrical appliances in the classroom, e.g., overhead projector, TV, VCR, CD player, electronic balances, and accompanying manuals. An overhead of any circuit diagrams in the manuals might be helpful for the class discussion.
- The focus is laboratory skill development through working with electric circuits.
- Students are working to obtain their Electric Circuit Operator Licences. This licence can be subdivided into two parts: building electric circuits and using meters. The activities that relate to meters may have to be modified depending on the school's equipment, e.g., ammeters, voltmeters, and/or multimeters.
- Throughout this activity and unit, students obtain approval for their circuits before turning them on. Keeping an ongoing record of students' performance of lab skills throughout the activity (and unit) may be helpful in determining whether a student has demonstrated sufficient achievement to obtain an Electric Circuit Operator Licence.
- Students are provided with a classroom map template, circuit diagrams, instructions for connecting meters, instructions for reading meters, and practice worksheets for reading meters. Throughout the unit, students practise building circuits and it is expected that they build a circuit independently by the end of the unit.
- As an extension, some students may draw circuit diagrams of the circuits they observe.
- As an extension, some students may create and write their own electric circuit analogies.

### **Teaching/Learning Strategies**

#### 3.1.1 Electrical Devices

- The teacher places electrical devices around the classroom. Students participate in a scavenger hunt of electrical devices in the classroom and record their findings. The teacher takes up the findings and records them on a class list, pointing out any devices and components missed, as well as safety features.
- Students show the location of all electrical devices in the classroom on the classroom map template.
- Students write a reflection on their experience of identifying household and workplace circuits and their components.
- Students review their prior knowledge of electricity by brainstorming electrical terms from everyday life and previous science courses in a think/pair/share activity. The teacher records the terms and leads a class discussion on the meaning and/or use of the terms.

#### 3.1.2.1 Parts of a Circuit

- Students observe a simple circuit prepared by the teacher and use it to discuss each component of the circuit and its function. As each new term is introduced, it is added to the word wall.

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### 3.1.2.2 Energy Conversion in Appliances

- Students participate in a teacher-guided discussion on energy conversions, and identify the energy conversions used in the electrical appliances in the classroom.
- Students complete a chart summarizing the energy conversions. (The teacher might compare an electric circuit to something with which the students are familiar, e.g., water fall, and relate it to the circuit they are observing and the role of each component as it relates to energy conversion).

### 3.1.2.3 Electrical Symbols

- Independently, students draw the assembled circuit without instructions and post their drawings. Students discuss the differences between the drawings.
- The teacher introduces circuit symbols and circuit diagrams as a method of clearly communicating the design of circuits. The importance of following a symbol system can be reinforced by referring to the differences between students' drawings.
- Students participate in a class discussion of basic electricity concepts by studying circuit diagrams that appear in the manuals. They should discuss the components of the circuit as well as the energy conversions that occur in each electrical device.
- Students add the physics terminology and any other necessary terminology, e.g., source, load, switch, open and closed circuit, conducting wires, to the class word wall and to the glossary of terms in their portfolio. They define each term and draw the corresponding symbol.

### 3.1.2.4 Building Circuits

- The teacher leads a discussion on cooperative group work and explains the role of each student within the group. Students work in pairs and take turns building the assigned circuits. One student builds the circuit and the other provides feedback, based on the circuit diagram provided. When both students are satisfied with the circuit, they ask the teacher to approve it before closing the switch.
- Students begin to work on obtaining their Electric Circuit Operator Licences. Students practise building circuits from circuit diagrams.

### 3.1.3 Using Meters

- Once students have demonstrated their competence in building circuits, they begin the second part of the Electric Circuit Operator Licences: connecting and reading meters. The teacher presents students with assembled circuits and demonstrates how to connect the meters, e.g., voltmeters, ammeters, and/or multimeters properly.
- Students are provided with a circuit diagram and with instructions for connecting each type of meter to the circuit. Students practise connecting meters, waiting for the teacher's approval before closing the switch.
- The teacher instructs students in reading meters, including using proper units, and provides a set of instructions. Students practise reading the meters on worksheets provided by the teacher. The teacher discusses the answers with the class. When students have practised sufficiently, they build circuits and read the meters.

## Assessment & Evaluation of Student Achievement

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 3.1.1, the classroom map and written reflections are assessed for Making Connections using a checklist.
- Students who have demonstrated a minimum of Level 3 (70%) achievement in building electric circuits, connecting and reading meters, safe handling of electrical equipment, and electric circuit terminology may earn their Electric Circuit Operator Licence.

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## Resources

### Science Resources

#### Websites

Electricity Online – <http://library.thinkquest.org/28032/cgi-bin/psparse.cgi?src=home>

Crocodileclips.com – <http://www.crocodileclips.com/index.htm>

Electrical Safety World – <http://www.sce.com/site/index.html>

How Electricity Works – <http://science.howstuffworks.com/electricity.htm>

OhmZone – <http://www.article19.com/shockwave/oz.htm>

#### Software

*Crocodile Physics*

*Crocodile Clips*

### Workplace Link Resources

#### Websites

OSH Answers: Electrical Safety Basic Information

– [http://www.ccohs.ca/oshanswers/safety\\_haz/electrical.html](http://www.ccohs.ca/oshanswers/safety_haz/electrical.html)

## Activity 3.2: Building a Common Electrical Device

**Time:** 2 hours

### Description

Students use skills gained during activity 3.1 to build an electric circuit found in an everyday electrical device. Students demonstrate their understanding of the function of a circuit and the energy conversions that occur within the circuit through a presentation.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2b - reads, understands and uses written materials effectively;

CGE2d - writes and speaks fluently one or both of Canada's official languages;

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems.

**Strand(s):** Physics: Electrical Circuits; Scientific Inquiry: Science in Daily Life

#### Overall Expectations

PECV.01 - describe the characteristics of electrical circuits;

PECV.02 - investigate simple electrical circuits, using safe practices;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

#### Specific Expectations

PEC1.01 - use scientific terminology during investigations to describe basic electrical concepts and related units of measure;

PEC1.04 - use a variety of symbols to represent different components in electrical circuits;

PEC2.01 - formulate scientific questions about circuits and create a simple plan to carry out an investigation, including safety procedures;

PEC2.02 - design, build and test an electrical circuit to investigate the chosen question, using appropriate safety procedures;

PEC2.03 - conduct investigations using electrical materials, tools, and equipment safely;

PEC2.04 - measure and record the current and potential difference in simple circuits through the safe and proper use of an ammeter and a voltmeter;

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PEC2.06 - communicate plans and results of investigations about electrical circuits, using a variety of oral, written, and graphical formats;

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate;

SIL2.05 - assess data to make inferences and conclusions and to answer questions and refine procedures;

SIL2.06 - communicate plans, observations, and results, using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate.

### **Prior Knowledge & Skills**

- An understanding that electrical energy can be transformed into other forms of energy (Grade 6)
- Experience designing and constructing a variety of electrical circuits
- Understanding of symbols representing components of electrical circuits

### **Planning Notes**

- The intent is to show students an example of a circuit that is used in everyday life. If the necessary equipment is not available, the activity can be modified to use equipment commonly found in a school, e.g., a circuit containing bulbs. If a variety of equipment is not available, students can build the same circuit.
- Students build a simple circuit that is common in everyday life. Simple experiments can be found in many physics lab manuals and also in Resources at the end of this activity.
- The focus of this activity is on building circuits and relating electric circuits to everyday life. Students are not measuring current or voltage; those skills are focused on in activity 3.3.1.

### **Teaching/Learning Strategies**

- Students reflect on the process they used in Activity 3.1 for building and assessing their circuits. As a class, students create a checklist for self-assessing the circuit.
- Give students a circuit diagram representing an everyday object, e.g., doorbell, fan, alarm, buzzer, fuse, etc. Each student builds the circuit shown in the circuit diagram. After the circuit is approved by teacher, the student closes the circuit and tests the device.
- The teacher circulates and each student explains, orally, how the device works, with an emphasis on energy conversions.
- Each student presents his/her circuit to the class, explaining the components and how the circuit works.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- Laboratory performance skills are self-assessed for Inquiry using a checklist.
- Explanation of components of a circuit is evaluated for Knowledge/Understanding using a rubric.

### **Resources**

#### **Science Resources**

##### Websites

Tucson Electric Power: Experiments

– <http://www.tucsonelectric.com/community/educatoralservices/experiments/index.htm>

Crocodile Clips Ltd. – <http://www.crocodile-clips.com/index.htm>

How Electricity Works – <http://science.howstuffworks.com/electricity.htm>

### Activity 3.3: Properties of Series and Parallel Circuits

Time: 6 hours

#### Description

Students continue to investigate examples of electric circuits found in everyday life. Through a laboratory investigation, they determine the properties of series and parallel circuits. Students design data tables and record qualitative and quantitative data. They form conclusions from the experimental data and summarize the properties of series and parallel circuits using a graphic organizer.

#### Strand(s) & Learning Expectations

##### Ontario Catholic School Graduate Expectations

CGE2b - reads, understands and uses written materials effectively;  
CGE2d - writes and speaks fluently one or both of Canada's official languages;  
CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;  
CGE5a - works effectively as an interdependent team member.

**Strand(s):** Physics: Electrical Circuits; Scientific Inquiry: Science in Daily Life

##### Overall Expectations

PECV.01 - describe the characteristics of electrical circuits;  
PECV.02 - investigate simple electrical circuits, using safe practices;  
SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

##### Specific Expectations

PEC1.01 - use scientific terminology during investigations to describe basic electrical concepts and related units of measure;  
PEC1.02 - demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits;  
PEC1.03 - identify how household and workplace electric devices operate by converting energy to another form;  
PEC1.04 - use a variety of symbols to represent different components in electrical circuits;  
PEC2.04 - measure and record the current and potential difference in simple circuits through the safe and proper use of an ammeter and a voltmeter;  
SIL2.03 - conduct investigations safely, using appropriate lab equipment;  
SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate.

##### Prior Knowledge & Skills

- Experience preparing data tables
- An understanding that electrical energy can be transformed into other forms of energy
- Practice designing and constructing a variety of electrical circuits

##### Planning Notes

- Prepare copies of a graphic organizer for comparing series and parallel circuits (including circuit diagrams), as well as a checklist for peer assessing data tables.
- In activity 3.3.1, students work with series and parallel circuits. They may require an aid such as an enlarged copy of the circuit diagram. It is expected that by the end of the unit, students will be able to build a circuit without aids.

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- In activity 3.3.2, students modify a circuit so that two bulbs can be controlled by separate switches. Make available materials, e.g., additional connecting wires and switches, that students may require.

## Teaching/Learning Strategies

### 3.3.1 Identifying the Properties of Series and Parallel Circuits

- The teacher introduces series and parallel circuits by showing students examples of each type of circuit, e.g., strings of festive lights. Students observe the effect of removing one light bulb from each circuit and brainstorm and record possible reasons for the difference.
- The teacher introduces the terms *series* and *parallel*, if students are not yet familiar with them, and adds the terms to the word wall.
- The teacher provides the students with a graphic organizer for comparing series and parallel circuits. Students list and compare similarities and differences between the circuits. The term *parallel circuit* can be related to the mathematical concept of parallel lines by drawing the symbol for parallel lines next to the parallel circuit. Using a literacy strategy, such as concept attainment, students review the meanings of the terms series and parallel.
- Students investigate additional properties of series and parallel circuits, e.g., voltage and current, at various places in the circuit and brightness of the bulbs. Before beginning the experiment, students refer to their portfolio for examples of data tables and individually prepare a suitable data table for recording their data. Students peer assess the data tables using a checklist provided by the teacher. Students make necessary revisions to their data tables before proceeding with the experiment.
- The teacher leads a discussion on cooperative group work and explains the role of each student within the group. Students work in pairs and take turns building the assigned circuits. One student builds the circuit and the other provides feedback, based on the circuit diagram provided. When both students are satisfied with the circuit, they ask the teacher to approve it before closing the switch.
- Students make and record observations in their data tables, using appropriate units.
- Working in pairs, students form conclusions about the properties of series and parallel circuits and add information to the graphic organizer comparing series and parallel circuits. If students require assistance in interpreting the observations to make conclusions, a class discussion or guiding questions may be appropriate.
- If students' experiments do not provide suitable data for making conclusions, the teacher may:
  - discuss reasons for the inconsistencies, i.e., resistance;
  - have students with suitable data share with their classmates;
  - set up a demonstration and gather data as a group;
  - provide a set of sample data to use.

### 3.3.2 Applying the Properties of Series and Parallel Circuits

- Students participate in a class discussion reviewing the properties of series and parallel circuits, referring to the graphic organizer completed throughout activity 3.3.1.
- The teacher leads the class in a discussion of electrical appliances in the home and workplace that are controlled by separate switches, e.g., the lights in the classroom are controlled by a series of switches.
- Students work in pairs to build the circuit with two bulbs in series and one switch, and they ask the teacher's approval before closing the switch.
- Students are given the task of connecting the two bulbs in such a way that each one is controlled by a separate switch, allowing one bulb to be turned on, while the other is turned off.
- Students prepare a chart on which to record their problem-solving steps, with columns labelled Change Proposed and Results of Change. Students record their proposed change in the chart and orally explain their reasoning. Once the teacher approves the change, students complete the task. They write a reflection describing the problem-solving task using sentence stems.

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## Assessment & Evaluation of Student Achievement

See *Assessment & Evaluation of Student Achievement in Overview*, p. 8.

- In activity 3.3.1, the data tables are peer-assessed for Inquiry and Communication using a checklist.
- In activity 3.3.1, the data tables and experimental data are evaluated for Inquiry and Communication using a rubric.
- In activity 3.3.1, knowledge of the properties of series and parallel circuits is assessed for Knowledge/Understanding using a quiz.
- In activity 3.3.2, problem-solving and laboratory investigation skills are evaluated through observation for Inquiry using a rubric.

## Resources

### Science Resources

#### Websites

Crocodile Clips Ltd – <http://www.crocodile-clips.com/index.htm>

Electricity Online – <http://library.thinkquest.org/28032/cgi-bin/psparse.cgi?src=home>

#### Software

*Crocodile Physics*

## Activity 3.4: Troubleshooting Electrical Devices

**Time:** 7 hours

### Description

Students apply their knowledge of electrical circuits to solve simple problems in common electrical devices. They read appliance manuals to extract information, and prepare a poster summarizing the safety precautions associated with the use of the appliance. Students solve simple problems using a logical approach.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2b - reads, understands and uses written materials effectively;

CGE2d - writes and speaks fluently one or both of Canada's official languages;

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;

CGE5a - works effectively as an interdependent team member.

**Strand(s):** Physics: Electrical Circuits; Scientific Inquiry: Science in Daily Life

#### Overall Expectations

PECV.01 - describe the characteristics of electrical circuits;

PECV.02 - investigate simple electrical circuits, using safe practices;

PECV.03 - analyse the practical uses of electrical circuits and their impact on daily life;

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life.

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## Specific Expectations

PEC1.02 - demonstrate an understanding that electrical energy can be converted into other forms of usable energy within electrical circuits;

PEC1.03 - identify how household and workplace electrical devices operate by converting energy to another form;

PEC2.05 - extract and interpret information from instructions and manuals for circuits and electrical devices;

PEC3.01 - identify circuits and their components in household and workplace settings;

PEC3.02 - develop a logical checklist to troubleshoot an electrical device of personal choice;

SIL1.02 - explain the importance of a "fair test" for troubleshooting and testing everyday science problems;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate;

SIL3.03 - demonstrate and understanding of how problem-solving and decision-making activities in the workplace use scientific process skills.

## Prior Knowledge & Skills

- Experience in reading documents
- An understanding that electrical energy can be transformed into other forms of energy
- Ability to design and construct a variety of electrical circuits

## Planning Notes

- Provide index cards for summarizing information.
- Prepare copies of the Troubleshooting Log.
- Create simple problems with the appliances for students to solve, e.g., cables in TV or VCR are loose, no batteries in the device, not plugged in, no tape in VCR, light bulb missing/loose/burnt out.

## Teaching/Learning Strategies

### 3.4.1 Reading Manuals

- Students work in pairs to study an electrical device and its manual. Students read the manual and on an index card write a summary of the type of information the manual contains, paying attention to the headings in the manual. The class discusses similarities and differences between the information found in the various manuals and suggests reasons for the differences. Pay particular attention to the troubleshooting sections that students will be referring to in activity 3.4.2.
- Working in pairs, students read the safety section of the manual for another electrical device and individually prepare a safety poster listing the precautions that should be followed when using it. Students present the information on their posters to the class and display them on a safety bulletin board. Students might prepare their posters using a computer software program.

### 3.4.2 Troubleshooting

- Introduce students to troubleshooting by having them observe the teacher plug in the overhead projector, but find that it does not turn on. If students do not suggest ways to fix the problem, the teacher elicits suggestions from the students. The suggestions are tried and the results discussed until the problem is solved. As a class, discuss the problem-solving steps taken and the importance of following steps in a logical order.
- Students brainstorm a list of troubleshooting strategies that can be used when an appliance is not working, referring to the appliance manuals for ideas. The teacher records student responses on the board. Students participate in a class discussion to identify criteria for determining whether the responses are safe and reasonable. Unsafe or unreasonable suggestions are either modified or erased.

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- The teacher leads a discussion on safety precautions that need to be followed when troubleshooting, e.g., when electrical devices should be opened and when they should not be opened.
  - Students solve simple problems, e.g., cables in TV or VCR are loose, no batteries in the device, not plugged in, no tape in VCR, light bulb missing/loose/burnt out.
  - Students move through the stations and correct the problem in each appliance. They record their steps and results as they work in a Troubleshooting Log for each appliance. The Troubleshooting Log contains two columns, Action Taken and Result of Action, and a Summary section at the bottom. They write a one-paragraph summary indicating the problem they found and how they solved it.
  - Students participate in a class discussion on the importance of following a logical order of steps when troubleshooting. Students discuss how to determine whether to have an appliance repaired or replaced, and the environmental factors related to disposal of appliances.
  - Each student selects an appliance of personal interest that has not already been studied in class, and determines a logical order of steps that should be followed for troubleshooting. Students do not have to actually carry out the troubleshooting, only prepare the list of steps – a Troubleshooting Procedure. They use the results of their brainstorming troubleshooting strategies as a resource for completing this activity. Students can prepare their lists using a word-processing program.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 3.4.1, safety posters are evaluated for Inquiry and Communication using a rubric.
- In activity 3.4.2, Troubleshooting Procedure is evaluated for Making Connections using a rubric.

### **Resources**

#### **Workplace Link Resources**

##### Websites

City of Chilliwack: Electrical Fire Safety: Public Education: Fire Protection: Fire Department  
– <http://www.chilliwack.com/main/page.cfm?id=622>

OSH Answers: Electrical Safety: Basic Information  
– [http://www.ccohs.ca/oshanswers/safety\\_haz/electrical.html](http://www.ccohs.ca/oshanswers/safety_haz/electrical.html)

Electricity Online – <http://library.thinkquest.org/28032/cgi-bin/psparse.cgi?src=home>

Electrical Safety World – <http://www.sce.com/site/index.html>

#### **Resources for Catholic Teachers**

##### Websites

Ontario Catholic Curriculum Cooperative – <http://www.eoccc.org>

Faith and the Common Good – <http://www.faith-commongood.net>

##### CD-ROMs

*Curriculum Support for Catholic Schools.* Eastern Ontario Catholic Curriculum Cooperative, 2002.

## Unit 4: Chemistry: Properties of Common Materials

Time: 25 hours

### Unit Description

Students are made aware that both hazardous and non-hazardous materials surround them in their home, school, and workplace environments and that making decisions about the safe use, handling, and disposal of these materials is an important life skill. The skill emphasis is on inquiry, drawing conclusions, and making decisions based on data. Students develop an understanding of the importance of Household Hazardous Product symbols (HHPs) and Workplace Hazardous Materials Information System (WHMIS) symbols and of following safe procedures when handling common materials.

By designing and conducting laboratory investigations, they gain an understanding of the physical and chemical properties of various common materials and decide on how they can refine their investigation. Students plan and conduct a safe investigation of two similar materials and recommend the best material for a specified purpose based on its physical and chemical properties. Students practise and refine their literacy and communication skills. The Essential Skills are problem solving, decision making, and writing.

### Unit Synopsis Chart

Activity/ Time	Learning Expectations	Assessment Category Evaluation Categories, Tasks, and Tools	Tasks
4.1 Safety First  4 hours	CPMV.01, CPM1.01, 1.02  CGE5f, 7i, 7j	4.1: Product Safety Checklist for common labels is assessed by peers for Knowledge/ Understanding. 4.1: A written quiz of WHMIS/ HHP symbols is used to evaluate for Knowledge/Understanding. 4.1: The safety poster is assessed for Communication using a rubric.	Students: <ul style="list-style-type: none"><li>• examine labels of common household materials for chemical ingredients and HHP symbols;</li><li>• record findings using a Product Safety Checklist;</li><li>• design a Product Safety Checklist using WHMIS symbols to use for examining common workplace materials;</li><li>• provide feedback on partner's checklist;</li><li>• complete requirements for WHMIS/HHP Licence.</li></ul>
4.2 Describing Materials (Physical and Chemical Properties)  10 hours	CPMV.01, .02, .03, CPM1.03, 1.04, 1.05, 2.02, 2.03, 3.01, 3.02 SILV.02, SIL2.03, 2.04  CGE3c, 5f, 7i, 7j	4.2.1: Physical Property Checklists and their use are assessed for Knowledge/Understanding of terminology using a checklist. 4.2.1: The written paragraph is assessed for Communication and Making Connections using a rubric. 4.2.2: Chemical Test Checklists are assessed for Knowledge/ Understanding using a checklist or anecdotal records. 4.2.2: The observations data table is assessed for Inquiry and Communication using a rubric.	Students: <ul style="list-style-type: none"><li>• learn terminology used to describe materials;</li><li>• perform experiments to investigate properties of matter;</li><li>• record observations using appropriate terminology;</li><li>• design checklists to record physical and chemical properties;</li><li>• identify unknown materials using physical and chemical properties;</li><li>• write a paragraph describing the contributions of one ingredient of a mixture to the mixture's physical properties;</li><li>• earn Handling Lab Equipment Licences Part 2.</li></ul>

Activity/ Time	Learning Expectations	Assessment Category Evaluation Categories, Tasks, and Tools	Tasks
4.3 Chemicals in the Workplace  5 hours	CPMV.01, .02, CPM1.03, 1.04, 1.05, 2.02, 2.03 SILV.02, SIL2.03, 2.04  CGE3b, 3c, 5f, 7j	4.3: Investigations of workplace chemicals are evaluated for Inquiry using criteria with marking scheme.  4.3: Safety licence is granted, using a checklist.	Students: <ul style="list-style-type: none"> <li>• observe workplaces (or view simulations) and classify chemicals by hazard(s), use, and storage;</li> <li>• complete checklists of observations; identify unknown materials;</li> <li>• earn Safety Licences.</li> </ul>
4.4 The Best Material for the Job  6 hours	CPMV.02, .03, CPM2.01, 2.02, 2.03, 2.04, 3.01, 3.02, 3.03 SILV.02, .03, SIL2.03, 2.04, 2.05, 2.06, 3.02, 3.03  CGE2b, 3b, 3c, 5f, 7j	4.4: Experiment Practicality Template is assessed using a checklist  4.4: Investigations proposal and plan (revised, if needed) and the written reflection are evaluated for Inquiry and Making Connections using a rubric.  4.4: Poster is evaluated for Communication and Making Connections using a rubric.	Students: <ul style="list-style-type: none"> <li>• brainstorm properties of materials for a specified purpose;</li> <li>• prepare an Investigation Proposal;</li> <li>• conduct approved investigation, collect data, analyse results, and suggest improvements;</li> <li>• prepare poster of recommendation.</li> </ul>

### Activity 4.1: Safety First

**Time:** 4 hours

#### Description

Students are introduced to Household Hazardous Product (HHP) and Workplace Hazardous Materials Information System (WHMIS) symbols. They examine a variety of common materials found at home and in the workplace, and complete a checklist about these materials, with a focus on their safe handling, use, storage, and disposal. Students complete a safety poster for one material, using the HHP or WHMIS labels as the source of information.

#### Strand(s) & Learning Expectations

##### Ontario Catholic School Graduate Expectations

CGE5f - exercises Christian leadership in the achievement of individual and group goals;

CGE7i - respects the environment and uses resources wisely;

CGE7j - contributes to the common good.

**Strand(s):** Chemistry: Properties of Common Materials

##### Overall Expectations

CPMV.01 - explain the characteristics and classification of common materials using appropriate terminology.

##### Specific Expectations

CPM1.01 - recognize the symbols used to classify hazardous materials at home and in the workplace;

CPM1.02 - outline the hazards of common materials associated with safe and unsafe use.

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## Prior Knowledge & Skills

- Knowledge of General Lab Safety Rules
- Experience completing observation tables

## Planning Notes

- Activities from Unit 5: Making Personal Decisions are interspersed throughout this unit to permit the preliminary work required for the final task.
- Teachers should consult with the teacher responsible for Cooperative Education programs at the school to determine the most common community workplace sites for this unit. In addition, there is an opportunity to seek out community connections with small or large manufacturing companies, small businesses, and other local organizations. A visit to a quality control lab, or a visit from a local business person/volunteer/school personnel who makes purchasing decisions based on the nature of the materials needed would also be useful, e.g., custodial services (cleaners, paints), automotive technicians (oil, grease), hair stylists (shampoos, mousse), candle makers (wax, wicks), or textile manufacturers.
- This activity provides practice for the evaluation in Activity 4.3. Teachers should be sure to coordinate the materials (and work locations) that are most appropriate for Activity 4.3 to ensure that different materials and work locations are used for this activity.
- Maintain a wide variety of common materials (with HHP or WHMIS labels) used in the household and workplace. Proper storage and cataloguing is critical, e.g., keep a list of their IUPAC (International Union of Pure and Applied Chemistry) name, common name, CAS (Chemical Abstracts Service) registration number.
- Prepare or find a list of commonly used chemicals or use a periodic table for students to reference when looking at labels.
- Prepare lab stations with common household products that include HHP symbols. This activity can be done so that each student receives only one label and product and completes only one form. Use the four different symbols and ensure that three of these symbols have the three different degrees of hazard shapes.
- As an extension of the HHP activity, students could determine where materials are stored in their own homes, whether they are safely stored, and how home storage could be improved.
- Prepare lab stations which simulate work environments, e.g., food preparation area, auto shop, custodial storage area. If a visit to a workplace is used, combine this activity with Activity 4.3 for the field trip. Check with the board and school field trip procedures and requirements.
- Provide handouts for HHP and WHMIS symbols and a chemicals list or periodic table.
- Prepare Product Safety Checklists for the HHP activity modelled on forms found in the workplace. This should include a space for the product name, major chemical ingredient (if available), pictures of the symbols for students to check, and a list of typical precautions to check off, including safe handling, storage, disposal, and any personal protective equipment required depending on the products chosen. Instructions should be included on the form as they would be in the workplace. Check with local industries and businesses for permission to use parts of their training information. Additional sources can be found in Resources.
- Book the computer lab and make available the WHMIS symbols.
- Students may need assistance in providing peer assessment for checklists. The teacher should model this activity in a large group with a sample of a completed checklist containing errors before students complete the individual activities.
- The teacher should have several versions of the WHMIS/HHP tests for rewrite purposes to provide multiple opportunities for success.

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- Students earn Handling Lab Equipment Part 2 Licence through teacher observation.
  - Additional time (taken from the hours set aside for Activity 5.1) should be planned at the beginning or end of this activity for students to complete Activity 5.1 from Unit 5.

### **Teaching/Learning Strategies**

- The teacher introduces safety in the home and workplace with a short video and leads a discussion of the issues around the use of chemicals: storage, misuse, disposal.
- Students engage in a Jigsaw activity. In Expert groups, they examine the labels of household products at lab stations representing various areas of the house (kitchen, bathroom, garage, baby's room, garden shed, laundry area, maintenance area) and complete a checklist for each product, identifying any chemicals on the chemical list. Each group makes three suggestions for storage, use, and disposal of chemicals in their area. They regroup into Home groups, so that each group includes students who have looked at each of the different HHP shapes and each of the different HHP symbols. They share their suggestions from the previous group. Using a teacher-provided HHP handout and information from the Product Safety Checklists collected in the previous activity, students classify household products based on the major chemical ingredient.
- Students participate in a teacher-led discussion of storage, use, and disposal of chemicals in the home and the community.
- The teacher introduces the Workplace Hazardous Materials Information System (WHMIS), provides a handout, and reviews the parts of the Product Safety Checklist.
- Students design their own checklist for recording information about workplace chemicals with WHMIS symbols using the previous checklist as a model.
- Students visit lab stations that resemble actual work environments, e.g., a food preparation area, custodial storage area, auto shop. Alternatively, students could visit workplaces or different areas of the school, e.g., auto shop, cafeteria, custodian's office.
- Working in pairs, students complete their partner's checklist identifying WHMIS symbols, and what precautions should be taken when handling these materials, including proper storage and disposal.
- Students provide written feedback on each other's checklists with regards to completeness and accuracy, making constructive suggestions for improvement.
- Students complete a written quiz to obtain their WHMIS/HHP licences.
- Students choose a product that contains either an HHP or a WHMIS symbol and create a safety poster, which is displayed in the classroom. The poster includes the main chemical ingredient of the product and describes the proper handling, use, storage, and disposal of the product.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In Activity 4.1, use of WHMIS/HHP symbols is evaluated for Knowledge/Understanding using a quiz.
- In Activity 4.1, the safety poster is assessed for Communication using a rubric.

### **Resources**

#### **Science Resources**

Science Teachers Association of Ontario. *Stay Safe*. Toronto, ON: STAO, 2002. ISBN 1-894592-22-0

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## Workplace Link Resources

### Websites

Live Safe! Work Smart! – [www.curriculum.org/occ/resources/livesafe9-10.shtml](http://www.curriculum.org/occ/resources/livesafe9-10.shtml)

WHMIS – [www.hc-sc.gc.ca/hecs-secs/whmis/](http://www.hc-sc.gc.ca/hecs-secs/whmis/)

HRSDC – [www15.hrdc-drhc.gc.ca/English/general/home\\_e.asp](http://www15.hrdc-drhc.gc.ca/English/general/home_e.asp)

## Activity 4.2: Describing Materials (Physical and Chemical Properties)

**Time:** 10 hours

### Description

Students learn the terminology used to describe the physical and chemical characteristics of various household and workplace materials. They work in pairs to observe the physical properties of materials and classify those observations using appropriate terminology. Students observe the chemical properties of various materials through teacher demonstration and/or at stations.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;

CGE5f - exercises Christian leadership in the achievement of individual and group goals;

CGE7i - respects the environment and uses resources wisely;

CGE7j - contributes to the common good.

**Strand(s):** Chemistry: Properties of Common Materials; Scientific Inquiry: Science in Daily Life

#### Overall Expectations

CPMV.01 - explain the characteristics and classification of common materials, using appropriate terminology;

CPMV.02 - investigate the physical and chemical properties of common materials through laboratory activities;

CPMV.03 - analyse how the use of various materials is based on their physical and chemical properties;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

#### Specific Expectations

CPM1.03 - explain the characteristics of pure substance and mixtures, using appropriate scientific terminology;

CPM1.04 - describe the physical properties of common materials;

CPM1.05 - describe the chemical properties of common materials, using appropriate terminology;

CPM2.02 - use appropriate laboratory safety and disposal procedures while conducting investigations;

CPM2.03 - organize and record the observations of the investigations, using appropriate formats;

CPM3.01 - investigate the physical and chemical properties of the component materials of two similar products;

CPM3.02 - compare the physical and chemical properties of the materials investigated and relate these properties to how they are used;

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate.

### Prior Knowledge & Skills

- Physical and chemical properties
- Experience in making qualitative observations

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- Experience in creating a safety checklist and carrying out an investigation safely
  - Attainment of handling Lab Equipment Part 1 Operator Licences (Unit 1) and WHMIS/HHP Operator Licences (Activity 4.1)

### Planning Notes

- Prepare maps of the classroom and any area that includes safety equipment, e.g., first aid stations, broken glass buckets, sand buckets, spill pillows, eye wash stations, fire blankets, fire extinguishers. **Note:** Students may not appreciate that fire extinguishers are only useful in the hands of expert-trained firefighters. Check with the Emergency Procedures Protocol at your school.
- Have a kettle available so that students can see that water vapour, ice cubes, and liquid water can all be present in the room at the same time. This is the introduction to the three states of matter.
- Prepare lists of the chemicals students will use together with their common names, safety precautions, and protective equipment to be worn.
- For the initial activity, prepare a list of terms and their meanings for students.
- As terms are finalized and discussed, place them on the word wall and prepare small cards or laminated strips in envelopes for students to use for sorting activities.
- Prepare approximately ten lab stations with various materials, e.g., hair gel, oil, vinegar, salt, sugar, flour, copper, foam, copper sulphate, clear balloon filled with air. The number of physical properties that can be observed is only limited by the amount of time available to the class. Consider terms most often seen on Material Safety Data Sheets (MSDS) as those most important to these students.
- Locate common examples of mixtures for students to observe.
- A teacher not familiar with chemical reactions should perform all experiments and demonstrations before the students attempt them to ensure they are safe.
- Ensure that the appropriate equipment is in place to protect everyone (students and demonstrator) during a demonstration.
- Time (not included in the 10 hours designated for this activity) should be set aside at the beginning or end of this activity for students to complete Activity 5.2 from Unit 5: Making Personal Decisions.

### Teaching/Learning Strategies

#### 4.2.1 Physical Properties

- In pairs, students review their Lab Safety Rules and Handling Lab Equipment Part 1 Licensing Documentation from their portfolio (Activity 1.2).
- Students locate the safety equipment on a teacher-prepared map of the classroom and make a written note of when and how to use it. They can include this in their portfolio.
- The teacher introduces the activity on properties by showing students a glass containing the clear colourless liquid and asking them how they would know whether it is drinkable. The teacher leads a discussion of the types of observations students would make to decide whether it was safe if there was no label (e.g., liquid, solid, gas, colour, clarity). Using a discrepant event, demonstrate for students that a quick conclusion is not always the best one.

Examples of discrepant events:

- Replace the water with baby oil, and when students have concluded that the clear colourless liquid is water, drop in an ice cube.
- Make ice cubes of the water obtained from microwaving 4 cups shredded red cabbages with 2 cups water. Put a couple of drops of sodium hydroxide or hydrochloric acid in the beaker to be used for the water and let dry. When the ice cube is added to the water, the purple colour will change as it melts. Check the pH of the tap water first, and try before performing in front of students to make sure the colour does change.

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- Students participate in a teacher-led discussion on the unique properties of water, i.e., solid form is less dense (floats on its liquid form); it is one of the few materials that can be presented as a liquid, solid, and gas all on the same lab bench; it is the universal solvent, etc.
  - In groups of four, students answer four questions for each state of matter beginning with solid, then liquid, then gas. Possible questions include: How might you transport it across the room? How would you store a quantity of it? What are three different examples from three different workplaces? How would you know it is there?
  - In a teacher-led discussion, students indicate which question was the most difficult to complete and why. During these discussions, the teacher gauges the students' level of understanding of chemical terminology.
  - The terms *solid*, *liquid*, and *gas* are added to the word wall.
  - The teacher leads a discussion about using materials wisely and respecting the environment during their disposal.
  - Students are shown the correct procedures for observing chemicals safely.
  - At five lab stations, students observe and record properties of various materials in their own words. *Safety Note:* Students wear safety glasses during this activity.
  - Groups of students that visited the same stations compare their descriptions with a list of science terms provided by the teacher.
  - Through teacher discussion and feedback, students become familiar with the terminology for describing physical properties of materials.
  - Students rotate to five new stations and add to their observations, using the new terms, e.g., colour, state of matter, lustre, clarity, solubility, odour, magnetism, heat conductivity, electrical conductivity, malleability, hardness. See Planning Notes.
  - Students record their observations in a table. In groups, they sort the new terminology in Venn diagrams of two states of matter at a time.
  - Students prepare a Physical Properties Checklists similar to the Product Safety Checklist developed in Activity 4.1.
  - Students are given several unknown materials to classify using their checklists. After they have completed their checklists, they are given descriptions of the same number of unknown materials. Students use their checklists to match each description to the unknown product. Pairs of students compare answers and discuss any differences.
  - Small groups of students examine several different mixtures of common materials and compare their physical properties. Through discussion, each group of students decides what particular contribution one of the ingredients makes to the overall property of the mixture, e.g., one group might examine a variety of fabrics with a mixture of polyester and another material and reach the conclusion that the polyester reduces wrinkling of the fabric.
  - Using an appropriate cooperative learning strategy (e.g., the "one stray, three stay" method from *Beyond Monet*), students share their findings.
  - After a teacher-led discussion, students individually write a paragraph stating which mixture was examined, their results, and their justification.

#### 4.2.2 Chemical Properties

- The teacher demonstrates one or two reactions and relates them to safety in the workplace, modelling safe material-handling skills. Students record their observations on a data table.
- The teacher leads a class discussion on the observations after each demonstration. Demonstration suggestions include, but are not limited to, a small piece of sodium in water, zinc metal placed in strong acid, combustion of magnesium, etc.

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- Students submit their data table of observations for assessment.
  - Students participate in a teacher-led discussion, emphasizing that chemical changes are taking place and new chemicals are being formed with different properties. These chemical tests are often used as another way to identify unknown materials. Students think of other familiar chemical tests (test strips for pools, drug or alcohol tests, glucose for diabetics, etc.).
  - Using safe procedures, students participate in several quick chemical tests, including litmus test for acids and bases, starch test with iodine, test for carbonates with hydrochloric acid, cobalt paper for water, etc.
  - Students prepare a Chemical Tests Checklist with a space for Positive, Negative, and Observation. Working in pairs, they identify unknown white powders, e.g., baking soda, baking powder, corn starch, citric acid.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In activity 4.2.1, Physical Property Checklists and their use are assessed for Knowledge/Understanding of terminology using a checklist.
- In activity 4.2.1, the written paragraph is assessed for Communication and Making Connections using a rubric.
- In activity 4.2.2, Chemical Tests Checklists are assessed for Knowledge/Understanding using a checklist or anecdotal records from reviewing the student's observations data table.
- In activity 4.2.2, the observations data table is evaluated for Inquiry and Communication using a rubric.
- After assessing student laboratory equipment use, teacher grants Handling Lab Equipment Part 2 Licence.

### **Resources**

#### **Science Resources**

##### Print

Science Teachers Association of Ontario. *Stay Safe*. Toronto, ON: STAO, 2002. ISBN 1-894592-22-0

##### Websites

The Catalyst – [www.thecatalyst.org](http://www.thecatalyst.org)

University of Leicester – [www.le.ac.uk/chemistry/schools/resource.html](http://www.le.ac.uk/chemistry/schools/resource.html)

Links for Chemistry Teachers – [www.chemistrycoach.com/links\\_for\\_chemistry\\_teachers.htm](http://www.chemistrycoach.com/links_for_chemistry_teachers.htm)

Education Index: Chemistry Resources – [www.educationindex.com/chem/](http://www.educationindex.com/chem/)

– [www.anachem.umu.se/cgi-bin.pointer.exe?Demonstrations](http://www.anachem.umu.se/cgi-bin.pointer.exe?Demonstrations)

The Teacher's Corner – [www.theteacherscorner.net/science](http://www.theteacherscorner.net/science)

Queen's University: Science Education Resource Page – <http://educ.queensu.ca/~science/>

The Science Page: Science Resources for Teachers – <http://sciencepage.org/teachers.htm>

The Science Spot: Chemistry Lesson Plan – <http://sciencespot.net/Pages/classchemlsn.html>

Journal of Chemical Education Online – <http://jchemed.chem.wisc.edu/HS/>

#### **Teaching and Learning Resources**

##### Print

Bennett, B., C. Rolheiser, and L. Stevahn. *Cooperative Learning: Where Heart Meets Mind*. Toronto, ON: Educational Connections, 1991. ISBN 0969538804

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### Websites

Learner.org: Reactions in Chemistry – [www.learner.org/resources/series168.html](http://www.learner.org/resources/series168.html).

TeachersFirst.com – [www.teachersfirst.com](http://www.teachersfirst.com)

### **Resources for Catholic Teachers**

#### Websites

Faith and the Common Good – <http://www.faith-commongood.net>

#### CD-ROMs

*Curriculum Support for Catholic Schools*. Eastern Ontario Catholic Curriculum Cooperative, 2002.

## **Activity 4.3: Chemicals in the Workplace**

**Time:** 5 hours

### **Description**

Students learn that workplaces require the use of chemicals, e.g., cleaners, solvents, and other potential dangers, and that it is the duty of every worker to be aware of the hazards associated with their workplace. Students are exposed to real or simulated workplace environments and examine the chemicals used in a variety of workplaces, including the hazards, uses, and storage of them. Students complete a teacher-generated checklist, and work with a partner to compare and refine their checklist before evaluation.

### **Strand(s) & Learning Expectations**

#### **Ontario Catholic School Graduation Expectations**

CGE3b - creates, adapts, and evaluates new ideas in light of the common good;

CGE3c - think reflectively and creatively to evaluate situations and solve problems;

CGE5f - exercises Christian leadership in the achievement of individual and group goals;

CGE7j - contributes to the common good.

**Strand(s):** Scientific Inquiry: Science in Daily Life; Chemistry: Properties of Common Materials

#### **Overall Expectations**

CPMV.01 - explain the characteristics and classification of common materials, using appropriate terminology;

CPMV.02 - investigate the physical and chemical properties of common materials through laboratory activities;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems.

#### **Specific Expectations**

CPM1.03 - explain the characteristics of pure substance and mixtures, using appropriate scientific terminology;

CPM1.04 - describe the physical properties of common materials;

CPM1.05 - describe the chemical properties of common materials, using appropriate terminology;

CPM2.02 - use appropriate laboratory safety and disposal procedures while conducting investigations;

CPM2.03 - organize and record the observations of the investigations, using appropriate formats;

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate.

### **Prior Knowledge & Skills**

- Experience organizing observations in charts or tables
- Attainment of WHMIS/HHP Safety Licence

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## Planning Notes

- If possible, plan a field trip to a local workplace (see Planning Notes for Activity 4.1). Arrangements for visits to local workplaces must be made in advance, following board and school policies. Alternatively, students could view different locations in the school, e.g., cafeteria, janitorial storage, science chemical storage, to view how chemicals are used and stored.
- Gather information from workplace safety campaigns and articles on workplace safety from the media. Enlist people from local organizations to present to the class.
- If field trips or visits to in-school work areas cannot be made, the teacher could use the stations set up for Activity 4.1.
- Prepare chemicals for “missing label” lab, together with information sheets. The information sheets should give enough information for students to use a physical and chemical (pH test, addition of dilute hydrochloric acid, iodine, use of cobalt paper, etc.) property to identify the material.
- Prepare checklists for students to use. Combine the Product Safety Checklist from Activity 4.1 with the Physical Properties and Chemical Tests Checklists from Activity 4.2.

## Teaching/Learning Strategies

- Students participate in a teacher-led discussion about workplace environments they have experienced. They describe the conditions at their places of employment (part-time jobs) and ask at home for descriptions of the workplaces of family/friends including the chemicals and dangers that exist in these workplaces. Students record these and bring them to school for discussion.
- Working together, the teacher and students make a classification chart summarizing the types of workplaces, e.g., retail, food service, industrial, and the types of chemicals and storage that are used in these environments. Students copy this information for their own records.
- Students observe the workplace environment(s), either real or simulated, in the lab. (If simulated in the lab, the teacher could use sample workplaces such as a restaurant, a factory, a greenhouse, etc.) Students record where and how chemicals are used and stored.
- In a simulated workplace, students assume the role of Manager in Training and solve the following problems: Labels have been misplaced. The unlabelled chemicals must be identified before they can be labelled for disposal. Individually, students use the teacher-provided checklist and handout to identify the chemicals and follow the instructions to dispose of them. They check the WHMIS symbols that should appear on the labels, identifying the precautions that must be followed.
- The teacher provides a workplace scenario, and the student outlines the types of chemicals and storage expected at this workplace.
- The teacher grants Use, Storage, and Disposal of Chemicals Licences, if appropriate.

## Assessment & Evaluation of Student Achievement

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- In Activity 4.3, the investigation of workplace chemicals is evaluated for Inquiry using criteria with marking scheme.

## Resources

### Science Resources

#### Websites

The Catalyst – [www.thecatalyst.org](http://www.thecatalyst.org)

University of Leicester – [www.le.ac.uk/chemistry/schools/resource.html](http://www.le.ac.uk/chemistry/schools/resource.html)

Links for Chemistry Teachers – [www.chemistrycoach.com/links\\_for\\_chemistry\\_teachers.htm](http://www.chemistrycoach.com/links_for_chemistry_teachers.htm)

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Education Index: Chemistry Resources – [www.educationindex.com/chem/](http://www.educationindex.com/chem/)

The Teacher's Corner – [www.theteacherscorner.net/science](http://www.theteacherscorner.net/science)

Queen's University: Science Education Resource Page – <http://educ.queensu.ca/~science/>

The Science Page: Science Resources for Teachers – <http://sciencepage.org/teachers.htm>

The Science Spot: Chemistry Lesson Plan – <http://sciencespot.net/Pages/classchemlsn.html>

Journal of Chemical Education Online – <http://jchemed.chem.wisc.edu/HS/>

## Teaching and Learning Resources

### Websites

Learner.org: Reactions in Chemistry – [www.learner.org/resources/series168.html](http://www.learner.org/resources/series168.html).

TeachersFirst.com – [www.teachersfirst.com](http://www.teachersfirst.com)

## Activity 4.4: The Best Material for the Job

**Time:** 6 hours

### Description

Students conduct an investigation comparing two materials and determine which material is better for a workplace scenario. Students conduct their investigations using safe practices and dispose of chemicals and other materials with concern for the environment. They create a poster presenting their recommendations. This activity is similar to Unit 5: Making a Personal Decision and provides assessment opportunities.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduation Expectations

CGE2b - reads, understands and uses written materials effectively;

CGE3b - creates, adapts, and evaluates new ideas in light of the common good;

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;

CGE5f - exercises Christian leadership in the achievement of individual and group goals;

CGE7j - contributes to the common good.

**Strand(s):** Chemistry: Properties of Common Materials; Scientific Inquiry: Science in Daily Life

#### Overall Expectations

CPMV.02 - investigate the physical and chemical properties of common materials through laboratory activities;

CPMV.03 - analyse how the use of various materials is based on their physical and chemical properties;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life.

#### Specific Expectations

CPM2.01 - plan and conduct investigations on the physical and chemical properties of substances, using lab equipment and materials safely and accurately;

CPM2.02 - use appropriate laboratory safety and disposal procedures while conducting investigations;

CPM2.03 - organize and record the observations of the investigations, using appropriate formats;

CPM2.04 - interpret and communicate the results of investigations;

CPM3.01 - investigate the physical and chemical properties of the component materials of two similar products;

CPM3.02 - compare the physical and chemical properties of the materials investigated and relate these properties to how they are used;

CPM3.03 - present a recommendation based on the results of the investigation and the research of the product, appropriate for someone interested in using the product;

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SIL2.03 - conduct investigations safely, using appropriate lab equipment;  
SIL2.04 - observe and record data, using a variety of formats, including the use of SI units, where appropriate;  
SIL2.05 - assess data to make inferences and conclusions and to answer questions and refine procedures;  
SIL2.06 - communicate plans, observations, and results, using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate;  
SIL3.02 - evaluate the investigation of the topic they selected and suggest possible refinements;  
SIL3.03 - demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process skills.

### **Prior Knowledge & Skills**

- Understanding of the concept of a fair test and of experimental control
- Ability to prepare data charts in a presentable format
- Ability to formulate questions for investigations based on data collection through the investigative process

### **Planning Notes**

- Teachers should consult with teachers responsible for the Cooperative Education programs to seek out community connections with small or large manufacturing companies, small businesses, or organizations that are interested in finding the right material to make the right product. A visit to a quality control lab, or a visit from a local business person/volunteer who had to make a choice of material could also be arranged.
- Choose a product of interest/familiarity to all students – one that is easy to find several different varieties of, e.g., apples, potatoes, toy cars, pencils, pens.
- Provide students with examples by giving them appropriate product and workplace examples, e.g., soap (daycare), hair mousse (hair stylist), wood for burning (wood-burning furnace manufacturers), plastic bags (grocery store), candles (candle-making business), wire fencing (farm). It may be useful to provide a description of the workplace and employer if students are to prepare a presentation for this particular workplace.
- Organize students into research pairs to conduct experiments, and allow time for discussion of results.
- It is possible to stagger the experiments and have some students begin at different times.
- Prepare for the experiments by preparing bins according to materials lists, or by ensuring that students are aware of the equipment available at lab benches.
- Ask students to keep a tracking sheet of their progress in the portfolios for the teacher's signature of approval when their plan is safe and workable.
- If time is limited, a Gallery Presentation method may be used, in which posters are displayed around the room and students circulate to observe the work.
- Provide each student with a copy of the evaluation rubric for this activity when the task is assigned.
- Assess student understanding of the fair test to determine whether students need to review the concept prior to experimental design.
- Prepare an Experiment Practicality Checklist so that students are familiar with the criteria.
- Time (not included in the 6 hours designated for this activity) should be set aside at the conclusion of this activity for students to complete Activity 5.3 from Unit 5.

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## Teaching/Learning Strategies

- The teacher outlines the project students undertake in their roles as Managers in Training in a new job. They are to experimentally examine two materials based on criteria they develop, choose which is the better product based on the experiment, and provide a justification for their choice in a presentation designed for someone who would use the product.
- Groups of students are given several different samples of the same product (e.g., types of paint) and must reach consensus on which product they prefer. They list the reasons for choosing the product.
- In a teacher-led discussion, the class develops the criteria students use to make their choices, e.g., for apples: colour, taste, size, freshness; for paint (gloss, colour, coverage).
- In groups, students brainstorm the criteria that would be important for making a decision about recommending a product made of given materials in a particular workplace (see Planning Notes).
- Each group exchanges the product and workplace information and the criteria with another group. The new group examines the criteria and indicates which could be examined experimentally.
- Students are reminded of the equipment available, of the safety procedures they must consider, and the timeframe of the experiment.
- Students determine testability of the criteria, using the template (Appendix 4.4.1: Sample Experiment Practicality Template) and give feedback to the group.
- In pairs, students prepare an Investigative Proposal and Plan including data tables, which is reviewed orally with the teacher. Each pair of students investigates a different material property (see Planning Notes).
- Students prepare an individual proposal and plan using the rubric (Appendix 4.4.2: Plan and Design an Investigation). Students submit the plan for approval before beginning the experiment.
- The teacher evaluates the Investigation Proposal and Plan using the Sample Teacher Evaluation Rubric (Appendix 4.4.2: Plan and Design an Investigation).
- Students make appropriate revisions to their Investigation Proposal and Plan, as identified by the teacher.
- Students conduct a rehearsal of the investigation to ensure that they have requested all the necessary equipment, and complete a materials requisition form if anything is missing.
- Students conduct the investigation and collect data using proper data tables.
- Pairs of students analyse results and give an oral presentation of their findings and recommendations, with emphasis on fair testing, to another pair of students.
- Students give constructive feedback on the presentation.
- Students complete a written reflection on the results of the experiment, making suggestions for improvement. This is assessed using a rubric (Appendix 4.4.3: Sample Rubric for Evaluation of Results, Refinements, and Reflections).
- Individually, students prepare a poster appropriate for the user of the material tested.

## Assessment & Evaluation of Student Achievement

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- The Experiment Practicality Template is assessed using the Experiment Practicality Checklist.
- The revised Investigation Proposal and Plan and the written reflection are evaluated for Inquiry and Making Connections using a rubric.

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## Resources

### Science Resources

#### Websites

The Catalyst – [www.thecatalyst.org](http://www.thecatalyst.org)

University of Leicester – [www.le.ac.uk/chemistry/schools/resource.html](http://www.le.ac.uk/chemistry/schools/resource.html)

Links for Chemistry Teachers – [www.chemistrycoach.com/links\\_for\\_chemistry\\_teachers.htm](http://www.chemistrycoach.com/links_for_chemistry_teachers.htm)

Education Index: Chemistry Resources – [www.educationindex.com/chem/](http://www.educationindex.com/chem/)

[www.anachem.umu.se/cgi-bin.pointer.exe?Demonstrations](http://www.anachem.umu.se/cgi-bin.pointer.exe?Demonstrations)

The Teacher's Corner – [www.theteacherscorner.net/science](http://www.theteacherscorner.net/science)

Queen's University: Science Education Resource Page – <http://educ.queensu.ca/~science/>

The Science Page: Science Resources for Teachers – <http://sciencepage.org/teachers.htm>

The Science Spot: Chemistry Lesson Plan – <http://sciencespot.net/Pages/classchemlsn.html>

Journal of Chemical Education Online – <http://jchemed.chem.wisc.edu/HS/>

### Teaching and Learning Resources

#### Websites

Learner.org: Reactions in Chemistry – [www.learner.org/resources/series168.html](http://www.learner.org/resources/series168.html).

TeachersFirst.com – [www.teachersfirst.com](http://www.teachersfirst.com)

### Workplace Link Resources

#### Print

*The First Step... Student Safety Handbook*. London, ON: London Occupational Safety and Health Information Service, 2000. ISBN 0-9681735-1-9

#### Websites

WHMIS – [www.hc-sc.gc.ca/hecs-secs/whmis/](http://www.hc-sc.gc.ca/hecs-secs/whmis/)

Live Safe! Work Smart! – [www.curriculum.org/occ/resources/livesafe9-10.shtml](http://www.curriculum.org/occ/resources/livesafe9-10.shtml)

HRSDC – [www15.hrdc-drhc.gc.ca/English/general/home\\_e.asp](http://www15.hrdc-drhc.gc.ca/English/general/home_e.asp)

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### Appendix 4.4.1: Sample Experiment Practicality Template

<b>Criterion</b>	<b>Yes/No</b>	<b>Comment: Discuss reasons for this decision</b>
Is the question testable by experiment in class?		
Is the experiment safe? What precautions are needed?		
Are there costs associated with the experiment?		
Are materials required for the experiment readily available?		
Can the experiment be done in the time available?		
Are there any other areas of concern related to the experiment?		

## Appendix 4.4.2: Plan and Design an Investigation

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Knowledge/ Understanding</b> Fair Test – understand the concept of fair test	- plan shows limited understanding of a fair test	- plan shows moderate understanding of a fair test	- plan shows considerable understanding of a fair test	- plan shows thorough understanding of a fair test
<b>Inquiry</b> Procedure – support collecting the intended data	- procedure supports data collection with limited effectiveness	- procedure supports data collection with moderate effectiveness	- procedure supports data collection with considerable effectiveness	- procedure supports data collection with a high degree of effectiveness
Data tables appropriate for the data being collected	- data tables will record the collected data with limited effectiveness	- data tables will record the collected data with moderate effectiveness	- data tables will record the collected data with considerable effectiveness	- data tables will record the collected data with thorough effectiveness
<b>Communication</b> Communicate the procedure in clear and logical steps	- communicates the step in the procedure with limited clarity and logic	- communicates the step in the procedure with some clarity and logic	- communicates the step in the procedure with considerable clarity and logic	- communicates the step in the procedure with clarity and logic
<b>Making Connections</b> Safety Checklist – Address safety concerns of the experimental procedures	- addresses safety concerns with limited effectiveness	- addresses safety concerns with some effectiveness	- addresses safety concerns with moderate effectiveness	- addresses safety concerns with considerable effectiveness

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

The strengths of the plan are:

Changes the student needs to make before doing the experiment include:

### Appendix 4.4.3: Sample Rubric for Evaluation of Results, Refinements, and Reflections

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80 – 100%)
<b>Inquiry</b> – Apply data analysis skills to make conclusions	- infrequently applies the data analysis skills necessary to make conclusions	- sometimes applies the data analysis skills necessary to make conclusions	- usually applies the data analysis skills necessary to make conclusions	- always applies the data analysis skills necessary to make conclusions
– Apply the skill of evaluating flaws in experimental design or performance with accuracy	- applies the skill of evaluating flaws in experimental design or performance with limited accuracy	- applies the skill of evaluating flaws in experimental design or performance with some accuracy	- applies the skill of evaluating flaws in experimental design or performance with considerable accuracy	- applies the skill of evaluating flaws in experimental design or performance with a high degree of accuracy
<b>Making Connections</b> – Make meaningful suggestions for improvement to the design of the experiment	- makes suggestions for improvement with limited effectiveness	- makes suggestions for improvement with moderate effectiveness	- makes suggestions for improvement with considerable effectiveness	- makes suggestions for improvement with thorough effectiveness

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

## Unit 5: Making Personal Decisions: Product Comparison Report

Time: 20 hours

### Unit Description

Students demonstrate the laboratory and technical inquiry skills, communication skills, and the concept of “fair test” that they acquired throughout the course. By investigating a personally chosen topic, students collect qualitative and quantitative data through scientific investigations, and research on a product of their choice, and provide a recommendation that one product be chosen over the other.

Students use existing product comparisons to review questioning skills for decision making. Students submit a proposal outlining the questions they plan to test and focus on the design of a personal investigation. Students carry out, evaluate, and refine their investigation. Students summarize their investigations and recommendations in a report. They self-assess and receive teacher and peer feedback to improve their final product.

### Unit Synopsis Chart

Activity/ Time	Learning Expectations	Assessment and Evaluation Categories, Tasks, and Tools	Tasks
5.1 Finding Information: The Questioning Consumer  2 hours	SILV.02, SIL1.01, 2.01 BSAV.02, BSA2.04 PECV.02, PEC2.05  CGE2d, 2e, 3c	5.1: Ability to find information and formulate questions is evaluated for Knowledge/ Understanding and Communication using a short written or oral test	Students: <ul style="list-style-type: none"> <li>• review questioning skills;</li> <li>• read existing product comparison reports on an electrical appliance, formulate questions, and answer questions;</li> <li>• review Physics terminology;</li> <li>• complete a test on reading science information and formulating questions.</li> </ul>
5.2 Decision Making: The Question and Proposal  3 hours	SILV.02, .03, SIL2.01, 3.01  CGE2b, 2c, 2d, 5d	5.2.1: Student questions are assessed for Inquiry and Making Connections using the Sample Experiment Practicality Template 5.2.2: Experimental proposal is evaluated for Communication using a rubric.	Students: <ul style="list-style-type: none"> <li>• develop testable questions of interest;</li> <li>• determine testability of various questions with rationale;</li> <li>• prepare a proposal for question of interest.</li> </ul>
5.3 Planning the Investigation  3 hours	SILV.01, .02, SIL1.02, 2.02 BSAV.03, BSA3.01, 3.02  CGE2c, 2d, 3c, 4f	5.3: Proposals are self- assessed using the Sample Self-Assessment Rubric. 5.3: The Investigation Plan is evaluated for all categories of the Achievement chart using the Sample Teacher Evaluation Rubric.	Students: <ul style="list-style-type: none"> <li>• brainstorm questions using manipulatives;</li> <li>• write a plan to test two similar products;</li> <li>• create a safety checklist for the investigation;</li> <li>• conduct a peer assessment of plan;</li> <li>• conference with the teacher for evaluation.</li> </ul>

<b>Activity/ Time</b>	<b>Learning Expectations</b>	<b>Assessment and Evaluation Categories, Tasks, and Tools</b>	<b>Tasks</b>
5.4 Conducting the Investigation  8 hours	SILV.02, SIL2.03, 2.04, 2.06  CPMV.02, CPM2.02, 2.03  CGE4f	5.4.2: Students' lab performance skills are evaluated for Inquiry and Communication using a rubric.	Students: <ul style="list-style-type: none"> <li>• conduct a dry run of the experiment and plan and prepare a requisition of materials if applicable;</li> <li>• conduct the investigation with a partner recording data, providing feedback.</li> </ul>
5.5 Evaluating the Evidence  2 hours	SILV.01, .02, .03, SIL1.02, 2.05, 3.02, 3.03  CGE4b, 5a, 5f, 5g	5.5: Report is evaluated for Knowledge/Understanding, Inquiry, and Making Connections using a rubric.	Students: <ul style="list-style-type: none"> <li>• interpret data, draw conclusions, and discuss fair test;</li> <li>• reflect on their investigation, make refinements, and suggest improvements;</li> <li>• submit experimental results, reflection, and refinements for evaluation.</li> </ul>
5.6 Preparing the Product Comparison Report  2 hours	SILV.02, SIL2.06 BSAV.02, BSA2.05 CPMV.02, .03, CPM2.04, 3.03  CGE 4f, 5g	5.6: Final report is evaluated for Communication and Making Connections using a rubric.	Students: <ul style="list-style-type: none"> <li>• prepare a product comparison report in a format chosen by the class, based on the evidence and recommendation from the investigation.</li> </ul>

### **Activity 5.1: Finding Information: The Questioning Consumer**

**Time:** 2 hours

#### **Description**

Earlier in the course, students were introduced to the final evaluation activity – producing a Product Comparison Report. In this activity, students review the concepts and rehearse the skills necessary for success in this final task. Students read an existing product comparison report about electrical appliances and answer literacy questions that require them to use directly and/or indirectly stated information, and to make personal connections to the reading. Students formulate questions based on the electrical appliances, and classify the questions as testable by experimental investigation, testable by media-based investigations, or not testable. Multiple opportunities for success and immediate feedback are built into this activity before the activity's evaluation – a written or oral test. The Essential Skills in this activity include finding information and document use.

#### **Strand(s) & Learning Expectations**

##### **Ontario Catholic School Graduate Expectations**

CGE2d - writes and speaks fluently one or both of Canada's official languages;

CGE2e - uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life;

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems.

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**Strand(s):** Scientific Inquiry: Science in Daily Life; Biology: Staying Alive; Physics: Electrical Circuits

### **Overall Expectations**

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

BSAV.02 - investigate, through laboratory activities, the processes which simple and complex organisms use to sustain life;

PECV.02 - investigate simple electrical circuits, using safe practices.

### **Specific Expectations**

SIL1.01 - describe how the procedures, skills, and tools employed in different areas of science are also evident in daily life;

SIL2.01 - formulate questions about problems or issues that can be scientifically tested;

BSA2.04 - extract and interpret information from a variety of sources;

PEC2.05 - extract and interpret information from instructions and manuals for circuits and electrical devices.

### **Prior Knowledge & Skills**

- Experience formulating and classifying types of questions
- Ability to compare two materials (Unit 4: Chemistry: Properties of Common Materials)
- Basic knowledge of concepts and terminology relating to electrical appliances (Unit 3: Physics: Electrical Circuits)
- Practice interpreting data from tables and charts including numerical and computational data
- Experience in answering literacy-type questions using EQAO Questions. See Overview p. 16, Appendix A.

### **Planning Notes**

- Students formulate and classify questions, to help ensure success in the final unit. To leave ample time for the student to master this skill, this activity should be completed in advance. This may occur while Unit 4 Chemistry: Properties of Common Materials is still in progress.
- This activity includes the first evaluation counting towards the final thirty percent of the course.
- Gather a variety of product comparison reports about the electrical appliances to allow for student choice.
- Students will combine their comparison skills with formulating types of questions. Some support may be required to link the two concepts, as students are required to formulate a comparison question testable by experiment in Activity 5.2.

### **Teaching/Learning Strategies**

- Students review their list and classification of questions and their glossary of terms, from the Physics: Electrical Circuits unit found in their portfolios.
- The teacher gives each student an individual Progress Chart, which is kept in their portfolio (see Appendix 5.1: Progress Chart), and provides instructions about how to complete it.
- The teacher provides a variety of consumer product reports for an electrical appliance. Students read and interpret data from these reports and answer questions in writing.
- Students formulate questions based on the text and classify the questions. Feedback is provided by the teacher and by peers.

- 
- The teacher administers a written or oral test to evaluate students' ability to find information and formulate questions. On this test, students formulate two questions that can be further investigated based on their interpretation of the data from a set of existing product comparisons. One of these questions should be answerable through media-based research and the second researched through an experimental investigation. Students also answer questions using directly and indirectly stated information.
  - Students record the results of the evaluations (Appendix 5.1: Progress Chart).

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- The ability to find information and formulate questions is evaluated for Knowledge/Understanding and Communication using a short written or oral test.

### **Resources**

#### **Literacy Resources**

##### Print

Barton, Mary Lee and Deborah L. Jordan. "S-22 Question-Answer Relationship (QAR)," in *Teaching Reading in Science*. Aurora, CO: McREL, 2001, pp. 117-119. ISBN 1893476030

Sejnost, Roberta and Sharon Thiese. *Reading and Writing Across Content Areas*. Glenview, IL: Skylight, 2001 (pp. 13-14). ISBN 157517362X

##### **Websites**

Ontario Secondary School Literacy Test – [www.eqao.com](http://www.eqao.com)

#### **Workplace Link Resources**

##### Print

*Consumer Report* magazine

*Car and Driver* magazine

*Road and Track* magazine

##### Websites

ConsumersReports4Kids – [www.zillions.org](http://www.zillions.org)

Yahoo Shopping: Consumer Reports

– <http://shopping.yahoo.com/premium/consumerreports/welcomeback.html>

Contact local companies for representatives who do comparisons of products.

## Appendix 5.1: Progress Chart

		Name:	Achievement Chart Category Evaluated			
Activity	Title	Date	KU	I	C	MC
5.1	Written/Oral Test					
5.2.1	Experiment Practicality Template Marking Scheme					
5.2.2	Proposal Rubric					
5.3	Teacher and Self-Assessment Rubric					
5.4.2	Observation of Experiment Checklist					
5.5	Experimental Results, Reflection, and Refinements Rubric					
5.6	Product Comparison Report Rubric					

**Legend:**

KU = Knowledge/Understanding  
C = Communication

I = Inquiry  
MC = Making Connections

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## Activity 5.2 Decision Making: The Question and Proposal

**Time:** 3 hours

### Description

Based on a testable question, students prepare a proposal outlining the research comparison they will perform through an experimental investigation. They explore and answer questions of personal interest based on a product or a characteristic of that product. This activity builds on the previous activity and prepares students to develop their experiment plan in the next activity. Students receive feedback from the teacher and their peers about the practicality of the question and their proposal. The Essential Skills include writing, reading text, and decision making.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2c - presents information and ideas clearly and honestly and with sensitivity to others;

CGE2d - writes and speaks fluently one or both of Canada's official languages;

CGE2e - uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life;

CGE5d - finds meaning, dignity, fulfillment, and vocation in work, which contributes to the common good.

**Strand(s):** Scientific Inquiry: Science in Daily Life

#### Overall Expectations

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life.

#### Specific Expectations

SIL2.01 - formulate questions about problems or issues that can be scientifically tested;

SIL3.01 - develop and investigate research questions about an everyday science-related topic of personal interest.

### Prior Knowledge & Skills

- Operator's Licences earned in previous units
- Exposure to the experimental practicality template in Unit 1 Inquiry: Science in Daily Life
- Ability to compare two types of materials (Unit 4: Chemistry: Properties of Common Materials)

### Planning Notes

- This activity is the critical proposal stage for the final thirty percent. To leave ample time for students to complete this proposal, it should be completed in advance. This may occur while Unit 4: Chemistry: Properties of Common Materials is still in progress.
- Students having difficulty with topic selection may need teacher guidance in finding an area of interest.
- Prepare a variety of question samples, such as:
  - Which has a higher boiling point, water or vinegar?
  - Which is the most durable roofing material, steel or asphalt?
  - Which would be a better planet to colonize, Mars or Venus?
  - If I have to pave a driveway, which material would be better, asphalt or concrete?
  - Do apple trees produce more fruit if fertilized with "natural" fertilizers or with chemically produced ones?

- 
- Students may submit the proposal orally on an audio tape, CD, or in a face-to-face conference if writing inhibits the completion of the proposal.

## Teaching/Learning Strategies

### 5.2.1 Deciding on a Question

- Students review the list of questions collected in their portfolios and/or use a list of guiding questions to choose an area of interest.
- The teacher provides a list of sample questions to small groups of students who discuss and analyse them using the template (Appendix 4.4.1: Sample Experiment Practicality Template).
- Students choose a product in their area of interest, e.g., skateboard, camera, MP3 player, that has two models, materials, or styles that can be compared.
- Each student formulates a question that compares the two products (or a characteristic of that product), keeping in mind that the answer to the question leads to a recommendation for one product over the other.
- Using the template (Appendix 4.4.1: Sample Experiment Practicality Template) students analyse the question as to its appropriateness for in-class experimentation.
- Students receive ongoing teacher and peer feedback on choosing products of personal interest and posing appropriate questions.
- Students revise the question, as needed, until it has met the criteria and is approved by the teacher.
- Students submit the results and rationale of this decision-making activity as a proposal for evaluation, and record the results of the evaluations on their Progress Chart (Appendix 5.1: Progress Chart).

### 5.2.2 Writing the Proposal

- The teacher explains the requirements for the written proposal.
- Students write an experimental proposal, including a brief outline of the experiment, the type of data to be collected, and a list of the equipment needed to conduct the investigation, and submit these to the teacher for evaluation.
- Students record the results of the evaluations in their Progress Chart.

## Assessment & Evaluation Strategies

- In activity 5.2.1, students' questions are evaluated for Inquiry and Making Connections using Appendix 4.4.2: Sample Experiment Practicality Template.
- In activity 5.2.2, the experimental proposal is evaluated by the teacher for Communication using a rubric.

## Resources

### Science Resources

#### Print

Sci-Tech Ontario. *Real Science: Using Projects to Engage Students and Meet the Goals of the Ontario Curriculum, Grades 9 to 12*. First Edition. Ontario: Sci-Tech Ontario, 2003.

Haduch, Bill. *Science Fair Success Secrets*. New York: Dutton Children's Books, 2002.  
ISBN 0-525-46534-0

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## Resources for Catholic Teachers

### Websites

Ontario Catholic Curriculum Cooperative – <http://www.eoccc.org>

Faith and the Common Good – <http://www.faith-commongood.net>

### CD-ROMs

*Curriculum Support for Catholic Schools*. Eastern Ontario Catholic Curriculum Cooperative, 2002.

## Activity 5.3: Planning the Investigation

**Time:** 3 hours

### Description

Each student plans an experiment based on the proposal approved in Activity 5.2. Students brainstorm a procedure for considering the use of common lab equipment, e.g., beakers, thermometers, test tubes, hot plates, for answering the question. Students review skills by looking through their portfolios for samples of labs completed, different ways of presenting procedures and data, safety checklists, and measuring skills. They write an Investigation Plan, which includes an explanation outlining how their procedure meets the “fair test” criteria. Prior to submission for final evaluation, students self-assess the Investigation Plan, receive peer feedback, and revise as needed. The Essential Skills include job task planning and organizing, continuous learning, and writing.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE2c - presents information and ideas clearly and honestly and with sensitivity to others;

CGE2d - writes and speaks fluently one or both of Canada's official languages;

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems;

CGE4f - applies effective communication, decision-making, problem-solving, time and resource management skills.

**Strand(s):** Scientific Inquiry: Science in Daily Life; Biology: Staying Alive

#### Overall Expectations

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

BSAV.03 - analyse how personal health and safety in everyday life and in the workplace are protected through the proper use of equipment and safety practices.

#### Specific Expectations

SIL1.02 - explain the importance of a “fair test” for troubleshooting and testing everyday science problems;

SIL2.02 - plan, conduct, and refine simple investigations to answer student-generated questions;

BSA3.01 - develop and investigate research questions about an everyday science-related topic of personal interest;

BSA3.02 - evaluate the investigation of the topic they selected and suggest possible refinements.

#### Prior Knowledge & Skills

- Experience in gathering and presenting information in a scientifically acceptable format
- Operator's Licences earned in previous units
- Formulation of safety checklist in the Biology unit
- Experience in writing material lists, in lab procedures, in creating charts for collecting data, and in writing procedures that meet the “fair test” criteria
- Experience in developing a proposal for the research comparison by an experimental investigation, based on a testable question

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## Planning Notes

- To allow time for students to develop a doable investigation, this activity should be completed in advance, which may occur while Unit 4: Chemistry: Properties of Common Materials is still in progress.
- Prepare a list of approved investigations ensuring that appropriate materials are available for each investigation.
- Collect the equipment and have it readily available to students.
- Use the three-minute conference to offer evaluation and meaningful feedback for the students' work (See Appendix 5.3.1: Plan and Design an Investigation for a sample rubric to be used in the formal teacher conference.
- Pre-select groups of four students to share lab equipment as they brainstorm their investigations.
- If students have not previously obtained an operator's licence required for this activity, provide an opportunity for them to earn their licence.
- Meet with students who require additional guidance to prepare appropriate, doable investigations early, and conference again as the need arises.

## Teaching/Learning Strategies

- Students brainstorm a procedure for answering the question selected in Activity 5.2 using equipment typically found at a lab station, e.g., beakers, thermometers, test tubes, and any other required manipulatives specified in their proposal. For the purpose of management, students may be grouped with other students, but each student works independently with the equipment where resources permit.
- Students look through their portfolios for samples of completed labs, ways of presenting procedures and data, safety checklist (from the Biology unit), and measuring skills to prepare their written plan.
- Students prepare their written plan, which should include, but is not limited to, a materials list, a procedure, charts on which to record observations and data, and a safety checklist. They also explain how their procedure meets the "fair test" criteria.
- Students self-assess their proposals using the rubric (Appendix 5.3.1: Plan and Design an Investigation) and ask another student to give feedback.
- Based on the feedback, students make appropriate revisions to their investigation plan.
- The teacher assesses the Investigation Plan, using the same rubric.
- Each student meets with the teacher for a three-minute conference. The student and teacher compare their assessments and discuss differences. The student makes revisions to his or her investigation plan, if necessary.
- Students record the evaluation results on their Progress Chart.

## Assessment & Evaluation of Student Achievement

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- Proposals are self-assessed using Appendix 5.3.1: Plan and Design an Investigation.
- The investigation plan is evaluated for all categories of the Achievement chart, using Appendix 5.3.1: Plan and Design an Investigation – Sample Teacher Evaluation Rubric, as a focus for the three-minute conference between the teacher and student.

## Resources

### Science Resources

[Print](#)

Science Teachers of Ontario. *Stay Safe*. Toronto: STAO, 2002. ISBN 1-894592-22-0

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## **Assessment and Evaluation Resources**

### Print

Chappuis, S., R. Stiggins, J. Arter, and J. Chappuis. *Assessment for Learning: An Action Guide for School Leaders*. Portland, OR: Assessment Training Institute, 2004. ISBN 0-9655101-4X

Gregory, K., C. Cameron, and A. Davies. *Conferencing and Reporting*. Merville, BC: Connections, 2001. ISBN 096821603X

Gregory, K., C. Cameron, and A. Davies. *Self-Assessment and Goal Setting*. Merville, BC: Connections, 2000. ISBN 0968216021

**Appendix 5.3.1: Plan and Design an Investigation –  
Sample Teacher Evaluation Rubric**

<b>Criteria</b>	<b>Level 1 (50-59%)</b>	<b>Level 2 (60-69%)</b>	<b>Level 3 (70-79%)</b>	<b>Level 4 (80-100%)</b>
<b>Knowledge/ Understanding</b> Fair Test – understand the concept of fair test	- plan shows limited understanding of a fair test	- plan shows moderate understanding of a fair test	- plan shows considerable understanding of a fair test	- plan shows thorough understanding of a fair test
<b>Inquiry</b> Procedure – support collecting the intended data	- procedure supports data collection with limited effectiveness	- procedure supports data collection with moderate effectiveness	- procedure supports data collection with considerable effectiveness	- procedure supports data collection with a high degree of effectiveness
Data tables appropriate for the data being collected	- data tables will record the collected data with limited effectiveness	- data tables will record the collected data with moderate effectiveness	- data tables will record the collected data with considerable effectiveness	- data tables will record the collected data with thorough effectiveness
<b>Communication</b> Communicate the procedure in clear and logical steps	- communicates the procedure with limited clarity and logical sequence	- communicates the procedure with moderate clarity and logical sequence	- communicates the procedure with considerable clarity	- communicates the procedure with thorough clarity
<b>Making Connections</b> Safety Checklist – Address safety concerns of the experimental procedures	- addresses safety concerns with limited effectiveness	- addresses safety concerns with some effectiveness	- addresses safety concerns with moderate effectiveness	- addresses safety concerns with considerable effectiveness

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

**Appendix 5.3.2: Plan and Design an Investigation –  
Sample Peer Assessment Checklist**

Category	Yes	Needs work	No
Is the <b>materials list</b> complete?			
Is the <b>materials list</b> appropriate?			
Is the <b>procedure</b> listed in clear and logical steps?			
Will the <b>procedures</b> allow the experimenter to gather the intended data?			
Does the overall plan demonstrate an understanding of the <b>concept of fair test</b> ?			
Do <b>data table(s)</b> anticipate all observations and measurements to be made according to the procedure given?			
Does the <b>safety checklist</b> address all safety concerns related to the written procedures?			

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## Activity 5.4: Conducting the Investigation

**Time:** 8 hours

### Description

Students are paired and assigned the roles of Researcher and Lab Assistant to conduct the investigations. Prior to conducting the investigation, they rehearse the experiment and identify whether all necessary materials have been collected. The Researcher carries out his/her selected experiment and the Lab Assistant provides assistance. Students reverse roles so each student has the opportunity to conduct his/her experiment. The Essential Skills include continuous learning and oral communication.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE4f - applies effective communication, decision-making, problem-solving, time and resource management skills.

**Strand(s):** Scientific Inquiry: Science in Daily Life; Chemistry: Properties of Common Materials

#### Overall Expectations

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

CPMV.02 - investigate the physical and chemical properties of common materials through laboratory activities.

#### Specific Expectations

SIL2.03 - conduct investigations safely, using appropriate lab equipment;

SIL2.04 - observe and record data, using a variety of formats, including the use of SI unit, where appropriate;

SIL2.06 - communicate plans, observations, and results, using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate;

CPM2.02 - use appropriate laboratory safety and disposal procedures while conducting investigations;

CPM2.03 - organize and record the observations of the investigations using appropriate formats.

### Prior Knowledge & Skills

- Experience in safely conducting investigations involving the creation of data tables and the recording of data and observations
- Creation of an investigation plan and safety checklist
- Acquisition of operator's licence(s) in any skill(s) necessary for their investigation

### Planning Notes

- There is room for flexibility in grouping the students for the activity. The Researcher and Lab Assistant need to work together for the rehearsal, the actual experiment, and the evaluation in Activity 5.5. To ensure that every student has an opportunity to experience both roles, students may reverse roles for the entire sequence or be assigned to another partner for the entire sequence. It may be necessary to have a student complete the rehearsal, the investigation, and the evaluation in Activity 5.5 before switching roles.
- Prepare student copies of the requisition slips and rubrics (Appendix 5.4: Sample Teacher Evaluation Rubric).
- If students do not have the appropriate licence, arrangements should be made for the student to acquire the licence(s) prior to conducting the investigation.

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## Teaching/Learning Strategies

### 5.4.1 Rehearsing

- The teacher pairs students and assigns the roles of Researcher and Lab Assistant to carry out the experiments.
- The teacher reviews guidelines for positive group work with the class and clearly defines the roles of Researcher and Lab Assistant.
- The teacher discusses the rubric (Appendix 5.4: Sample Teacher Evaluation Rubric) with the class.
- The Researcher communicates the research plan to the Lab Assistant, explaining the experimental procedure. The Researcher ensures the Lab Assistant is familiar with the Safety Checklist, provides the observation charts/tables, and shows the Lab Assistant where and how to complete the table. The Lab Assistant checks that all necessary materials are present.
- The Researcher and Lab Assistant perform a dry run of the experiment. If they discover that they need additional materials, the Lab Assistant completes a requisition slip and submits it to the teacher.
- The students reverse roles and repeat the activity.

### 5.4.2 The Experiment

- The students assume the Researcher and Lab Assistant roles and conduct their own investigation. During the investigation, both students follow the guidelines identified on the Safety Checklist created in Activity 5.3.
- While the students are conducting the investigation, the teacher circulates and discusses the experiment and results with the Lab Assistant.
- The teacher completes the rubric (Appendix 5.4: Sample Teacher Evaluation Rubric) and returns it to the students, and students update their Progress Charts.
- When the investigations are complete, the students reverse roles and conduct their investigations again.

## Assessment & Evaluation of Student Achievement

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- Students' lab performance skills are evaluated for Inquiry when they are in the role of the Researcher.
- Students are evaluated for Communication when they are in the role of the Lab Assistant.

## Resources

### Science Resources

[Print](#)

Science Teachers of Ontario. *Stay Safe*. Toronto, ON: STAO, 2002. ISBN 1-894592-22-0

## Appendix 5.4: Sample Teacher Evaluation Rubric

### Thinking/Inquiry Skills (The Role of Researcher)

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
- use of lab equipment and materials	- uses lab materials and equipment with limited accuracy	- uses lab materials and equipment with some accuracy	- uses lab materials and equipment with considerable accuracy	- uses lab materials and equipment with a high degree of accuracy
- follow procedure using necessary safety precautions	- follows procedure using necessary safety precautions with limited effectiveness	- follows procedure using necessary safety precautions with some effectiveness	- follows procedure using necessary safety precautions with considerable effectiveness	- follows procedure using necessary safety precautions with a high degree of effectiveness
- make observations	- makes observations with limited accuracy	- makes observations with some accuracy	- makes observations with considerable accuracy	- makes observations with a high degree of accuracy
- dispose of materials and clean workstation	- disposes of materials and cleans workstation with limited effectiveness	- disposes of materials and cleans workstation with some effectiveness	- disposes of materials and cleans workstation with considerable effectiveness	- disposes of materials and cleans workstation with a high degree of effectiveness

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

### Communication Skills (The Role of Lab Assistant)

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
- record observations (with units, where appropriate)	- records observations (with units, where appropriate) with limited effectiveness	- records observations (with units, where appropriate) with some effectiveness	- records observations (with units, where appropriate) with considerable effectiveness	- records observations (with units, where appropriate) with a high degree of effectiveness
- orally describe the experiment	- orally describes the experiment with limited clarity	- orally describes the experiment with moderate clarity	- orally describes the experiment with considerable clarity	- orally describes the experiment with high degree of clarity

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

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## Activity 5.5: Evaluating the Evidence

**Time:** 2 hours

### Description

Students analyse their results from the experiment performed in Activity 5.4 and evaluate the implementation of their experimental plan developed in Activity 5.3. A peer discussion between Lab Assistants and Researchers assists them in refining conclusions that are clearly supported by the data from their experiment. Students provide a written rationale for deciding which product is better, based on their chosen criteria, or indicate that further research must be done. Researchers and Lab Assistants evaluate their experimental plan and implementation and make meaningful suggestions for improvement. This recorded data is used to create the Product Comparison Report in the next activity. This report is submitted with their conclusions and product choice for evaluation. The report includes a reflection on the use of science skills to solve problems and help make decisions in the workplace. The Essential Skills addressed are numeracy, writing, reading text, continuous learning, and oral communication.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE5a - works effectively as an interdependent team member;

CGE5f - exercises Christian leadership in the achievement of individual and group goals;

CGE5g - achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others;

CGE4b - demonstrates flexibility and adaptability.

**Strand(s):** Scientific Inquiry: Science in Daily Life

#### Overall Expectations

SILV.01 - illustrate how science is a part of daily life;

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

SILV.03 - examine the connections between science and activities in daily life.

#### Specific Expectations

SIL1.02 - explain the importance of a "fair test" for troubleshooting and testing everyday science problems;

SIL2.05 - assess data to make inferences and conclusions and to answer questions and refine procedures;

SIL3.02 - evaluate the investigation of the topic they selected and suggest possible refinements;

SIL3.03 - demonstrate an understanding of how problem-solving and decision-making activities in the workplace use scientific process skills.

### Prior Knowledge & Skills

- Practice giving feedback to peers
- Ability to interpret data, draw conclusions, evaluate results, and make suggestions to improve experiments
- Use of science skills for problem solving and decision making in the workplace

### Planning Notes

- Partners for this activity must be the same partners that worked together for Activity 5.4 to ensure that they understand the experiment and can provide meaningful feedback.
- Discussion should take place as soon as possible after completion of the experiment, since written feedback is not recorded during the lab.

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- Students understand that the essence of this activity is not a judgement of the performance of the experiment, but an evaluation of the experiment in order to make a sound conclusion (Was the test fair (controlled)? Were the numbers accurately recorded? Was the difference between the measurements significant?) and suggest meaningful improvements.
  - To limit the number of students who are performing experiments at one time, teachers may schedule Activity 5.4 on a staggered basis, so that some students are engaged in Activity 5.5 while other students perform their experiment from Activity 5.4.
  - Data and conclusions may need to be copied, one to be handed in for evaluation and one to be used by the student for Activity 5.6.

### **Teaching/Learning Strategies**

- Students consult their portfolio for examples of prior data analysis and presentations of conclusions.
- Students individually interpret data and make conclusions and decisions in a format that can be presented to a partner.
- Students share data, conclusions, and decisions, and discuss the conclusions of the experiments with a partner.
- Students provide feedback using Appendix 5.5.1: Suggested Stems for Peer Feedback to list the experimental strengths and areas for improvement, especially with respect to “fair test.”
- Students refine conclusions and decisions based on discussion and on the list of strengths and areas for improvement.
- Students prepare a written report and reflection about their performance, using Appendix 5.5.2: Suggested Questions for Refinements and Reflection Report.
- Students submit the report, including results, refinements, and a reflection on the application of scientific skills to workplace problem solving and decision making based on experimental performance. They include a copy of data and conclusions for evaluation and record the results in their progress charts.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- An analysis of the investigation performed in Activity 5.4 is given as peer feedback, using Appendix 5.5.1: Suggested Stems for Peer Feedback.
- The report is evaluated for Knowledge/Understanding, Inquiry, and Making Connections, using a rubric (Appendix 5.5.3: Sample Rubric for Evaluation of Results, Refinements, and Reflections).

### **Resources**

#### **Science Resources**

Print

Haduch, Bill. *Science Fair Success Secrets*. New York: Dutton Children’s Books, 2002.  
ISBN 0-525-46534-0

#### **Assessment and Evaluation Resources**

Print

Gregory, K., C. Cameron, and A. Davies. *Conferencing and Reporting*. Merville, BC: Connections Publishing, 2001. ISBN 0-9682160-3-X

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## Appendix 5.5.1: Suggested Stems for Peer Feedback

### Experimental Plan

- Two things that worked well in the experimental plan were...
- Two things I would have changed were...

### Performing the Experiment

- When we did the experiment, we could be confident with the data collected because...
- When we did the experiment, the data collected may have been inaccurate because...

### Making Conclusions

- Overall, this was a fair test because...

OR

- Overall, this was not a fair test because...
- The data collected supports the final conclusion because...

## Appendix 5.5.2: Suggested Questions for Refinements and Reflection Report

Please be sure to use the scientific terms we have used this semester when answering the questions.

1. How does your data support your conclusion?
2. Did your experiment meet the fair test criteria? Explain why or why not.
3. Did your experiment enable you to make a decision about your product? Explain why or why not.
4. If you could only change either the plan or the way the experiment was performed, which would lead to better results?
5. What improvements would you make to your experiment if:
  - you had the same amount of time, materials, and equipment?
  - you had more time and could access any materials or equipment you wanted?
6. Thinking of another product you might purchase, how would the science skills you have learned in this unit help you to make a decision on what to buy?
7. What did you learn from this course?

### Appendix 5.5.3: Sample Rubric for Evaluation of Results, Refinements, and Reflections

Criteria/Category	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Knowledge/ Understanding</b> Explain the importance of a fair test	- demonstrates limited understanding of the concept of fair test	- demonstrates some understanding of the concept of fair test	- demonstrates considerable understanding of the concept of fair test	- demonstrates thorough understanding of the concept of fair test
<b>Inquiry</b> Apply the skill of evaluating flaws in experimental design or performance	- applies the skill of evaluating flaws in experimental design or performance with limited accuracy	- applies the skill of evaluating flaws in experimental design or performance with some accuracy	- applies the skill of evaluating flaws in experimental design or performance with considerable accuracy	- applies the skill of evaluating flaws in experimental design or performance with a high degree of accuracy
<b>Making Connections</b> Make meaningful suggestions for improvement to the design of the experiment	- makes suggestions for improvement with limited effectiveness	- makes suggestions for improvement with moderate effectiveness	- makes suggestions for improvement with considerable effectiveness	- makes suggestions for improvement with a high degree of effectiveness
<b>Making Connections</b> Demonstrate understanding of how the scientific process skills of problem solving and decision making are connected to the workplace	- shows limited understanding of connections	- shows some understanding of connections	- shows considerable understanding of connections	- shows thorough understanding of connections

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.

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## Activity 5.6: Preparing the Product Comparison Report

**Time:** 2 hours

### Description

The class decided early in the course about the format for the final class product, e.g., a webpage, magazine, presentation, posters, science fair. After reviewing the requirements for this format and examining examples, students present their consumer choice, based on their experimental evidence. Groups of students, or the entire class, may choose to combine their individual reports into a single product. However, students are evaluated on their individual contribution. The Essential Skills addressed include document use and reading text.

### Strand(s) & Learning Expectations

#### Ontario Catholic School Graduate Expectations

CGE4f - a self-directed, responsible, life long learner who applies effective communication, decision-making, problem-solving, time and resource management skills;

CGE5g - a collaborative contributor who achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others.

**Strand(s):** Science Inquiry: Science in Daily Life; Biology: Staying Alive;  
Chemistry: Properties of Common Materials

#### Overall Expectations

SILV.02 - use appropriate scientific skills, tools, and safety procedures to investigate problems;

BSAV.02 - investigate, through laboratory activities, the processes which simple and complex organisms use to sustain life;

CPMV.02 - investigate the physical and chemical properties of common materials through laboratory activities;

CPMV.03 - analyse how the use of various materials is based on their physical and chemical properties.

#### Specific Expectations

SIL2.06 - communicate plans, observations, and results, using a variety of oral, written, and graphic representations, and including the use of SI units, where appropriate;

BSA2.05 - communicate observations, interpretation of results, and information through appropriate formats;

CPM2.04 - interpret and communicate the results of investigations;

CPM3.03 - present a recommendation based on the results of the investigation and the research of the product, appropriate for someone interested in using the product.

### Prior Knowledge & Skills

- Collection and interpretation of experimental data
- Familiarity with the format chosen for the class presentation

### Planning Notes

- The criteria for this report should be developed with the class prior to beginning this activity.
- Examples of the chosen format should be collected to show students before they begin work on their individual contribution. If appropriate, the existing product comparisons used in Activity 5.1 may be used.
- Students who have investigated a different component of the same product may choose to compile their results into a single report. Alternatively, the whole class may choose to compile their results into one class project, e.g., a class magazine or website. Teachers should remind students that they will be evaluated on their individual contribution.

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- Some dry-lab data may need to be provided for students who did not experience success in collecting data in their investigation, so that they still have an opportunity to participate in this activity. Consider using data collected during the Chemistry unit.
  - Based on the needs and interests of the students and the school, a class may choose an everyday context within which to complete this project for a specific audience. For example, the class may choose to make recommendations to assist parents of younger children in the purchase of toys; examine cosmetics or woodworking tools in order to assist the school cosmetology or woodworking class in making purchases; or examine athletic equipment in order to assist the athletic department in the purchase of new equipment.

### **Teaching/Learning Strategies**

- The teacher leads an examination of examples of existing product comparisons from everyday life to review the components and criteria required in their final product. (Regardless of the format, each report should include a graphic layout, a summary of evidence, and a conclusion/recommendation).
- Students receive feedback from the teacher and their peers as they work on their individual contributions.
- Students prepare their individual report for a consumer interested in that product.
- The teacher coordinates the compilation of the individual reports into one or more products, e.g., magazine, website. These products are shared with the whole class or the intended audience, as appropriate.
- Students submit their report for evaluation and record their results on the Progress Chart.

### **Assessment & Evaluation of Student Achievement**

*See Assessment & Evaluation of Student Achievement in Overview, p. 8.*

- The final report is evaluated for Communication and Making Connections using a rubric (see Appendix 5.6: Sample Rubric for Evaluating the Product Comparison Report)

### **Resources**

#### **Workplace Link Resources**

##### Print

*Car and Driver* magazine

*Road and Track* magazine

Photography magazines

*Consumer Report* magazine

##### Websites

ConsumersReports4Kids – [www.zillions.org](http://www.zillions.org)

#### **Resources for Catholic Teachers**

##### Websites

Ontario Catholic Curriculum Cooperative – <http://www.eoccc.org>

Faith and the Common Good – <http://www.faith-commongood.net>

##### CD-ROMs

*Curriculum Support for Catholic Schools*. Eastern Ontario Catholic Curriculum Cooperative, 2002.

## Appendix 5.6: Sample Rubric for Evaluating the Product Comparison Report

Criteria/Category	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
<b>Communication</b> Use terms, including S.I. units	- uses terms, including S.I. units, with limited accuracy	- uses terms, including S.I. units, with some accuracy	- uses terms, including S.I. units, with considerable accuracy	- uses terms, including S.I. units, with a high degree of accuracy
Communicate recommendation with the audience in mind	- recommendation has limited relevance for the intended audience	- recommendation has some relevance for the intended audience	- recommendation has considerable relevance for the intended audience	- recommendation is relevant for the intended audience
Communicate recommendation using a variety of formats	- uses a variety of formats with limited effectiveness	- uses a variety of formats with some effectiveness	- uses a variety of formats with considerable effectiveness	- uses a variety of formats with thorough effectiveness
<b>Making Connections</b> Present a recommendation based on the results of the investigation of the product	- recommendation has limited connections to the conclusions of the experiment	- recommendation has some connections to the results of the experiment and is justifiable by the data	- recommendation is connected to and is justified by some data	- recommendation is connected to and justified by considerable data

**Note:** A student whose achievement is below Level 1 (50%) has not met the expectations for this assignment or activity.