

Catholic District School Board Writing Partnership

Science

Course Profile

Science

Grade 12

University/College Preparation

SNC4M

• *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.

Course Profiles are professional development materials designed to help teachers implement the new Grade 12 secondary school curriculum. These materials were created by writing partnerships of school boards and subject associations. The development of these resources was funded by the Ontario Ministry of Education. This document reflects the views of the developers and not necessarily those of the Ministry. Permission is given to reproduce these materials for any purpose except profit. Teachers are also encouraged to amend, revise, edit, cut, paste, and otherwise adapt this material for educational purposes.

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

© Queen's Printer for Ontario, 2002

Acknowledgments

Catholic District School Board Writing Team – Science

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

Lead Board

Hamilton-Wentworth Catholic District School Board

Project Manager

Remo Presutti, Hamilton-Wentworth Catholic District School Board

Writing Team

Donna Stack-Durward, Hamilton-Wentworth CDSB (Lead Writer)

Julie D'Angela, Hamilton-Wentworth CDSB

Anne Rees, Hamilton-Wentworth CDSB

Internal Review Team

Josie Ciapanna, Hamilton-Wentworth CDSB

Jerry Creedon

Institute for Catholic Education (ICE)

Course Overview

Science, SNC4M, Grade 12, University/College Preparation

Policy Document: *The Ontario Curriculum, Grades 11 and 12, Science, 2000.*

Prerequisite: Science, Grade 11, University/College Preparation

Course Description

This course enables students, including those who do not intend to pursue science-related programs, to further develop their understanding of science and its technological applications. Students will explore a range of topics including organic products in everyday life, pathogens and disease, energy alternatives and their impact globally, communications systems, and science and contemporary societal issues. Emphasis will be placed on relating these topics to global issues as well as to daily life, and on developing skills in the areas of experimentation, research, critical thinking, and analysis.

How This Course Supports the Catholic School Graduate Expectations

This course integrates Catholic beliefs, values, and Church teachings within the context of knowledge and skills. The social context of science is explored in this course. Students participate in discussions involving people's fundamental rights of food, shelter, health care, education, and employment. This exploration is done, for example, through cost and benefit analysis of a society's choice of energy sources and use. Ultimately, this course provides students with an understanding that global justice means taking responsibilities seriously by bridging national, social, economic, and ideological differences. Students become aware of the dignity and rights of others and learn to respect each other and work together. As members of a Catholic community, students are encouraged to live according to faith values that are often at odds with the prevailing values of our society. Teachers are encouraged to use the many opportunities found in this course to integrate core values of Scripture and Catholic tradition. By discussing global issues such as energy consumption, spread of infectious disease, and widespread use of pesticides, students are challenged to develop a social conscience. Economic choices made by society must be judged by how they protect the life and dignity of the human person, support the family, and serve the common good. The moral dimension and human consequences of the global economy are emphasized in each unit. Stewardship and care for creation are infused into the teaching and learning strategies suggested. This Course Profile provides assistance to teachers in the form of resources that are authentic, genuinely relevant, and practical.

Course Notes

University/College Preparation courses are designed to broaden students' interests, knowledge, and skills and to provide them with general information relevant to their lives now and in the future. This course is designed to promote scientific and technological literacy. Teachers can accomplish this goal by becoming aware of the students' interests and skills level and by using real world examples that are relevant to the students' lives. This course places a lot of emphasis on students' gaining competence at making connections between scientific knowledge and its application. Students are asked to consider and analyse the impact of science on society and on the environment, both locally and globally. This course provides an excellent opportunity for students to see the relevance of science and technology to society and the environment (STSE). Students are encouraged to view science as an opportunity to weigh complex combinations of facts and to value the development of science and technology that has given rise to our modern society.

Each unit involves many opportunities for research, analysis, and impact assessments.

This course has a strong emphasis on research and the use of technology. Teachers are encouraged to help students develop their research skills in a logical manner that will prepare them for further study in any discipline. When conducting surveys, students must be instructed to accept “No comment” as a valid answer to any question, and to respect that some people may choose not to respond at all. Group work is recommended to build communication skills among students. The teacher could maintain the same groups for several activities or change the group members according to their interests and/or skills.

This course is organized into five units of study: Pathogens and Disease, Energy Alternatives and Global Impact, Communications Systems, Organic Products in Everyday Life, and Science and Contemporary Societal Issues. The order, organization, and teaching strategies recommended for the units allow students to develop, then practise, higher-level thinking and problem-solving skills. The first unit, Pathogens and Disease, uses a problem-based learning approach and sets the standards for lab procedures. The last unit, Science and Contemporary Societal Issues, contains expectations that could be integrated into the other four units. This unit explores current issues and offers teachers flexibility with respect to the specific examples used. Specific expectations such as SS1.05 could be combined with PD1.05 (Pathogens and Disease), and SS3.02 could be combined with PD3.05. In this Course Profile, Science and Contemporary Societal Issues is the last unit of study. The order of the activities within each unit is also flexible; for example, in the fourth unit on organic products, after the first activity the order of the activities is not critical – personal health-care products could be studied before soaps and detergents. However, when reorganizing the expectations, the teacher must be aware that the introduction of the basic scientific concepts, e.g., emulsification in Unit 4, must also be reclustered to ensure that a logical presentation of knowledge and skills is preserved. Culminating tasks are suggested for Units 1 and 5, and teachers are encouraged to consider creating culminating tasks for the other units.

Teachers must incorporate the skills essential for scientific investigation; these skills apply to all areas of the course content. In this Course Profile, these skills expectations have been coded as Scientific Investigation Skills (SIS.01 to SIS.10). Assessment of the students’ mastery of these skills must be included in the evaluation of students’ achievement. The teacher must provide ample opportunities for students to engage in safe, relevant laboratory activities in all units of this course. The health and safety of teachers and students must be routinely addressed when conducting laboratory activities as outlined in the Workplace Hazardous Materials Information System (WHMIS) legislation. This is especially of concern in the Pathogens and Disease unit, where students are to design and conduct experiments to investigate the effects of various drug therapies on pathogenesis. Teachers should only use non-pathogenic bacteria in this activity and ensure that proper sterile techniques are taught and followed. Teachers need to take precautionary measures to ensure that students with allergies are not placed at risk. They should discuss this issue with students and follow safe practices outlined in school or board policy. It may be appropriate to use parent permission forms.

Throughout this Course Profile, students have the opportunity to become reflective and critical thinkers who examine, evaluate, and apply knowledge of interdependent systems for the development of a just and compassionate society. A Student Journal is introduced in Unit 1 and teachers are encouraged to continue its use throughout in all units. Teachers should be sensitive to the personal nature of the experience and support students in avoiding disclosure and discussion of sensitive issues.

Units: Titles and Time

* Unit 1	Pathogens and Disease	20 hours
Unit 2	Energy Alternatives and Global Impact	22 hours
Unit 3	Communications Systems	22 hours
Unit 4	Organic Products in Everyday Life	22 hours
Unit 5	Science and Contemporary Societal Issues	24 hours

* This unit is fully developed within this Course Profile.

Unit 1: Pathogens and Disease

Time: 20 hours

Unit Description

This unit uses a problem-based learning approach to introduce students to the study of pathogens and disease. A problem-based approach encourages students to become self-directed learners. They acquire knowledge through team participation and individual research. This approach is used to maximize motivation in the students and to set a model that could be used in other units in the course. Students continue to learn more about their own body as a continuation of the Body Input and Body Function unit in the SNC3M course. They investigate pathogens, the diseases they cause, human responses to them, and the means and technologies developed to control them. Students compile Pathogen Profiles on various types of pathogens. Through laboratory investigations, students identify the characteristics of bacteria, the effects of various antiseptics on bacterial growth, and the role of sterile techniques in processes such as pasteurization. Students study the modes of transmission of diseases and discuss the various agencies involved in controlling the spread of diseases both globally and locally. The unit includes a culminating task based on the problem-based learning approach, where students in Research Teams become experts on a particular pathogen. Each Team presents its report to the class during a Disease Forum.

The first activity introduces the connection between pathogens and disease using a problem-based learning approach. The Lazarus story is used to discuss how past societies have viewed disease, and students are encouraged to follow Jesus' teachings in accepting individuals. The culminating task and the use of the Student Journal are introduced.

Through the discussion of familiar diseases, the second activity introduces characteristics and life cycles of pathogens. A video provides students with additional information on pathogens. By participating in a jigsaw activity, students explore the modes of transmission of diseases.

In Activity 3, students develop an awareness of the widespread commercial use of antiseptics and conduct a laboratory investigation into their effects on bacterial growth. Beginning with the Pathogen Profiles already completed, students learn more about the mechanisms humans have for controlling pathogens, specifically the human immune system. Through class discussions, story and article reviews, and a scavenger hunt students investigate various drug therapies. Students reflect on the impact on society of overusing and misusing antibiotics.

In Activity 4, students discuss the many opportunities for food contamination to occur, and the technological advances and agencies that serve to control it. Students create a Then and Now Timeline on a specific technological advancement used in food preparation and preservation. Students practise proper sterile techniques in a lab activity where they investigate the effect of pasteurization on pathogenesis. A respect for cultural differences is encouraged through class discussion on how various cultures and countries control the spread of pathogens in foods.

Activity 5 is the culminating task for this strand. Students participate in a Disease Forum where as research epidemiologists, they present information on a specific pathogen and the disease it produces. Students discuss and reflect on the present and future implications of strategies used to control diseases caused by the pathogens presented. A video is used to highlight the inequalities that exist in our world and raise student awareness about the implications of these inequalities on the control of disease. Students are encouraged to reflect on the way Jesus healed the sick without discrimination and whether our scientifically and technologically advanced society does the same?

Note: In the Unit Overview Charts the assessment category being emphasized in each cluster is written in **bold face type**.

Unit Overview Chart

Cluster	Learning Expectations	Achievement Categories	Focus
1	PDV.01, PD1.01 SIS.05, .06, .07 CGE1c, 4f, 5a, 5e	Communication	Pathogens and Disease - introduce scenario and problem-based learning approaches - begin Pathogen Profiles - create a Web diagram and Action Plan for the Culminating Task
2	PDV.01, .02, PD1.02, 1.03, PD2.02, 3.01 SIS.05, .06 CGE2c, 3c, 5a, 7b, 7e	Knowledge/ Understanding Inquiry Communication	Characteristics of Pathogens - identify types of pathogens and their life cycles - identify modes of transmission through a jigsaw activity
3	PDV.02, PD1.04, 1.05, 1.06, PD2.01, 2.03, 2.04, PD3.02, 3.04 SIS.01, .02, .03, .04, .05, .06, .07, .08 CGE2b, 3c, 5a	Inquiry Knowledge/ Understanding Communication Making Connections	Immune System - perform a lab activity on the effects of antiseptics - construct a concept map of the body's defence systems - conduct a scavenger hunt of resources on drug therapies - complete an article review on the use/misuse of antibiotics
4	PDV.03, PD2.05, PD3.01, 3.03, 3.04, 3.05 SIS.01, .02, .03, .04, .06, .07, .08, .10. CGE1d, 1h, 3f, 5a, 5e, 7e, 7f	Knowledge/ Understanding Inquiry Communication Making Connections	Sterile Techniques and Food Preparation - create a Then and Now timeline on technological advancements in food preparation and preservation - perform a lab activity on pasteurization
5	PDV.01, .02, .03, PD3.01, 3.05 SIS.05, .06, .07, .08 CGE1d, 1e, 1h, 2c, 2e, 3b, 3c, 3e, 3f, 4f, 5a, 7d, 7e, 7f	Knowledge/ Understanding Communication Making Connections	Culminating Task - research a specific disease using a problem-based learning approach - present findings at a Disease Forum and complete Pathogen Profiles for each disease presented

Unit 2: Energy Alternatives and Global Impact

Time: 22 hours

Unit Description

Students study the scientific principles of energy production and they research alternative energy sources. Students become aware of how their energy choices affect the environment both locally and globally. They have the opportunity to design a system using alternative energy sources – solar powered cars or wind generators. Students assess their behaviour and consider how changing their patterns of energy use can impact on the environment. They become aware of choices that can make them responsible stewards of the Earth. Students study Canada's role in nuclear technology, specifically the development and future of CANDU reactors, and participate in a debate on the use of nuclear technology. Students collect, read, analyse, and reflect on several news articles discussing global and local energy sources, societal demands for energy, and environmental impact of energy use.

In the first activity, students make a list of all the energy-using devices/appliances that they use regularly (directly and indirectly). After defining renewable and non-renewable energy sources, students categorize the list accordingly. Students identify which appliances they could use less or stop using, to conserve energy. Students brainstorm examples of conventional and alternative energy sources and produce a Venn diagram comparing them. This diagram will continue to be developed throughout the unit. Students read and critique a news article describing the environmental impact of a specific alternate energy source used in Canada, e.g., use of wind energy in Ontario.

In Activity 2, students create an Energy Consumption Wheel made of two circles held by a paper fastener – the top circle has a window cut out and the bottom one has the information summary – that identifies and describes which activities consume the most energy and how changing patterns of behaviour reduce the energy consumed. Students reflect on the impact human activities have on the environment.

In Activity 3, students view a video or listen to a speaker discuss the ways technology can provide answers to energy, e.g., fossil fuel, shortages. Students gather and analyse data through research on an alternative and/or emerging technology such as wind power, fermentation of waste products, electric cars, or solar power. Students create an advertisement campaign for this technology and present the campaign to the class. Using the knowledge gained, the class discusses the suitability of alternative energy sources in Canada, given data on national and regional natural resources, and they reflect on the impact on society of changing to alternative energy sources.

In Activity 4, students research and design a system that uses an alternate energy source and include a cost and benefits analysis. If possible, students in teams could build and test the designs.

In the last activity, students study nuclear energy. Students learn about the Canadian input into nuclear research by reading essays or viewing videos on the role of Canadian researchers, e.g., Lawrence, and the CANDU reactor. Students describe the scientific principles of fission and a chain reaction and their applications in nuclear generating stations. Students locate nuclear generating stations in Canada and in the world. The terms fusion and fission are compared. Students read or view news footage of nuclear disasters such as Chernobyl (1986) or Three Mile Island (1979) and reflect on the unintended consequences of nuclear technology. Students prepare and participate in a parliamentary debate on the use of nuclear technology. Students make a final reflection on the tremendous need humans have for energy; with so many technologies available today, there are costs that are not always obvious and often lead to paradoxes and moral dilemmas.

Unit Overview Chart

Cluster	Learning Expectations	Achievement Categories	Focus
1	EAV.01, EA1.01, 1.02, EA3.03 CGE2b, 3c, 4g, 7e	Knowledge/ Understanding Making Connections	Energy Use - make a list of personal energy use - describe conventional and alternative energy sources - read and analyse news articles on energy use (global and regional)
2	EA1.04, EA2.01 SIS.05, .08 CGE3c, 3f	Knowledge/ Understanding Inquiry	Impact and Behaviour - gather data on human activities and energy consumption - consider effects of changing behaviours - create an Energy Consumption wheel

Cluster	Learning Expectations	Achievement Categories	Focus
3	EAV.03, EA1.01, 1.03, EA2.02, 2.04, EA3.02, 3.04, 3.05 SIS.05, .08 CGE2c, 3c, 7b, 7i	Knowledge/ Understanding Inquiry Communication Making Connections	Technology and Energy Use - view a video or listen to a speaker re: technology and energy use - describe technologies used for energy alternatives - gather and analyse data relating to responsible energy use - identify new energy applications - prepare argument for alternative energy systems and discuss their suitability in Canada
4	EAV.02, EA2.05, EV3.04 SIS.02, 07, .08 CGE5a, 5f, 7e	Inquiry Making Connections	Designs of the Future - research and design alternative energy source
5	EAV.03, EA1.04, 1.05, 1.06, EA2.03, EA3.01 SIS.05, .08, .10 CGE2b, 4f, 5a, 7i	Knowledge/ Understanding Communication Making Connections	The Nuclear Alternatives - read about Canadian input into nuclear research - describe scientific principles, feasibility, costs of fission and fusion - describe the CANDU reactor - prepare and participate in a debate on nuclear technology

Unit 3: Communications System

Time: 22 hours

Unit Description

Students examine the scientific principles that are the basis for modern communications systems. The Technology in Everyday Life unit of the SNC 3M course introduces the role of technology. In this unit, students describe the technologies involved in communications systems. They study how energy transformations, such as those involving sound and electromagnetic radiation, are used in communications technology. They participate in a Communications/Technology Fair where they design, build, and test a simple communications device. Students assess the impact of new communications systems on individuals and communities; specifically, students discuss the advantages and disadvantages of personal surveillance and cell phones. They reflect on how the world has been affected by our widespread use of various communications systems.

In the first activity, students identify, describe, and assess the impact of communications systems have on lifestyles and the workplace through a brainstorming exercise and a critique of an article on the topic. Students reflect on the impact of communications technology on today's society and what life before these advances was like.

In Activity 2, students identify and describe the technologies involved in selected communications systems, e.g., the Internet, and introduce Canadian technological innovations (see Resources). Using the systems discussed in Activity 1, students investigate the technology behind one of the systems and present the information in a poster. In the poster students include career information specific to the technology researched.

In Activity 3, students explain the scientific principles underlying communications systems and technologies. They produce a concept map of this information. Students study the role of energy transformation in the transmission and reception of signals in communication systems.

In Activity 4, students apply the knowledge gained in Activity 3 to specific applications of various types of energy conversion to communications technology. Students describe the electromagnetic spectrum and study how electromagnetic radiation is applied in radio, television, and telephone systems. The use of semiconductors in computers is studied. The energy transformations involved in the functioning of a microphone are described. For the applications discussed, students summarize their findings in a graphic organizer.

Activity 5 is a Communication/Technology Fair. Students in teams design, build, and test a simple device that converts energy to produce a communication device. Examples of such devices include doorbells and loudspeakers. Students explore the scientific principles, define specific terms, research the commercial development of the device, and present the information orally to the class.

In Activity 6, students brainstorm possible future communications systems and read an article proposing future technological advances. Students assess the effects of the use of these new systems locally and globally. Students choose a new communications system (e.g., cell phones), assess the impact it has on individual lifestyles at home and at work, and write a discussion paper about it. Students make a list of how often they are under surveillance (e.g., school cameras, variety/department store security, work cameras, etc.) and discuss the impact of surveillance on the privacy of the individual, considering the risks and benefits to the community of such systems. Students design, conduct, and analyse an impact survey for their school on the use of surveillance technology. Students reflect on how the world has been affected by our dependence on communications systems, e.g., effects on time management, networking, and world trade.

Unit Overview Chart

Cluster	Learning Expectations	Achievement Categories	Focus
1	CSV.03, CS3.01 CGE1d, 3c, 3e, 3f	Making Connections	Identifying Communications Systems - identify, describe, and assess the impact of communications systems-critique an article - reflect on impact of communications systems
2	CS1.01, 1.02 SIS.05, .10 CGE2e	Knowledge/ Understanding	Identifying Communications Technologies - identify and describe technologies used in a communications system - make a poster about one communications system - research possible careers
3	CSV.01, CS1.01, 1.03, 1.08, CS2.01 SIS.06	Knowledge/ Understanding Communication	Scientific Principles - explain the scientific principles underlying communications systems/technology - produce a concept map - describe energy transformations occurring in communications systems
4	CSV.01, CS1.01, 1.04, 1.05, 1.06, 1.07, 1.09 SIS.06 CGE2e	Knowledge/ Understanding Making Connections	Energy Transformation - explain various examples of energy transformation used in communications systems: electromagnetic radiation, semiconductors, sound-produce a graphic organizer

Cluster	Learning Expectations	Achievement Categories	Focus
5	CSV.02, CS2.02, 2.03, 2.04 SIS.01, .02, .03, .07, .08 CGE2b, 2c, 2e, 4b, 4f, 7g	Inquiry Communication	Communication/Technology Fair - design, build, and test a device to transform energy - research commercial history of the device and present orally - research role of Canadians in technology
6	CSV.03, CS3.02, 3.03 SIS.05, .08 CGE2c, 2e, 3c, 3e, 4g, 7f	Making Connections Communication	Impact and Forecast - brainstorm possible new communications systems and read an article about future communications systems - research and discuss the future impact of new communications systems - write a discussion paper - discuss the impact of surveillance systems on the privacy of individuals and communities - design and conduct an impact survey - reflect on global effects of communications systems

Unit 4: Organic Products in Everyday Life

Time: 22 hours

Unit Description

Students learn about products that they use everyday. They describe the products' properties and the benefits and hazards of their use. This unit builds on information from the SNC3M Everyday Chemicals and Safe Practice unit of study. Students perform lab investigations into the action of antacids and they study the process of emulsification when they make hand cream. Students discover how soaps and detergents function, how products are made from crude oil, why sunscreen is useful, and the chemical properties of pesticides and fertilizers. Through a cost/benefit analysis, students increase their awareness of the global environmental impact of using organic products. They do research and produce a timeline describing the use and production of an organic product of their choice.

In the first activity, students compare the properties and structures of organic and inorganic substances through teacher-directed lessons. In a brainstorming activity, students produce a list of examples of organic products used in everyday life.

In Activity 2, students review the principles of chemical bonding and then make simple models/drawings showing the active parts of a soap molecule, i.e., hydrophobic and hydrophilic regions. Students explain how dish detergents' action on fats is an example of how an emulsifying agent functions. The principles involved in the making and use of soaps and detergents are discussed and students make a flow chart that summarizes the processes. Through discussion and research, students analyse the costs and benefits of using phosphate detergents and assess their global impact on the environment, summarizing their findings and thoughts in a brief discussion paper.

In Activity 3, students examine the use of organic products in several types of pharmaceutical and personal care products. Students describe the action of antacids and summarize it in a graphic organizer. Students perform a lab investigation into the chemical properties and action of antacids. Students describe how sunscreens protect skin from ultraviolet radiation and produce a magazine advertisement explaining why children and youths should use sunscreen regularly. They define the term emulsion and perform a lab activity to produce hand cream to demonstrate the nature of emulsifiers.

(Note: Teachers must caution students against using this product for personal use.)

In the fourth activity, in a lab activity or through a computer simulation, students investigate the scientific principles of fractional distillation. Students summarize in a flow chart the separation of crude oil into its fractions. As a follow-up activity students view a video on the crude oil industry in Canada and discuss the role of this industry in the economy of Canada.

In Activity 5, students study the properties, nature, and action of chemical fertilizers and pesticides and discuss their use in agriculture. Students research and produce a fact sheet or Venn diagram comparing chemical and natural fertilizers. Students orally report the findings to the class. Students participate in a discussion on the use and effects of pesticides and fertilizers on the environment (locally, regionally, and globally.) Students reflect on their role as stewards of the environment and consider what efforts are being made and need to be made to act responsibly and preserve the planet.

The last activity could be expanded and used as a culminating activity for this unit. Students research the use and production of a representative organic product and produce a detailed timeline summarizing the findings. Students refer to the list made in Activity 1 for possible products to research, e.g., various cosmetics or Aspirin. Students should collect information on careers related to the current production of the chosen product. Students present the timeline to the class and reflect on the effect the use and production of these products have on the local and global environment. To expand this activity, students could perform a lab investigation/simulation, research the chemical properties of the product, do a cost/benefit analysis of using it, and assess the impact its production and use has on the environment, e.g., use of animal testing.

Unit Overview Chart

Cluster	Learning Expectations	Achievement Categories	Focus
1	OPV.01, OP1.02 CGE2c	Knowledge/ Understanding	Organic Products - compare organic and inorganic substances - brainstorm examples of organic products
2	OPV.01, .03, OP1.01, 1.03, 1.04, OP2.01, OP3.01 SIS.04, .08 CGE3c, 3f, 4f, 4g, 7f	Knowledge/ Understanding Inquiry Making Connections	Soaps and Detergents - explain the scientific principles and make a flow chart - make models/diagrams representing soap molecules - analyse cost/benefit of using phosphate detergents and assess global impact of phosphate detergents then write a discussion paper
3	OPV.01, .02, OP1.01, 1.07, 1.08, OP2.02, 2.05 SIS.01, .02, .03, .06, .07 CGE5a	Knowledge/ Understanding Inquiry	Health Care Products - explain the action of antacids and summarize in a graphic organizer - perform a lab activity investigating antacids - describe role of sunscreens and produce a magazine ad - define emulsion and describe the action of emulsifiers - perform a lab activity to produce hand cream
4	OPV.01, .02, OP1.05, OP2.03 SIS.07 CGE5a	Knowledge/ Understanding Inquiry	Products from Oil - perform a lab activity/simulation on the process of fractional distillation - summarize using a flow chart the separation of crude oil - view and discuss a video on the crude oil industry in Canada

Cluster	Learning Expectations	Achievement Categories	Focus
5	OPV.01, .02, .03, OP1.01, 1.06, OP2.04, OP3.02 SIS.08 CGE1d, 2e, 3b, 4f, 7g	Knowledge/ Understanding Communication Making Connections	Pesticides and Fertilizers - define the properties of chemical fertilizers and pesticides - produce a fact sheet comparing chemical and natural pesticides and fertilizers and present to the class - discuss the use and effects of pesticides and fertilizers locally, regionally and globally
6	OPV.03, OP3.03 SIS.08, .10 CGE2e, 3e, 4a, 4f, 7b, 7i	Making Connections Communication	Organic Product Timeline - research the use and production of an organic produce and produce a detailed timeline and present to the class - reflects on the effect the use and production of this product have on the environment, locally, regionally, and globally

Unit 5: Science and Contemporary Societal Issues

Time: 24 hours

Unit Description

Students explore the way scientific knowledge has evolved and continues to evolve. Students examine the role science plays in resolving contemporary social issues. Students discover connections between science and technology. Students compile a Media File in which they collect, read, and analyse articles/reports on current local and global issues in science and technology that affect the world. Through a series of interviews of local groups, e.g., police, agencies, cultural groups students learn about the diversity of their community and how science and technology interact with and affect these groups. Students learn to critique media reports for their scientific, sociological, and moral perspectives. Students are encouraged to put a human face on science and technology. Students reflect on their relationship with the world around them and their reliance on science and technology.

In Activity 1, students make a list of the 10 most significant issues they feel society is facing today. Students rank their items, define each in ten words, or less, then share their thoughts with the class. Students check off those issues that involve science and/or technology. A class list is produced and posted in the room to be used as a source of topics for research in Activity 7. Using the jigsaw method, students read and critique an article on a current issue from one of the following perspectives: scientific, sociological, or moral. Students in groups of three discuss the article from the three perspectives. Students collect and critique three to five articles in their Media File. Through a brainstorm exercise, students define and distinguish words commonly associated with the study of science, e.g., science, theory, fact, hypothesis, law, etc. Students rank the words in terms of their scientific certainty and discuss their ranking.

In Activity 2, students view a video or read an article on the life of a scientist(s), e.g., Watson and Crick, and write a report explaining how evidence, theories, and paradigms contributed to their discoveries. Students research and make a timeline outlining the historical relationship between experimental evidence, scientific inference, and accepted theory for a specific area of scientific study, e.g., periodic table, cell theory.

In Activity 3, students define the 10 principles of science: objectivity, tentativeness, consistency, causality, parsimony, materiality, relativity, dynamism, continuous discovery, and social limitation. Students use these principles and apply them to several case studies, e.g., how cholera spreads (the story of John Snow); the story of Fredrick Banting. See Resources for suggested case studies.

In Activity 4, students brainstorm the meaning of the word technology and related terms (Research and Development). They research and describe examples where science led to advances in technology and vice versa, e.g., laser, tungsten light bulbs. Students share their findings with the class. Canadian examples should be introduced (see Resources).

In Activity 5, students use the Breathalyser as a case study where science and technology work together to address a societal issue - drunk driving. Students research how alcohol affects behaviour and driving and conduct an investigation to learn the functioning of the Borkenstein Breathalyser. They collect and scientifically critique reports from the media relating to drinking and driving in their Media File. Students interview local police to discover current technology being used to identify drunk drivers, and present their findings in a report. Students may also interview various other groups – teens, associations against drunk drivers, etc – and write an article for a local newspaper summarizing public opinion on this issue, assessing the levels of funding, and analysing how effectively they think technology is addressing this issue.

In Activity 6, students in small groups research, interview, and prepare a scientific abstract on specific types of alternative medicine practised in their community, e.g., acupuncture. Students collate their reports in a class newsletter.

In Activity 7, students describe how scientific research and development is funded in Canada. Students refer to the list made in Activity 1, and choose an issue to research (e.g., cloning) and, in teams, debate the possible positive and negative effects of a scientific discovery on society and the environment. Students reflect on the future of science and technology in Canada and in other parts of the world.

Unit Overview Chart

Cluster	Learning Expectations	Achievement Categories	Focus
1	SS1.01, SS2.03 CGE2b, 2e	Knowledge/ Understanding Communication	Your Perspective - identify the top 10 issues facing society today - define terms: science, fact, theory - find, read and analyse an article
2	SSV.01, SS1.02, 1.03, SS1.04 CGE1h, 5g	Knowledge/ Understanding Communication	Historical perspective - view a video or read an article on the life of a scientist - research and develop a timeline of historical and experimental evidence - discuss how scientific discoveries lead to paradigm shifts
3	SS2.01 CGE3c	Communication	Ten Principles of Science - read and analyse case studies using the 10 principles of science
4	SSV.02, SS1.05, 1.06, SIS.08 CGE3f	Knowledge/ Understanding	Science and Technology - describe terms related to technology - research and describes examples of science that advanced technology and vice versa - present report to class

Cluster	Learning Expectations	Achievement Categories	Focus
5	SSV.02, .03, SS2.02, 2.03, SS3.01, 3.03, SIS.01, .02, .03, .04, .05, .06, .07, .08, .09 CGE1d, 2e, 3e, 3f, 5e, 5g, 7b	Inquiry Making Connections	Science, Society and Technology: Breathalyser, A Case Study - identify the societal issue that led to the development of the Breathalyser - conduct investigation showing how it functions - research and interview local police and various groups and write a newspaper article
6	SSV.03, SS2.04, SIS.08 CGE 2e, 3e, 3f, 4c, 5a	Communication	Alternative Medicines - research, interview and prepare an abstract on a specific type of alternative medicine, e.g., Chinese acupuncture, First Nations herbal remedies, etc. - present abstracts as a class newsletter
7	SSV.02, SS3.02, 3.04 CGE1d.1h, 2e, 3b, 3f, 7d, 7e	Knowledge/ Understanding Making Connections	Future Issues - describe how science, research and development are funded in Canada - choose one issue, research and debate its positive and negative effects

Teaching/Learning Strategies

The expectations in this course call for students to do a considerable amount of research and analysis of data and information. The lab activities reinforce the learning of scientific concepts and promote the development of scientific investigation skills (SIS) and provide an active, experimental approach to learning. Connections between science, technology, society, and the environment (STSE) are dealt with through readings and research into real-world problems and issues.

The strategies used in this Course Profile should provide students with multiple opportunities to develop and demonstrate their learning and skills across all four categories of the Achievement Chart. The research reports required throughout the course may be varied in length and format to give students the opportunity to highlight their strengths and maximize their achievement.

In planning this course, consideration should be given to both the course expectations and the needs of individual students. The teacher should provide learning experiences that promote interest, understanding, and excellence. The following is a list of suggestions with examples of links to the course expectations.

Expectations that require Knowledge can be developed through:

- brainstorming (OP1.02);
- teacher-directed lessons and discussions (OP1.03, EA1.05, CS1.02);
- small group instruction (SS1.01);
- independent research;
- self-directed learning, etc.

Expectations that involve Inquiry can be met by:

- conducting and analysing experiments (OP2.02, OP2.05, PD2.01, PD2.05);
- designing lab investigations (PD2.04, OP2.02);
- formulating questions;
- making models (OP2.01);
- designing and building devices (EA2.05, CS2.03);
- solving problems (SS2.01).

Expectations that encourage Communication can be demonstrated by:

- written reports (PD3.03);
- discussion papers (OP3.01);
- case studies (SS2.01);
- group discussions;
- debates (SS3.02, EA3.01);
- seminars;
- student presentations, e.g., oral presentations, multi-media presentations, video and audio presentations, skits, photo essays etc. (SS2.04).

Expectations where students expand their knowledge to Make Connections can be developed through:

- independent research (OP3.03, PD3.03);
- exposure to reflective papers by experts in a given field (SS3.01);
- portfolios, media files (SS3.04);
- timeline (OP3.03);
- article critique (EA3.03).

Assessment & Evaluation of Student Achievement

The primary purpose of assessment and evaluation is to improve student learning. Information gathered through assessment helps the teacher determine students' strengths and weaknesses in their achievement of the curriculum expectations in this course.

In order to enable students to demonstrate that they have mastered the expectations, the teacher must establish a balanced assessment plan for the course and select appropriate methods, strategies, and tools. Students are required to demonstrate that they have developed both independent research skills and independent learning skills. Assessment and evaluation must be based on the curriculum expectations for this course and the achievement levels outlined in the *Program Planning and Assessment, 2000* document. When designing and planning this Course Profile, the learning expectations were clustered in order to balance the categories within the Achievement Chart.

At the beginning and throughout the course, the teacher must share the assessment criteria with the students and their parents/guardians and give feedback that guides the students' efforts towards improvement. The assessment results should be used to motivate students and to help them establish next steps in their learning goals. To ensure that assessment and evaluations are valid and reliable the teacher must use assessment and evaluation strategies that:

- are varied in nature, administered over a period of time, and demonstrate the full range of their learning;
- promote the students' ability to assess their own learning and to set specific goals.

The corresponding methods of assessment are:

- paper-and-pencil task;
- personal communication task;
- performance task.

Possible assessment strategies include:

- paper-and-pencil task: tests, quizzes, concept maps, essays, written reports/lab reports, research papers;
- personal communication task: interviews, conferences, journals, student-teacher conferencing, and classroom discussions;
- performance task: individual presentations, plays/skits, and lab performance.

The tools used to effectively measure the students' learning and mastery of skills are as follows:

- checklists;
- marking schemes;
- rating scales,
- rubrics.

Peer and self-assessment is encouraged. Students could participate in peer editing and assessment of assignments, lab reports, presentations, and projects. Continuous self-assessment allows students the opportunity to track their own skills development and focuses them on self-improvement.

Seventy percent of the grade is based on assessments and evaluations conducted throughout the course. This portion of the grade should reflect the students' most consistent level of achievement, although special consideration should be given to the most recent evidence of achievement. It is recommended that teachers consider having a midterm test following the completion of at least two of the units, and a final examination. Thirty per cent of the grade is based on the final evaluation. It is suggested that several components comprise the final evaluation component. A final examination that covers all significant learning done in the course should be a major component. In addition to the exam, it is suggested that a research essay on a current issue in science and technology (see Unit 5 for suggestions) be included. An essay, not a report, is recommended to ensure students include reflections on values and social conscience.

Accommodations

Teachers must consider the needs of exceptional students in the planning of the science curriculum. Accommodation to the program activities and/or the environment may be necessary. Teachers should consult individual students Individual Education Plan (IEP) for specific direction on accommodation for individuals. Where the student has an IEP, the teacher must meet the needs of the student as outlined in the Plan. For students with physical or learning impairments, classroom and laboratory activities should be altered to permit as much participation as possible. Where possible, peers should be encouraged to assist students in order to allow them to participate in some group or individual activities.

For assessment, it may be necessary to use oral testing, a scribe, or other demonstrations of learning to determine the level of achievement of certain students. The various products required in this course may be presented in different ways to accommodate the different skills and strengths of the students.

Exceptional students, as well as other students who are not identified as exceptional but who have an IEP and are receiving special education programs and services, should be given every opportunity to achieve the curriculum expectations set out for this course.

Enrichment possibilities should be considered. Students may be encouraged to read additional articles relating to the topics of study. They may also be encouraged to participate in special events sponsored by colleges, universities, or private industry that allows them to extend their work beyond the classroom.

Resources

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 publications, teachers need to ensure that their board has a Cancopy licence and that this licence covers the resource 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. 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 from the Internet is not allowed without the permission of the owner.

Texts

Aikenhead, Glen. *Logical Reasoning in Science and Technology*. Toronto: John Wiley & Sons, 1991. ISBN 0-471-79532-1

Carpenter, Thomas. *Inventors: Profiles in Canadian Genius*. Toronto: Camden House, 1990. ISBN 0-920656-95-1

Field, Dennis. *Science: Process & Discovery*. Toronto: Addison-Wesley, 1985. ISBN 0-201-18628-4

Wall, Byron. *Science In Society*. Toronto: Wall and Thompson, 1989. ISBN 0-921332-25-4

Bible references

Mark 1:40-42 – Jesus cleanses a leper

Luke 16: 19-31 – Lazarus' story

Video

Race for the Double Helix, A&E Special.

Websites

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. Catholic Teachings

Catholic Stewardship – <http://www.catholicstewardship.com/>

Catholic Relief Services – <http://www.catholicrelief.org/>

Canadian Conference of Catholic Bishops – <http://www.cccb.ca/>

Oneworld Online – <http://www.oneworld.org/>

The Vatican Catechism of Catholic Church – <http://www.vatican.va/archive/catechism/ccc-toc.htm>

Organic Products in Everyday Life

Consumer organic products – <http://antoine.fsu.umd.edu/chem/senese/101/consumer/resources.shtml>

Experiments online: antacids, phosphate detergents, Aspirin
– <http://wwwchem.csustan.edu/chem1002/CHEM1002.HTM>

Friends of the Earth – <http://www.foei.org/>

Pesticides – <http://vm.cfsan.fda.gov/~frf/pestglos.html>

Malathion – <http://ep.llnl.gov/msds/pdb/pdb-structures.html>

Soaps and detergents – <http://www.sdahq.org/sdalatest/html/soapproductsl.htm>

World Wildlife Fund – <http://www.worldwildlife.org/>

Energy Alternatives and Global Impact

Atomic Energy of Canada – <http://www.aec.ca/>

Earth Energy Society of Canada – <http://www.earthenergy.ca/>

Electric cars – <http://www.drivingthefuture.com/carbprop.htm>

Greenpeace – <http://www.greenpeace.org/>

Hydro Ontario – <http://www.hydroone.com/>

Solar energy – <http://www.solarenergysociety.ca/>

Traditional and alternative power sources – <http://www.energy.ca.gov/education>

History of alternative energy industry in Canada – <http://www.nextcity.com/main/article/ep/980620.htm>

Pathogens and Disease

Case study – <http://quest.classroom.com/archive/africaquest1998/start/pg00418.htm>

– <http://pages.progidy.net/pdeziel/cdc.htm>

World map of disease/info – www.cdc.gov/travel/diseases.htm – http://vaccines.com/official_sites.htm

History of Jenner – <http://www.accessexcellence.org/AE/AEC/CC/vaccines-how/why.html>

History of diseases – www.who.int/vaccines-diseases/history/history.shtml

Vaccines – <http://vaccines.com/foradults.htm>

Assembly of First Nations – http://www.afn.ca/assembly_of_first_nations.htm

World Health Organization – <http://www.who.int/home-page/>

OSS Considerations

Students can benefit from Co-operative Education placements that are related to science and technology. Students should explore various science-related careers throughout this course and consider them when developing their Annual Education Plan (AEP). Students may consider the possibility of job shadowing someone in order to experience a science/technology-related career.

Students graduating from Ontario schools are expected to be technologically literate. This course allows students multiple opportunities to understand and apply technological concepts, to use computers in various applications, and to analyse the implications of technology on individuals and on society.

Teachers must adopt measures to provide a safe environment for learning that is free from harassment, violence, and expressions of prejudice.

Coded Expectations, Science, Grade 12, University/College Preparation, SNC4M

Scientific Investigation Skills

- SIS.01** - demonstrate an understanding of safety practices consistent with Workplace Hazardous Materials Information System (WHMIS) legislation by selecting and applying appropriate techniques for handling, storing, and disposing of laboratory materials (e.g., safely handle organic compounds);
- SIS.02** - select appropriate instruments and use them effectively and accurately in collecting observations and data (e.g., microscopes, electrical equipment, meters, data loggers);
- SIS.03** - demonstrate the skills required to plan and carry out investigations using laboratory equipment safely, effectively, and accurately (e.g., design and carry out an experiment to investigate the effectiveness of different antacids);
- SIS.04** - select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate scientific ideas, plans, and experimental results (e.g., draw and label a diagram of the structure of an organic molecule, identifying its active sites);
- SIS.05** - locate, select, analyse, and integrate information on topics under study, working independently and as part of a team, and using appropriate library and electronic research tools, including Internet sites;
- SIS.06** - compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams (e.g., summarize in a chart the various modes of disease transmission);
- SIS.07** - communicate the procedures and results of laboratory investigations and research for specific purposes using data tables and laboratory reports (e.g., an investigation of physical and chemical properties of organic products in everyday life; an investigation concerning the application of solar power in battery-driven cars);
- SIS.08** - research and evaluate information on a specialized topic in science, and apply it to the world outside the school (e.g., conduct an impact survey on emerging global communication systems; assess the positive and negative aspects of the Human Genome Project);
- SIS.09** - select and use appropriate SI units;
- SIS.10** - identify and collect information on careers related to the science subject area under study (e.g., TV repair person, VCR technician).

Organic Products in Everyday Life

Overall Expectations

- OPV.01** · describe the properties, benefits, and hazards of representative everyday organic products, and the use of these products in personal daily life, industry, and agriculture;
- OPV.02** · investigate the properties of everyday organic products, using appropriate laboratory procedures and equipment safely and accurately, and gathering and integrating information from print and electronic sources;
- OPV.03** · analyse the impact on society and the environment of the use of organic products.

Specific Expectations

Understanding Basic Concepts

- OP1.01** – define, with examples, terms such as: *soap, detergent, emulsion, emulsifying agent, herbicide, pesticide*;
- OP1.02** – compare the properties and structures of inorganic and organic substances (e.g., draw diagrams to show the similarities and differences between inorganic and organic molecules);
- OP1.03** – explain the scientific principles involved in the making and use of soaps and detergents (e.g., the principles of bonding related to the making of detergents);
- OP1.04** – explain, giving examples, the action of an emulsifying agent (e.g., the effect of dish detergent on fats);
- OP1.05** – explain the scientific principles involved in the separation of crude oil into its fractions (e.g., into diesel fuel, gasoline, petroleum jelly);
- OP1.06** – describe the properties of chemical fertilizers and pesticides, and their use in agriculture;
- OP1.07** – summarize, using scientific principles, the dangers of UV radiation and the role of sunscreens in protecting the skin;
- OP1.08** – explain the action of various pharmaceuticals, and their role in personal health-care products (e.g., draw flow charts to show the action and use of aspirin/ASA, antacids, and vitamins in personal health care).

Developing Skills of Inquiry and Communication

- OP2.01** – illustrate the relationship between the structure and function of various organic products by constructing for each a simple model of its molecule and identifying its active parts (e.g., draw and label a diagram of a soap molecule, including its hydrophylic and hydrophobic parts);
- OP2.02** – investigate through experimentation the nature of emulsifiers and emulsions (e.g., conduct an experiment to make mayonnaise, or hand cream);
- OP2.03** – use laboratory investigation or computer simulation to illustrate the scientific principles upon which fractional distillation of petroleum products is based (e.g., conduct an experiment on the fractional distillation of oil);
- OP2.04** – compare, through research in print and electronic sources, the nature and action of chemical and natural fertilizers (e.g., draw a Venn diagram showing the similarities and differences in the action of chemical and natural fertilizers);
- OP2.05** – conduct a laboratory investigation into the chemical properties and chemical action of pharmaceutical products (e.g., into the function of antacids or aspirin/ASA).

Relating Science to Technology, Society, and the Environment

- OP3.01** – analyse the costs and benefits of using organic products (e.g., most pesticides, phosphate detergents), and assess their global impact on the environment;
- OP3.02** – identify and describe strategies for pest control other than the use of organic products (e.g., research alternatives to pesticide use in agriculture and the home);
- OP3.03** – describe the use and production of representative organic products over time (e.g., cosmetics and other pharmaceutical products).

Pathogens and Disease

Overall Expectations

- PDV.01** · demonstrate an understanding of micro-organisms, their biological effects, the diseases they cause, and the metabolic and environmental barriers to the spread of disease;
- PDV.02** · investigate the nature and growth of representative pathogens, the response of the immune system to them, and the effect on them of various drug therapies and sterilization techniques, using appropriate laboratory procedures and equipment safely and accurately, and gathering and integrating information from print and electronic sources;
- PDV.03** · evaluate the measures available for the control of disease, including the role of public policy and the use of health-related technologies and scientific knowledge.

Specific Expectations

Understanding Basic Concepts

- PD1.01** – define, with examples when appropriate, such terms as: *micro-organism, pathogen, parasite, disease, epidemiology, pathogenesis, vector*;
- PD1.02** – describe the characteristics and reproductive cycles of representative pathogens (e.g., lysogenic cycle, lytic cycle, infectious cycle of malaria);
- PD1.03** – describe the modes of transmission of diseases, including those that are insect-borne (e.g., malaria, encephalitis), airborne (e.g., influenza, tuberculosis), water-borne (e.g., cholera, poliomyelitis), sexually transmitted (STDs; e.g., AIDS), and food-borne (e.g., mad cow disease, trichinosis, food poisoning);
- PD1.04** – describe and explain the immune response of the body as a natural defence against infection (e.g., the immune response to salmonella food poisoning, or trichinosis);
- PD1.05** – describe the use of vaccines, antibiotics, antiseptics, and other drug therapies in the control of pathogenesis;
- PD1.06** – describe non-medicinal ways to protect oneself from contracting pathogenic diseases (e.g., aseptic techniques, personal hygiene).

Developing Skills of Inquiry and Communication

- PD2.01** – investigate experimentally, using aseptic techniques, the characteristics and growth of non-pathogenic bacteria (e.g., conduct an experiment to compare different types of bacteria, using commercially prepared slides);
- PD2.02** – present a comparative analysis, based on their own research, of the various modes of transmission of pathogens;
- PD2.03** – research and report on the nature of the immune response in the human body (e.g., summarize the steps in the human immune response to a typical pathogen);
- PD2.04** – identify, through laboratory investigation, the effects of various drug therapies on pathogenesis (e.g., ask a testable question, propose a hypothesis, and conduct an experiment related to the effect of mouthwash or penicillin on the growth of bacteria);
- PD2.05** – demonstrate, through laboratory investigation, the effect on pathogenesis of the use of sterile techniques (e.g., the effect on pathogenesis of the pasteurization of dairy products).

Relating Science to Technology, Society, and the Environment

- PD3.01** – describe some of the means used by agencies and governments to control the spread of disease, both locally and globally;
- PD3.02** – evaluate the impact on an individual and on society of the misuse of antibiotics in the control of infection (e.g., chart the cause-and-effect relationships between the use of antibiotics and vaccines and the development of viral mutations and resistant strains of bacteria);

-
- PD3.03** – research and explain the impact on disease control of technological advances in food preparation and preservation (e.g., the impact of freezing, pasteurization, radiation, and canning on food marketing);
- PD3.04** – describe aseptic techniques used in the workplace and explain their importance (e.g., the techniques used to prevent food poisoning or the spread of disease in a food preparation facility or a restaurant);
- PD3.05** – research and describe the impact on populations of the use of new technologies to control disease (e.g., gather and integrate information on community demographics and rates of infant survival to illustrate the effect over time of new vaccines and antibiotics).

Energy Alternatives and Global Impact

Overall Expectations

- EA V.01** · demonstrate an understanding of the scientific principles of energy production from conventional and alternative sources;
- EA V.02** · compare the practical value of a variety of alternative energy sources, through investigation and cost-benefit analysis;
- EA V.03** · assess conventional and alternative energy sources in terms of their ability to satisfy societal demand and of their environmental impact.

Specific Expectations

Understanding Basic Concepts

- EA1.01** – define, with examples when appropriate, terms such as: *joule, rad, watt, fission, fusion, chain reaction, activation energy, renewable/non-renewable resources, conventional/alternative energy sources*;
- EA1.02** – compare and contrast conventional and alternative energy sources with respect to criteria such as availability, renewability, cost, and environmental impact (e.g., draw a Venn diagram showing similarities and differences between the use of fossil fuels and geothermal energy);
- EA1.03** – describe technologies created in response to dwindling non-renewable energy resources (e.g., windmills, solar panels, electric cars);
- EA1.04** – compare the relative amounts of energy released in various physical, chemical, and nuclear transformations (e.g., create charts to compare the energy released in condensation of water vapour, combustion of gasoline, and splitting of the atom);
- EA1.05** – describe the scientific principles of fission and a chain reaction and their applications in nuclear generating stations (e.g., the scientific principles applied in the CANDU reactor);
- EA1.06** – compare and contrast nuclear fission and nuclear fusion according to such criteria as feasibility, costs, and energy efficiencies.

Developing Skills of Inquiry and Communication

- EA2.01** – analyse data to determine which human activities consume the most energy, and how changing patterns of behaviour can reduce the total amount of energy consumed;
- EA2.02** – gather and analyse data, experimentally or through research, to evaluate alternative and emerging technologies as examples of responsible energy use (e.g., technologies related to wind power, solar power, electric cars, ethanol fuel, or the fermentation of waste products);
- EA2.03** – evaluate arguments for the use of nuclear technology, based on research into its advantages and disadvantages (e.g., production of greenhouse gases from fossil fuels is reduced but production of nuclear waste is increased);

-
- EA2.04** – present an argument, based on research and scientific analysis, for the use of an alternative energy system (e.g., a solar cooker, or a solar collector);
- EA2.05** – design a system that uses an alternative energy source (e.g., design, build, and test a working model of a wind generator, or a solar-powered car).

Relating Science to Technology, Society, and the Environment

- EA3.01** – identify, based on information integrated from print and electronic sources, short- and long-term environmental effects of by-products from nuclear generating stations;
- EA3.02** – identify new energy applications inspired by traditional energy sources (e.g., battery-operated cars including those powered by fuel cells);
- EA3.03** – evaluate the environmental impact of a specific alternative source of energy (e.g., conduct an environmental impact survey that covers such issues as costs and waste production/management);
- EA3.04** – analyse the costs and benefits to society of alternative energy systems, and assess the impact of their use on a global scale (e.g., wind generators, or tidal power plants);
- EA3.05** – evaluate the suitability of alternative energy sources, using research into the regional availability of natural resources in Canada (e.g., draw a correlation map for Canada showing regional energy systems and the distribution of natural resources, including water, fossil fuels, heat sinks, and wind and tides).

Communications Systems

Overall Expectations

- CSV.01** · explain the fundamental scientific principles that are applied in modern communications systems;
- CSV.02** · explain, on the basis of their findings from laboratory investigations, how modern communications systems function;
- CSV.03** · evaluate the advantages and disadvantages of modern communications systems, for both the individual and society.

Specific Expectations

Understanding Basic Concepts

- CS1.01** – define, with examples when appropriate, terms such as: *wave, wavelength, frequency, semi-conductor, electromagnetic spectrum, fibre optic cabling*;
- CS1.02** – identify and describe the technologies involved in various communications systems (e.g., technologies involved in the Global Positioning System [GPS], or the Internet);
- CS1.03** – explain the fundamental scientific principles related to the use of a communications technology (e.g., fibre optics in a communications system);
- CS1.04** – explain, based on information from print and electronic sources, how electromagnetic radiation, as a form of energy, is produced and transmitted (e.g., radio waves);
- CS1.05** – identify and describe (e.g., outline, in a concept diagram) the properties and applications of the various regions of the electromagnetic spectrum;
- CS1.06** – identify and describe the applications of the electromagnetic spectrum in communications systems (e.g., radio, television, telephone, radar, satellites, fibre optics, or converters);
- CS1.07** – identify and explain the application of semi-conductors in communications systems (e.g., the use of semi-conductors in computers and graphic projection devices);
- CS1.08** – explain the energy transformations that take place to permit the transmission and reception of signals in communications systems;
- CS1.09** – describe how sound energy is received, analysed, and reproduced electronically (e.g., energy transformations in the functioning of a microphone).

Developing Skills of Inquiry and Communication

- CS2.01** – explain and analyse scientific principles related to communications systems (e.g., the Internet) using appropriate terminology;
- CS2.02** – describe and follow procedures for the safe and accurate use of electrical equipment as outlined in the Occupational Health and Safety Act and the Fire Code (e.g., describe the safety measures followed in an experiment involving the use of electrical equipment);
- CS2.03** – design, construct, and test a simple device that transforms energy (e.g., sound, light) from one form to another (e.g., design, construct, and test a prototype of a photovoltaic cell, loudspeaker, or doorbell);
- CS2.04** – identify and describe, through experimentation, how common communications equipment functions (e.g., conduct an experiment related to the design and functioning of a telephone or radio).

Relating Science to Technology, Society, and the Environment

- CS3.01** – assess the impact of new communications systems (e.g., cell phones) on individual lifestyles and on home and workplace environments;
- CS3.02** – assess the impact of new communications systems (e.g., the Internet, surveillance technologies) on the privacy of individuals and communities, focusing on risks and benefits;
- CS3.03** – forecast and assess the future effects of the use of new communications systems, locally and globally (e.g., the effects on time management, networking, and world trade).

Science and Contemporary Societal Issues

Overall Expectations

- SSV.01** · demonstrate an understanding of how scientific knowledge has evolved and continues to evolve through scientific discoveries, past and present;
- SSV.02** · assess the strengths and limitations of scientific knowledge and procedures as means for resolving contemporary societal issues;
- SSV.03** · evaluate the social and environmental implications and technological applications of contemporary scientific discoveries, and consider different cultural and societal perspectives on the discoveries.

Specific Expectations

Understanding Basic Concepts

- SS1.01** – formulate definitions of scientific terms such as: *principle, law, theory, fact, observation, concept, inference, causality*;
- SS1.02** – explain how scientific knowledge evolves as new evidence comes to light and as theories are modified (e.g., draw a timeline chart to outline the historical relationship between experimental evidence, scientific inference, and accepted theory);
- SS1.03** – explain how evidence, theories, and paradigms contributed to a recent scientific discovery (e.g., write a report on James Watson and Francis Crick’s work in establishing the physical structure of DNA, describing the relationship between scientific ways of thinking, experimental evidence, and the nature of the resulting theory);
- SS1.04** – explain how a scientific discovery can lead to a paradigm shift in responses to a problem (e.g., conduct a media search on how the discovery of stomach bacteria changed the treatment of “lifestyle” diseases such as stomach ulcers);
- SS1.05** – identify technologies that have been developed as a result of a scientific discovery (e.g., the standard tungsten incandescent bulb or the tungsten-halogen bulb following research into high-resistance filaments);
- SS1.06** – identify examples of the growth of scientific knowledge as a result of a technological invention (e.g., compile and display recent data on distant galaxies obtained by the Hubble Space Telescope).

Developing Skills of Inquiry and Communication

SS2.01 – demonstrate, through laboratory investigation, case study, or computer simulation, the habits of mind appropriate to scientific investigation, including objectivity, tentativeness, accuracy, and consistency (e.g., collect, record, and analyse data related to a case study involving the possible impact of the physical environment on genetic expression in humans);

SS2.02 – analyse and interpret, through laboratory investigation, case study, or computer simulation, scientific evidence relevant to a contemporary societal issue (e.g., ask a testable question and propose a hypothesis related to the cause-and-effect relationship between water chlorination and formation of organo-chlorides);

SS2.03 – research and defend, from a scientific perspective, a particular view of a contemporary societal issue as reported in the media (e.g., summarize the point of view presented in a magazine article on government support for hepatitis sufferers, and assess its merit from a scientific perspective);

SS2.04 – evaluate, through interview and research, differing cultural perspectives on a contemporary subject or issue to which science is also relevant (e.g., a First Nations' perspective on maintaining natural balance through the use of alternative medicines).

Relating Science to Technology, Society, and the Environment

SS3.01 – explain how a particular technological application of a scientific discovery is perceived by various interest groups in the community (e.g., present the views of different groups on the risks and benefits of using bovine growth hormone in milk production);

SS3.02 – assess the possible positive and negative effects of a scientific discovery on society and the environment (e.g., positive and negative aspects of the Human Genome Project);

SS3.03 – analyse ways in which societal needs or demands influence scientific and technological endeavours (e.g., relate levels of funding for AIDS research over time to societal influences);

SS3.04 – describe the processes by which the private and public sectors have cooperated to establish and fund some Canadian research projects in science and technology.

Ontario Catholic School Graduate Expectations

The graduate is expected to be:

A Discerning Believer Formed in the Catholic Faith Community who

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

An Effective Communicator who

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

A Reflective and Creative Thinker who

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

A Self-Directed, Responsible, Life Long Learner who

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

A Collaborative Contributor who

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

A Caring Family Member who

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

A Responsible Citizen who

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

Unit 1: Pathogens and Disease

Time: 20 hours

Unit Description

This unit uses a problem-based learning approach to introduce students to the study of pathogens and disease. A problem-based approach encourages students to become self-directed learners. They acquire knowledge through team participation and individual research. This approach is used to maximize motivation in the students and to set a model that can be used other units in the course. Students continue to learn more about their own body as a continuation of the Body Input and Body Function unit in the SNC3M course. They investigate pathogens, the diseases they cause, human responses to them, and the means and technologies developed to control them. Students compile Pathogen Profiles on various types of pathogens. Through laboratory investigations, students identify the characteristics of bacteria, the effects of antiseptics on bacterial growth, and the role of sterile techniques in processes such as pasteurization. Students study the modes of transmission of diseases and discuss the various agencies involved in controlling the spread of diseases both globally and locally. The unit includes a culminating task based on the problem-based learning approach, where students in Research Teams become experts on a particular pathogen. Each team presents a report to the class during a Disease Forum. By reading and reflecting on the Lazarus story from the Bible, students are encouraged to see how Jesus is still a model for us today. Students are invited to reflect on the way Jesus healed the sick without discrimination, and whether our scientifically and technologically advanced society does the same. They are then challenged to view social justice issues relating to the spread and control of diseases from a non-North American perspective.

This unit involves many lab activities and allows the teacher to set the standards for lab performance and report writing that will be used throughout the course. This course involves the use of higher-level thinking skills that the students may require help developing. The approach suggested allows students the opportunity to identify, practise, and refine these skills. For example, throughout this unit students are introduced to the skills involved in critiquing articles or other forms of media. Students have numerous opportunities to communicate their ideas and make connections between scientific concepts, technological applications, and real-world events, such as the spread of specific diseases, the need for the use of aseptic techniques in food preparation, and the results of the misuse of antibiotics in controlling infections.

Students are introduced to the Student Journal. This journal is used as a place to organize their Pathogen Profiles, scrapbook materials (articles, readings), and research for the unit's culminating activity. It also serves as a place for students to record their reflections. Quizzes or other paper-and-pencil tasks are used to provide the teacher with an ongoing assessment of the students' learning. Group work is included in each activity. Students are encouraged to develop skills in communication, cooperation, and listening through group work, problem-based activities, jigsaw activities, class discussions, group research projects, and peer editing of lab reports.

The structure of the groups from one lesson to the next may vary, e.g., by interest, or be consistent; the approach taken should meet the individual needs of the class. Although students work in groups teachers are reminded that it is the individual students' work that is used for the final assessment. Students are encouraged to participate in peer reviews (lab reports and projects), class time should be given for students to receive feedback from their peers when this is done.

The first activity introduces the connection between pathogens and disease introducing the problem-based learning approach. The Lazarus story is used to discuss how past societies have viewed disease, and students are encouraged to follow Jesus' teachings in accepting individuals. The culminating task and the use of the Student Journal are introduced. Appendix 2 describes the way the Student Journal could be organized and used in this unit.

In the second activity the characteristics and lifestyles of pathogens are introduced through the discussion of familiar diseases. A video provides students with additional information on pathogens. By participating in a jigsaw activity students explore the modes of transmission of diseases.

In Activity 3, students develop an awareness of the widespread commercial use of antiseptics and conduct a laboratory investigation into antiseptics' effects on bacterial growth. Beginning with the Pathogen Profiles already completed, students learn more about the mechanisms humans have for controlling pathogens, specifically the human immune system. Through class discussions, story and article reviews, and a scavenger hunt students investigate various drug therapies. Students reflect on the impact of overusing and misusing antibiotics on society.

In Activity 4, students discuss the many ways food contamination can occur and the technological advances and agencies that control it. Students create a Then and Now Timeline on a specific technological advancement used in food preparation and preservation. Students practise proper sterile techniques in a lab activity where they investigate the effect of pasteurization on pathogenesis. A respect for cultural differences is encouraged through class discussion on how various cultures and countries control the spread of pathogens in foods.

Activity 5 is the culminating task for this unit. Students participate in a Disease Forum where they present information on a specific pathogen and the disease it produces as research epidemiologists. Students discuss and reflect on the present and future implications of strategies used to control diseases caused by the pathogens that have been presented. A video is used to highlight the inequalities that exist in our world and to raise student awareness about the implications of these inequalities on the spread and control of disease. Students are encouraged to reflect on the way Jesus healed the sick yet without discrimination and whether our scientifically and technologically advanced society does the same.

Unit Synopsis Chart

Activity/Time	Learning Expectations	Assessment Categories	Tasks
1. What's Happening? 3 hours	PDV.01, PD1.01 SIS.05, .06, .07 CGE 1c, 4f, 5a, 5e	Communication	- students investigate a pathogen and disease using a problem-based learning approach - students create a Web Diagram and Action Plan for their Culminating Task
2. A Day in the Life of a Pathogen 2.1 Characteristics of Pathogens and their Reproductive Cycles 2.2 Those Sneaky Things 3 hours	PDV.01, .02, PD1.02, 1.03, PD2.02, PD3.01 SIS.05, .06 CGE 2c, 3c, 5a, 7b, 7e	Knowledge/ Understanding Inquiry Communication	- students create a summary chart on the types of pathogens - students research, participate in a jigsaw activity and create a comparative analysis chart on the modes of pathogenic transmission

Activity/Time	Learning Expectations	Assessment Categories	Tasks
3. On the Defense! 3.1 Investigating the Effects of Antiseptics 3.2 Controlling Pathogens 4 hours	PDV.02, PD1.04, 1.05, 1.06, PD2.01, 2.03, 2.04, PD3.02, 3.04 SIS.01, .02, .03, .04, .05, .06, .07 CGE 2b, 3c, 5a	Inquiry Communication Making Connections Knowledge/ Understanding	- students perform a lab activity on the effects of antiseptics on bacterial growth - students construct a concept map summarizing the body's specific defence against pathogens - students read the story of Edward Jenner - student take part in a scavenger hunt on drug therapies used to control pathogens - students locate and review an article on the use/misuse of antibiotics
4. Stop that Growth! 4.1 Food Safety 4.2 Food Preservation Technologies 4 hours	PDV.03, PD2.05, PD3.01, 3.03, 3.04, 3.05 SIS.01, .02, .03, .04, .06, .07, .08, .10 CGE 1d, 1h, 3f, 5a, 5e, 7e, 7f	Knowledge/ Understanding Inquiry Communication Making Connections	- students create a Then and Now Timeline on a technological advancement in food preparation and preservation - students complete a lab investigation on the effects of pasteurization
5. Epidemiologists in Action! 6 hours	PDV.01, .02, .03, PD3.01, 3.05 SIS.05, .06, .07, .08 CGE 1d, 1e, 1h, 2c, 2e, 3b, 3c, 3e, 3f, 4f, 5a, 7d, 7e, 7f	Communication Making Connections Knowledge/ Understanding	- students research a case study on a disease - students present their Culminating Task at a Disease Forum and complete their Student Journal

Activity 1: What's Happening?

Time: 3 hours

Description

Using a problem-based learning approach, students are introduced to pathogens and disease. Students use Lazarus' story to discuss how society, both past and present, reacts to disease. The Culminating Task for the unit is introduced, along with the Student Journal, which is used as an organizational tool throughout the course.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

CGE1c - actively reflects on God's Word as communicated through the Hebrew and Christian scriptures;
 CGE4f - applies effective communication, decision-making, problem-solving, time and resource management skills;

CGE5a - works effectively as an interdependent team member;

CGE5e - respects the rights, responsibilities, and contributions of self and others.

Strand(s): Pathogens and Disease

Overall Expectations

PDV.01 - demonstrate an understanding of micro-organisms, their biological effects, the diseases they cause, and the metabolic and environmental barriers to the spread of disease.

Specific Expectations

PD1.01 - define, with examples when appropriate, such terms as: *micro-organism, pathogen, parasite, disease, epidemiology, pathogenesis, vector.*

Scientific Investigation Skills

SIS.05 - locate, select, analyse, and integrate information on topics under study, working independently and as part of a team, and using appropriate library and electronic research tools, including Internet sites;

SIS.06 - compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams;

SIS.07 - communicate the procedures and results of laboratory investigations and research for specific purposes using data tables and laboratory reports.

Planning Notes

- Make copies of Appendix 1: What’s Happening? and Appendix 3: Pathogen Profile for each student. Alternatively, Appendix 3 could be made available for the students electronically, e.g., on a class/school web site, since students will be using it as a template for future activities.
- Book the library/resource centre or computers for research of scenario.
- The Student Journal is introduced in this activity and students are encouraged to use it throughout the unit and then throughout the course. Refer to Appendix 2 for a detailed description of the Student Journal.
- Have chart paper and Bibles available for the students.
- Read and prepare copies of the Culminating Task, as described in the Activity 5 Planning Notes (Appendices 5 and 6). It is recommended that the Culminating Task be introduced and explained after completing the “What’s Happening?” activity. Students should form their Research Teams, brainstorm the problem, and propose an Action Plan for the teacher’s approval.

Prior Knowledge & Skills

Grade 9 Applied or Academic Science – Biology

Teaching/Learning Strategies

Problem-Based Learning

The teacher:

- introduces problem-based learning by outlining its purpose and the steps involved.
- presents the class with a scenario and leads the class through a sample problem-based learning activity. Whenever possible, the teacher should encourage students to justify their responses, e.g., choice of questions/subtopics to be researched, in their role as facilitator (Refer to Appendix 1). After the web diagram has been made, the class can be divided into smaller groups. Instruct students to discuss their present knowledge, opinions, and viewpoints on each of the questions/subtopics identified in the web diagram. Chart paper could be used to record their ideas. Each group shares its ideas with the class.
- allows class time to research the scenario and assists students when needed.
- leads the class in a discussion of their findings to reach a consensus on the identity of the pathogen. For the pathogen discussed, students begin a Pathogen Profile (refer to Appendix 3). The teacher instructs students to complete the Profile as relevant information is introduced in the unit, e.g., the reproductive cycles are discussed in Activity 2.1.

-
- outlines the Student Journal (refer to Appendix 2). The teacher provides and encourages students to participate in feedback with the class on the problem solving process. The teacher instructs students to reflect in Section A of their Journals on their contributions to the group and the skills they need to improve to ensure success in any similar future activities.
 - instructs students to read the Lazarus' story in the Bible. In this story, Lazarus suffers from a pathogen similar to that researched in the scenario. The teacher leads a discussion on how Jesus and society dealt with this disease thousands of years ago. The teacher invites students to discuss and reflect on this passage in their Student Journal, Section A, using the following as possible questions. It is suggested that the students compare their own response to the individual (John) in the scenario to the response of Lazarus' peers.
 - Who was Lazarus?
 - How did Jesus respond to him?
 - Who in today's society is Lazarus (individuals or groups of people)?
 - How are they treated by society?
 - How would Jesus want us to react to them?

The Culminating Task

The teacher:

- introduces the Culminating Task, in which students are provided with scenarios of diseases to research following the problem-based learning approach modelled above. The teacher allows students time to read, form Research Teams, discuss the scenarios provided, and propose an Action Plan (refer to Activity 5, Appendices 5 and 6).

Students:

- read the handout "What's Happening?", discuss it, and contribute to the creation of a web diagram for the scenario (PD1.01).
- discuss in small groups the questions that arose from the scenario and summarize individuals' knowledge of views and opinions on the questions (subtopics) listed in the web diagram. Groups record their ideas on chart paper and present them to the class.
- follow the outline given in Appendix 1 to solve the problem presented.
- begin a Pathogen Profile for the pathogen discussed and researched. Note that any sections that are not completed at this time will be done during later activities within the unit.
- reflect in their journals on the problem solving process used in this activity.
- read and discuss the Lazarus story. Students reflect on this story and on the scenario researched in Section A of their Student Journal.
- become informed about the Culminating Task for this unit. Students read the scenarios given, form interest groups (Research Teams), and begin their task by brainstorming on the problem presented. Each group creates a web diagram for their scenario and proposes a Plan of Action. These items are included in Section C of the Student Journal.

Assessment & Evaluation of Student Achievement

- Teacher assessment of Web diagram.

Accommodations

- Students with physical and/or learning disabilities are encouraged to use the computer for their Student Journal, and those with visual impairments could have the scenarios read to them.
- Enrichment activities could include finding other Biblical passages that deal with illness. Students could research an illness that no longer affects our society but is still prevalent in other countries, and identify the factors that have removed the disease from our society.

Resources

Print

The New American Catholic Bible. Wichita, Kansas: Catholic Bible Publications, 1992.

Galbraith, Don, et al. *Understanding Biology*. Toronto: J. Wiley & Sons, 1989. ISBN 0-471-79654-9

Internet

Discover Magazine – www.discover.com

“Vital Signs: Numbness of the Arm: – http://discover.com/feb_02/featvital.html

“Blindsided by Tetanus” – www.discover.com/jan_00/feattetanus.html

“Mystery Rash” – www.discover.com/oct_01/featvital.html

“Fast Track to Trouble” – www.discover.com/june_01/featvital.html

“The Chameleon Disease” – www.discover.com/mar_01/featvital.html

“Just a Fluke?” – www.discover.com/apr_01/featvital.html

All the Virology on the WWW – www.tulane.edu/~dmsander/garryfavweb.html

The World Health Organization – www.who.int/home-page/

Health Headquarters – www.accessexcellence.org/HHQ/

Online Interactive Tutorials of Diseases – www.micro.msb.le.ac.uk/Tutorials/Tutorials.html

Canada’s Role in Fighting Tuberculosis – www.lung.ca/tb/

History of Diseases – www.mic.ki.se/HistDis.html

American Museum of Natural History – The World of Infectious Diseases

– www.amnh.org/exhibitions/epidemic/

Problem-based learning – <http://www.mcli.dist.maricopa.edu/pbl/info.html>

Appendix 1

What's Happening? A Problem-Based Learning Scenario

John comes into the office concerned about rashes on his arm and face. Eight years ago, he moved to Canada from a tropical country to study biology. After conducting a routine physical examination, you notice a growth on his arm. He tells you that his arm and face get itchy and often become numb. You decided to take a biopsy of a growth on his left elbow. The biopsy report identifies the pathogen. As required, you notify the Health Department of the case and discuss the disease with John. You suggest that he contact anyone he has had close contact with since his symptoms began and insist that they get tested for the pathogen. There are no vaccines against this pathogen and it is spread by respiratory droplets. You stress the importance of immediate action, as the pathogen can easily spread beneath the skin and attack the peripheral nerves of the extremities, causing permanent damage and even arthritis. In some advanced cases, people may lose fingers and toes because the numbness puts them at risk for burns and injuries. John's full cooperation with his treatment has allowed an effective and rapid recovery.

1. Read the scenario provided.
2. Identify the most relevant and significant topics/information/issues presented in the scenario.
3. As a class, or in small groups, discuss the scenario and create a web diagram that identifies all the questions/subtopics you have about the situation described (the pathogen and the disease).
4. Write a summary of your present knowledge, opinions, and viewpoints on each question you identified in your web diagram.
5. Add questions about the issue to which you have no answers, but think should be addressed.
6. Discuss where you think you will find the needed information to answer each question.
7. Divide the questions/subtopics among the students in the class. Students researching the same question/subtopic work co-operatively and compile a brief point-form report. When using the Internet, be sure that your sites are appropriate, and include a complete Works Cited list with your work.
8. One member of each group presents their findings to the class. Using all the information collected, the pathogen is identified.

Teacher's Note:

- For this unit of study the subtopics/questions should include the following:
- the name of the pathogen and the disease it causes
- characteristics and reproductive cycles of the pathogen
- mode of transmission
- human immune response
- drug therapies
- ways to protect oneself

Answer to Scenario: The disease is Leprosy, caused by *Mycobacterium leprae*.

Appendix 2

The Student Journal

The Student Journal is a tool for reflection, analysis, and research that is introduced in this unit, but could also be used throughout the course. The Student Journal should be a binder or folder that allows students to insert items on a regular basis. It should be divided into four sections: Section A (Reflections), Section B (Scrapbook), Section C (Culminating Task), and Section D (Pathogen Profiles).

Section A, Reflections, provides students with the opportunity to reflect on issues in both a scientific and ethical manner. The topic of Pathogens and Disease provides many occasions for such reflection and gives an excellent chance to raise student awareness of various issues. Some issues include the current state and distribution of health care and resources, the unique ability of humans to harm and to help (specifically in their capacity both to control and to accelerate the spread of disease), and society's perception of and reaction to disease, using Jesus as a role model of acceptance and compassion. Students are encouraged to look back to their earlier entries and consider how the information researched and presented has changed their views and attitudes.

Section B, Scrapbook, develops student's analytical and critical thinking skills. Students add to their scrapbook various articles and other samples of media that deal with pathogens and disease, and critique articles and media samples.

In Section C, Culminating Task, students are asked to include all background work and research used to solve the problem scenario of their Culminating Task, with proper referencing where appropriate. Each student in the research group is responsible for investigating a different aspect of their chosen scenario, and therefore, their research should reflect that aspect. In addition to their research, they must include a summary of their research (a report) that demonstrates their knowledge.

Section D, Pathogen Profiles. At the end of this unit, students will have at least five different Pathogen Profiles representing different types of pathogens with different modes of transmission. The first profile (on leprosy) is researched and completed as a class in Activity 1. A second profile on a different disease is researched and completed as part of their Culminating Task. During the Disease Forum, as students from each research group share their scenario and solution with the class, further profiles are completed. Thus, students are required to complete a Pathogen Profile for each of the pathogens and diseases presented. This activity provides them with a collection of information about pathogens and their associated diseases, reflecting the topics covered throughout the unit.

Appendix 3

Pathogen Profile

Profile Card # _____

Name of pathogen: _____

Name of disease: _____

Characteristics of Pathogen:
Reproductive Cycle of Pathogen (Diagram):
Mode of Transmission:
Human Immune Response:
Available Drug Therapies:
Methods to Prevent/Protect Against Disease:
Source of Information (Internet address, bibliographic information):

Activity 2: A Day in the Life of a Pathogen

Time: 3 hours

Description

Students are introduced to the characteristics of pathogens through a video, examples of pathogenic outbreaks, and class discussions. Through an informal jigsaw activity, students gain knowledge on modes of pathogenic transmission. Students reflect on the impact of the rapid spread of disease on society/populations and the importance of preventing the spread of diseases.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

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

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

CGE5a - works effectively as an interdependent team member;

CGE7b - accepts accountability for one's own actions;

CGE7e - witnesses Catholic social teachings by promoting equality, democracy, and solidarity for a just, peaceful, and compassionate society.

Strand(s): Pathogens and Disease

Overall Expectations

PDV.01 - demonstrate an understanding of micro-organisms, their biological effects, the diseases they cause, and the metabolic and environmental barriers to the spread of disease;

PDV.02 - investigate the nature and growth of representative pathogens, the response of the immune system to them, and the effect on them of various drug therapies and sterilization techniques, using appropriate laboratory procedures and equipment safely and accurately, and gathering and integrating information from print and electronic sources.

Specific Expectations

PD1.02 - describe the characteristics and reproductive cycles of representative pathogens;

PD1.03 - describe the modes of transmission of diseases, including those that are insect-borne, airborne, water-borne, sexually transmitted, and food-borne;

PD2.02 - present a comparative analysis, based on their own research, of the various modes of transmission of pathogens;

PD3.01 - describe some of the means used by agencies and governments to control the spread of disease, both locally and globally.

Scientific Investigation Skills

SIS.05 - locate, select, analyse, and integrate information on topics under study, working independently and as part of a team, and using appropriate library and electronic research tools, including Internet sites;

SIS.06 - compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams.

Prior Knowledge & Skills

Grade 9 Applied or Academic Science – Biology

Planning Notes

- Gather pictures that illustrate bacterial, viral, and parasitic life cycles.
- Preview videos about the life cycles of micro-organisms (see Resources).
- Book the library/resource centre or computers for student research. Compile a list of useful websites to assist student research (see Resources).

-
- Prepare a checklist to assess comparative analyses of the different modes of pathogenic transmission.
 - Prepare a graphic organizer for students to record the agencies and governments involved in controlling the spread of disease. Students use the organizer again in Activity 4.1 (agencies involved in controlling the spread of disease in foods).
 - Prepare a pencil-and-paper task (quiz) on the characteristics of pathogens, their reproductive cycles, and the modes of transmission of diseases.

Teaching/Learning Strategies

Activity 2.1 – Characteristics of Pathogens and Their Reproductive Cycles

The teacher:

- summarizes characteristics about the three main pathogens (bacteria, viruses, and parasites) in chart form. Possible characteristics include: unicellular/multicellular, size, cellular composition, life cycle (PD1.02).
- uses a video to introduce the pathway by which pathogens cause disease (See Resources).
- instructs the students to make notes during the video.
- introduces the reproductive cycles of pathogens and emphasizes their role in causing disease using real-life examples. For example, the teacher describes the life cycle of bacteria using the following scenario: “You wake up in the morning and feel fine, but by noon, your throat feels swollen and sore. What has happened?” This leads into a discussion about the rapid rate of reproduction of bacteria through the simple, asexual method of binary fission, and the teacher proceeds to describe the process of binary fission. The teacher follows the above format to describe the life cycles of viruses – both lytic (influenza) and lysogenic (HIV) – and parasites (malaria). (PD1.02)
- instructs students to summarize the life cycles of the different pathogens in their notes. Note: Students should be instructed to complete this section on the Pathogen Profile 1 begun in Activity 1.
- instructs students to reflect in Section A of their Journal on the impact of the rapid spread of disease on populations/societies.

Students:

- produce a summary chart about the characteristics of representative pathogens that cause disease.
- watch and make notes from a video.
- summarize the life cycles of the different pathogens in their notes. If not already completed, students are instructed to complete the life cycle section on the Pathogen Profile begun in Activity 1.
- reflect in Section A of their Journal.

Activity 2.2 – Those Sneaky Things!

The teacher:

- introduces the modes of transmission of pathogens by describing an example of a pathogenic outbreak, e.g., *E. coli*, tuberculosis, HIV, pneumonia (see Resources). The teacher discusses the example with the students by asking questions such as: What happened? What was the cause of the outbreak? Why do you think so many people were affected?
- brainstorms with the class to identify the various modes of disease transmission.
- divides students into five groups for an informal jigsaw activity about the modes of pathogenic transmission, and assigns each group one of the five modes of transmission: insect, water, air, food, and sexual. The teacher instructs students to conduct research on their topic, summarizing the information in point form, including the pathway of infection for their assigned pathogen, characteristics of its transmission, and examples of diseases transmitted in this way. Each member of the “expert group” presents the information to a different group of students (PD1.03). Note: If the Internet is used for research, students should be advised of the ethical use of the Internet.

-
- instructs students to create a comparative analysis of the five modes of transmission in chart form using the information from the presentations (PD2.02, SIS.05, SIS.06).
 - monitors small group presentations.
 - collects and assesses the comparative analyses.
 - introduces the identity of and means by which agencies and governments attempt to control the spread of disease and provides students with a graphic organizer to record the agencies discussed (PD3.01). (**Note:** Agencies involved in controlling the spread of disease in foods will be discussed further in Activity 4).
 - instructs students to reflect in section A of their Journal, on the importance of preventing the transmission of pathogens, e.g., STDs.
 - distributes a paper-and-pencil task (quiz).

Students:

- participate in the discussion about an example of a pathogenic outbreak.
- divide the topics to be investigated among their group members. Students are responsible for investigating one aspect of a specific mode of transmission and sharing their information with their group members.
- prepare a point-form summary that describes the assigned mode of transmission.
- individually, present their summary within small groups (PD1.03).
- compare and analyse the five modes of pathogenic transmission using the information from the group, and submit for assessment (PD2.02).
- using the graphic organizer provided, identify the agencies involved in protecting the public from the spread of disease (PD3.01).
- reflect in Section A of their Journals about strategies to prevent the transmission of pathogens and the role that agencies and governments have to protect the public.
- write a paper-and-pencil task (quiz).

Assessment & Evaluation of Student Achievement

- Comparative chart on the modes of pathogenic transmission is assessed for Knowledge/Understanding, Inquiry and Communication using a marking scheme (PD2.02).
- The paper-and-pencil task (quiz) on the characteristics of pathogens, their reproductive cycles, and the modes of transmission of diseases assesses Knowledge/Understanding using a marking scheme (PD1.02, 1.03).

Accommodations

- Enrichment activities could include having students produce a pamphlet, community newsletter, or commercial on how to reduce/stop the transmission of pathogens.

Resources

Print

Galbraith, Don, et al. *Understanding Biology*. Toronto: J. Wiley & Sons, 1989. ISBN 0-471-79654-9
Challenge and A Responsibility, AIDS A Catholic Educational Approach to HIV. Toronto: OCCB, 1999.

Internet

Online Biology Book – www.gened.emc.maricopa.edu/bio/bio181/BIOBK/BioBookTOC.html

Big Picture Book of Viruses – www.virology.net/Big_Virology/BVHomePage.html

Science Photo Library – www.sciencephoto.com/index.html

Microbiology Web Sites – <http://science.nhmccd.edu/biol/microbio.html>

Mednets – www.mednets.com

Video

Viruses. International Video Network. 1995. ISBN 1-563-45474-2

Infectious Diseases: Great Minds of Medicine Series. New York. 1997. ISBN 1-575-23139-5

Bacteria. Teacher's Video Company, Scottsdale, Arizona. www.teachersvideo.com

Bacteria and Viruses. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH1796

Deadly Parasites. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH7918

Bacteria. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH6115

The Emerging Viruses. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH7467

E.Coli: Case of the Mysterious Microbe - Films for the Humanities and Sciences. Fort Erie, Ontario. ECH7945

Activity 3: On the Defense!

Time: 4 hours

Description

Students develop an awareness of the widespread commercial use of antiseptics and conduct a laboratory investigation into their effects on bacterial growth. Beginning with the Pathogen Profiles already completed, students learn more about the mechanisms humans have for controlling pathogens, specifically the human immune system. Through class discussions, a story, article reviews, and a scavenger hunt of resources, students investigate various drug therapies. Students reflect on the impact of overusing and misusing antibiotics on society.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

CGE2b - reads, understands, and uses written materials effectively;

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

CGE 5a - works effectively as an interdependent team member.

Strand(s): Pathogens and Disease

Overall Expectations

PDV.02 - investigate the nature and growth of representative pathogens, the immune system response to them, and the effect on pathogens of various drug therapies and sterilization techniques, using appropriate laboratory procedures and equipment safely and accurately, and gathering and integrating information from print and electronic sources.

Specific Expectations

PD1.04 - describe and explain the immune response of the body as a natural defense against infection;

PD1.05 - describe the use of vaccines, antibiotics, antiseptics, and other drug therapies in the control of pathogenesis;

PD1.06 - describe non-medicinal ways to protect oneself from contracting pathogenic diseases;

PD2.01 - investigate experimentally, using aseptic techniques, the characteristics and growth of non-pathogenic bacteria;

PD2.03 - research and report on the nature of the immune response in the human body;

PD2.04 - identify, through laboratory investigation, the effects of various drug therapies on pathogenesis;

PD3.02 - evaluate the impact on individuals and on society of the misuse of antibiotics in the control of infection;

PD3.04 - describe aseptic techniques used in the workplace and explain their importance.

Scientific Investigation Skills

SIS.01 - demonstrate an understanding of safety practices consistent with Workplace Hazardous Materials Information System (WHMIS) legislation by selecting and applying appropriate techniques for handling, storing, and disposing of laboratory materials;

SIS.02 - select appropriate instruments and use them effectively and accurately in collecting observations and data;

SIS.03 - demonstrate the skills required to plan and carry out investigations using laboratory equipment safely, effectively, and accurately;

SIS.04 - select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate scientific ideas, plans, and experimental results;

SIS.05 - locate, select, analyse, and integrate information on topics under study, working independently and as part of a team, and using appropriate library and electronic research tools, including Internet sites;

SIS.06 - compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams;

SIS.07 - communicate the procedures and results of laboratory investigations and research for specific purposes using data tables and laboratory reports.

Planning Notes

- Book library/resource centre or computers.
- If possible, invite a public health nurse or other health care personnel to visit the class to speak about the control and treatment of pathogenic diseases. Many pamphlets and booklets are available. Check with your local/regional health care unit or local pharmacy. When discussing vaccines, be sensitive to students who have not been vaccinated.
- Make available the story of Edward Jenner (see Resources). Prepare a question sheet to accompany the article. Possible questions include:
 - Describe the variolation process.
 - Do you think that Jenner's experiments were ethical? Explain your opinion.
 - What effects do disease-causing organisms have on the body?
 - What are vaccines and how do they work?
 - Describe the different methods in which vaccines are made.
 - Explain why vaccines are important.
- Prepare guidelines and assessment for article critique, e.g., marking scheme.
- Collect and prepare materials as per lab procedure (see Resources, Calderwood and Campbell).
- **SAFETY WARNING: Students must not collect bacterial samples. This can be very dangerous because they can collect pathogenic strains. Use only non-pathogenic bacteria (e.g., *Bacillus subtilis*) available from a biological supplier. Follow board policy procedure for bacterial disposal.**
- It is suggested that students obtain a variety of antiseptic agents to be used in the investigation, Effects of Antiseptics. In addition, teachers may choose to have some antiseptic agents on hand for students to use.
- Create a checklist to assess students' inquiry skills during the investigation.
- Prepare a rubric or marking scheme to assess students' lab reports.
- Prepare an outline for the chart for the scavenger hunt activity.
- Prepare a quiz on the methods used to control pathogenesis.

Prior Knowledge & Skills

- Grade 9 Science, Applied or Academic – Biology

Teaching/Learning Strategies

Activity 3.1 – Investigating the Effects of Antiseptics

The teacher:

- brainstorms with the class the meaning of the term antiseptic, and instructs students to gather and analyse magazine advertisements and/or product labels advertising antiseptics. It is suggested that students look up products appropriate for the following laboratory investigation, and thus, discover experimentally whether they do control the growth and/or reproduction of a specific pathogen.
- introduces to students the laboratory investigation, Effects of Antiseptics, in which they test the effectiveness of different antiseptics (provided by students) in controlling bacterial growth (PDV.02, PD2.04).
- demonstrates and instructs students to practise aseptic techniques and the proper methods of inoculation, sterilization, and streaking, and emphasizes the importance of safety when working with the bacterial culture (PD1.06, PD2.01).
- **SAFETY WARNING: Use only non-pathogenic bacteria, clean all work areas before and after use, and wash hands thoroughly before and after conducting the experiment. Discuss with students the proper disposal of plates following board outline.**
- assists students with the laboratory investigation and instructs students to describe in their discussion why and where aseptic techniques are used in the workplace.
- assesses student inquiry skills using a checklist (SIS.01, SIS.03).
- instructs students to exchange their reports for peer editing, make the corrections suggested, and then submit for assessment.

Students:

- gather magazine advertisements and/or product labels that promote antiseptic properties, analyse them, and include them in Section B of their Student Journal. Students compare and contrast the ads. What type of products are they? And the labels (What common chemicals do they have?) What do these products promise?
- read lab procedures and bring to class a variety of appropriate antiseptic products (if appropriate, use the products analysed earlier) for the laboratory investigation.
- practise proper aseptic techniques with caution while performing the laboratory investigation. Follow instructions on the disposal of the plates when the lab is completed (PD2.01).
- complete a laboratory report, participate in peer editing, make necessary corrections, and submit a final report for assessment.

Activity 3.2 – Controlling Pathogens

The teacher:

- refers students to the previously completed Pathogen Profile from Activity 1, the Culminating Task scenario, and any other scenarios and case studies discussed in class, and asks students to make a list of the specific defence mechanisms described in each.
- with the class, organizes the list into categories and discusses these and other mechanisms not listed but used by the body to defend itself. Instruct students to create a graphic organizer, e.g., concept map, of this information.
- initiates a discussion on medical and non-medical ways to protect oneself from pathogens by using the following question: “What can you do to prevent getting sick?”
- distributes and discusses with the class the story of Edward Jenner and a matching question sheet (see Resources).

-
- instructs the students, with a partner or individually, to embark on a scavenger hunt of resources to help them to identify, define, describe the use of, and give examples of various drug therapies that are used to control pathogenesis, and to record the information in a chart in their notebooks. (PD1.05)
Note: If the Internet is used, students should be advised of the ethical use of the Internet.
 - instructs students to locate and critique a journal article describing the use and/or overuse of drug therapies, and add this to Section B of their Journal (PD3.02).
 - organizes the class into small groups to discuss the article reviews and the impact that the misuse of antibiotics can have on individuals and on society.
 - instructs students to reflect in Section A of their Journal on their views and concerns about when and what will happen when antibiotics, vaccines and other drug therapies no longer work.
 - assesses students' knowledge of the methods used to control pathogenesis with a paper-and-pencil task, e.g., quiz.

Students:

- refer back to the Pathogen Profiles and previously introduced scenarios and produce a list of the body's specific defense mechanisms.
- summarize the body's natural responses to pathogens in a concept map (PD1.04).
- brainstorm the various ways to protect themselves from contracting a pathogenic disease.
- read and answer questions on the story of Edward Jenner (PD1.05).
- take part in a research scavenger hunt to identify various drug therapies used to control pathogenesis, along with their definitions, uses, and examples. Students summarize their research in a chart (PD1.05).
- locate an article which discusses the use and misuse of antibiotics, critique the article in Section B of their Journal (PD3.02).
- share their article reviews and their views in small groups.
- reflect in their Journal on the impact that the misuse of antibiotics can have on individuals and society (PD3.02).
- complete a paper-and-pencil task on the methods used to control pathogenesis.

Assessment & Evaluation of Student Achievement

- Article critique is assessed for Communication and Making Connections using a marking scheme (PD3.02).
- Students' inquiry skills are assessed using a checklist (SIS.03).
- The "Effects of Antiseptics" lab report is assessed for Knowledge/Understanding, Communication, and Inquiry using a rubric (PD2.04).
- Paper-and-pencil task is assessed for Knowledge/Understanding using a marking scheme (PD1.04, 1.05).

Accommodations

- Students with physical and learning impairments may be paired with another student during the laboratory investigation, where necessary.
- For enrichment, students could make a timeline of medical advances in the area of disease control. Students could re-plate their bacteria and subject the next generation to the same antiseptic used during Activity 3.1, and note any growth.

Resources

Print

Caulderwood, Carol, and Neil Campbell. *Understanding Biology: Laboratory Manual*. Toronto: John Wiley & Sons, 1989. ISBN 0-471-79635-2.

Internet

“Vaccines – How and Why?” The Story of Edward Jenner

– www.accessexcellence.org/AE/AEC/CC/vaccines_how_why.html

The Immune System

– http://library.thinkquest.org/2935/Natures_Best/Nat_Best_Low_Level/Immune_page.L.html

Immunology and Immune Defenses Against Microbial Pathogens

– www.bact.wisc.edu/Bact303/Immunology

Biology II Anatomy and Physiology – Immune System – www.sirinet.net/~jgjohnso/immunestudy.html

“Antibacterial Products: Do They Really Work?”

– <http://www.securityworld.com/library/health/antibacterialproducts.html>

Video

Our Immune System. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH5510

Cell Wars: How the Immune System works. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH2439

A History of Antibiotics. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH1130

Penicillin: Discovering the Truth. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH7468

Vaccinations: Hidden Harm? Films for the Humanities and Sciences. Fort Erie, Ontario. ECH11176

Superbugs: When Antibiotics Don't Work. Films for the Humanities and Sciences. Fort Erie, Ontario. ECH8349

Passing the Bug: The End of Antibiotics? Films for the Humanities and Sciences. Fort Erie, Ontario. ECH8580

Activity 4: Stop that Growth!

Time: 4 hours

Description

Students discuss the many ways food contamination can occur and the technological advances and agencies that serve to control it. Students create a Then and Now Timeline on a specific technological advancement used in food preparation and preservation. Students practise proper sterile techniques in a lab activity where they investigate the effect of pasteurization on pathogenesis. A respect for cultural differences is encouraged through class discussion on how various cultures and countries control the spread of pathogens in foods.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

CGE1d - develops attitudes and values founded on Catholic social teaching, and acts to promote social responsibility, human solidarity, and the common good;

CGE1h - respects the faith traditions, world religions, and life-journeys of all people of good will;

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;

CGE5a - works effectively as an interdependent team member;

CGE5e - respects the rights, responsibilities, and contributions of self and others;
CGE7e - witnesses Catholic social teachings 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.

Strand(s): Pathogens and Disease

Overall Expectations

PDV.03 - evaluate the measures available for the control of disease, including the role of public policy and the use of health-related technologies and scientific knowledge.

Specific Expectations

PD2.05 - demonstrate, through laboratory investigation, the effect on pathogenesis of the use of sterile techniques;
PD3.01 - describe some of the means used by agencies and governments to control the spread of disease, both locally and globally;
PD3.03 - research and explain the impact on disease control of technological advances in food preparation and preservation;
PD3.04 - describe aseptic techniques used in the workplace and explain their importance;
PD3.05 - research and describe the impact on populations of the use of new technologies to control disease.

Scientific Investigation Expectations

SIS.01 - demonstrate an understanding of safety practices consistent with Workplace Hazardous Materials Information System (WHMIS) legislation by selecting and applying appropriate techniques for handling, storing, and disposing of laboratory materials;
SIS.02 - select appropriate instruments and use them effectively and accurately in collecting observations and data;
SIS.03 - demonstrate the skills required to plan and carry out investigations using laboratory equipment safely, effectively, and accurately;
SIS.04 - select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate scientific ideas, plans, and experimental results;
SIS.06 - compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams;
SIS.07 - communicate the procedures and results of laboratory investigations and research for specific purposes, using data tables and laboratory reports;
SIS.08 - research and evaluate information on a specialized topic in science, and apply it to the world outside the school;
SIS.10 - identify and collect information on careers related to the science subject under study.

Prior Knowledge & Skills

Grade 10 Applied or Academic Science – Biology

Planning Notes

- If possible, invite the local Health and Safety Inspector to visit the class or to participate in a telephone interview or e-mail communication, to introduce/discuss the role of agencies in the control of the spread of disease.
- Preview a video on food preservation technologies, including pasteurization, and prepare a question worksheet (see Resources).
- Prepare marking scheme for Then and Now Timeline.
- Book library/resource centre or computers, and/or collect resources that will assist the students with their research.

-
- Organize materials required for the lab investigation, Effects of Pasteurization (refer to Appendix 4). **SAFETY WARNING: Use only non-pathogenic bacteria, clean all work areas before and after, and wash hands thoroughly. Dispose of bacteria following board policy.**
 - Review the history of pasteurization and the experiments of Spallenzini and Pasteur.
 - Create a checklist to assess students' inquiry skills during the investigation.

Activity 4.1 – Food Safety

The teacher:

- discusses food safety using the following questions: What did you eat today? Where did it come from? Where was it produced, grown, and imported from? Is the food that you eat safe? With the students the teacher makes a flow chart of the route that foods take from farm or feedlot to consumer.
- discusses the many places where food can be contaminated, and the role of controlling agencies in food preparation and preservation (PD3.01).
- introduces the Canadian agencies responsible for the creation and enforcement of food safety regulations (if available, the local Health and Safety Inspector could be invited to speak to the class). The teacher instructs the students to add to the graphic organizer from Activity 2 the agencies involved in enforcing food safety (see Resources).
- discusses the identity and the role of global agencies in the control of the spread of foodborne diseases, and instructs students to create a table comparing how Canadian and global agencies each attempt to control its spread. The teacher asks students to consider the ways factors such as climate, e.g., tropical or desert, create challenges to various communities/societies. The teacher encourages students to develop a respect for cultural differences being sensitive to individuals from different cultural backgrounds and their practices of food preparation and preservation.
- instructs students to reflect in Section B of their Journal on the importance of having agencies (both local and international) monitor and attempt to control the spread of disease, and consider what happens when one of the regulatory systems fail.

Students:

- discuss the pathway taken by foods to get to consumers, identify opportunities for food contamination, and recognize the importance of food safety regulations and controls.
- identify the Canadian agencies responsible for food safety and add this information to their graphic organizer from Activity 2. Include any global agencies discussed (PD3.01).
- participate in a class discussion about how various factors, e.g., climate, funding, etc., affect how communities/countries control the spread of disease through food contamination.
- reflect in Section A of their Journal about the role of agencies in controlling and preventing the spread of food-borne illnesses, and consider in their reflection what happens to individuals, communities, and agencies when one or more of these systems fail.

Activity 4.2 – Food Preservation Technologies

The teacher:

- introduces the students to the importance of food preservation technologies (radiation, freezing, pasteurization, and canning) using a video. The teacher stops the video at key points to ask the students questions and discuss the technologies presented (see Resources) (PD3.03).
- instructs students to individually research the history, use, applications, and impact on populations of one technological advancement in food preparation and preservation that prevents disease (e.g., pasteurization, freezing, canning, irradiation, dehydration, freeze-drying, salting, pickling, fermentation, carbonation) and presents this information in a Then and Now Timeline (PD3.03, PD3.05). **Note:** If the Internet is used, students should be advised of the ethical use of the Internet.

-
- collects and displays the timelines, and allows students the opportunity to view them.
 - using Then and Now Timeline, introduces the experiments of Spallenzini and Pasteur.
 - reviews aseptic techniques and introduces the laboratory investigation, Effects of Pasteurization (PD2.05). (Refer to Appendix 4 and Resources.)
 - **SAFETY WARNING: Instruct students to clean all work areas before and after, wash hands thoroughly and follow board policy when disposing of the contents of the flasks.**
 - instructs students to perform laboratory investigation and complete a laboratory report.
 - assesses student inquiry skills using a checklist (SIS.01, SIS.03).
 - collects and assesses laboratory reports (SIS.07).

Students:

- view and answer questions on a video about food preparation technologies. They choose one technology and research its history, use, application, and impact on populations. Students present their information in a Then and Now Timeline and submit it for assessment (PD3.03, PD3.05).
- view other students' timelines and participate in a class discussion on the impact these technologies have had on individuals and society (PD3.05).
- Prepare a Journal reflection on their concerns, views, and opinions on the issues raised during the class discussion.
- read lab activity thoroughly and following safety precautions, perform laboratory investigation and complete and submit a lab report for assessment (PD2.05).

Assessment & Evaluation of Student Achievement

- The Effects of Pasteurization lab report is assessed for Knowledge/Understanding, Inquiry, and Communication using a marking scheme or rubric (PD2.05).
- The Then and Now Timeline is assessed for Knowledge/Understanding, Communication, and Making Connections using a marking scheme (PD3.03).

Accommodations

- For students with physical limitations, ensure access to lab workstations, and encourage peer assistance, when necessary.
- For enrichment, students interview a student/friend that is working/has worked for a fast-food establishment on their knowledge of aseptic techniques used in the workplace, and its importance in preventing food poisoning and the spread of disease. Students write a short report on their findings and submit the report for assessment.
- For enrichment, students could research a particularly severe event/epidemic using books, primary sources, etc., to reconstruct what happened and what changes in laws and regulations came about. Students could write a newspaper article retelling the story for a modern audience.

Resources

Text

Kormondy, Edward, Bernice Essensfeld. "Pasteur's Experiment." *Biology: Laboratory Manual*. Addison-Wesley, 1984. ISBN 0-201-03818-8

Internet

The Bad Bug Book – www.vh.cfsan.fda.gov/~mow/intro.html

Gateway to Government Food Safety – www.foodsafety.gov/

Foodborne Illnesses – www.cfsan.fda.gov/~mow/foodborn.html

Health Canada – www.hc-sc.gc.ca/

Canadian Food Inspection Agency – www.inspection.gc.ca/

Health Canada – Food Quality and Safety – www.hc-sc.gc.ca/datahpsb/npu/cpc9.htm

Canadian Partnership for Consumer Food Safety Education – www.canfightbac.org/english/indexe.shtml

How Food Preservation Works – www.howstuffworks.com/food-preservation.htm

Food Safety – www.cdc.gov/foodsafety/edu.htm

Ontario Ministry of Health – www.gov.on.ca/health/index/html

Ontario Ministry of Agriculture and Rural Affairs – www.gov.on.ca/omfra

Pasteurization – www.foodsci.uoguelph.ca/dairyedu/pasteurization.html

The History of Canned Food – www.cannedfood.org/history.html

Video

Food Safety: The Usual Suspects. Classroom Video (2880). Coquitlam, B.C. 1999

Food-Borne Illnesses and Their Prevention. Films for the Humanities and Sciences. Fort Erie, ECH8222

Story of Louis Pasteur. Teacher's Video Company. Scottsdale, Arizona. – www.teachersvideo.com

Appendix 4 – Investigating the Effects of Pasteurization on Beef Broth

(Modelling Spallenzini's Experiment)

Purpose: The purpose of this activity is to investigate the effects of pasteurization (sterile technique) on bacterial growth.

Hypothesis: Hypothesize on the effects of pasteurization and specifically on which apparatus used will prevent bacterial growth.

Materials:

- 4 Erlenmeyer flasks (250 mL)
- Beef stock
- Hot plate
- S-shaped glass tube
- J-shaped glass tube
- 4 one-holed rubber stoppers
- 2 straight glass tubes
- 1 glass stopper

Procedure:

1. Gather materials.
2. Label flasks as #1, #2, #3, and #4.
3. Prepare beef broth mixture according to instructions.
3. Add 100 mL of beef broth to each flask.
4. In flask #1, insert a straight piece of glass tubing into a one-holed rubber stopper
5. In flask #2, insert a j-shaped glass tube into a one-holed rubber stopper.
6. In flask #3, insert an s-shaped glass tube into a one-holed rubber stopper.
7. In flask #4, insert a straight piece of glass tubing into a one-holed rubber stopper.
8. Bring the broth in each flask to a boil for several minutes.
9. Remove from heat and seal the glass tubing in #4 with plasticine. **Note:** If flask is sealed while boiling, the stopper will likely blow out.
10. Allow the broth to cool.

SAFETY NOTE: Do not remove any of the stoppers at any time during the experiment.

10. Predict what will occur in each flask.
11. Allow the broth to sit for the next few days. Each day, make observations of the bacterial growth (a cloudy broth indicates bacterial growth).

Analysis:

1. Define pasteurization. Describe the changes that occurred in each flask and account for these changes.
2. Predict changes to the results obtained in each flask if left for one month, six months, and one year.
3. Summarize Spallenzini and Pasteur's experiments and compare their experiments to the experiment performed in class.
4. Name and describe commercial/workplace applications for this experiment. Choose one workplace application and research career opportunities in it.

Teacher's Note: Bacterial growth will cause broth to turn cloudy.

In flask #1, bacteria will enter the broth and grow, causing broth to become cloudy.

In flask #2, some bacteria will enter the broth and grow, but not as many as in flask #1.

In flask #3, no bacteria (or very little) will enter the broth and grow, and therefore broth will remain clear.

In flask #4, no bacteria will enter the broth, and therefore there will be no growth and broth will remain clear.

Activity 5: Epidemiologists In Action!

Time: 6 hours

Description

The Culminating Activity is a task that students work on throughout the unit. Students take on the role of epidemiologists and, as a team, use the knowledge gained in the unit and through individual research to investigate a problem. Students further develop their problem-solving skills and their ability to critically analyse issues as informed, responsible Catholic citizens. Students present their findings to the class during a Disease Forum and complete Pathogen Profiles for each disease discussed. Following the Forum, students receive peer feedback and reflect on what they have learned in this activity and in this unit.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

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”;

CGE1h - respects the faith traditions, world religions, and life-journeys of all people of good will;

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

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;

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

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

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;

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

CGE5a - works effectively as an interdependent team member;

CGE7d - promotes the sacredness of life;

CGE7e - witnesses Catholic social teachings 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.

Strand(s): Pathogens and Disease

Overall Expectations

PDV.01 - demonstrate an understanding of micro-organisms, their biological effects, the diseases they cause, and the metabolic and environmental barriers to the spread of disease;

PDV.02 - investigate the nature and growth of representative pathogens, the response of the immune system to them, and the effect on pathogens of various drug therapies and sterilization techniques, using appropriate laboratory procedures and equipment safely and accurately, and gathering and integrating information from print and electronic sources;

PDV.03 - evaluate the measures available for the control of disease, including the role of public policy and the use of health-related technologies and scientific knowledge.

Specific Expectations

PD3.01 - describe some of the means used by agencies and governments to control the spread of disease, both locally and globally;

PD3.05 - research and describe the impact on populations of the use of new technologies to control disease.

Scientific Investigation Expectations

SIS.05 - locate, select, analyse, and integrate information on topics under study, working independently and as part of a team, and using appropriate library and electronic research tools, including Internet sites;

SIS.06 - compile, organize, and interpret data, using appropriate formats and treatments, including tables, flow charts, graphs, and diagrams;

SIS.07 - communicate the procedures and results of laboratory investigations and research for specific purposes, using data tables and laboratory reports;

SIS.08 - research and evaluate information on a specialized topic in science, and apply it to the world outside the school.

Planning Notes

- Refer to Appendix 5: Teacher Resource for specific teaching suggestions.
- Make copies of Appendix 6.
- Prepare the assessment tool discussed in class using the criteria agreed upon with the students.
- Prepare scenarios, one per mode of transmission. The scenario found in Activity 1 can be used as a template.
- Book computers or library/resource centre for student research.
- Preview a video or locate a reading that raises awareness of the connections between diseases and social and economic inequalities (see Resources).

Teaching/Learning Strategies

The teacher:

- distributes the scenario and outlines the activity (refer to Appendices 5 and 6).
- leads a discussion on the format and procedure students are to follow, and helps students organize themselves into interest groups which become their Research Teams.
- discusses with the class the possible assessment tools for the task, e.g., rubrics, marking schemes, checklists, and helps students choose the most appropriate one for the task. Using student input, the teacher creates the criteria for the tool, e.g., a rubric.
- assists students to construct web diagrams and an Action Plan in their teams. The teacher collects and approves each web diagram and plan.
- provides class time for students to conduct research, to discuss within their teams their progress, and to prepare their reports. Note: If the Internet is used, students should be advised of its ethical use
- discusses with the students the format for peer assessment.
- facilitates the Disease Forum, instructing students to complete a Pathogen Profile for each pathogen, as well as peer assessments and a self-assessment. The teacher reminds students to complete all Pathogen Profiles started throughout this unit.
- shows video or a news/magazine article on social justice issue relating to the control/spread of disease.
- uses the issues raised in the video/news article and student presentations to facilitate a discussion about the current status of the fight against diseases caused by known pathogens, the role of governments and agencies to control the spread of disease, and the implications of strategies used to control the spread of disease.

-
- instructs students to reflect in their student Journals on the effectiveness of regional, national, and global strategies used to control the spread of pathogenic diseases.
 - allows time for student peer feedback and instructs students to make a Journal reflection. Students are invited to refer back to their earlier Journal reflections made after reading the Lazarus story, and reflect on how their attitudes may have changed. Students are also encouraged to reflect on how Jesus healed the sick without discrimination and whether our scientifically and technologically advanced society does the same. Students make a statement reflecting their opinions and views on the status of social justice in the world today and on their role as Catholics.
 - collects and assesses Student Journal for evidence of inquiry and research skills.

Students:

- read the activity handout provided, Appendix 6 – Epidemiologists in Action!, read and discuss the given scenarios, form Research Teams to research a chosen scenario, and discuss the assessment tool to be used for this activity.
- following the problem solving format used in Activity 1, each team brainstorms and produces a web diagram for the problem depicted in their scenario. They propose an Action Plan to follow.
- have conducted research throughout the unit, both in class and independently, and recorded their findings in Section C of their Student Journal.
- present their reports at the Disease Forum.
- assess peer presentations and provide peer feedback. Students make reflections in Student Journals.
- watch a video or read an article on social justice and disease issues.
- participate in a class discussion about regional, national, and global strategies used to control diseases caused by pathogens, and the future of this fight.
- reflect on the issues raised in the class discussion as the last entry in their Student Journal.
- submit their Student Journal for assessment.

Assessment & Evaluation of Student Achievement

- Presentation is assessed for Communication using a rubric or other assessment tool (PD3.01, PD3.05).
- Student Journal: Section C is assessed for Inquiry, Communication, and Making Connections using an appropriate marking scheme or rubric (PD3.01).
- Student Journal: Sections C and D are is assessed for Knowledge/Understanding, Communication, and Making Connections using a marking scheme (PD 1.02, 1.03, 1.04, 1.05, 1.06, 3.01, 3.05).

Accommodations

- Students can be provided with a detailed research outline to aid their investigation if necessary.
- Enrichment activities include using multi-media software to enhance their presentations, and identifying and collecting information about careers related to epidemiology, e.g., conduct an interview of an epidemiologist.

Resources

Internet

The World of Parasites – <http://martin.parasitology.mcgill.ca/JIMSPAGE/WORLDOF.HTM>

Mednets – www.mednets.com

Emerging Infectious Diseases – www.cdc.gov/ncidod/eid/

Bad Bug Book – <http://vm.cfsan.fda.gov/~MOW/intro.html>

Epidemic! The World of Infectious Disease – <http://www.amnh.org/exhibitions/epidemic/index.html>

Excellence in Curriculum Integration through Teaching Epidemiology (EXCITE) – www.cdc.gov/excite/

“Antibiotics – Too much of a Good Thing?” – www.accessexcellence.org/HHQ/HLC/HNA/index.html

Fighting Disease: Health at the end of the Millennium

– www.un.org/Pubs/CyberSchoolBus/special/health/index.html

Pan American Health Organization – www.paho.org/

The World Health Report (1996) – www.who.int/whr/1996/exsume.htm

WHO fact sheet – African Trypanosomiasis or Sleeping Sickness – www.who.int/inf-fs/en/fact259.html

Video

Bring Down the Walls: Celebrating a Century of Catholic Social Teaching: Lumen Catechetical Consultants. Silver Spring, M.D. 1991.

Appendix 5

Teacher's Resource – Culminating Activity Organizer

This activity involves both individual research and group presentations. It is designed as a problem-solving task and so will require time for students to brainstorm and plan their approach to the problem presented in the scenarios given. For best results, students should be encouraged and given time for planning and research several times within the unit. For example, following Activity 3.2, students could be given time to work on this assignment and research the specific mode of transmission for the pathogen they are investigating.

Students submit their research, complete an individual summary report on their findings, and participate in their group's presentation. They also complete Pathogen Profiles for each pathogen presented. Peer assessments and feedback are provided for each group presentation. Students complete a self-assessment and reflect on the activity and class discussions.

The following is a breakdown of the tasks, with approximate times, to aid the teacher in organizing this unit.

- Step 1 Prepare scenarios: one scenario for each mode of transmission. The sample scenario in Appendix 1 can be used as a guide (see Resources for web sites).
- Step 2 Allow students class time to read the scenarios, choose one to investigate, form five groups (Research Teams) based on interest, and brainstorm questions and subtopics to be researched (produce a web diagram). Students should be encouraged to use the problem-based learning format introduced in Activity 1. Students submit their web diagrams and a Plan of Action for the teacher's approval. Confer with students about their Plan of Action and where appropriate, guide students to rethink elements of it. With the class discuss which assessment tool(s), e.g., rubric, marking scheme, and/or rating scale are most appropriate for this activity. Once a consensus is achieved the students participate in the determination of the criteria to be used for assessing this activity – brainstorm with the students what categories (be specific) should be included and how they should be weighted. (60-70 minutes)
- Step 3 Arrange for and allow students research time in the library/resource centre. Suggest one class period for class research. Instruct students to record their research in their Student Journals: Section C. Teacher monitors student progress. (70 minutes)
- Step 4 Allow students planning time to discuss in their groups their progress. (20-25 minutes)
- Step 5 Allow students time to collate their individual research, prepare their individual reports and organize their group presentation. Students are encouraged to be creative and use their collective talents when designing their presentations. (60-70 minutes)
- Step 6 Facilitate the presentations at the Disease Forum. Suggest that the class chairs be organized into a large circle to promote class discussion and collaboration between group members. Groups must be aware of the time limits (suggest 15 minutes per group) and any other restrictions on their presentations. Instruct students to complete a peer review for each group and complete a Pathogen Profile for each pathogen discussed. (15 x 5 (number of groups) = 75 minutes)
- Step 7 Allow class time for peer review feedback and individual reflection. (20-30 minutes)

Appendix 6

Epidemiologists in Action!

The Assignment

An epidemiologist studies disease and their determinants in specific populations. They use this information to assist public health decision-making and to develop and evaluate strategies to control and prevent health problems.

You are an epidemiologist who works for an International Medical Research Team. You and four other epidemiologists have just been assigned to investigate a problem. You and your fellow researchers must each compile a report of your individual research. As a group, you must make a presentation during the Annual Disease Forum (to the class) on _____. Your team's report is to be 15 minutes in length in a format of your choice.

Procedure

1. Read this page and the scenarios available.
2. Choose one scenario to investigate, meet with the other researchers interested in the same scenario and form an International Medical Research Team.
3. With your classmates, brainstorm and decide on the best tool for assessment of this task. For example, the class could choose a rubric and then define the criteria for it.
4. In your Research Team, produce a web diagram using the information given in the scenario. Brainstorm and propose questions to be answered/researched, and make hypotheses about the nature of the pathogen and the disease. Summarize your group's present knowledge on the issue and include any opinions individuals may have.
5. Choose a format for your report and the best method for presenting the group's findings to the class.
6. Develop an Action Plan describing how your group has organized the research tasks, where you expect to find the information needed, how your group will present the information, and what materials will be needed for the class presentation.
7. Obtain the teacher's approval for the web diagram and for the Action Plan.
8. Conduct research. Some class time will be given, but you are expected also to conduct independent research. Include scientific information that supports and refutes your original beliefs and ideas. Include a brief description of technologies that were/are being used in this area. Record all your research and progress in Section C of your Student Journal.
9. Meet with your group at regular intervals to discuss your progress and collate your information. Limited class time will be given for this.
10. Attend the Disease Forum and make your group presentation. The presentation must provide students with the information needed to complete a Pathogen Profile for your case.
11. Evaluate your peers using the assessment tool agreed upon initially.
12. Using the same assessment tool, evaluate your own presentation, research skills, and report.
13. Make a Journal reflection on how what you have learned in this unit encourages you to be more Christ-like.
14. Submit your Student Journal for assessment.