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The Ontario Curriculum  
Grades 9-12

# Environmental Education

Scope and Sequence  
of Expectations

2009 Edition

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This publication is available only on the Ministry of Education's website, at <http://www.edu.gov.on.ca>.

# PREFACE

This resource guide supersedes *The Ontario Curriculum, Grades 9–12: Environmental Education – Scope and Sequence of Expectations, 2008*.

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Environmental education is defined as education about the environment, for the environment, and in the environment that promotes an understanding of, rich and active experience in, and an appreciation for the dynamic interactions of:

- The Earth’s physical and biological systems
- The dependency of our social and economic systems on these natural systems
- The scientific and human dimensions of environmental issues
- The positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems.

(*Shaping Our Schools, Shaping Our Future*, p. 6)

The document *Acting Today, Shaping Tomorrow: A Policy Framework for Environmental Education in Ontario Schools* was released in February 2009 in order to guide the implementation of environmental education in boards and schools across the province. One of the goals of this policy framework is as follows:

By the end of Grade 12, students will acquire knowledge, skills, and perspectives that foster understanding of their fundamental connections to each other, to the world around them, and to all living things.

(*Acting Today, Shaping Tomorrow*, p. 11)

The policy framework emphasizes the necessity of ensuring that young people become environmentally active and responsible citizens. Students need to have the knowledge and skills that will enable them to understand and deal with complex issues that affect the environment now and in the future. For example, students need to develop skills in problem solving, inquiry, decision making, action planning, higher-level thinking, systems thinking, and critical literacy. They also need to be able to identify issues and perspectives, carry out research, and communicate their ideas in meaningful ways.

To help achieve this goal the Ministry of Education is working to embed environmental education expectations and opportunities in all grades and in all subjects of the Ontario curriculum, as appropriate, as part of the ongoing curriculum review process. A *Scope and Sequence* resource document was prepared in 2008 to assist teachers in bringing environmental education into the classroom in each discipline in Grades 9 to 12. Each year in the fall, the *Scope and Sequence* document will be updated to reflect changes in the curriculum documents that are in effect in that school year.

The present document has been updated to include expectations from the following revised documents:

*The Ontario Curriculum, Grades 10–12: Computer Studies, 2008*

*The Ontario Curriculum, Grades 9–10: Science, 2008*

*The Ontario Curriculum, Grades 11–12: Science, 2008*

*The Ontario Curriculum, Grades 9–10: Technological Education, 2009*

*The Ontario Curriculum, Grades 11–12: Technological Education, 2009*

Some disciplines, by virtue of their content, are more closely linked to the study of environmental topics and issues than others, but all disciplines provide opportunities to incorporate environmental education to some extent. This document identifies both the expectations that are connected explicitly with aspects of environmental education, and those that can provide opportunities for teachers and students to make connections to environmental topics or issues in various ways. Brief explanations of such opportunities are provided as appropriate in notes following the relevant expectations throughout the document.

The expectations listed in this resource document are taken from the current Ontario curriculum policy documents for Grades 9 and 10 and Grades 11 and 12 in the following disciplines:

- the arts
- business studies
- Canadian and world studies
- classical studies and international languages
- computer studies
- English
- English as a second language and English literacy development
- French as a second language
- guidance and career education
- health and physical education
- interdisciplinary studies
- mathematics
- Native languages
- Native studies
- science
- social sciences and humanities
- technological education

(The date of publication of each of the documents represented is given in the heading at the start of the section for each discipline.)

The disciplines are organized alphabetically in the document, and expectations are presented under the name of the strand within which they appear in the curriculum policy document. (Examples and teacher prompts are included only if they have an environmental connection.)

Expectations are cited in the way in which they appear in the various documents. For example, the overall and specific expectations from recently revised documents are identified using the numbering system that is used in the particular document (e.g., “1”, “1.1”, “1.2”, or “A1”, “A1.1”, “A1.2”). Expectations from older documents are identified as follows:

- for overall expectations
- for specific expectations

For the purposes of this document, the text that normally precedes the expectations – “By the end of Grade x, students will” – has been omitted.

Expectations that are related to one another (e.g., an overall expectation and its corresponding specific expectations; several specific expectations from the same subsection) are grouped wherever possible. Line spaces are used to indicate that expectations are from separate sections in the same strand.

# **THE ARTS, GRADES 9 AND 10 (1999) AND GRADES 11 AND 12 (2000)**

*See the Preface for important information on the organization of the following material.*

The arts curriculum invites students to identify issues of relevance to them and explore their thoughts and feelings about those issues. Students often identify the environment as an area of critical concern. Through dance, dramatic arts, media arts, music, and visual arts, students can represent their thoughts, feelings, ideas, and understandings with respect to environmental issues.

Although only a few expectations in the arts curriculum explicitly address environmental education, in each of the strands in the various subjects the development of environmental understanding can be fostered through both the learning context (e.g., a topic, thematic unit, or issue related to the environment) and learning materials (e.g., a nature print, a song or play about the environment). In the study of the arts, historical, political, social, and/or economic issues are often referred to; it would be a small step to extend these examples to include environmental issues.

## **Media Arts, Grade 10, Open (ASM20)**

### ***Theory***

- demonstrate an understanding of ecological and environmental considerations in the development and production of media art

## **Visual Arts, Grade 11, University/College Preparation (AVI3M)**

### ***Theory***

- describe environmental concerns related to the production of works of fine art, works in applied design, and works in crafts (e.g., production hazards, recycling, disposal of materials such as lead used in pottery glazes)

# **BUSINESS STUDIES, GRADES 9 AND 10 (2006) AND GRADES 11 AND 12 (2006)**

*See the Preface for important information on the organization of the following material.*

The business studies curriculum identifies two critical areas of learning that can be connected with environmental education. These are: (1) “ethical, moral, and legal considerations in business” – i.e., “the understanding and/or determination of social and environmental consequences of business practices on the local, national, and global levels” and (2) “business skills” – i.e., “the knowledge and skills necessary for success in business”, when considered within an environmental context (see page 5 of the policy documents for Grades 9 and 10 and Grades 11 and 12). In addition, business courses cover one of the fundamental principles of business and economics – that is, the role of business enterprises in responding to people’s needs and wants. This topic offers rich opportunities for making environmental connections, in that responding to “wants” can conflict with meeting “needs”, including the need to protect the environment.

The expectations in each course that address these areas are identified below.

## **Introduction to Business, Grade 9 or 10, Open (BBI10/BBI20)**

### ***Business Fundamentals***

- demonstrate an understanding of how businesses respond to needs, wants, supply, and demand
  
- demonstrate an understanding of ethics and social responsibility in business
  - explain the concepts of ethics and social responsibility as they apply to business (e.g., workplace safety, antidiscrimination issues, accessibility issues for people with disabilities, environmental responsibility, respect for labour laws, fair trade)
  - explain controversial business issues from a local, national, and international perspective (e.g., accounting scandals, environmental impact of some business practices, insider trading, fraud)
  
- demonstrate an understanding of the benefits and challenges for Canada in the field of international business
  - explain the potential benefits (e.g., access to markets, cheaper labour, increased quality and quantity of goods, access to resources) and social costs (e.g., outsourcing, human rights or labour abuses, environmental degradation) of international business for domestic and foreign partners

### ***Functions of a Business***

- demonstrate an understanding of sound management practices in business
  - explain the importance of ethical behaviour with respect to employees, the environment, and communities

### ***Entrepreneurship***

- analyse the importance of invention and innovation in entrepreneurship
  - describe how entrepreneurs discover opportunities in people's needs, wants, and problems

*Note:* Environmental connections can readily be made in the context of these expectations.

## **Information and Communication Technology in Business, Grade 9 or 10, Open (BTT10/BTT20)**

### ***Ethics and Issues in Information and Communication Technology***

- assess the impact of information and communication technology on personal health and the environment
  - explain the impact of information and communication technology on the environment (e.g., disposal of hardware, recycling of paper and toner cartridges)

## **ACCOUNTING**

*The subject matter in these courses does not lend itself to environmental education.*

## **ENTREPRENEURSHIP**

### **Entrepreneurship: The Venture, Grade 11, College Preparation (BDI3C)**

#### ***Enterprising People and Entrepreneurs***

- compare the characteristics and contributions of various entrepreneurs
  - outline the importance of incorporating ethical practices and social responsibility when operating a business venture
  - describe the impact that local entrepreneurs have had on the community (e.g., by creating jobs, providing community leadership, funding scholarships)
  - describe how entrepreneurs have been agents of change (e.g., by developing new products, methods of production, and ways of doing business)
  - describe the effect that changes brought about by entrepreneurs have had on the lives of people (e.g., workers, consumers, business people)



*Note:* Attention can be drawn to entrepreneurs who have made a difference with respect to the environment.

### ***Ideas and Opportunities for New Ventures***

- analyse various methods of generating ideas and identifying opportunities to satisfy needs and wants
  - explain how new ventures have been developed in response to consumer needs or wants
  - describe how similar needs and wants have been satisfied in different ways (e.g., alternative methods of healing, such as Aboriginal or Chinese methods, versus Western medicine; organic produce versus genetically modified produce)
- generate realistic new ideas and identify possible opportunities for a school-based or student-run business
  - apply creative-thinking strategies (e.g., mind mapping, brainstorming) to determine possible solutions to unsatisfied needs and wants in the school or the community

### ***The Benefits of a Venture Plan***

- describe why it is important for a venture plan to be flexible, ethical, and adaptable

*Note:* The importance of considering the environment when creating a venture plan can be emphasized in the context of this expectation.

### ***Developing and Completing a Venture Plan for the Proposed Business***

*All expectations*

*Note:* Students could choose a business relating to the environment or could consider the environmental impact of their proposed business.

## **Entrepreneurship: The Enterprising Person, Grade 11, Open (BDP30)**

### ***The Changing Nature of the Workplace***

- describe the major factors affecting the labour market
- analyse the changing nature of work and the workplace

*Note:* The specific expectations corresponding to these overalls provide opportunities for making environmental connections. Societal concerns about protecting the environment and dealing with climate change will have an effect on available jobs and on the demand for various types of labour and skills, as well as on practices in the workplace.

### ***Entrepreneurship and the Enterprising Employee***

- describe the roles of entrepreneurs that benefit communities and society (e.g., agents of change, creators of jobs and wealth, role models of ethical behaviour, advocates for community development)

### ***The Enterprising Experience: Planning and Organizing an Event***

- generate and evaluate ideas for an event in the school or the community and identify a realistic event to plan and organize

*Note:* The event could be related to an environmental issue or concern.

## **Entrepreneurship: Venture Planning in an Electronic Age, Grade 12, College Preparation (BDV4C)**

### ***The Venture Concept***

- identify community problems, needs, or wants, and explain how selected problems, needs, or wants could be addressed
- identify community problems, needs, or wants that could best be addressed by a not-for-profit venture, and explain why

*Note:* The problems and needs identified in these two specific expectations could be related to the environment.

## **INFORMATION AND COMMUNICATION TECHNOLOGY**

### **Information and Communication Technology: The Digital Environment, Grade 11, Open (BTA3O)**

#### ***Digital Literacy***

- identify features and benefits of a networked environment

*Note:* An environmental connection can be made in terms of reductions in the use of resources, such as paper and cables, in a networked environment.

#### ***E-Business***

- evaluate the impact of e-business

*Note:* The topic of e-business offers opportunities for making environmental connections, particularly with respect to the potential for conserving resources.

## **Information and Communication Technology: Multimedia Solutions, Grade 12, College Preparation (BTX4C)**

### ***The Electronic Business Environment***

- describe the positive and negative effects of information and communication technology on businesses and working conditions (e.g., more efficient communication, ease of information sharing/retrieval, job loss/reassignment, technical difficulties)

*Note:* An environmental perspective could be introduced in connection with this expectation, focusing primarily on resource use.

## **Information and Communication Technology in the Workplace, Grade 12, Workplace Preparation (BTX4E)**

### ***The Electronic Workplace Environment***

- explain the ways in which workplace settings have changed as a result of recent developments in information and communication technology
- explain how information and communication technology affects the way in which business is conducted (e.g., more efficient communication, ease of information sharing and retrieval, reduced mailing costs)

*Note:* Content related to these expectations could be examined from an environmental perspective.

## ***INTERNATIONAL BUSINESS***

### **International Business Fundamentals, Grade 12, University/College Preparation (BBB4M)**

#### ***Business, Trade, and the Economy***

- evaluate the benefits (e.g., decreased prices, increased quantity and quality of products, technological developments) and drawbacks (e.g., loss of jobs, increased foreign ownership of Canadian companies) of international trade for Canada

*Note:* The evaluation of the risks and benefits of international trade could take environmental impacts into account.

### ***The Global Environment for Business***

- analyse ways in which Canadian businesses have been affected by globalization
  - analyse how, in an era of globalization, consumer choices and attitudes affect Canadian business decisions
- assess the effects of current trends in global business activity and economic conditions
  - explain how globalization creates the need for standardization of products, services, and processes (e.g., through the International Organization for Standardization)

**Note:** Various environmental concerns and considerations related to globalization can be explored in the context of these expectations.

### ***Factors Influencing Success in International Markets***

- evaluate the advantages and disadvantages in both developed countries and developing countries with regard to business opportunities (e.g., size of consumer base, government regulations, infrastructure, cost of labour)
- describe the roles corporations can play in the setting of international and domestic policy (e.g., lobbying, participating in trade missions)

### ***Marketing Challenges and Approaches, and Distribution***

- demonstrate an understanding of the logistics of, and challenges associated with, distribution to local, national, and international markets

**Note:** This overall expectation, supported by its corresponding specific expectations (under Distribution and Logistics), provides an opportunity to consider environmental concerns related to the transportation of goods.

### ***Working in International Markets***

- analyse the ways in which ethical considerations affect international business decisions
  - evaluate the ethical issues that arise for companies competing internationally, in relation to the following groups: consumers (e.g., safety, fair pricing, disclosure); stockholders (e.g., fair return, controlled risk); employees (e.g., fair wages, good working conditions, outsourcing, regulation of child labour); the host country (e.g., effects on local economy, respect for local laws and cultural preservation); and society (e.g., sustainability of development, practices to combat corruption)

**Note:** Ethical considerations would include, among other environmental concerns, the need to protect the environment of the host country. Other specific expectations in the subsection Ethical Issues also provide opportunities to make links to environmental issues.

## **International Business Essentials, Grade 12, Workplace Preparation (BBB4E)**

### ***Canada in the Global Marketplace***

- identify the advantages, disadvantages, and challenges associated with international business activity
- determine how Canadians have been affected by international business activity
  - describe the effects of foreign investment on Canada
  - explain how the needs and wants of Canadians may present opportunities for foreign companies
  - identify Canada's current major trading partners and the products traded

*Note:* These expectations provide significant opportunities to explore the environmental concerns and implications connected with international business and trade and foreign investment in Canada.

### ***Conducting International Business***

- demonstrate an understanding of the way in which ethical considerations affect international business decisions
  - compare the code of ethics for a variety of international companies
  - summarize the ethical issues that arise for companies that are competing internationally (e.g., fair wages, regulation of child labour, cultural preservation, environmental practices)

### ***International Careers and Skills***

- illustrate the impact of recent international events (e.g., 9/11, the outbreak of SARS in Toronto, the discovery of BSE in Canadian cattle) on Canadian international business

*Note:* Events connected with climate change or other environmental phenomena can be considered in the context of this expectation.

## **MARKETING**

### **Marketing: Goods, Services, Events, Grade 11, College Preparation (BMI3C)**

#### ***Marketing Fundamentals***

- summarize the factors that motivate a customer to purchase a product (e.g., discretionary income, peer pressure, social responsibility, evolving needs and wants)

- compare the purposes of marketing for profit and not-for-profit organizations (e.g., to sell products and lifestyles, to raise funds, to raise awareness about issues)
- describe, drawing on computer research, ethnocultural, linguistic, and geographical factors that firms should consider when they enter the global market (e.g., cultural variations in consumer preference and buying behaviour, language barriers, expense of delivery to distant markets)

*Note:* Environmental considerations are relevant to the topic of each of these expectations.

### ***The Marketing Mix***

- compare the advantages and disadvantages of the various ways of delivering goods and services (e.g., truck, train, plane, auto, the Internet) from the producer to the consumer

### ***Trends in Marketing***

- identify and describe various environmental, ethical, social, and legal issues that affect marketing activities
  - identify examples of businesses that include corporate social responsibility as a component of their marketing philosophy (e.g., not using animals in product testing, sponsoring charitable events, hosting children’s camps, engaging in responsible environmental practices)

### ***The Marketing Plan***

- explain how a marketing plan can address the areas of ethics and social responsibility (e.g., by identifying diverse markets, by requiring environmentally friendly components in the product and its packaging, by incorporating positive social messages for healthy products)

*Note:* The product, service, or event chosen for marketing will determine the extent of the environmental considerations that need to be taken into account.

## **Marketing: Retail and Service, Grade 11, Workplace Preparation (BMX3E)**

### ***Marketing Fundamentals***

- summarize changes in lifestyles and consumer needs and wants over the past few decades and explain their impact on retail and service businesses (e.g., changing gender roles, consumer demand for fast food, use of portable communication and entertainment devices)
- explain how changing demographics, tastes, preferences, and psychographics of Canadian consumers have influenced their buying decisions (e.g., needs of aging population; interest in organic, green, or energy-efficient products)

### ***Trends in Retail and Service Marketing***

- identify and describe various environmental, ethical, social, and legal issues that affect the retail and service industries
  - describe ways in which marketing activities (e.g., packaging, labelling) have been influenced by the environmental movement
  - identify ways that federal, provincial, and municipal laws and regulations (e.g., concerning health and safety, environmental protection, product standards) can affect how retail and service businesses operate

## ***BUSINESS LEADERSHIP***

### **Business Leadership: Management Fundamentals, Grade 12, University/College Preparation (BOH4M)**

#### ***Foundations of Management***

- evaluate the impact of issues related to ethics and social responsibility on the management of organizations
  - evaluate the impact of major ethical issues (e.g., bribery, harassment, polluting the environment, theft in the workplace, Aboriginal land claims versus interests of resource companies) and dilemmas (e.g., for the individual, the workplace, and the local and global community) on management strategies and decision making
  - explain the nature of corporate ethical and social responsibility and analyse, on the basis of research, including stakeholder analysis, a particular company's commitment to it (e.g., in relation to non-discriminatory hiring, promotion, and retention practices; implementing the Persons with Disabilities Act and the Accessibility for Ontarians with Disabilities Act; environmental issues; customer/supplier relationships)

### **Business Leadership: Becoming a Manager, Grade 12, Workplace Preparation (BOG4E)**

#### ***The Role of the Manager***

- explain the need for ethical and socially responsible behaviour in business management

*Note:* Socially responsible behaviour in business management includes protection of the environment.

# **CANADIAN AND WORLD STUDIES, GRADES 9 AND 10 (2005) AND GRADES 11 AND 12 (2005)**

*See the Preface for important information on the organization of the following material.*

Many of the courses in the Canadian and world studies (CWS) curriculum deal with subjects that focus on the environment or are closely connected to environmental concerns and phenomena – for example, courses in geography – or that involve developments and relationships in human life from which environmental factors cannot be separated – for example, courses in history and economics. In some courses, expectations that concern the environment may be too numerous to list in full, and in those cases, *only the relevant overall expectations are listed* in this document. In some cases, *examples* of the corresponding specific expectations that serve to strengthen environmental connections may also be listed or a note may be provided summarizing the nature of the opportunities for environmental connections offered by the corresponding specific expectations.

The last strand of every course in the CWS curriculum focuses on methods of inquiry and research particular to each of the subject areas. The expectations in this strand help students develop skills that will enable them to think critically and independently and become responsible members of society. These skills provide a necessary foundation for students to become environmentally literate citizens as well. This environmental connection is broad, and the expectations in the inquiry and research strands have consequently not been identified individually unless they offer opportunities to explore *specific* topics related to the environment.

## **Geography of Canada, Grade 9, Academic (CGC1D)**

### ***Geographic Foundations: Space and Systems***

- demonstrate an understanding of the regional diversity of Canada's natural and human systems
- analyse local and regional factors that affect Canada's natural and human systems

### ***Human-Environment Interactions***

- explain the relationship of Canada's renewable and non-renewable resources to the Canadian economy
- analyse the ways in which natural systems interact with human systems and make predictions about the outcomes of these interactions
- evaluate various ways of ensuring resource sustainability in Canada



### ***Global Connections***

- describe how Canada's diverse geography affects its economic, cultural, and environmental links to other countries
  - explain how Canada's natural systems form part of global natural systems (e.g., Pacific Ring of Fire, continental shelves, global biomes)
- analyse connections between Canada and other countries
  - compare Canada's approaches to specific concerns (e.g., species loss, deforestation, pesticide use, cross-border pollution, movement of people, trade) with the approaches of other nations
  - evaluate Canada's participation in organizations that deal with global issues (e.g., global warming, biodiversity, human rights)
- report on global issues that affect Canadians
  - compare, in terms of resource use and consumption, the "ecological footprint" of an average Canadian with that of an average citizen in a developing country
  - produce a set of guidelines for developing a solution to a global geographic or environmental issue

### ***Understanding and Managing Change***

- explain how natural and human systems change over time and from place to place
- predict how current or anticipated changes in the geography of Canada will affect the country's future economic, social, and environmental well-being
- explain how global economic and environmental factors affect individual choices

### ***Methods of Geographic Inquiry and Communication***

- use the methods and tools of geographic inquiry to locate, gather, evaluate, and organize information about Canada's natural and human systems
- analyse and interpret data gathered in inquiries into the geography of Canada, using a variety of methods and geotechnologies
  - collect and synthesize information about the local ecozone
  - make planning decisions concerning a regional community after studying its existing natural and human systems (e.g., transportation, communication, energy networks, ecozones)

## **Geography of Canada, Grade 9, Applied (CGC1P)**

### ***Geographic Foundations: Space and Systems***

- identify patterns and diversity in Canada's natural and human systems
- illustrate regional differences using the concept of ecozone

- describe issues that affect natural and human systems in Canada

### ***Human-Environment Interactions***

- assess the impact of human systems and/or resource extraction on the natural environment
- describe ways in which renewable, non-renewable, and flow resources are used in Canada
- relate current lifestyle choices of Canadians to the prospects for sustaining Canada’s economic and environmental well-being

### ***Global Connections***

- identify the economic, cultural, and environmental connections between Canada and other countries
  - compare Canadian and global trends in resource consumption and pollution (e.g., level of development versus rate of resource use, GDP versus pollution levels)
- report on how Canada influences and is influenced by its economic, cultural, and environmental connections with other countries
  - evaluate Canada’s effectiveness and commitment in responding to global challenges (e.g., climate change, depletion of ocean resources, terrorism) and promoting international well-being (e.g., humanitarian aid, human rights advocacy, peacekeeping)
- explain how current global issues affect Canadians
  - compare the “ecological footprint” of a typical Canadian with those of people from other countries

### ***Understanding and Managing Change***

- explain the relationship between sustainability, stewardship, and an “ecological footprint”
  - describe how regional disparities (e.g., in resource accessibility) affect the economic sustainability of communities
- identify current or anticipated physical, social, or economic changes and explain how they could affect the lives of Canadians
- apply the concepts of stewardship and sustainability to analyse a current national or international issue
  - predict the impact of selected technological changes (e.g., in communications and information technology, renewable energy technology) on the future quality of life for Canadians (e.g., working conditions, air and water quality, education, transportation)

### ***Methods of Geographic Inquiry and Communication***

- use the methods and tools of geographic inquiry to locate, gather, evaluate, and organize information about Canada’s natural and human systems
- analyse and interpret data gathered in inquiries into the geography of Canada, using a variety of methods and geotechnologies

- collect and synthesize information about the local ecozone
- conduct an inquiry, using a variety of appropriate tools, into a current Canadian geographic issue (e.g., loss of farm land, declining fish stocks, petroleum industry in the Arctic)

## **Canadian History Since World War I, Grade 10, Academic (CHC2D)**

### ***Communities: Local, National, and Global***

- explain how local, national, and global influences have helped shape Canadian identity
- analyse the impact of external forces and events on Canada and its policies since 1914

*Note:* Some of the specific expectations in this strand provide opportunities to explore how historical forces and events have influenced interactions between social, economic, and natural systems, as well as some of the positive and negative consequences they have had on the natural environment (e.g., the decision to use atomic weapons against Japan; economic globalization; the Gulf War, 1991; the Kyoto Protocol on Climate Change).

### ***Change and Continuity***

- analyse changing demographic patterns and their impact on Canadian society since 1914

*Note:* Some of the specific expectations in this strand provide opportunities to explore how historical patterns have influenced interactions between social, economic, and natural systems, as well as some of the positive and negative consequences they have had on the natural environment (e.g., the impact of the population shift to the suburbs; the impact of the baby boom generation on material consumption).

### ***Citizenship and Heritage***

- analyse the contributions of various social and political movements in Canada since 1914

*Note:* This overall expectation provides the opportunity to evaluate the social, economic, and environmental consequences of the ideologies and platforms of various political parties and movements.

### ***Social, Economic, and Political Structures***

- analyse how changing economic and social conditions have affected Canadians since 1914

*Note:* Some of the specific expectations in this strand provide an opportunity to explore the impact that the natural environment has had on economic and social conditions (e.g., drought as a factor in the Depression of the 1930s; the loss of fisheries in Newfoundland in the 1990s).

## **Canadian History Since World War I, Grade 10, Applied (CHC2P)**

### ***Communities: Local, National, and Global***

- describe some of the major local, national, and global forces and events that have influenced Canada's policies and Canadian identity since 1914

*Note:* The expectations in this strand provide opportunities to examine some of the positive and negative consequences that historical forces and events have had with respect to the natural environment (e.g., the effect of wars, the effect of trade policies and economic policies)

### ***Change and Continuity***

- explain some major ways in which Canada's population has changed since 1914
- evaluate the impact of some technological developments on Canadians in different periods

*Note:* The expectations in this strand provide an opportunity to illustrate that technological developments and changes in population demographics have had both positive and negative consequences for the natural environment (e.g., negative effects of the increased material consumption that came about as a consequence of the postwar baby boom; the impact of landmines).

### ***Citizenship and Heritage***

- describe the impact of significant social and political movements on Canadian society

*Note:* This overall expectation provides the opportunity to examine the social, economic, and environmental consequences of the ideologies and values of various political parties and movements.

### ***Social, Economic, and Political Structures***

- explain changing economic conditions and patterns and how they have affected Canadians

*Note:* Some of the specific expectations in this strand provide opportunities to examine how economic and social conditions can affect the natural environment. (e.g., environmental regulations under NAFTA; the spread of disease).

## **Civics, Grade 10, Open (CHV20)**

### ***Informed Citizenship***

- explain the legal rights and responsibilities associated with Canadian citizenship
- explain what it means to be a “global citizen” and why it is important to be one

*Note:* The expectations in this strand, viewed from an environmental perspective, would help students acquire both the skills and the personal attributes of environmentally literate citizens.

### ***Purposeful Citizenship***

- demonstrate an understanding of the beliefs and values underlying democratic citizenship and explain how they guide citizens' actions
- describe the diversity of beliefs and values of various individuals and groups in Canadian society
- analyse responses, at the local, national, and international levels, to civic issues that involve multiple perspectives and differing civic purposes

**Note:** Many of the expectations in this strand, viewed from an environmental perspective, would help students develop the skills and the personal attributes of environmentally literate citizens. Some of the specific expectations provide an environmental context.

### ***Active Citizenship***

- apply appropriate inquiry skills to the research of questions and issues of civic importance
- demonstrate an understanding of the various ways in which decisions are made and conflicts resolved in matters of civic importance, and the various ways in which individual citizens participate in these processes

**Note:** The expectations in this strand, viewed from an environmental perspective, would help student develop the skills and personal attributes of environmentally literate citizens. Important among these is an understanding of the value of personal action.

## ***ECONOMICS***

*In today's world, applications of some of the fundamental principles of economics, such as supply and demand, scarcity and choice, and the self-interest of economic stakeholders, inevitably involve environmental considerations. Many of the expectations identified below focus on these principles.*

### **The Individual and the Economy, Grade 11, University/College Preparation (CIE3M)**

#### ***Economic Decision Making***

- explain how the scarcity of economic resources requires individuals and societies to make economic choices
  - explain, using specific examples, the economic problem of scarcity and the choices and trade-offs that individuals and societies must make

**Note:** Trade-offs made necessary by a scarcity of resources often involve negative consequences for the environment.

### ***Economic Stakeholders***

- describe the economic rights and responsibilities of citizens
  - describe the economic responsibilities of Canadian citizens (e.g., respect for laws against pollution, vandalism, etc.; awareness of the economic implications of public issues)
  - analyse a current issue (e.g., pollution), identifying how the economic rights of individuals must be balanced by economic responsibility and public accountability

### ***Self-Interest and Interdependence***

- explain how self-interest in a market makes consumers and producers interdependent
  - describe the criteria that consumers and producers each use to determine which of several choices is in their own best interest
- describe ways in which governments in Canada intervene in the economy to balance the competing self-interests of stakeholders
- assess the extent, nature, and impact of Canada's economic interdependence with other nations
  - assess the benefits and disadvantages to trading partners of international specialization and trade arising from comparative advantage between Canada and Mexico in the production of wheat and radios)

*Note:* The ideas explored in this strand provide ample opportunity to make environmental connections, in view of societal concerns about climate change and the role of environmental considerations in the negotiation of free trade agreements.

### ***Methods of Economic Inquiry and Communication***

- use economic models (e.g., competitive market) to analyse economic relationships and to forecast outcomes (e.g., how changes in supply and demand will affect price and output)
- use methods of economic inquiry (e.g., cost-benefit analysis) to evaluate an economic choice from the perspective of the affected stakeholders

## **Making Economic Choices, Grade 11, Workplace Preparation (CIC3E)**

### ***Economic Decision Making***

- identify the economic choices that individuals, organizations, and societies must make because resources are scarce

### ***Economic Stakeholders***

- describe the economic roles that an individual plays

- differentiate between consumer wants and needs and consumer demand (e.g., consumers' willingness and ability to pay for goods and services)

**Note:** To achieve this expectation, students would need to understand why the resources are scarce.

### ***Self-Interest and Interdependence***

- explain how self-interest motivates both consumers and producers in a market and creates interdependence
  - describe how consumers and producers each determine what is in their own best interest (e.g., satisfaction of needs and wants, profitability)
- describe the extent and nature of Canada's economic interdependence with other nations and the significance of this interdependence to Canadian stakeholders

### ***Economic Institutions***

- describe specific examples of the ways in which government is involved in the Canadian economy (e.g., consumer, regulator, producer, distributor of income, tariff collector, quota setter)

**Note:** This expectation can be applied to topics that provide environmental connections. For example, the government acts as a regulator with respect to the environmental impact of economic activity.

### ***Methods of Economic Inquiry and Communication***

- apply a cost-benefit analysis to define a problem and to identify and evaluate choices from the point of view of different stakeholders

**Note:** A productive application for this expectation would involve environmental considerations.

## **Analysing Current Economic Issues, Grade 12, University Preparation (CIA4U)**

### ***Economic Decision Making***

- analyse the changing importance of the public and private sectors of the economy and what this means for the achievement of the macroeconomic goals of freedom and equity
  - describe the effects of changes in the economic influence of markets and the public sector (e.g., a reduced level of public services, deregulation, privatization)

**Note:** The possible consequences of privatization for the environment and the role of environment in considerations of equity can be addressed in the context of these expectations.

## **Economic Stakeholders**

- describe economic stakeholder groups and the criteria each uses to make economic decisions
- explain the economic rights and responsibilities of “the economic citizen”
  - explain the concept of stewardship as it applies to specific examples of economic responsibility and choice (e.g., pollution, income distribution, use of resources and energy)
- compare the ways and the degree to which different types of economic systems satisfy the needs of stakeholders
  - analyse the economic and social/cultural impact of resource development on traditional lands of First Nation peoples (e.g., logging or commercial fishing in British Columbia, pipeline construction or mining in the North, gaming in Ontario)

## **Economic Institutions**

- analyse the nature and functions of international economic institutions and their impact on the Canadian economy
  - describe the nature and role of international economic agreements and institutions (e.g., North American Free Trade Agreement, Kyoto Protocol, World Trade Organization, International Monetary Fund, Organization for Economic Cooperation and Development)
  - analyse the growth of private-sector multinational corporations and their impact on the Canadian economy
  - analyse the costs and benefits to Canadian stakeholders of the trend towards freer international trade

## **Methods of Economic Inquiry and Communication**

- apply economic concepts (e.g., opportunity cost, demand, absolute advantage) and models (e.g., production-possibility boundary, the market, circular flow) to identify and analyse choices, forecast economic change, and define a reality, problem, or issue
- apply the cost-benefit method of inquiry to current economic issues to evaluate choices, using stakeholder criteria and economic goals

**Note:** These expectations allow for applications involving environmental issues.

# **GEOGRAPHY**

*By their very nature, the strands Geographic Foundations: Space and Systems, Human-Environment Interactions, and Global Connections incorporate environmental education. Consequently, the specific expectations in these strands that relate to the environment or provide opportunities to make environmental connections are too numerous to list, and in most cases, only the overall expectations have been identified below.*



# **The Americas: Geographic Patterns and Issues, Grade 11, University/College Preparation (CGD3M)**

## ***Geographic Foundations: Space and Systems***

- describe and compare the natural characteristics of the equatorial, midlatitude, and polar regions of the Americas
  - identify how colonizing countries have influenced people and the environment in selected regions of the Americas
- compare the diverse human systems and cultural realms of the Americas
- analyse the political, economic, and social factors that contribute to disparities in economic development within the Americas
  - analyse development patterns in selected regions of the Americas (e.g., Bolivia, north-eastern Brazil, the Caribbean, the Arctic) and identify the benefits and disadvantages of development for each region chosen

## ***Human-Environment Interactions***

- analyse the causes and effects of human-environment interactions in various ecological zones of the Americas
- evaluate the environmental and economic consequences for the Americas of natural hazards and climatic variations
- analyse the linkages between population shifts and changes in physical and human environments in the Americas

## ***Global Connections***

- evaluate the impact of the global economy on the environment and peoples of the Americas
- analyse how the nations of the Americas interact to promote or defend their political, economic, environmental, and social interests
- assess the roles of current and emerging major powers in the Americas
  - analyse selected examples of relationships that have developed between regions in the Americas because of environmental problems (e.g., oil spills, ozone depletion), resource needs (e.g., energy exchanges, water transfers), and border conflicts

## ***Understanding and Managing Change***

- evaluate the effects of various political, economic, social, and technological changes on physical and human environments in the Americas
- analyse the problem of underdevelopment in the Americas and explain the difficulties in alleviating it

- evaluate various aid programs in the Americas and their impact
  - analyse a development project in the Americas to determine its effect on local environments and economies, including those of indigenous peoples (e.g., mining in the Amazon, rural improvement projects in Central America, mining of the Athabasca oil sands in Alberta)

## **Physical Geography: Patterns, Processes, and Interactions, Grade 11, University/College Preparation (CGF3M)**

### ***Geographic Foundations: Space and Systems***

- analyse the sources and nature of energy flows through the lithosphere, atmosphere, hydrosphere, and biosphere
- explain the physical processes that create landforms, climate, soils, and vegetation

*Note:* The specific expectations in this strand deal with the interrelationship of these components.

### ***Human-Environment Interactions***

- explain how the earth provides both a habitat for life and a resource for society
- evaluate the impact of natural systems on people and their activities
- evaluate the impact of human life on the environment
- explain the importance of stewardship and sustainability as guiding principles for human use of the physical environment

### ***Global Connections***

- explain the importance of water to global systems
- explain the reasons for the global patterns of continents and oceans, landforms, climate, soils, and vegetation
- analyse local, regional, and global issues related to physical geography

### ***Understanding and Managing Change***

- analyse the causes and consequences of climate change
- analyse how changes in natural systems are caused by natural phenomena
- explain how human uses of the earth, especially uses involving technology, cause changes over time in natural systems

## **Geographics: The Geographer’s Toolkit, Grade 11, Workplace Preparation (CGT3E)**

### ***Human-Environment Interactions***

- explain the use of geotechnologies in studying and managing human-environment interactions
- evaluate the usefulness of geotechnologies for identifying environmental concerns and developing possible solutions

### ***Global Connections***

- explain the use of geotechnologies in addressing matters of global concern
  - describe the role of geotechnologies in addressing issues affecting the world as a whole (e.g., global warming, high population densities)
- use techniques of geographic inquiry to complete an investigation concerning global physical, demographic, or economic patterns
  - explain a global phenomenon (e.g., rainforest destruction, desertification, globalization) incorporating geotechnology (e.g., use ArcView to illustrate epicentres and magnitudes of seismic activity)

### ***Understanding and Managing Change***

- explain and demonstrate the use of geotechnologies to monitor and predict change in the physical and human environment
  - describe the role of geotechnologies, especially satellite imaging, in monitoring changing features and phenomena (e.g., sea ice, forests, oil spills)
- evaluate the implications for the user of developments in geotechnology
  - use geotechnology to illustrate changes in the physical and/or cultural geography of their local community

## **Travel and Tourism: A Regional Geographic Perspective, Grade 11, Open (CGG3O)**

### ***Human-Environment Interactions***

- explain how environmental factors affect patterns of travel and tourism
- analyse the impact of different types of travel and tourism on the natural environment
- evaluate the effectiveness of programs and initiatives designed to manage and protect the resources on which tourism is based

### ***Global Connections***

- explain the social, environmental, cultural, economic, and political effects of travel and tourism on various destination regions
- compare the characteristics of selected tourist regions of the world

### ***Understanding and Managing Change***

- analyse the social, environmental, cultural, economic, and political effects of tourism-related development on a community or region
- evaluate the impact on travel and tourism of the plans, policies, and initiatives of governments, businesses, and other organizations

### ***Methods of Geographic Inquiry and Communication***

- develop possible solutions to problems or issues related to travel, tourism, or regional geography (e.g., a plan to protect a fragile ecosystem from the effects of travel and tourism), using appropriate forecasting, decision-making, and/or problem-solving strategies

## **Canadian and World Issues: A Geographic Analysis, Grade 12, University Preparation (CGW4U)**

### ***Geographic Foundations: Space and Systems***

- explain how the earth's natural and human systems are interconnected in multiple, complex ways
- analyse the causes and effects of economic disparities around the world
- compare the cultural, economic, and political aspirations of selected groups and the effects of their actions on local, national, and global geographic issues

### ***Human-Environment Interactions***

- analyse the impact of selected global trends on people and environments at the local, national, and global level
- analyse geographic issues that arise from the impact of human activities on the environment in different regions of the world
- evaluate approaches, policies, and principles relating to the protection and sustainability of the planet's life-support systems

### ***Global Connections***

- analyse the influences that increase the interdependence of countries around the world

- identify current global sustainability issues and environmental threats (e.g., greenhouse gas emissions, global warming)
- explain how inequities in the distribution of resources (e.g., water scarcity, unequal land distribution) and boundary disputes (e.g., confiscation of land) contribute to uprisings and conflicts
- analyse instances of international cooperation and conflict and explain the factors that contributed to each
- evaluate the social, economic, and environmental impact of the strategies for sustainable development implemented by a variety of individuals, organizations, and institutions

### ***Understanding and Managing Change***

- analyse trends and predict changes in the human use of the earth and its resources
- evaluate the cultural, economic, and environmental impact of changing technology
- evaluate the effectiveness of short-term and long-term solutions to geographic problems and issues at the local, national, and global level

## **World Geography: Human Patterns and Interactions, Grade 12, University Preparation (CGU4U)**

### ***Geographic Foundations: Space and Systems***

- apply concepts of spatial interaction to explain the impact of spatial factors on human systems
- 
- explain the influence of social, political, cultural, economic, and environmental factors on human environments and activities

### ***Human-Environment Interactions***

- explain how humans have modified the natural environment to create particular landscapes
- analyse the environments of urban areas to determine the effects on them of large-scale rural-to-urban migration
- evaluate ways in which humans adapt or have adapted to the natural environment and natural phenomena

### ***Global Connections***

- analyse examples of cultural/economic/ecological convergence and divergence to identify their causes
- evaluate the effects of the information revolution, technological progress, and global trade on selected world regions

## **The Environment and Resource Management, Grade 12, University/College Preparation (CGR4M)**

### ***Geographic Foundations: Space and Systems***

- analyse how the earth's major components – the lithosphere, atmosphere, hydrosphere, and biosphere – interact and are interdependent
- explain how key ecological processes contribute to ecosystem health
- analyse how the distribution of ecosystems has been and continues to be influenced by natural conditions

### ***Human-Environment Interactions***

- explain significant short-term and long-term effects of human activity on the natural environment
- analyse and evaluate interrelationships among the environment, the economy, and society
- analyse patterns of resource availability and use

### ***Global Connections***

- analyse environmental and resource management issues and explain their global implications
- explain how population growth affects the sustainability of global ecosystems
- evaluate the effectiveness of the efforts of the international community to deal with environmental and resource management issues

### ***Understanding and Managing Change***

- evaluate the impact of economic, social, political, and technological change on natural and human systems
- explain the purpose of environmental laws and regulations at the local, provincial, and national levels and evaluate their effectiveness over time
- evaluate a variety of approaches to resolving environmental and resource management concerns on a local, regional, and national scale

### ***Methods of Geographic Inquiry and Communication***

- use the methods and tools of geographic inquiry to locate, gather, evaluate, and organize information about environmental and resource management issues and concerns

## **Geomatics: Geotechnologies in Action, Grade 12, University/College Preparation (CGO4M)**

### ***Geographic Foundations: Space and Systems***

- analyse how geotechnologies are used in studying physical and human systems
  - utilize geotechnologies in analyses of physical systems (e.g., resource mapping, climate modelling, forest mapping)
  - utilize geotechnologies in analyses of human systems (e.g., market analysis, route planning, precision farming, land use planning)

### ***Human-Environment Interactions***

- analyse how geotechnologies are used in studying and managing human-environment interactions
- evaluate the effectiveness of geotechnologies in identifying environmental problems and finding solutions

### ***Understanding and Managing Change***

- explain the use of geotechnologies in monitoring change in dynamic systems
- evaluate the use of geotechnologies in modelling and predicting future change

## **World Geography: Urban Patterns and Interactions, Grade 12, College Preparation (CGU4C)**

### ***Geographic Foundations: Space and Systems***

- analyse and compare the characteristics of major urban systems in different parts of the world
  - describe how social, political, cultural, environmental, and economic factors, patterns, and processes have influenced and continue to influence the development of selected cities and urban environments
- explain how social, political, cultural, environmental, and economic processes shape urban places

### ***Human-Environment Interactions***

- describe how the natural environment influences the location and development of settlements
- explain how humans modify the environment to meet urban needs
- assess the effects of human activities on urban and regional ecosystems and propose solutions to urban environmental problems

### ***Global Connections***

- describe the influence of social, cultural, political, environmental, and economic factors on the development of urban settlements in different parts of the world
- analyse the relationships between cities and their surrounding regions

### ***Understanding and Managing Change***

- assess the impact of human migrations on urban systems and patterns
- assess various ways of managing urban change in selected world regions
- analyse various proposed solutions to typical problems of large urban areas

## **The Environment and Resource Management, Grade 12, Workplace Preparation (CGR4E)**

### ***Geographic Foundations: Space and Systems***

- explain relationships among the earth's major components: the lithosphere, atmosphere, hydrosphere, and biosphere
- explain key ecological processes and their significance for ecosystem health
- analyse patterns of bioregions and resource distribution on the earth

### ***Human-Environment Interactions***

- explain how humans both depend upon and are an integral part of ecosystems
- analyse how human activities have positive and negative effects on natural systems
- analyse patterns of resource availability and use

### ***Global Connections***

- explain the relationships among population growth, increasing consumption of resources, and environmental degradation on a global scale
- explain how the sustainable use of resources may be achieved through the cooperation of governments, businesses, industries, non-governmental organizations, and citizens around the world, even though their environmental perspectives may differ
- evaluate the effectiveness of international efforts to deal with global environmental issues

### ***Understanding and Managing Change***

- describe trends in the consumption of natural resources and in resource management practices



- describe the process of environmental degradation in an ecosystem and assess an existing rehabilitation strategy or devise a new one
- evaluate the effects that environmental protection and resource management have on society

## **HISTORY**

*Cause-and-effect relationships are critical to the study of history and often provide a rich context for making connections to environmental factors and concerns. The two strands in the history courses that incorporate environmental education to the greatest extent are Communities: Local, National, and Global, and Social, Economic, and Political Structures (specifically, the Economic Development section).*

### **American History, Grade 11, University Preparation (CHA3U)**

#### **Communities: Local, National, and Global**

- analyse the development of the United States as a world power and how American policy has influenced communities outside the United States
  - assess the impact of American policies on other nations since 1945 (e.g., rebuilding Europe and Japan after World War II; veto on the United Nations Security Council; competition in the space race; involvement in Cuba, Nicaragua, the Middle East, and the Balkans; position on the Kyoto Protocol on Climate Change; war on terrorism)
  - assess the factors (e.g., geographic, ideological, political, economic) that have contributed to the United States’ status as a world power

#### **Social, Economic, and Political Structures**

- analyse the forces that have influenced American economic development
  - compare American capitalism in the nineteenth and twentieth centuries (e.g., Reconstruction, robber barons, muckrakers, anti-trust legislation, anti-combines legislation, black market during Prohibition, stock market crash of 1929, Great Depression, postwar affluence, labour legislation, Reaganomics, environmental regulation)

### **World History to the Sixteenth Century, Grade 11, University/College Preparation (CHW3M)**

*Note:* The expectations identified below focus on the evolution of human relationships with the natural environment over time, knowledge that will enhance students’ understanding of current environmental concerns.

#### **Communities: Characteristics, Development, and Interaction**

- analyse how selected societies have evolved and responded to challenges

- explain the development of societies from hunter-gatherer to horticultural/pastoral societies, to rural agricultural communities, and then to urban communities
- analyse the factors that contributed to the differentiation of societies (e.g., climate, geography, resources, decisions of leaders, external pressures, size)

### ***Change and Continuity***

- analyse the factors that contributed to the process of change from earliest times to the sixteenth century
  - identify major changes that took place in the world before the sixteenth century (e.g., climatic shifts, domestication of plants and animals, discovery of the wheel, the Neolithic Revolution, development of writing, invention of the printing press, military innovations)

### ***Social, Economic, and Political Structures***

- analyse the development and diversity of social structures in various regions of the world prior to the sixteenth century
  - describe the roles of different members of society in the early stages of human history (e.g., warrior, hunter, healer, spiritual leader)
  - analyse the factors that influenced the development of a variety of forms of social structure (e.g., scarcity of resources and nomadic society, threat of invasion and militaristic society, religion and monastic society, industrial technology and urban society)
- analyse diverse economic structures and the factors that affected their development
  - describe the diverse forms of economic organization that existed prior to the sixteenth century (e.g., horticultural, agricultural, commercial, nomadic, feudal, slave-based)

## **Canadian History and Politics Since 1945, Grade 11, College Preparation (CHH3C)**

### ***Communities: Local, National, and Global***

- explain how global economic and environmental forces have affected Canadians since 1945
  - describe ongoing global environmental challenges and assess the role of Canadians in addressing these challenges (e.g., Greenpeace, negotiations with the United States on acid precipitation, fishing moratoriums, Kyoto Protocol on Climate Change)
- assess Canada’s continuing role in the world community since 1945
  - describe Canada’s participation in international agreements and organizations (e.g., agreements to participate in United Nations peacekeeping operations, World Health Organization [WHO], Universal Declaration of Human Rights, Draft United Nations Declaration on the Rights of Indigenous Peoples, International Campaign to Ban Landmines)

**Note:** The examples in these expectations illustrate how environmental connections can be made in the context of the expectations.

### ***Change and Continuity***

- analyse key developments in Canada’s relations with the United States since 1945 (e.g., defence agreements such as NORAD; trade agreements such as the Auto Pact and NAFTA; changing mandate of the Foreign Investment Review Agency [FIRA]; trade disputes over softwood lumber and following the mad cow crisis; the CRTC’s Canadian content rules; changes in the aftermath of world events such as the Cuban Missile Crisis and September 11)
- analyse continuing issues, concerns, and strengths in Canadian society since 1945
  - assess how the continuing forces of capitalism and free enterprise have affected Canada since 1945 (e.g., exploitation of natural resources, private banking systems, deregulation and privatization of Crown corporations, environmental degradation, increase in part-time employment, economic disparities, loss of national sovereignty, growth of companies such as Bombardier, Magna International, and WestJet)

### ***Citizenship and Heritage***

- assess the advantages and disadvantages of globalization and offshore industries for Canadian workers and other Canadian citizens
- explain the importance of active citizenship and respect for heritage in the lives of Canadians
  - describe the workings of different levels of government, with a focus on how they relate to the rights and responsibilities of active citizenship
- explain how different individuals and communities in Canada seek to fulfil their ambitions and express their identities
  - identify significant Canadian individuals who, through their actions, have affected Canada’s image at home and/or abroad (e.g., Rosalie Abella, Susan Aglukark, Lincoln Alexander, Louise Arbour, Roberta Bondar, Rosemary Brown, Thérèse Casgrain, Roméo Dallaire, Wayne Gretzky, Rick Hansen, Stephen Lewis, Donald H. Oliver, Lester B. Pearson, Bruny Surin, David Suzuki, Pierre Trudeau)

### ***Social, Economic, and Political Structures***

- analyse changes in the Canadian economy since 1945
  - assess the effects of public and private investment and economic policy on local, provincial, and national economies (e.g., sponsorship of megaprojects such as the TransCanada Pipeline; National Energy Program; privatization of Crown corporations such as Petro-Canada, Air Canada; wage and price controls; Bank of Canada monetary policies; branch plants; downsizing)
  - describe developments in Canada’s resource industries since 1945 (e.g., Leduc oil wells; the Tar Sands; Hibernia; nuclear power plants; developments in hydroelectricity, mining, forestry, fishing)

## **Canadian History and Politics Since 1945, Grade 11, Workplace Preparation (CHH3E)**

### ***Communities: Local, National, and Global***

- describe how key global economic and environmental forces have affected Canadians since 1945
  - identify major international economic organizations and agreements and describe their impact on Canadians (e.g., Organization of the Petroleum Exporting Countries [OPEC], European Economic Community, General Agreement on Tariffs and Trade [GATT])
  - identify ongoing global environmental challenges and describe the role of Canadians in addressing these challenges (e.g., Greenpeace, negotiations with the United States on acid precipitation, fishing moratoriums, Kyoto Protocol on Climate Change)

### ***Change and Continuity***

- describe key developments in Canada’s relations with the United States since 1945 (e.g., defence agreements such as NORAD; trade agreements such as the North American Free Trade Agreement [NAFTA]; changing mandate of the Foreign Investment Review Agency [FIRA]; trade disputes over softwood lumber and following the mad cow crisis; the CRTC’s Canadian content rules; changes in the aftermath of world events such as September 11)

*Note:* A number of environmental issues that have affected Canada–U.S. relations since 1945 could be addressed in the context of this expectation, including cross-border pollution, diversion of water to the south, and the negotiation of air and water quality agreements.

- identify continuing issues, concerns, and strengths in Canadian society

### ***Citizenship and Heritage***

- explain the importance of active citizenship and respect for heritage in the everyday lives of Canadians
  - demonstrate an understanding of the workings of different levels of government, with a focus on how they relate to the rights and responsibilities of active citizenship
  - explain how individual citizens can participate in political decision making by communicating with government officials (e.g., letters to politicians, “town hall” meetings, petitions)

*Note:* These expectations help students understand their right – and their responsibility – to take meaningful action as citizens in a democracy – a necessary foundation for becoming environmentally responsible citizens.

### ***Social, Economic, and Political Structures***

- describe changes in the Canadian economy since 1945
  - identify important effects of government policies and programs on national, provincial, and local economies (e.g., sponsorship of megaprojects such as the TransCanada Pipeline or James Bay hydroelectric project, the National Energy Program, wage and price controls, Bank of Canada monetary policies)

- describe the impact of major developments in the Canadian consumer economy since 1945 (e.g., suburbanization, subsidized housing, targeting of teenage consumers, shopping malls, personal credit cards, automated service)

## **World History Since 1900: Global and Regional Perspectives, Grade 11, Open (CHT3O)**

### ***Change and Continuity***

- describe the nature and impact of significant change since 1900
  - describe major technological and economic changes since 1900 and their impact on society (e.g., the automobile, electricity, electronic and computer technology; progressive taxation, consumerism, global capitalism)
- explain the importance of chronology and cause-and-effect relationships within the context of history since 1900
  - analyse the relationships between selected political, social, economic, and cultural issues and events since the beginning of the twentieth century (e.g., World War I and isolationism, the Great Depression and social welfare legislation, fishing practices and territorial waters, civil disobedience and economic disruption)

### ***Citizenship and Heritage***

- describe elements that have helped to create a sense of international and global unity (e.g., political ideologies such as pacifism, communism, and socialism; international women's movements; humanitarian idealism; global environmental concerns)

### ***Social, Economic, and Political Structures***

- describe and assess local, national, and global implications of major economic crises since 1900 (e.g., the Great Depression, China's Great Leap Forward, the 1973 OPEC oil crisis, eastern Europe and the collapse of the Soviet Union, the Asian financial crisis of the 1990s, the technology stock crash of 2000, the Enron scandal)
- analyse the problems that have faced the underdeveloped world in achieving economic stability and prosperity (e.g., lack of capital investment, exploitation of citizens as cheap labour, fragile taxation base, political corruption, foreign ownership, debt load)

## **Canada: History, Identity, and Culture, Grade 12, University Preparation (CHI4U)**

### ***Communities: Local, National, and Global***

- describe the characteristics of Aboriginal communities before and after contact with Europeans and analyse the significant effects of the interactions between Aboriginal communities and the colonizers

- describe various aspects of Aboriginal life prior to contact with Europeans (e.g., traditional economies, spirituality, relationship with the environment, political organization)
- analyse significant aspects and effects of the interactions between Aboriginal peoples and European colonists (e.g., spread of disease; introduction of new weapons; missions; Aboriginal peoples’ sharing of environmental knowledge with Europeans; the Royal Proclamation of 1763; territorial relocation; emergence of the Métis; treaties; Riel Rebellion; movement towards self-government)

### ***Change and Continuity***

- assess changes in Canada’s rural-agricultural and urban-industrial communities
  - evaluate the changing economic and cultural contributions of Canadian agricultural and resource-based communities (e.g., fishing villages, mining and mill towns, Prairie breadbasket, oil sands; . . .)
- analyse the relationship between major technological and social changes in Canada
  - analyse how changes in technology (e.g., introduction of steam power, combustion engine, automation, mechanization, electricity, telephone, labour-saving appliances, radio, television, computers) have affected Canadian homes and workplaces

### ***Social, Economic, and Political Structures***

- assess the effectiveness of various economic policies and initiatives in promoting Canadian sovereignty (e.g., National Policy; Halibut Treaty, 1923; Foreign Investment Review Agency; National Energy Program; Arctic Environmental Protection Strategy, 1991; Turbot War, 1995)
- assess the efforts of popular movements to reform Canadian society
  - analyse the growth of environmentalism (e.g., establishment of national parks, Federation of Ontario Naturalists, work of Jane Jacobs, Greenpeace, Lubicon-Daishowa dispute, James Bay hydroelectric project protests, ratification of the Kyoto Protocol on Climate Change) and its influence on how Canadians live

## **World History: The West and the World, Grade 12, University Preparation (CHY4U)**

### ***Communities: Local, National, and Global***

- describe the development of urbanization and its impact on various communities and the environment (e.g., development of administrative, market, commercial, and industrial towns and cities; the rise of the metropolis and metropolitan sprawl; issues of inner cities and suburbia; issues of law, order, and infrastructure; cycles of construction and destruction of the urban landscape; loss of agricultural land; pollution)
- assess various types of interactions that have occurred among diverse peoples and cultures, and the impact of these interactions, since the sixteenth century

- analyse the impact of Western colonization on both the colonizer and the colonized (e.g., enrichment and impoverishment; exploitation of resources and indigenous populations; cultural transfers; exposure to highly contagious diseases; introduction of non-indigenous species; assimilation and acculturation; ethnic cleansing; revival of commitment to indigenous cultural identities)

### ***Citizenship and Heritage***

- explain how key Western beliefs, philosophies, and ideologies have shaped the West and the rest of the world since the sixteenth century
  - describe the main tenets of key modern beliefs and philosophies and explain how they have shaped Western thought (e.g., the Reformation and Calvinism, rationalism and empiricism, romanticism, various forms of socialism, Darwinism, Marxism-Leninism, fascism and Nazism, liberal democracy, feminism, consumerism, environmentalism, conflicting conceptions of globalization)

### ***Social, Economic, and Political Structures***

- analyse significant economic developments in the West and the rest of the world since the sixteenth century
  - analyse the effects of industrialization and free enterprise capitalism on the economies and environment of the West and the rest of the world (e.g., unprecedented increase in material wealth, creation of large factories and industrial cities, increase in resource and market imperialism, rise of consumerism; resource depletion, air and water pollution)
  - assess the consequences of international economic interrelationships that have developed since the sixteenth century (e.g., labour and resource exploitation of poor countries, widening disparities of economic opportunity and wealth, environmental degradation, cultural homogenization, globalized production and marketing, revival of economic and cultural nationalism, increased demand for rights for women and children)

## **World History: The West and the World, Grade 12, College Preparation (CHY4C)**

### ***Communities: Local, National, and Global***

- demonstrate an understanding of a variety of types of communities that have evolved since the sixteenth century
  - identify pivotal developments and issues in the process of urbanization and describe their impact on the environment (e.g., development of administrative, market, commercial, and industrial towns and cities; the rise of the metropolis and metropolitan sprawl; issues of inner cities and suburbia; issues of law, order, and infrastructure; cycles of construction and destruction of the urban landscape; loss of agricultural land; pollution)

### ***Change and Continuity***

- identify internal and external forces that have influenced the process and scope of change that has occurred in different regions from the sixteenth century to the present (e.g., developments in religion; changing views of the universe, from the geocentric to the heliocentric to notions of an expanding universe; social reform; disease; limited resources; conflict and war; human migration; climate change)

### ***Citizenship and Heritage***

- describe key Western beliefs, philosophies, and ideologies that have shaped the West and the rest of the world since the sixteenth century
  - describe the main tenets of some key modern beliefs and philosophies and how they have shaped Western thought (e.g., the Reformation and Calvinism, rationalism and empiricism, romanticism, socialism, Darwinism, Marxism-Leninism, fascism and Nazism, liberal democracy, feminism, environmentalism, competing concepts of globalization)

### ***Social, Economic, and Political Structures***

- explain significant economic developments in the West and the rest of the world since the sixteenth century
  - describe the effects of industrialization and free enterprise capitalism on the economies and environment of the West and the rest of the world (e.g., unprecedented increase in material wealth, creation of large factories and industrial cities, increase in resource and market imperialism, rise of consumerism; resource depletion, air and water pollution)
  - describe the consequences of global economic interrelationships that developed in the twentieth century (e.g., labour and resource exploitation, widening disparities of economic opportunity and wealth, environmental degradation, cultural homogenization, globalized production and marketing, revival of economic and cultural nationalism, increased demand for rights for women and children)

## **Adventures in World History, Grade 12, Workplace Preparation (CHM4E)**

### ***Communities: Local, National, and Global***

- explain how people in different communities have developed skills and created implements in order to work productively
  - identify selected developments in tool making from the Stone Age to the present (e.g., fashioning of stone and obsidian implements, invention and uses of the wheel, development of measuring systems and devices)
- explain the effects of pivotal inventions and technological innovations on community life

**Note:** These expectations focus on the evolution of human relationships with the natural environment over time, knowledge that will enhance students' understanding of current environmental concerns.



# **LAW**

## **Understanding Canadian Law, Grade 11, University/College Preparation (CLU3M)**

### ***Rights and Freedoms***

- describe the sources of rights and freedoms in Canada and explain how particular rights and freedoms may conflict

*Note:* This overall expectation could include a consideration of environmental rights.

### ***Regulation and Dispute Resolution***

- explain the dynamic nature of law, including the way in which it evolves in response to technology and changes in societal values
  - explain how changes in attitudes and societal values bring about changes in the law (e.g., censorship, gambling, and drinking and driving laws; laws relating to women and children; laws protecting the environment; laws regulating the workplace; legal requirements of a valid marriage)

## **Understanding Canadian Law, Grade 11, Workplace Preparation (CLU3E)**

### ***Rights and Freedoms***

- explain how recognition of rights, responsibilities, and freedoms has developed in Canada

*Note:* This expectation allows for consideration of environmental issues.

## **Canadian and International Law, Grade 12, University Preparation (CLN4U)**

### ***Heritage***

- describe the relationship between law and societal values

### ***Rights and Freedoms***

- analyse the conflicts between minority and majority rights and responsibilities in a democratic society, and examine the methods available to resolve these conflicts

*Note:* The first expectation above can be applied to incorporate the relationship between law and societal concerns about the environment, and the second could be applied to conflicts related to the environment.

### **Regulation and Dispute Resolution**

- evaluate the effectiveness of governments, courts, and individual and collective action in protecting the environment
- evaluate the effectiveness of international laws, treaties, and agreements in resolving conflicts of a global nature
  - evaluate the effectiveness of international treaties for the protection of the environment (e.g., Kyoto Protocol, 2002; Johannesburg Summit; World Summit on Sustainable Development)

## **POLITICS**

*Many of the expectations in the Politics courses address processes and relationships that are highly relevant to current issues related to the environment. The expectations identified below lend themselves well to making environmental connections in the classroom.*

### **Canadian Politics and Citizenship, Grade 11, Open (CPC30)**

#### **Citizenship, Democracy, and Participation**

- describe the key features of citizenship and democracy
- evaluate the influence of various forms of citizen action on public policy

#### **Power, Influence, and the Resolution of Differences**

- explain power relationships among individuals, groups, and governments
- analyse how pressure groups, media, technology, and governments influence the political process
- evaluate different approaches to conflict resolution

#### **Decision-Making Systems and Processes**

- describe the extent to which political and economic systems and institutions in Canada meet people's needs and promote the common good
  - explain how selected choices made in Canada (e.g., ratification of the Kyoto Protocol, Ontario's Drive Clean program, NAFTA, the ban on cod fishing) are likely to affect the current and future well-being of people and environments in Canada and around the world

#### **Values, Beliefs, and Ideologies**

- explain how political ideologies and the political spectrum in Canada influence debates on current issues

- evaluate the major historical, geographic, economic, and cultural influences that shape Canadian political ideologies
- describe the factors that shape the political values and beliefs of Canadians

## **Canadian and World Politics, Grade 12, University/College Preparation (CPW4U)**

### ***Participation in the International Community***

- explain the rights and responsibilities of individual citizens, groups, and states in the international community
  - describe the rights and obligations of selected international groups (e.g., UNESCO, International Monetary Fund [IMF], environmental lobby groups)
  - describe the actions of individuals, including Canadians, who have influenced global affairs (e.g., Nelson Mandela, Jimmy Carter, Kim Dae-jung, Aung San Suu Kyi, Pope John Paul II, Lester B. Pearson, David Suzuki, Stephen Lewis, Craig Kielburger)
- evaluate the role of Canada and Canadians in the international community
  - evaluate the role of pressure groups in formulating and implementing Canada’s foreign policy (e.g., anti-landmine activists, the environmentalist lobby, the media, the Alliance of Manufacturers and Exporters Canada)
- describe the structure and function of international intergovernmental and non-governmental organizations
  - explain the origins, functions, and objectives of selected international non-governmental organizations (NGOs) (e.g., International Committee of the Red Cross/Red Crescent, Amnesty International, Greenpeace)

### ***Power, Influence, and the Resolution of Differences***

- analyse how natural resources and human resources help to determine the power and influence of a country (e.g., geography, demography, economic resources and markets, military strength and diplomatic traditions)
- evaluate Canada’s role and influence in international relations
  - describe some important factors shaping Canadian foreign policy (e.g., commitments under the 1997 Mine Ban Treaty, Kyoto Protocol, North American Free Trade Agreement)

### ***Values, Beliefs, and Ideologies***

- compare the aspirations, expectations, and life conditions of people in developed and developing nations
  - compare key elements of selected theories concerning the nature of effective development (e.g., in relation to human development, global industrialization, sustainable national development, ecological preservation)

# **CLASSICAL AND INTERNATIONAL LANGUAGES, GRADES 9 AND 10 (1999) AND CLASSICAL STUDIES AND INTERNATIONAL LANGUAGES, GRADES 11 AND 12 (2000)**

*See the Preface for important information on the organization of the following material.*

Although none of the expectations in the classical studies and international languages curriculum explicitly addresses environmental education, in each of the strands in the various courses the development of environmental understanding can be fostered through both the learning context (e.g., a topic, thematic unit, or issue related to the environment) and learning materials (e.g., books, websites, media). Students could address aspects of life and/or culture in ancient times from an environmental perspective or present a topic from an environmental point of view in a debate, panel discussion, speech, or written assignment.

## **International Languages, Level 4, Open (LBADO–LYXDO)**

### ***Writing***

- convey information and express opinions in writing, using different forms (e.g., write a résumé, business letter, or personal composition on an environmental or other issue)

**Note:** The example in this expectation illustrates how environmental connections can be introduced in the context of expectations in classical studies and international languages courses.

# COMPUTER STUDIES, GRADES 10 TO 12 (2008)

## Introduction to Computer Studies, Grade 10, Open (ICS2O)

### ***C. Computers and Society***

#### **C2. Environmental Stewardship and Sustainability**

**C2.** describe computer use policies that promote environmental stewardship and sustainability

**C2.1** describe the negative effects of computers and computer use on the environment (*e.g., chemicals from electronic waste dumped in landfills – domestic or overseas – leaching into soil and groundwater; unnecessary use of paper; heavy power consumption*) and on human health (*e.g., effects of exposure to radiation ...*)

**C2.2** identify measures that help reduce the negative effects of computers on the environment (*e.g., lab regulations, school policies, corporate policies, provincial policies, paperless workplaces*) and on human health ...

**C2.3** describe ways in which computers are or could be used to reduce resource use and to support environmental protection measures (*e.g., computer modelling to reduce use of physical resources; interpretation of large amounts of environmental data; management of natural resources; programmable temperature control to reduce energy consumption*)

**C2.4** describe, on the basis of research, how and where recycled electronic waste is processed, and identify local companies and institutions that offer such services

## Introduction to Computer Science, Grade 11, University Preparation (ICS3U)

### ***D. Topics in Computer Science***

#### **D1. Environmental Stewardship and Sustainability**

**D1.** describe policies on computer use that promote environmental stewardship and sustainability

**D1.1** describe the negative effects of computer use on the environment (*e.g., creation of e-waste, excessive use of paper resulting from unnecessary printing of files and emails, heavy power consumption*) and on human health (*e.g., exposure to radiation ...*)

**D1.2** identify measures that help reduce the impact of computers on the environment (*e.g., lab regulations, school policies, corporate and government policies promoting paperless workplaces and computer recycling and reuse*) and on human health ...

**D1.3** describe ways in which computers are or could be used to reduce resource use and to support environmental protection measures (*e.g., computer modelling to reduce use of physical resources; management of natural resources*)

**D1.4** identify government agencies and community partners that provide resources and guidance for environmental stewardship (*e.g., local community recycling centres, private companies that refurbish computers, printer cartridge recycling programs*)

## **D2. Exploring Computer Science**

**D2.2** demonstrate an understanding of an area of collaborative research between computer science and another field (*e.g., ... geology, ... climatology, ...*)

# **Introduction to Computer Programming, Grade 11, College Preparation (ICS3C)**

## ***B. Software Development***

### **B3. Designing Simple Algorithms**

**B3.2** solve problems (*e.g., ... fuel consumption on a car trip; ... temperature at a given altitude, using the environmental lapse rate*) by applying mathematical equations or formulas in an algorithm

## ***D. Computers and Society***

### **D1. Environmental Stewardship and Sustainability**

**D1.** describe computer use policies that promote environmental stewardship and sustainability

**D1.1** describe negative effects of computer use on the environment (*e.g., creation of waste, unnecessary printing of emails, heavy power consumption*) and on human health (*e.g., exposure to radiation, ...*)

**D1.2** identify measures that help reduce the impact of computers on the environment (*e.g., lab regulations, school policies, corporate policies, provincial policies, paperless workplaces, computer recycling and reuse*) and on human health ...

**D1.3** describe ways in which computers are or could be used to reduce resource use and to support environmental protection measures (*e.g., computer modelling to reduce use of physical resources; interpretation of large amounts of environmental data; management of natural resources; programmable temperature control to reduce energy consumption*)

**D1.4** identify government agencies and community partners that provide environmental stewardship opportunities (*e.g., local community recycling centres, private companies that refurbish computers, printer cartridge recycling programs*)

### **D3. Emerging Technologies**

**D3.3** describe some of the solutions to complex problems affecting society that have been or are being developed through the use of advanced computer programming and emerging technologies (*e.g., monitoring and regulating electrical supply and demand; ... analysing large-scale meteorological data to predict catastrophic storms*)

## Computer Science, Grade 12, University Preparation (ICS4U)

### ***D. Topics in Computer Science***

#### **D1. Environmental Stewardship and Sustainability**

- D1.** assess strategies and initiatives that promote environmental stewardship with respect to the use of computers and related technologies
- D1.1** outline strategies to reduce the impact of computers and related technologies on the environment (*e.g., reduce, reuse, and recycle; turn computers and monitors off at end of day; participate in printer cartridge recycling*) and on human health ...
- D1.2** investigate and report on governmental and community initiatives that encourage environmental stewardship and promote programs and practices that support sustainability (*e.g., local community recycling centres, private companies that refurbish computers, printer cartridge recycling programs*)

#### **D4. Exploring Computer Science**

- D4.1** report on some areas of collaborative research between computer science and other fields (*e.g., ... geology, ... climatology, ...*), on the basis of information found in industry publications (*e.g., from the ACM and IEEE*)

## Computer Programming, Grade 12, College Preparation (ICS4C)

### ***D. Computers and Society***

#### **D1. Environmental Stewardship and Sustainability**

- D1.** analyse and apply strategies that promote environmental stewardship with respect to the use of computers and related technologies
- D1.1** outline and apply strategies to reduce the impact of computers and related technologies on the environment (*e.g., reduce, reuse, and recycle; turn computers and monitors off at end of day; participate in printer cartridge recycling*) and on human health ...
- D1.2** investigate and describe governmental and community initiatives promoting environmental stewardship and sustainability (*e.g., local community recycling centres, private companies that refurbish computers, printer cartridge recycling programs*)

# ENGLISH, GRADES 9 AND 10 (2007) AND GRADES 11 AND 12 (2007)

*See the Preface for important information on the organization of the following material.*

Although none of the expectations in the English curriculum explicitly addresses environmental education, in each of the strands in the various courses the development of environmental understanding can be fostered through both the learning context (e.g., a topic, thematic unit, or issue related to the environment) and learning materials (e.g., books, websites, media).

In all courses in the English curriculum, students are encouraged “to look beyond the literal meaning of texts and to think about fairness, equity, social justice, and citizenship in a global society” (see the section “Instructional Approaches” in the front matter of both the Grade 9–10 and 11–12 policy documents). In addition to the opportunities to explore environmental issues afforded by this approach, students acquire literacy skills, including skills related to research and inquiry, that support the development of environmental literacy (see the section “Literacy, Mathematical Literacy, and Inquiry/Research Skills” in the front matter of the policy documents).

In many cases, when global, historical, political, social, and/or economic issues are referred to in the expectations (especially when they are connected to Aboriginal perspectives), the inclusion of environmental topics would be a logical extension and would help students appreciate the scope of the impact that the environment has on their world.

## English, Grade 9, Applied (ENG1P)

### **Media Studies**

**3.1** describe the topic, purpose, and audience for media texts they plan to create (*e.g., a storyboard for a music video to raise money for an environmental cause; the outline for a radio broadcast over the school PA system to commemorate a famous Canadian*) and identify challenges they may face in achieving their purpose

**Note:** One of the examples in this expectation illustrates how environmental connections can be made through the choice of the topic and purpose of the media texts students are expected to create. A similar approach can be adopted in expectations in the Writing strand, with respect to pieces of writing students are expected to produce.



## English, Grade 10, Applied (ENG2P)

### **Reading and Literature Studies**

- 1.1 read several different short, contemporary, student- and teacher-selected texts from diverse cultures, identifying specific purposes for reading (*e.g., identify information from a recycling brochure or from the website of an environmental organization to use in an assignment about protecting the environment; ...*)

**Note:** One of the examples illustrates how an environmental connection can be made in the context of a reading assignment.

## English, Grade 11, University Preparation (ENG3U)

### **Media Studies**

- 1.4 explain why the same media text might prompt different responses from different audiences (*e.g., explain why a war veteran and a student might have different reactions to their country's flag; explain why a parent and a teen might respond differently to a Young Adult novel depicting teen issues and behaviour in a realistic way*)

**Teacher prompts:** “Why might some people be offended by certain ring tones?” “Why does this documentary on climate change prompt such conflicting responses among viewers?”

**Note:** The teacher prompt in this expectation illustrates how environmental connections can be made in the context of exploring differing responses to media texts. In this instance, students would learn about different perspectives on an environmental issue.

## English, Grade 12, University Preparation (ENG4U)

### **Oral Communication**

- 1.8 identify and analyse in detail the perspectives and/or biases evident in oral texts, including complex and challenging texts, commenting with understanding and increasing insight on any questions they may raise about beliefs, values, identity, and power (*e.g., compare and analyse the meaning in the songs of several hip-hop artists; analyse the perspectives of various participants on an expert panel about global warming*)

**Note:** One of the examples illustrates how an environmental connection can be made in the context of this expectation, enabling students to examine various perspectives on a global environmental issue.

## English, Grade 12, College Preparation (ENG4C)

### **Reading and Literature Studies**

**1.5** extend understanding of texts, including increasingly complex or difficult texts, by making appropriate and increasingly rich connections between the ideas in them and personal knowledge, experience, and insights; other texts; and the world around them (*e.g., compare their own values to those of an Olympic athlete profiled in a magazine article; compare their own food choices with those recommended in Canada’s Food Guide; verify the credibility of descriptions of the environment in a futuristic novel by reading current articles about the likely effects of global warming*)

**Note:** One of the examples illustrates how an environmental connection can be made in the context of this expectation, enabling students to examine the possible future impact of global warming.

## Business and Technological Communication, Grade 12, Open (EBT4O)

### **Investigating Business and Technological Communications and Culture**

**1.4** research and demonstrate an understanding of the ways in which communications technologies influence business practices (*e.g., the role of rich web communications systems that combine presentation, training, and online video-conferencing technology in supplementing or replacing face-to-face meetings that require travel; ... the impact of new communications technologies on the ecological “footprints” of various businesses*)

**Teacher prompts:** “How possible is it to have a paperless office?” “What are some examples of waste in the workplace?” ... “Give an example of a communications technology that has increased efficiency in the workplace or home. Do you know of any examples that have decreased rather than increased efficiency? In what way?”

**Note:** The examples and teacher prompts illustrate how environmental connections can be made in the context of learning about communications technologies in business, enabling students to examine the environmental implications of different technologies.

## **ENGLISH AS A SECOND LANGUAGE AND ENGLISH LITERACY DEVELOPMENT, GRADES 9 TO 12 (2007)**

Although none of the expectations in the English as a Second Language and English Literacy Development (ESL and ELD) curriculum explicitly addresses environmental education, in each of the strands in the various courses – Listening and Speaking, Reading, Writing, and Socio-cultural Competence and Media Literacy – the development of environmental understanding can be fostered through both the learning context (e.g., a topic, thematic unit, or issue related to the environment) and learning materials (e.g., books, websites, media). The expectations in the Socio-cultural Competence and Media Literacy strand in particular lend themselves to making environmental connections, as students learn about the rights and responsibilities of Canadian citizens and the current social and cultural realities of Canada. Students could address aspects of Canadian life and culture from an environmental perspective or present a topic from an environmental point of view in a presentation, debate, panel discussion, speech, or written assignment, or they could create a media text exploring an environmental issue.

## **FRENCH AS A SECOND LANGUAGE – CORE, EXTENDED, AND IMMERSION FRENCH, GRADES 9 AND 10 (1999) AND GRADES 11 AND 12 (2000)**

Although none of the expectations in the French as a Second Language (FSL) curriculum explicitly addresses environmental education, in each of the strands in the various courses – Oral Communication, Reading, and Writing – the development of environmental understanding can be fostered through both the learning context (e.g., a topic, thematic unit, or issue related to the environment) and materials (e.g., books, websites, media). Students could address aspects of life and/or culture in French-speaking countries or communities from an environmental perspective or present a topic from an environmental point of view in a debate, panel discussion, speech, or written assignment.

# **GUIDANCE AND CAREER EDUCATION, GRADES 9 AND 10 (2006) AND GRADES 11 AND 12 (2006)**

*See the Preface for important information on the organization of the following material.*

Courses in guidance and career education provide opportunities for students to make environmental connections by exploring careers related to the environment, considering how current environmental concerns and developments may affect jobs and the labour market, and learning about workplace practices that have been adopted to protect the environment. Relevant expectations are listed below.

## **Learning Strategies 1: Skills for Success in Secondary School, Grade 9, Open (GLS10/GLE10/GLE20)**

### ***Exploration of Opportunities***

*All expectations in the strand*

**Note:** The expectations in this strand allow students who are interested in the environment to identify and research related careers.

## **Career Studies, Grade 10, Open (GLC20)**

### ***Exploration of Opportunities***

- identify current trends in society and the economy and describe their effect on work opportunities and work environments

**Note:** This overall expectation, along with its corresponding specific expectations, gives students the opportunity to make various environmental connections.

## **Discovering the Workplace, Grade 10, Open (GLD20)**

### ***Exploration of Opportunities***

- demonstrate an understanding of the nature of work and of workplace expectations and issues
  - identify various workplace issues (e.g., ethics, confidentiality, harassment, equity, responsible use of technology) and explain how policies and procedures dealing with these issues contribute to a positive and productive work environment

**Note:** “Workplace issues” would include whether procedures are in place to protect the environment, such as paper recycling and safe disposal of hazardous substances.

## **Designing Your Future, Grade 11, Open (GWL30)**

### ***Exploration of Opportunities***

- analyse emerging social and economic trends and their impact on individuals, workplaces, and career opportunities

*Note:* Learning related to the expectations in this strand can address trends such as globalization and growing environmental concerns, as well as employment and entrepreneurial opportunities that may emerge in connection with those trends.

## **Leadership and Peer Support, Grade 11, Open (GPP30)**

### ***Interpersonal Knowledge and Skills***

- demonstrate effective use of leadership skills in classroom groups and in planning school or community events

### ***Exploration of Opportunities***

- demonstrate the ability to design and implement a plan or program that addresses needs identified in the school or the community

*Note:* Environmental connections can be made by applying the requirements described in the expectations above to school or community needs related to the environment.

## **Advanced Learning Strategies: Skills for Success After Secondary School, Grade 12, Open (GLS40/GLE40/GLE30)**

### ***Exploration of Opportunities***

- assess the effects of information technology on selected fields of work, including its impact on educational and skill requirements, learning opportunities, how work is done, and employment opportunities
- compare emerging work-style alternatives (e.g., contract work, telecommuting, talent pooling) and other employment-related trends (e.g., changing composition of the labour market, impact of education level on earnings and employment), and explain how these trends may influence their education and career plans

*Note:* These two expectations allow for environmental connections related to conservation of energy and resources and the influence of growing environmental concerns on employment opportunities, respectively.

## **Navigating the Workplace, Grade 12, Open (GLN40)**

### ***Exploration of Opportunities***

- identify workplace issues (e.g., harassment, ethics, confidentiality and the right to privacy, responsible use of computers, gender equity) and explain how policies and procedures dealing with them contribute to a positive and productive work environment
- identify potential health and safety hazards in a workplace setting

**Note:** “Workplace issues” would include whether procedures that protect the environment are in place, such as paper recycling and safe disposal of hazardous substances. Also, by identifying health and safety hazards, students can learn about environmental concerns associated with cleaning products and other substances used in workplace environments, building materials, air vents, and so on.

# HEALTH AND PHYSICAL EDUCATION, GRADES 9 AND 10 (1999) AND GRADES 11 AND 12 (2000)

*See the Preface for important information on the organization of the following material.*

Health and physical education courses provide opportunities for environmental education in several ways. In the Active Living strand of all Healthy Active Living Education (HALE) courses, students are required to demonstrate positive and responsible behaviour in the physical activity setting. If that setting is out of doors, responsible behaviour with respect to the environment should be emphasized. Various other opportunities present themselves in connection with other strands. They are explained below.

## Healthy Active Living Education, Grade 9, Open (PPL10)

### **Active Living**

- demonstrate positive, responsible personal and social behaviour (e.g., striving for personal best, practising regularly, encouraging others, modelling positive behaviour, playing fair) in physical activity settings
- identify the factors that affect choices of activities with potential for lifelong participation and enjoyment

*Note:* Being out of doors is one of the factors that could affect people's choice of activities for lifelong participation and enjoyment. A closely related idea is the need to care for the environment with which people would like to interact throughout their lives.

## Healthy Active Living Education, Grade 10, Open (PPL20)

### **Active Living**

- demonstrate positive, responsible personal and social behaviour (e.g., striving for personal best, practising regularly, encouraging others, modelling positive behaviour, playing fair) in physical activity settings

### **Healthy Living**

- explain how healthy eating fits into a healthy lifestyle

*Note:* An environmental connection to the idea of healthy eating would be a consideration of organic foods, leading to learning about where our food originates and how it is grown, produced, or processed.

### **Living Skills**

- explain their reasoning for their personal choices and actions related to health and well-being



*Note:* Students' reasoning may include wanting to be in an outdoor setting and this consideration could involve thinking about protection of the environment.

## **Healthy Active Living Education, Grade 11, Open (PPL30)**

### ***Active Living***

- demonstrate positive, responsible personal and social behaviour in physical activity settings (e.g., encouraging and helping others, striving for personal bests, showing respect for others, demonstrating good sportsmanship)

### ***Healthy Living***

- describe factors (e.g., environmental, hormonal, nutritional) affecting reproductive health in males and females

*Note:* Consideration of chemicals in foods (e.g., pesticides) and in the environment (e.g., environmental estrogens) is an important aspect of this expectation, as are factors related to the physical environment.

## **Health for Life, Grade 11, Open (PPZ30)**

### ***Determinants of Health***

- analyse how various lifestyle choices (e.g., decisions pertaining to nutrition, physical activity, and smoking) affect health
- implement a personal plan for healthy living
- analyse the social factors that influence personal health (e.g., employment, education, socio-economic status, isolation, rural and urban settings, access to health and recreational services)

*Note:* An environmental connection to the idea of healthy eating would be a consideration of organic foods, leading to learning about where our food originates and how it is grown, produced, or processed.

### ***Community Health***

- analyse how the environment influences the health of the community
  - analyse the environmental factors (e.g., air and water quality, living conditions) that affect personal health (e.g., increase in respiratory and communicable diseases)
  - describe environmental influences on health on the local, national, and global levels (e.g., pollution, industrial activity, weather)

- analyse the impact of public health policies and government regulations on environmental health and community health (e.g., water treatment, waste disposal management, immunization program)
- identify school and workplace health issues (e.g., air quality, occupational injuries)

## **Healthy Active Living Education, Grade 12, Open (PPL4O)**

### ***Active Living***

- demonstrate positive, responsible personal and social behaviour in physical activity settings (e.g., modelling positive behaviour, facilitating group cohesiveness and cooperation)
- demonstrate behaviour that minimizes risk to themselves and others (e.g., when dealing with a capsized kayak, by assessing the safety of climbing equipment, by adopting the principles of fair play)

*Note:* Depending on the activity involved, an understanding of the natural environment could help minimize risk (e.g., understanding wind and wave dynamics, avalanche control).

## **Recreation and Fitness Leadership, Grade 12, College Preparation (PLF4C)**

### ***Facilitation of Recreation and Leisure***

- explain the personal, social, economic, and environmental benefits of recreation and leisure

*Note:* Many of the specific expectations in this strand lend themselves to environmental education to some extent, depending on the needs of the participants and/or the community and whether the recreation or leisure activity takes place out of doors.

# **INTERDISCIPLINARY STUDIES, GRADES 11 AND 12 (2002)**

*See the Preface for important information on the organization of the following material.*

The depth of knowledge relating to the environment that students may acquire in single-credit interdisciplinary studies courses or multiple-credit packages will depend on the courses selected for interdisciplinary study. The Theory and Foundation strand in each interdisciplinary studies course emphasizes examining each discipline from the perspective of the other component discipline(s), and focuses on the use of higher-level thinking skills to integrate knowledge and skills associated with the different disciplines. This approach supports systems thinking, a form of analysis that is essential for understanding environmental issues and concerns. The other two strands in the interdisciplinary studies courses – Processes and Methods of Research, and Implementation, Evaluation, Impacts, and Consequences – will equip student with other important inquiry and critical-thinking skills that will help them become environmentally literate citizens.

## **Interdisciplinary Studies, Grade 11, Open (IDC30/IDP30)**

### ***Implementation, Evaluation, Impacts, and Consequences***

- analyse and describe the impact on society of interdisciplinary approaches and solutions to real-life situations
  - describe and critically analyse contemporary examples of interdisciplinary products and activities that provide innovative approaches and solutions to a variety of real-life situations in the local community (e.g., the coordination of local transportation systems, the delivery of services through e-commerce and e-government, the development of community health and recreation facilities)

**Note:** Students can choose an environmental issue or project as one of the real-life situations that would be the object of their study of interdisciplinary approaches.

## **Interdisciplinary Studies, Grade 12, University Preparation (IDC4U/IDP4U)**

### ***Implementation, Evaluation, Impacts, and Consequences***

- analyse and describe the impact on society of interdisciplinary approaches and solutions to real-life situations
  - describe and critically analyse the contributions to society of leading practitioners who have engaged in interdisciplinary endeavours related to the subjects or disciplines studied and describe the potential impact of their work on future society (e.g., David Suzuki, biologist; Buckminster Fuller, futurist; Margaret Mead, anthropologist; Douglas Cardinal, architect)

**Note:** The example of David Suzuki illustrates how an environmental connection can be made in the context of this expectation.

- identify postsecondary training requirements for and potential employment opportunities in interdisciplinary fields related to the subjects or disciplines under study (e.g., by searching trade and professional publications, consulting university calendars, or inviting guest speakers to class) and describe possible future trends and opportunities (e.g., by researching economic forecasts and futurist speculations)

**Note:** Students could explore educational opportunities in the field of environmental studies or careers in related fields.

## **Interdisciplinary Studies, Grade 12, Open (IDC40/IDP40)**

### ***Theory and Foundation***

- analyse and describe the different perspectives of various disciplines on the same topic as exemplified in key interdisciplinary texts, and explain how these texts have influenced human endeavour (e.g., the influence on urban development of *The Death and Life of Great American Cities* by Jane Jacobs, the influence on health care of *On Death and Dying* by Elisabeth Kübler-Ross)
- demonstrate an understanding of the collaborative attitudes and skills that contribute to the research and creation of interdisciplinary products and activities (e.g., the ability to manage conflict and delegate tasks in planning a public exhibition of school art, to test and extend ideas by role-playing diverse perspectives on environmental issues in biotechnology developments, or to identify decision points in designing a municipal facility)
- identify and describe the strategies that community organizations use to address interdisciplinary issues, problems, and decisions (e.g., a municipality responding to changing environmental concerns, an arts organization funding diverse cultural activities)

**Note:** The examples illustrate how environmental connections can be made in the context of these expectations.

### ***Implementation, Evaluation, Impacts, and Consequences***

- analyse and describe the impact on society of interdisciplinary approaches and solutions to real-life situations
  - describe and critically analyse the potential cultural, economic, political, environmental, and technological impacts on present and future societies of interdisciplinary endeavours related to the subjects or disciplines studied (e.g., the impact of the Bauhaus movement on modern architecture, design, and the arts; of cybernetics on effective organizations; of alternative medicine on health-care systems)

# MATHEMATICS, GRADES 9 AND 10 (2005) AND GRADES 11 AND 12 (2007)

*See the Preface for important information on the organization of the following material.*

Although expectations in the mathematics curriculum do not explicitly address environmental education, the development of environmental understanding can be fostered through the learning context (e.g., problems and examples related to environmental issues such as climate change, habitat destruction, population growth, energy conservation, and waste management). Skills related to data management and measurement can readily be applied to environmental education (e.g., environmental monitoring could involve using trigonometry to determine the height of trees). In addition, becoming practised in the use of mathematical processes such as problem solving and connecting, and developing the literacy and inquiry skills described in the introduction to the mathematics policy documents, will equip students with the qualities and skills they need to become environmentally literate, responsible citizens.

## Principles of Mathematics, Grade 9, Academic (MPM1D)

### ***Measurement and Geometry***

- explain the significance of optimal area, surface area, or volume in various applications (e.g., the minimum amount of packaging material; the relationship between surface area and heat loss)
- solve problems involving the surface areas and volumes of prisms, pyramids, cylinders, cones, and spheres, including composite figures (***Sample problem:*** Break-bit Cereal is sold in a single-serving size, in a box in the shape of a rectangular prism of dimensions 5 cm by 4 cm by 10 cm. The manufacturer also sells the cereal in a larger size, in a box with dimensions double those of the smaller box. Compare the surface areas and the volumes of the two boxes, and explain the implications of your answers.)

**Note:** The examples and the sample problem in these expectations illustrate how connections can be made to environmental issues such as waste (e.g., excess packaging) and energy conservation (e.g., heat loss).

## Foundations for College Mathematics, Grade 11, College Preparation (MBF3C)

### ***Geometry and Trigonometry***

- 1.4 solve design problems that satisfy given constraints (e.g., design a rectangular berm that would contain all the oil that could leak from a cylindrical storage tank of a given height and radius), using physical models (e.g., built from popsicle sticks, cardboard, duct tape) or drawings (e.g., made using design or drawing software), and state any assumptions made

*Note:* The example illustrates how the context of environmental protection (i.e., containing an oil spill) can be introduced in connection with the expectation.

## Mathematics for Work and Everyday Life, Grade 11, Workplace Preparation (MEL3E)

### ***Transportation and Travel***

3.1 gather, interpret, and describe information about the impact (e.g., monetary, health, environmental) of daily travel (e.g., to work and/or school), using available means (e.g., car, taxi, motorcycle, public transportation, bicycle, walking)

**Sample problem:** Discuss the impact if 100 students decided to walk the 3-km distance to school instead of taking a school bus.

*Note:* This expectation gives students the opportunity to calculate the environmental impact of various means of transportation.

## Advanced Functions, Grade 12, University Preparation (MHF4U)

### ***Characteristics of Functions***

2.2 recognize real-world applications of combinations of functions (e.g., the motion of a damped pendulum can be represented by a function that is the product of a trigonometric function and an exponential function; the frequencies of tones associated with the numbers on a telephone involve the addition of two trigonometric functions), and solve related problems graphically

**Sample problem:** The rate at which a contaminant leaves a storm sewer and enters a lake depends on two factors: the concentration of the contaminant in the water from the sewer and the rate at which the water leaves the sewer. Both of these factors vary with time. The concentration of the contaminant, in kilograms per cubic metre of water, is given by  $c(t) = t^2$ , where  $t$  is in seconds. The rate at which water leaves the sewer, in cubic metres per second, is given by  $w(t) = 1/t^4 + 10$ . Determine the time at which the contaminant leaves the sewer and enters the lake at the maximum rate.

*Note:* The sample problem above illustrates how the learning context can be related to the environment – in this case, to water pollution.

## Foundations for College Mathematics, Grade 12, College Preparation (MAP4C)

### **Mathematical Models**

**2.2** describe trends based on given graphs, and use the trends to make predictions or justify decisions (e.g., given a graph of the men’s 100-m world record versus the year, predict the world record in the year 2050 and state your assumptions; given a graph showing the rising trend in graduation rates among Aboriginal youth, make predictions about future rates)

**Sample problem:** Given the following graph [*see page 138 of the curriculum document*], describe the trend in Canadian greenhouse gas emissions over the time period shown. Describe some factors that may have influenced these emissions over time. Predict the emissions today, explain your prediction using the graph and possible factors, and verify using current data.

**Note:** The sample problem illustrates how an environmental connection can be made in the context of this expectation – in this case, through a detailed examination of greenhouse gas emissions.

# **NATIVE LANGUAGES, GRADES 9 AND 10 (1999) AND GRADES 11 AND 12 (2000)**

*See the Preface for important information on the organization of the following material.*

In the Oral Communication, Reading, and Writing strands of the Native language courses, the development of environmental education can be fostered through the learning context (e.g., a topic, thematic unit, or issue related to the environment) and through materials used in the classroom (e.g., books, websites, media). Stories and legends play an important role in First Nation, Métis, and Inuit cultures, often telling of the relationship between humans and their environment. The retelling of such stories and legends in Native language courses thus offers a natural opportunity for environmental education. In addition, teachers of Native language courses can draw upon the understanding and involvement of the local community with respect to environmental concerns to help their students make environmental connections through language study.

## **Native Languages, Level 1, Open (NL1) (LNAAO–LNOAO)**

### ***Oral Communication***

- demonstrate an awareness of Native oral traditions (e.g., Native legends, stories, songs)

## **Native Languages, Level 2, Open (NL2) (LNABO–LNOBO)**

### ***Oral Communication***

- compare the creation stories of various Native communities
- retell Native legends and stories

## **Native Languages, Level 3, Open (NL3) (LNACO–LNOCO)**

### ***Oral Communication***

- use various forms of communication to express Native philosophy
  - retell Native legends, stories, and community histories with accuracy

**Note:** The particular philosophy will determine the extent of the environmental connections that can be made.



## **Native Languages, Level 4, Open (NL4) (LNADO–LNODO)**

### ***Oral Communication***

- demonstrate an understanding of the concept of citizenship in Native North American culture
  - demonstrate an understanding of and respect for Native cultural traditions and arts
  - demonstrate an understanding of citizenship as it applies to the local community
  - describe the concept of citizenship in Native North American culture
  - describe the concept of relationships in Native North American culture (Aboriginal world view)

*Note:* All of these expectations provide opportunities for making environmental connections, by virtue of their content.

## **Native Languages, Level 5, Open (NL5) (LNAEO–LNOEO)**

### ***Oral Communication***

- demonstrate an understanding of the concepts of citizenship and relationships (Aboriginal world view) in the context of an indigenous culture outside North America
  - express a point of view on contemporary issues (e.g., environmental issues, political issues) from a Native perspective
  - demonstrate an understanding of the concept of citizenship in an indigenous culture outside North America
  - demonstrate an understanding of the concept of relationships (Aboriginal world view) in an indigenous culture outside North America

*Note:* All of these expectations provide opportunities for making environmental connections, by virtue of their content.

# NATIVE STUDIES, GRADES 9 AND 10 (1999) AND GRADES 11 AND 12 (2000)

*See the Preface for important information on the organization of the following material.*

First Nation, Métis, and Inuit cultures in Canada, along with Indigenous cultures around the world, are characterized by a profound relationship with the natural environment, which informs various aspects of the lives of contemporary Aboriginal peoples. The Native studies curriculum explores this relationship and its implications from social, economic, political, and artistic perspectives. The expectations that address environmental topics and issues directly, along with those that provide opportunities for making environmental connections, are identified below.

## Expressing Aboriginal Cultures, Grade 9, Open (NAC10)

### **Relationships**

- demonstrate understanding of the relationships among Aboriginal peoples, their environments, and art forms
  - describe aspects of traditional and contemporary Aboriginal relationships, including the relationships of Aboriginal peoples among themselves, to their communities and nations, to Canada, and to the natural environment
  - describe how their art forms demonstrate the relationships of Aboriginal peoples to themselves, their families, their communities (including gender roles), their nations, Canada, and the natural environment
  - explain how natural environments affect the development of Aboriginal art forms (e.g., Inuit soapstone carving)
  - describe the role of art forms in relation to the environment in specific Aboriginal cultures
  
- identify how specific Aboriginal art forms reflect aspects of the society that produced them
  - identify materials (e.g., tobacco, sage, deer hide) that demonstrate specific relationships among Aboriginal peoples and their environments, including people
  - use appropriate natural materials to reproduce art forms that convey some aspect of Aboriginal peoples' beliefs or values related to good relationships
  - produce art forms, using multimedia approaches, to illustrate various relationships to the natural environment

### **Challenges**

- produce Aboriginal-style art forms that reflect solutions to contemporary issues of Aboriginal peoples

**Note:** Environmental issues are important among the contemporary issues of Aboriginal peoples.

## Aboriginal Peoples in Canada, Grade 10, Open (NAC20)

### **Identity**

- identify issues currently affecting Aboriginal peoples and the responses of local and national leadership to these issues

*Note:* Environmental issues are important among the issues currently affecting Aboriginal peoples.

### **Relationships**

- describe the different economic relationships that Aboriginal peoples in Canada have cultivated with the public and private sectors (e.g., ecotourism, co-management of Crown lands, banking)

### **Challenges**

- describe the impact of twentieth-century innovations in technology on Aboriginal communities
  - describe the impact that technological developments have had on Aboriginal society during the latter half of the twentieth century

*Note:* A variety of twentieth-century innovations in technology (e.g., snowmobiles, pesticides) have had an impact on Aboriginal communities and their environment.

## English: Contemporary Aboriginal Voices, Grade 11, University Preparation (NBE3U)

### **Identity**

- analyse the changing quality of life of Aboriginal communities (e.g., Alkali Lake, Davis Inlet), as depicted in media works

*Note:* Students could study media depictions of Aboriginal communities in which quality of life has been affected by environmental factors (e.g., Grassy Narrows, Kashechewan).

### **Challenges**

- identify challenges faced by Aboriginal peoples (e.g., challenges related to identity, urbanization, the need for improved educational and employment opportunities, the loss of extended family), as presented in the works of Aboriginal writers
- analyse Aboriginal writers' depictions of challenges faced by Aboriginal peoples that have resulted directly from societal influences (e.g., racism, ethnocentricity, marginalization)

*Note:* The challenges described in the works of Aboriginal writers would include challenges related to the environment.

- create media works (e.g., a radio documentary on the social changes occurring within an Aboriginal community, a photo essay on a day in the life of a community leader, a brochure on a local entrepreneur, a short video clip promoting an Aboriginal activity) that demonstrate an understanding of the issues associated with challenges faced by Aboriginal peoples

*Note:* The media works created by students could focus on environmental issues.

## **Current Aboriginal Issues in Canada, Grade 11, University/College Preparation (NDA3M)**

### ***Identity***

- demonstrate an understanding of how Aboriginal identity is linked to the physical environment
  - identify ways in which Aboriginal elders, healers, leaders, artists, and writers promote cultural perspectives and identities

*Note:* The specific expectation above provides an opportunity to examine Aboriginal art and writing that conveys Aboriginal peoples' strong links to the land and their relationship with the environment.

### ***Relationships***

- demonstrate an understanding of Aboriginal peoples' strong relationship to the land
  - describe how an Aboriginal world view defines and promotes close relationships (e.g., to the land, family, community, and culture)
  - explain how Aboriginal peoples' relationship with the land affects their perspectives on environmental issues (e.g., resource management), and compare the perspectives of non-Aboriginal society on these issues
  - identify current land-use issues that involve Aboriginal peoples, non-Aboriginal society, and Canadian governments (e.g., issues relating to mining and logging)
  - identify ways in which Aboriginal peoples and non-Aboriginal peoples could cooperate to achieve a common economic, political, or social objective (e.g., through World Earth Day; by jointly providing ecotourism tours)
  - predict how global trends (e.g., increasing scarcity of water, changes in economic opportunity) will impact on the relationship between Aboriginal peoples and Canadian society
  - describe sustainable land-use plans appropriate to local environments (e.g., the Porcupine Caribou Management Board) and resource megaprojects (e.g., the Mackenzie Valley pipeline)

- describe community service projects (e.g., sports camps, habitat restoration projects) that would promote a positive relationship between Aboriginal peoples and other Canadians

### **Challenges**

- demonstrate an understanding of contemporary Aboriginal education and health issues
  - describe how health and education issues relevant to the quality of life of Aboriginal peoples on and off reserves (e.g., the prevalence of diabetes, alcohol and substance abuse, teen pregnancy) are a mutual responsibility of Aboriginal peoples and Canadian society

*Note:* Many of the health problems that affect Aboriginal peoples are related to environmental issues (e.g., water quality, pollution).

- explain Aboriginal and non-Aboriginal perspectives on a specific treaty right (e.g., fishing rights, hunting rights, logging rights)

## **Aboriginal Beliefs, Values, and Aspirations in Contemporary Society, Grade 11, College Preparation (NBV3C)**

### **Identity**

- explain specific environmental influences (e.g., salmon migration on the Northwest Coast; caribou migration for the Dene people, utilization of forests and lakes by the Ojibway and Cree communities) on the social and cultural identity of Aboriginal peoples
- demonstrate an understanding of how Aboriginal peoples' identity as custodians and protectors of the land entrusted to them by the Creator (e.g., as expressed in the thanksgiving address) inspires their historical and contemporary commitment to remaining on their lands (e.g., as reflected in their negotiation of treaties such as the Maritimes Treaty of 1752 and Treaty No. 11)
- describe how Aboriginal practices, behaviours, beliefs, and symbols (e.g., hunting and fishing traditions; ceremonies and feasts; the use of drums, music, and dance) strengthen Aboriginal cultural identities

### **Relationships**

- explain how Aboriginal peoples' relationship to the land traditionally sustained them in various environments across Canada
- explain how Aboriginal peoples' links to the land and to a sustainable environment are part of their cultural identity
  - identify customs, ceremonies, and spiritual beliefs that connect Aboriginal peoples to nature and to one another (e.g., hunters' respect for animal bones, drumming, dream interpretations, traditional roles of family members in different Aboriginal cultures)
  - identify examples of art, architecture, and artifacts that depict a spiritual and emotional link between Aboriginal peoples and their traditional lands (e.g., totem pole carvings; masks; designs of cultural centres; artwork of Daphne Odjig, Maxine Noel, and Joane Cardinal Schubert)

- demonstrate an understanding of traditional Aboriginal activities associated with the seasonal cycle
- describe how the spiritual relationship that Aboriginal peoples have with the land is integrated with their beliefs and values (e.g., the Aboriginal belief that many parts of nature have spirits)
- compare harvesting behaviours and beliefs of Aboriginal and non-Aboriginal peoples (e.g., wild rice harvesting, fishing practices on the east and west coasts of Canada)

## **English: Contemporary Aboriginal Voices, Grade 11, College Preparation (NBE3C)**

### ***Relationships***

- demonstrate an understanding of relationships (e.g., within the family or community; within the plant, animal, or spirit world) portrayed in the works of Aboriginal writers

### ***Challenges***

- demonstrate an understanding of Aboriginal writers’ descriptions of the challenges faced by Aboriginal peoples
  - analyse Aboriginal writers’ depictions of challenges faced by Aboriginal peoples that have resulted directly from societal influences (e.g., racism, ethnocentricity, marginalization)

**Note:** The challenges described in the works of Aboriginal writers would include challenges related to the environment.

- create media works (e.g., a radio documentary on the social changes occurring within an Aboriginal community, a photo essay on a day in the life of a community leader, a brochure on a local entrepreneur, a short video clip promoting an Aboriginal activity) that demonstrate an understanding of the issues associated with challenges faced by Aboriginal peoples

**Note:** The media works created by students could focus on environmental issues.

## **Aboriginal Beliefs, Values, and Aspirations in Contemporary Society, Grade 11, Workplace Preparation (NBV3E)**

### ***Identity***

- describe how traditional and contemporary beliefs and values of Aboriginal cultures influence present-day activities and behaviours
  - identify specific environmental influences (e.g., salmon migration on the Northwest Coast; caribou migration for the Dene people; utilization of forests and lakes by the Ojibway and Cree communities) on the social and cultural identity of Aboriginal peoples

- describe the importance of aspects of the environment (e.g., animals, fish, plants) to the identity of Aboriginal cultures
- identify characteristics of language, artistic symbols, and the spiritual beliefs of Aboriginal nations that relate to the natural environment (e.g., the language of the Iroquoian thanksgiving address, West Coast totem poles, Inuit stone carvings)
- describe the importance of Aboriginal customs inside and outside of Aboriginal communities (e.g., smudging, ceremonial uses of tobacco, naming ceremonies, walking out ceremonies, marriage ceremonies, burial ceremonies)
  
- identify Aboriginal businesses that incorporate traditional beliefs, values, and aspirations (e.g., ecotourism projects, wild rice marketing, Air Creebec)

### ***Relationships***

- explain how Aboriginal peoples’ relationship to the land traditionally sustained Aboriginal life in various environments across Canada and continues to be evident in the cultural practices of Aboriginal peoples today
  - describe the physical, intellectual, emotional, and spiritual beliefs of Aboriginal peoples related to the land
  - identify customs, ceremonies, and spiritual beliefs (e.g., respect for animal bones and spirits, uses of songs and drums, creation stories) that connect Aboriginal peoples to the natural environment and to one another
  
  - identify how provincial laws and developments such as hydro-electric dams may restrict Aboriginal harvesting, hunting, and fishing practices (e.g., Northern Manitoba Flood Agreement)

### ***Sovereignty***

- identify how the beliefs and teachings of contemporary elders support political, social, and economic growth (e.g., environmental protection to ensure survival of future generations) as a framework for Aboriginal self-determination
- describe Aboriginal beliefs and values (e.g., relationship to the land) that may affect future directions of treaties and agreements

### ***Challenges***

- identify the obstacles that Aboriginal peoples must overcome to protect and maintain their cultures and languages
  - describe the challenges of accommodating both Aboriginal and business corporation values concerning ecological sustainability in such areas as logging, mining, and the production of hydro-electric power

## **English: Contemporary Aboriginal Voices, Grade 11, Workplace Preparation (NBE3E)**

### ***Challenges***

- identify challenges to Aboriginal communities (e.g., urbanization, economic pressures) that are presented in media works
- examine the challenges facing Aboriginal peoples depicted in documentaries, news reports, journalistic accounts, and photographs (e.g., by examining bias in both the images and the scripts)

*Note:* The challenges depicted in media works would include challenges related to environmental issues.

## **Aboriginal Governance: Emerging Directions, Grade 12, University/College Preparation (NDG4M)**

### ***Identity***

- identify traditional beliefs and values that are part of Aboriginal identity and that affect Aboriginal decision making and leadership

### ***Challenges***

- describe the difference in how land is perceived by Aboriginal society and by Canadian society (e.g., in terms of respect for the land and all living things, compatible resource development, and sustainable small-scale economies) and explain the crucial importance of this difference to governance among Aboriginal peoples
- describe how the ways in which Aboriginal peoples perceive land (e.g., the Aboriginal belief that human beings were given special responsibilities to serve as stewards of the natural environment) may affect the future of Aboriginal and Canadian relations

## **Issues of Indigenous Peoples in a Global Context, Grade 12, University/College Preparation (NDW4M)**

### ***Identity***

- describe emerging global economic and environmental practices and their impact on indigenous cultural identity
  - describe the legal and political perspectives of the world views of indigenous peoples concerning their own social, economic, or cultural development (e.g., regarding governance, resource development, or the preservation of indigenous languages);
  - describe how indigenous peoples throughout the world have maintained the core principles of an indigenous world view (e.g., land stewardship; cooperation; reciprocal



relationships, such as “people with the Creator”, “people with people”, and “people with the environment”) or have lost their traditional ways (e.g., destruction of the rain forest)

- define the factors that indigenous peoples believe are critical for ensuring healthy, sustainable communities (e.g., a secure land base, political autonomy, a viable community-based economy)
- demonstrate an understanding of the different political, economic, and environmental issues that unite indigenous peoples throughout the world (e.g., decolonization, economic exploitation, preservation of biodiversity)

### ***Relationships***

- demonstrate an understanding that the North American Aboriginal cultural perspective on land is shared by indigenous peoples in various parts of the world

### ***Challenges***

- demonstrate an understanding of the global roles that indigenous peoples see for themselves (e.g., stewardship of the environment, co-management of resources with national governments)
- describe the strategies that indigenous peoples are using to sustain their cultures and languages, and to protect the environment
- describe how indigenous peoples are using their cultural practices and traditional teachings when developing new strategies to cope with change
- demonstrate an understanding of the issues that are of common interest to the world’s indigenous population (e.g., resource development, self-determination, the preservation of culture)
- describe the steps (e.g., resolving land claims, granting indigenous peoples rights to natural resources) that members of the international community have taken to ensure that indigenous peoples will have a sustainable land base for generations to come
- identify the successes that indigenous peoples have had in influencing the policies of national governments and multinational corporations (e.g., land-use policies, partnerships, co-management strategies)

# SCIENCE, GRADES 9 AND 10 (2008) AND GRADES 11 AND 12 (2008)

## Science, Grade 9, Academic (SNC1D)

### ***A. Scientific Investigation Skills and Career Exploration***

#### **A2. Career Exploration**

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., astrophysicist, geophysicist, conservation officer, park warden, fire protection engineer, hydrologist, electrician) and the education and training necessary for these careers
- A2.2** identify scientists, including Canadians (e.g., David Suzuki, Howard Alper, Roberta Bondar, Kenneth Hill), who have made a contribution to the fields of science under study

### ***B. Biology: Sustainable Ecosystems***

#### **B1. Relating Science to Technology, Society, and the Environment**

- B1.** assess the impact of human activities on the sustainability of terrestrial and/or aquatic ecosystems, and evaluate the effectiveness of courses of action intended to remedy or mitigate negative impacts
  - B1.1** assess, on the basis of research, the impact of a factor related to human activity (e.g., urban sprawl, introduction of invasive species, overhunting/overfishing) that threatens the sustainability of a terrestrial or aquatic ecosystem [IP, PR, AI, C]  
*Sample issue:* The Great Lakes constitute an important shipping route. Foreign ships often empty their ballast water, which can contain invasive species, directly into the lakes. The goby, which was likely imported in ballast water, is an aggressive fish that has taken over the spawning grounds of some native species, threatening the balance of the ecosystem.  
*Sample questions:* How has suburban development on the Niagara Escarpment or the Oak Ridges Moraine affected local ecosystems? How has the zebra mussel population in Lake Erie affected aquatic species and water quality? How has commercial logging affected the sustainability of forests in Northern Ontario?
  - B1.2** evaluate the effectiveness of government initiatives in Canada (federal, provincial, municipal), and/or the efforts of societal groups or non-governmental organizations, such as Aboriginal communities, environmental groups, or student organizations, with respect to an environmental issue that affects the sustainability of terrestrial or aquatic ecosystems (e.g., wetland restoration, recycling programs, Canada–Ontario Environmental Farm Plans, stewardship of national and provincial parks) [AI, C]  
*Sample issue:* Landfill sites can have negative effects on adjacent ecosystems, attracting pests, leaching toxic chemicals, and producing greenhouse gases. Municipal recycling and composting programs divert garbage, reducing the need for new landfill sites. However, many people, particularly rural residents and those in apartment buildings, may not be included in these programs.

**Sample questions:** What provincial or federal legislation attempts to protect special features or sensitive elements of terrestrial or freshwater ecosystems? How could such legislation be more effective? How have the actions of local wetland-reclamation, municipal tree-planting, Aboriginal fisheries-management, Great Lakes-rehabilitation, organic farming, or other groups helped to ensure ecological sustainability? What further action could such groups take?

## **B2. Developing Skills of Investigation and Communication**

- B2.** investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems
- B2.1** use appropriate terminology related to sustainable ecosystems, including, but not limited to: *bioaccumulation, biosphere, diversity, ecosystem, equilibrium, sustainability, sustainable use, protection, and watershed* [C]
- B2.2** interpret qualitative and quantitative data from undisturbed and disturbed ecosystems (terrestrial and/or aquatic), communicate the results graphically, and, extrapolating from the data, explain the importance of biodiversity for all sustainable ecosystems [PR, AI, C]
- B2.3** plan and conduct an investigation, involving both inquiry and research, into how a human activity affects soil composition or soil fertility (e.g., changes to soil composition resulting from the use of different compostable materials, organic or inorganic fertilizers, or pesticides), and, extrapolating from the data and information gathered, explain the impact of this activity on the sustainability of terrestrial ecosystems [IP, PR, AI, C]
- B2.4** plan and conduct an investigation, involving both inquiry and research, into how a human activity affects water quality (e.g., leaching of organic or inorganic fertilizers or pesticides into water systems, changes to watersheds resulting from deforestation or land development, diversion of ground water for industrial uses), and, extrapolating from the data and information gathered, explain the impact of this activity on the sustainability of aquatic ecosystems [IP, PR, AI, C]
- B2.5** analyse the effect of human activity on the populations of terrestrial and aquatic ecosystems by interpreting data and generating graphs (e.g., data from Statistics Canada, Parks Canada, and other websites on: the concentration in water of chemicals from fertilizer run-off and their effect on the growth of algae; stressors associated with human use of natural areas, such as trampled vegetation, wildlife mortality from motor vehicles, and the removal of plants, animals, and/or natural objects; suburban developments and their impact on the food supply for animals such as foxes and racoons) [PR, AI, C]

## **B3. Understanding Basic Concepts**

- B3.** demonstrate an understanding of the dynamic nature of ecosystems, particularly in terms of ecological balance and the impact of human activity on the sustainability of terrestrial and aquatic ecosystems
- B3.1** compare and contrast biotic and abiotic characteristics of sustainable and unsustainable terrestrial and aquatic ecosystems
- B3.2** describe the complementary processes of cellular respiration and photosynthesis with respect to the flow of energy and the cycling of matter within ecosystems (i.e., carbon dioxide is a by-product of cellular respiration and is used for photosynthesis, which produces oxygen needed for cellular respiration), and explain how human activities can disrupt the balance achieved by these processes (e.g., automobile use increases the

- amount of carbon dioxide in the atmosphere; planting more trees decreases the amount of carbon dioxide in the atmosphere)
- B3.3** describe the limiting factors of ecosystems (e.g., nutrients, space, water, energy, predators), and explain how these factors affect the carrying capacity of an ecosystem (e.g., the effect of an increase in the moose population on the wolf population in the same ecosystem)
- B3.4** identify the earth's four spheres (biosphere, hydrosphere, lithosphere, atmosphere), and describe the relationship that must exist between these spheres if diversity and sustainability are to be maintained
- B3.5** identify various factors related to human activity that have an impact on ecosystems (e.g., the introduction of invasive species; shoreline development; industrial emissions that result in acid rain), and explain how these factors affect the equilibrium and survival of ecosystems (e.g., invasive species push out native species and upset the equilibrium in an ecosystem; shoreline development affects the types of terrestrial and aquatic life that can live near lake shores or river banks; acid rain changes the pH of water, which affects the type of aquatic life that can survive in a lake)

## ***C. Chemistry: Atoms, Elements, and Compounds***

### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** assess social, environmental, and economic impacts of the use of common elements and compounds, with reference to their physical and chemical properties
- C1.1** assess the usefulness of and/or the hazards associated with common elements or compounds in terms of their physical and chemical properties [AI, C]  
**Sample issue:** Polyethylene is a versatile, flexible, and durable compound that is used in a range of products, including toys, plastic bottles, bulletproof vests, and plastic bags. However, its durability poses problems for the environment because products made from polyethylene are not biodegradable.  
**Sample questions:** ... What property of DDT allows it to continue to accumulate in the fatty tissue of mammals despite its ban by the Canadian government in the 1980s? How do the chemical properties of peroxide make it suitable for use in hair dye? What are the hazards associated with this use?
- C1.2** assess social, environmental, and economic impacts of the use of common elements or compounds [AI, C]  
**Sample issue:** By reducing the accumulation of ice on roads, road salt makes winter driving safer, decreasing medical and insurance costs associated with motor vehicle accidents. But the compounds in road salt damage roads and vehicles, pollute water systems, and harm animals and vegetation.  
**Sample questions:** How has the presence of mercury in water bodies in Northern Ontario affected the environment and the lives of Aboriginal people? How does the widespread use of agricultural chemicals in Canada or elsewhere affect the economy, society, and the environment? What are the economic benefits and environmental costs of diamond mining for Northern Canadian communities?

## ***D. Earth and Space Science: The Study of the Universe***

### **D1. Relating Science to Technology, Society, and the Environment**

**D1.2** assess some of the costs, hazards, and benefits of space exploration (e.g., the expense of developing new technologies, accidents resulting in loss of life, contributions to our knowledge of the universe), taking into account the benefits of technologies that were developed for the space program but that can be used to address environmental and other practical challenges on Earth (e.g., radiation monitors and barriers, sensors to monitor air and water quality, remote sensing technology, fire-resistant materials) [AI, C]

**Sample issue:** Technologies that were originally developed for space exploration now have a range of environmental, medical, business, and domestic uses. However, these technologies were developed at great cost, using funds that might have been directed to other types of research and development.

**Sample questions:** What hazards do humans face when they are in space? What technologies have been developed in response to these hazards? How have these technologies been adapted for use on Earth? How much money was spent to develop the Canadarm? How is Canadarm technology now used in other sectors such as medicine and the environment?

### **D3. Understanding Basic Concepts**

**D3.4** describe the sun's composition and energy source, and explain how its energy warms Earth and supports life on the planet (e.g., with reference to the types of radiation the sun emits and the interaction of the sun's energy with Earth's atmosphere)

## ***E. Physics: The Characteristics of Electricity***

### **E1. Relating Science to Technology, Society, and the Environment**

**E1.** assess some of the costs and benefits associated with the production of electrical energy from renewable and non-renewable sources, and analyse how electrical efficiencies and savings can be achieved, through both the design of technological devices and practices in the home

**E1.2** assess some of the social, economic, and environmental implications of the production of electrical energy in Canada from renewable and non-renewable sources (e.g., wind, solar, hydro, coal, oil, natural gas, nuclear) [AI, C]

**Sample issue:** The operation of wind farms along Lake Huron produces electricity from a renewable source, reducing dependence on non-renewable sources of electricity. However, the wind farms produce noise and visual pollution, affect local animal life, and reduce the amount of land available for agriculture.

**Sample questions:** What is the price difference between electricity produced from solar power and by coal-burning plants? What effects do coal mining, oil production, wind farms, and hydroelectric dams have on surrounding ecosystems? What types of hazardous substances are used or created in the production of solar power and nuclear power? What types of emissions are produced by coal-burning and hydroelectric power plants? What are the effects of these emissions on human health and the environment?

- E1.3** produce a plan of action to reduce electrical energy consumption at home (e.g., using EnerGuide information when purchasing appliances), and outline the roles and responsibilities of various groups (e.g., government, business, family members) in this endeavour [IP, AI, C]

**Sample issue:** Replacing incandescent light bulbs with compact fluorescent bulbs can reduce the energy needed to light a home by 75%. Although the bulbs are more expensive than incandescent bulbs, electrical companies sometimes provide coupons to reduce the price. Also, the Ontario government is phasing out incandescent bulbs, which will further reduce energy consumption.

**Sample questions:** What are EnerGuide and ENERGY STAR, and how can they be used when purchasing appliances or electronics? What is the difference in energy consumption between a conventional and a front-loading washing machine? What appliances consume electrical energy even when they are not in use?

## Science, Grade 9, Applied (SNC1P)

### A. Scientific Investigation Skills and Career Exploration

#### A2. Career Exploration

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., radar satellite technician, fish and wildlife technologist, ceramicist, electrician) and the education and training necessary for these careers
- A2.2** identify scientists, including Canadians (e.g., Kim Fernie, Robert Ackman, Helen Hogg, Kenneth Hill), who have made a contribution to the fields of science under study

### B. Biology: Sustainable Ecosystems and Human Activity

#### B1. Relating Science to Technology, Society, and the Environment

- B1.** analyse the impact of human activity on terrestrial or aquatic ecosystems, and assess the effectiveness of selected initiatives related to environmental sustainability
- B1.1** analyse, on the basis of research, how a human activity (e.g., urban sprawl, use of pesticides and fertilizers, creation of pollution, human interaction with wildlife) threatens the sustainability of a terrestrial or aquatic ecosystem [IP, PR, AI, C]
- Sample issue:** Pesticides and fertilizers are used to increase the productivity of land. However, run-off flows into water bodies and leaches into groundwater, poisoning the water or altering its chemical balance and affecting aquatic ecosystems.
- Sample questions:** How does the draining of wetlands for new subdivisions affect local waterbirds and plants that thrive in marshes? How does untreated waste released into rivers or lakes affect fish and animals that eat the fish? How does the introduction of Atlantic salmon or other sport fish affect indigenous lake trout and brook trout?
- B1.2** assess the effectiveness of a local initiative of personal interest that seeks to ensure the sustainability of a terrestrial or aquatic ecosystem (e.g., greening their school grounds; conservation efforts of local Aboriginal communities; naturalizing banks of local rivers or ponds with native vegetation; adoption of an integrated pest management strategy to

combat pests in a local garden), and explain why the initiative is important to the sustainability of the ecosystem [AI, C]

**Sample issue:** Municipal composting initiatives divert garbage from landfill sites and make compost available to gardeners. The use of compost reduces the need for chemical fertilizers, helping to ensure the sustainability of aquatic ecosystems by reducing fertilizer run-off. However, many people, such as those living in apartment buildings, are not included in composting programs.

**Sample questions:** What action has been taken to green the grounds of your school? What effect has such action had on the local ecosystem? What additional action could be taken? What local initiatives have been developed to reduce the amount of pollution released into nearby rivers or lakes? What additional initiatives could be taken to enhance the sustainability of these ecosystems? How has the implementation of an Environmental Farm Plan (EFP) changed practices at a local farm? What are the benefits of the plan with regard to the sustainability of the ecosystem?

## **B2. Developing Skills of Investigation and Communication**

- B2.** investigate some factors related to human activity that affect terrestrial or aquatic ecosystems, and describe the consequences that these factors have for the sustainability of these ecosystems;
- B2.1** use appropriate terminology related to sustainable ecosystems and human activity, including, but not limited to: *biodiversity, biotic, ecosystem, equilibrium, species diversity, sustainability, and watershed* [C]
- B2.2** investigate the characteristics and interactions of biotic and abiotic components of a terrestrial or aquatic ecosystem, and describe the importance of these components in a sustainable ecosystem [PR, AI, C]
- B2.3** compile and graph qualitative and quantitative data on organisms within an undisturbed or disturbed ecosystem (terrestrial or aquatic) (e.g., nematode and earthworm populations in soil or compost; bird populations during migration or winter feeding; tadpole and mosquito larvae populations in a local pond) [PR, AI, C]
- B2.4** plan and conduct an inquiry into how a factor related to human activity affects a terrestrial or aquatic ecosystem (e.g., how changes to soil composition from the use of different compostable materials or organic or inorganic fertilizers affect the types of plants that can be grown; how lower water levels resulting from water diversion affect waterfowl nesting areas and fish reproduction), and describe the consequences that this factor has for the sustainability of the ecosystem [IP, PR, AI, C]
- B2.5** analyse the effect of factors related to human activity on terrestrial or aquatic ecosystems by interpreting data and generating graphs (e.g., data on the concentration in water of chemicals from fertilizer run-off and their effect on the growth of algae) [AI, C]

## **B3. Understanding Basic Concepts**

- B3.** demonstrate an understanding of characteristics of terrestrial and aquatic ecosystems, the interdependence within and between ecosystems, and the impact humans have on the sustainability of these ecosystems
- B3.1** identify similarities and differences between terrestrial and aquatic ecosystems, and describe these similarities and differences using diagrams

- B3.2** describe the interdependence of the components within a terrestrial and an aquatic ecosystem, and explain how the components of both systems work together to ensure the sustainability of a larger ecosystem
- B3.3** describe the complementary processes of cellular respiration and photosynthesis with respect to the flow of energy and the cycling of matter within ecosystems (e.g., carbon dioxide is a by-product of cellular respiration and is used for photosynthesis, which produces oxygen needed for cellular respiration), and explain how human activities can disrupt the balance achieved by these processes (e.g., automobile use increases the amount of carbon dioxide in the atmosphere; planting trees reduces the amount of carbon dioxide in the atmosphere)
- B3.4** identify the major limiting factors of ecosystems (e.g., nutrients, space, water, predators), and explain how these factors are related to the carrying capacity of an ecosystem (e.g., how an increase in the moose population in an ecosystem affects the wolf population in the same ecosystem)
- B3.5** identify some factors related to human activity that have an impact on ecosystems (e.g., the use of fertilizers and pesticides; altered shorelines; organic and conventional farming; urban sprawl), and explain how these factors affect the equilibrium and survival of populations in terrestrial and aquatic ecosystems (e.g., fertilizers change the fertility of soil, affecting what types of plants can grow in it; pesticides leach into water systems, affecting water quality and aquatic life; shoreline development affects the types of aquatic life and terrestrial vegetation that can live by lake shores or river banks; urban sprawl wipes out fields and woods, destroying wildlife habitats)

## ***C. Chemistry: Exploring Matter***

### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** analyse how properties of common elements and/or simple compounds affect their use, and assess the social and environmental impact associated with their production or use
- C1.1** analyse how the chemical and physical properties of common elements and/or simple compounds affect the use of everyday materials that contain those elements and/or compounds [AI, C]  
*Sample issue:* Chlorine compounds have strong disinfectant properties and are used in bleach and to purify water. However, these compounds can be highly toxic and must be used with care.
- C1.2** assess the social and environmental impact of the production or use of a common element or simple compound [AI, C]  
*Sample issue:* The use of road salt makes winter driving safer, reducing the social costs of motor vehicle accidents, including loss of human life. But the compounds in road salt damage roads and vehicles, pollute water systems, and harm animals and vegetation.  
*Sample questions:* What are the social benefits and environmental costs of mining or refining metals such as nickel, iron, or gold? What is the environmental impact of using fertilizers rich in nitrogen on lawns and gardens? What is the environmental impact of the widespread use of plastics?



## ***D. Earth and Space Science: Space Exploration***

### **D1. Relating Science to Technology, Society, and the Environment**

**D1.1** research the challenges associated with space exploration, and explain the purpose of materials and technologies that were developed to address these challenges and how these materials and technologies are now used in other fields of endeavour (e.g., robotic arm technology developed for the space program is used in industry to handle hazardous chemicals; synthetic materials developed to protect astronauts are used in fire-fighting equipment) [IP, PR, AI, C]

**Sample questions:** Why is radiation a particular hazard for astronauts? What sorts of instruments are used to monitor radiation levels? What sorts of materials have been developed to protect astronauts from radiation? What uses would such instruments and materials have on Earth?

### **D3. Understanding Basic Concepts**

**D3.4** describe the characteristics of the sun and the effects of its energy on Earth and Earth's atmosphere

## ***E. Physics: Electrical Applications***

### **E1. Relating Science to Technology, Society, and the Environment**

**E1.** assess the major social, economic, and environmental costs and benefits of using electrical energy, distinguishing between renewable and non-renewable sources, and propose a plan of action to reduce energy costs

**E1.1** assess social, economic, and environmental costs and benefits of using a renewable and a non-renewable source of electrical energy (e.g., solar, wind, hydro, nuclear, coal, oil, natural gas), taking the issue of sustainability into account [AI, C]

**Sample issue:** The production of electricity at nuclear power plants generates very low levels of greenhouse gases. However, the construction and maintenance of nuclear power plants is expensive and the long-term storage of nuclear waste may have an impact on the environment.

**Sample questions:** Which method of production of electrical energy generates the greatest amount of greenhouse gases? Which generates the smallest amount? What are the economic and long-term environmental costs of producing nuclear energy? Of using solar energy? What are some of the social and environmental effects of oil production?

**E1.2** propose a plan of action to decrease household energy costs by applying their knowledge of the energy consumption of different types of appliances (e.g., front-load and top-load washing machines; cathode ray tube [CRT] and liquid crystal display [LCD] computer monitors) [PR, AI, C]

**Sample questions:** Which appliances in the home consume the greatest amount of energy? What are some options for reducing the amount of energy they consume? How cost-efficient is it to purchase a new energy-efficient appliance when a less efficient appliance is still in good working condition?

## Science, Grade 10, Academic (SNC2D)

### ***A. Scientific Investigation Skills and Career Exploration***

#### **A2. Career Exploration**

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., meteorologist, medical illustrator, geochemist, optical physicist) and the education and training necessary for these careers
- A2.2** identify scientists, including Canadians (e.g., Sheela Basrur, William Richard Peltier, Alice Wilson, Willard Doyle), who have made a contribution to the fields of science under study

### ***C. Chemistry: Chemical Reactions***

#### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** analyse a variety of safety and environmental issues associated with chemical reactions, including the ways in which chemical reactions can be applied to address environmental challenges
- C1.1** analyse, on the basis of research, various safety and environmental issues associated with chemical reactions and their reactants and/or product(s) (e.g., chemical reactions related to the use of cyanide in gold mining, the corrosion of metal supports on bridges, the use of different antibacterial agents such as chlorine and bromine in recreational pools) [IP, PR, AI, C]  
*Sample questions:* Why is it important to understand the chemical composition of chlorinating agents used in swimming pools before using them? What chemical reactions result in acid precipitation? What impact does it have on the environment? What sources of information are available on the safety or environmental implications of chemicals and chemical reactions? Why is it important to ensure that these sources are up to date? Why is it important to understand WHMIS information, including Material Safety Data Sheets, before using any chemicals?
- C1.2** analyse how an understanding of the properties of chemical substances and their reactions can be applied to solve environmental challenges (e.g., renewing the Great Lakes, neutralizing acid spills, scrubbing smokestack emissions) [AI, C]  
*Sample issue:* Spills from oil tankers damage the environment by contaminating water and shorelines, killing birds and aquatic life. Biological oil agents help break down the oil so it degrades faster and does less damage to the environment.  
*Sample questions:* How does the addition of lime reduce the acidification of water? How can this reaction be applied to renew lakes that have been affected by acid precipitation? Why is acid leaching used in soil contaminated with heavy metals?

### ***D. Earth and Space Science: Climate Change***

#### **D1. Relating Science to Technology, Society, and the Environment**

- D1.** analyse some of the effects of climate change around the world, and assess the effectiveness of initiatives that attempt to address the issue of climate change

**D1.1** analyse current and/or potential effects, both positive and negative, of climate change on human activity and natural systems (e.g., loss of habitat for Arctic mammals such as polar bears and loss of traditional lifestyles for Inuit as Arctic ice shrinks; famine as arable land is lost to desertification; an increase in water-borne disease and human resettlement as coastal lands are flooded; expansion of the growing season in some regions) [AI, C]

**Sample issue:** Scientists are researching changes in climate patterns as possible contributing factors to an increase in the number of smog days in Ontario and elsewhere in Canada. As the air quality worsens, people may curtail their outdoor activities, and those with respiratory problems may require medical attention, increasing health care costs.

**Sample questions:** How have recent extreme weather events such as heat waves in Europe or drought in southern Africa affected habitats in these regions? How might predicted changes to global temperature and precipitation affect agriculture in Ontario, Canada, or different areas around the world? How might the continuing reduction of the polar ice cap influence domestic and international transportation and shipping?

**D1.2** assess, on the basis of research, the effectiveness of some current individual, regional, national, or international initiatives that address the issue of climate change (e.g., Drive Clean, ENERGY STAR, federal and provincial government rebates for retrofitting older buildings to be more energy efficient, carbon offset programs, community tree-planting programs, municipal recycling programs, Intergovernmental Panel on Climate Change [IPCC]), and propose a further course of action related to one of these initiatives [PR, AI, C]

**Sample issue:** Governments and industry have created rebates or tax cuts to encourage consumers to replace their old appliances with efficient ENERGY STAR appliances. However, such initiatives do not take into account the resources used to create the new products or the problems associated with the disposal of old appliances.

**Sample questions:** What type of recycling and composting programs are in place in your community? What proportion of locally generated garbage do they divert from landfill sites? How could they be improved? What is the purpose of carbon offset credits? Do they achieve that purpose? Why or why not?

## **D2. Developing Skills of Investigation and Communication**

**D2.** investigate various natural and human factors that influence Earth's climate and climate change

**D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo, anthropogenic, atmosphere, cycles, heat sinks, and hydrosphere* [C]

**D2.2** design and build a model to illustrate the natural greenhouse effect, and use the model to explain the anthropogenic greenhouse effect [IP, PR, C]

**D2.3** analyse different sources of scientific data (e.g., lake cores, tree rings, fossils and preserved organisms, ice cores) for evidence of natural climate change and climate change influenced by human activity [PR, AI, C]

**D2.4** investigate a popular hypothesis on a cause-and-effect relationship having to do with climate change (e.g., the combustion of fossil fuels is responsible for rising global temperatures; the concentration of atmospheric CO<sub>2</sub> is responsible for rising global temperatures; global temperatures have been on the increase since the industrial

- revolution; the severity of cyclones, hurricanes, and tornadoes increases as atmospheric temperatures increase), using simulations and/or time-trend data that model climate profiles (e.g., data from Statistics Canada and Environment Canada) [PR, AI, C]
- D2.5** investigate, through laboratory inquiry or simulations, the effects of heat transfer within the hydrosphere and atmosphere [PR, AI]
  - D2.6** investigate, through laboratory inquiry or simulations, how water in its various states influences climate patterns (e.g., water bodies moderate climate, water vapour is a greenhouse gas, ice increases the albedo of Earth's surface) [PR, AI]
  - D2.7** investigate, through research or simulations, the influence of ocean currents on local and global heat transfer and precipitation patterns [PR, AI]
  - D2.8** classify the climate of their local region using various tools or systems (e.g., Ecoregions of Canada, bioclimate profiles), and compare their region to other regions in Ontario, Canada, and the world [AI, C]
  - D2.9** compare different perspectives and/or biases evident in discussions of climate change in scientific and non-scientific media (e.g., with reference to knowledge, beliefs, and values) [AI, C]

### **D3. Understanding Basic Concepts**

- D3.** demonstrate an understanding of natural and human factors, including the greenhouse effect, that influence Earth's climate and contribute to climate change
- D3.1** describe the principal components of Earth's climate system (e.g., the sun, oceans, and atmosphere; the topography and configuration of land masses) and how the system works
- D3.2** describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents
- D3.3** describe the natural greenhouse effect, explain its importance for life, and distinguish it from the anthropogenic greenhouse effect
- D3.4** identify natural phenomena (e.g., plate tectonics, uplift and weathering, solar radiance, cosmic ray cycles) and human activities (e.g., forest fires, deforestation, the burning of fossil fuels, industrial emissions) known to affect climate, and describe the role of both in Canada's contribution to climate change
- D3.5** describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour)
- D3.6** describe how different carbon and nitrogen compounds (e.g., carbon dioxide, methane, nitrous oxide) influence the trapping of heat in the atmosphere and hydrosphere
- D3.7** describe, in general terms, the causes and effects of the anthropogenic greenhouse effect, the depletion of stratospheric and tropospheric ozone, and the formation of ground-level ozone and smog
- D3.8** identify and describe indicators of global climate change (e.g., changes in: glacial and polar ice, sea levels, wind patterns, global carbon budget assessments)

## ***E. Physics: Light and Geometric Optics***

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.2** analyse a technological device that uses the properties of light (e.g., microscope, retroreflector, solar oven, camera), and explain how it has enhanced society [AI, C]

**Sample issue:** Cameras can produce a range of optical effects, from highly detailed and realistic to manipulated and abstract. Photographic images are used for a wide range of purposes that benefit society, including in the areas of culture, education, security, policing, entertainment, and the environment. However, the widespread use of cameras raises privacy concerns.

**Sample questions:** ... How are outdoor lights such as street or stadium lights designed to limit light pollution in surrounding areas?

## **Science, Grade 10, Applied (SNC2P)**

### **A. Scientific Investigation Skills and Career Exploration**

#### **A2. Career Exploration**

**A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., veterinarian assistant, quality control technician, conservation officer, sound and light technician) and the education and training necessary for these careers

### **B. Biology: Tissues, Organs, and Systems**

#### **B1. Relating Science to Technology, Society, and the Environment**

**B1.2** evaluate the effects that use of or exposure to a technology, substance, or environmental factor (e.g., cellphones, X-rays, UV radiation, personal audio players, cigarette smoke, pesticides, food additives/preservatives, vitamins, gene therapy) may have on the function of human tissues, organs, or systems [AI, C]

**Sample questions:** What impact does the ingestion of food additives have on the cells of the digestive system? What impact does smoking have on lung tissue? What effects does exposure to UV radiation have on skin? How can using a personal audio player affect a person's auditory system?

### **C. Chemistry: Chemical Reactions and Their Practical Applications**

#### **C1. Relating Science to Technology, Society, and the Environment**

**C1.** analyse how chemical reactions are employed in common products and processes, and assess the safety and environmental hazards associated with them

**C1.1** analyse, on the basis of research, the function of chemical reactions in the production of selected products and/or in processes commonly encountered at home or in the workplace (e.g., carbonation of soft drinks; rust proofing), and communicate their findings [IP, PR, AI, C]

**Sample questions:** How does the addition of ethanol to gasoline result in cleaner engine emissions? What chemical reactions are used in the rust-proofing process? How can chemical reactions affect the decomposition of important nutrients in food?

**C1.2** identify practical applications of chemical reactions in a particular profession (e.g., ceramics, cosmetology, firefighting, heating and cooling system technology, food preparation, plumbing, custodial services), and assess the associated hazards, including hazards associated with the handling and disposal of chemicals [PR, AI, C]

**Sample issue:** Class B fire extinguishers containing ammonium phosphate, sodium bicarbonate, or potassium bicarbonate are effective in smothering fires involving flammable liquids. However, some of these chemicals are corrosive and can cause damage if introduced to an ecosystem.

## **D. Earth and Space Science: Earth's Dynamic Climate**

### **D1. Relating Science to Technology, Society, and the Environment**

**D1.** analyse effects of human activity on climate change, and effects of climate change on living things and natural systems

**D1.1** analyse, on the basis of research, various ways in which living things and natural systems have been affected by climate change (e.g., the effect of loss of permafrost on northern roads and housing; the effect of longer growing seasons in some regions on farmers; the effect of warming oceans on coral reefs), and communicate their findings [IP, PR, AI, C]

**Sample issue:** Some areas of Canada have been experiencing hotter and drier summers, resulting in poor harvests, loss of wetland habitat, and increased incidence of forest fires. However, in other areas, an increase in the number of frost-free days has extended the agricultural growing season.

**Sample questions:** What effect does climate change have on air quality and extreme weather phenomena? How does global warming increase the vulnerability of Canadian forests to fire and pests? How does the destruction of forests affect animals and humans?

**D1.2** analyse ways in which human actions (e.g., burning fossil fuels, implementing tree-planting programs) have increased or decreased the production of greenhouse gases [AI, C]

**Sample issue:** Motor vehicle emissions are a major contributor to greenhouse gases. People can reduce such emissions by walking, biking, or using public transportation instead of driving; by keeping their vehicle in good operating condition; or by driving a hybrid vehicle.

**Sample questions:** Why do government and/or industry offer rebates to consumers buying programmable thermostats and compact fluorescent light bulbs? How does the production of oil from the Alberta oil sands contribute to greenhouse gas emissions? What is the difference in greenhouse gas emissions between a traditional SUV and a hybrid vehicle? What is “clean coal”, and what is its impact on greenhouse gas emissions? How does large-scale livestock farming increase the production of greenhouse gases? What actions have you and/or your community taken to help reduce levels of greenhouse gases?

### **D2. Developing Skills of Investigation and Communication**

**D2.** investigate various natural and human factors that have an impact on climate change and global warming

**D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere, and weather* [C]

**D2.2** investigate the principles of the natural greenhouse effect, using simulations, diagrams, and/or models, and compare these principles to those of an actual greenhouse [PR, AI]

- D2.3** use a research process to investigate a source of greenhouse gases (e.g., decaying garbage, animal digestive processes, burning biomass) and its effect on a region of Canada (e.g., melting of the polar ice cap in the Arctic, shrinking of glaciers in the Rockies) [IP, PR, AI]
- D2.4** conduct an inquiry to determine how different factors (e.g., an increase in surface temperature, an increase in water temperature) affect global warming and climate change [PR]
- D2.5** investigate their personal carbon footprint, using a computer simulation or numerical data (e.g., determine carbon emissions that result from their travelling to school, work, and recreation venues; from vacation travelling; from buying products imported from distant countries), and plan a course of action to reduce their footprint (e.g., a plan to increase their use of bicycles or public transit; to eat more local foods) [PR, AI, C]
- D2.6** compare different tools or systems used by scientists to make informed decisions on global climate change (e.g., Ecoregions of Canada, bioclimate profiles) [PR, AI]
- D2.7** compare different perspectives and/or biases evident in discussions of climate change in scientific and non-scientific media (e.g., with reference to knowledge, beliefs, and/or values) [PR, AI]

### **D3. Understanding Basic Concepts**

- D3.** demonstrate an understanding of various natural and human factors that contribute to climate change and global warming
- D3.1** describe the principal components of Earth's climate system (e.g., the sun, oceans, and the atmosphere; the topography and configuration of land masses)
- D3.2** describe the natural greenhouse effect, its importance for life, and the difference between it and the anthropogenic greenhouse effect
- D3.3** describe how heat is transferred and stored in both hydrospheric and atmospheric heat sinks
- D3.4** identify different greenhouse gases (e.g., carbon dioxide, methane, water vapour, nitrous oxide), and explain how they are produced naturally in the environment
- D3.5** describe methods by which greenhouse gases are produced by humans (e.g., burning of biomass, chemical reactions involving pollutants)
- D3.6** identify the natural and human causes of climate change in the world and, in particular, how Canada contributes to climate change
- D3.7** identify indicators of global climate change (e.g., changes in: the mass of glacial and polar ice, sea levels, wind patterns, global carbon budget assessments, migratory patterns of birds)

# **BIOLOGY**

## **Biology, Grade 11, University Preparation (SBI3U)**

### ***A. Scientific Investigation Skills and Career Exploration***

#### **A2. Career Exploration**

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., zoologist, botanist, geneticist, ecologist, pharmacologist, farmer, forester, horticulturalist) and the education and training necessary for these careers
- A2.2** describe the contributions of scientists, including Canadians (e.g., ... Louis Bernatchez, ... Helen Battle, Memory Elvin-Lewis), to the fields under study

### ***B. Diversity of Living Things***

#### **B1. Relating Science to Technology, Society, and the Environment**

- B1.1** analyse some of the risks and benefits of human intervention (e.g., tree plantations; monoculture of livestock or agricultural crops; overharvesting of wild plants for medicinal purposes; using pesticides to control pests; suppression of wild fires) to the biodiversity of aquatic or terrestrial ecosystems [AI, C]  
*Sample issue:* Stocking lakes with fish provides recreation for fishing enthusiasts and increases the amount of food available for humans and other animals. However, this practice also increases the competition for food, which could threaten native species and affect the natural biodiversity of the aquatic ecosystem.  
*Sample questions:* What types of conservation efforts have been made to help protect local wetlands from urban developments? In what ways does the planting of native species in a disturbed area help to improve the ecosystem? How and why might some species benefit from human intervention?
- B1.2** analyse the impact that climate change might have on the diversity of living things (e.g., rising temperatures can result in habitat loss or expansion; changing rainfall levels can cause drought or flooding of habitats) [AI, C]  
*Sample issue:* Some scientists believe that we are in the early stages of a human-made mass extinction partly caused by rapid climate change. Many species that cannot tolerate the change will become extinct. However, Earth's history has shown that extinction of some species creates opportunities for surviving species to adapt, evolve, and flourish.  
*Sample questions:* Why do higher temperatures affect the survival of some species in freshwater environments? Why would an increase in ocean temperatures endanger many species that depend on coral as a home and food supply? In what ways have longer growing seasons, which may include a second harvest, affected the biodiversity of agricultural lands? How might species such as the Eastern Massasauga rattlesnake be affected by increased water levels in their habitats?

#### **B3. Understanding Basic Concepts**

- B3.5** explain why biodiversity is important to maintaining viable ecosystems (e.g., biodiversity helps increase resilience to stress and resistance to diseases or invading species)



## **C. Evolution**

### **C1. Relating Science to Technology, Society, and the Environment**

**C1.** analyse the economic and environmental advantages and disadvantages of an artificial selection technology, and evaluate the impact of environmental changes on natural selection and endangered species

**C1.1** analyse, on the basis of research, the economic and environmental advantages and disadvantages of an artificial selection technology (e.g., livestock and horticultural breeding) [IP, PR, AI, C]

**Sample issue:** Selective breeding of agricultural crops can benefit populations in less-developed countries by producing hardier crops, increasing food supplies, and improving the nutritional content of food. However, opponents of artificial selection technology believe that it affects the natural ability of a species to reproduce, which negatively affects biodiversity.

**Sample questions:** How has selective breeding of specific crops helped to increase the yield of the crop and decrease the need for chemicals in the fields? How has the introduction of genetically engineered species in the horticultural industry affected other species planted in the same areas? ...

**C1.2** evaluate the possible impact of an environmental change on natural selection and on the vulnerability of species (e.g., adaptation to environmental changes can affect reproductive success of an organism) [AI, C]

**Sample issue:** An increase in forest fires in some areas of North America has affected the reproductive success of some species as their food supplies decrease and they are forced to adapt to adverse habitat conditions. Yet, forest fires also naturally promote changes in plant and animal species over time as the environment becomes more suitable for other species.

**Sample questions:** Why has a decline in the milkweed population, as a result of urbanization and pesticides, affected the migration of monarch butterflies? How has the introduction of bacteria and viruses in inland lakes affected the life cycle of carp? What impact has the loss of bamboo forests to urbanization had on the giant panda's ability to breed and live?

### **C2. Developing Skills of Investigation and Communication**

**C2.2** use a research process to investigate some of the key factors that affect the evolutionary process (e.g., genetic mutations, selective pressures, environmental stresses) [IP, PR]

## **F. Plants: Anatomy, Growth, and Function**

### **F1. Relating Science to Technology, Society, and the Environment**

**F1.1** evaluate, on the basis of research, the importance of plants to the growth and development of Canadian society (e.g., as a source of food, pharmaceuticals, Aboriginal medicines, building materials, flood and erosion control; as a resource for recreation and ecotourism) [IP, PR, AI, C]

**Sample issue:** The agricultural sector holds great economic potential as demand increases for products such as biofuels, biochemicals, and biopharmaceuticals. Bioresources could also support our efforts to produce renewable energy, improve health, and minimize environmental impact. However, critics are concerned about the impact of bioresources on the availability of food crops and the price of food.

**Sample questions:** In what ways does the local-food movement contribute to community development? How does the re-introduction of native plant species along river banks help to prevent land erosion? What plant species are considered important in sustaining Canada's growth in the agricultural sector? How might the increasing demand for straw-bale housing materials support Canada's agricultural sector and increase the sustainability of other natural resources?

- F1.2** evaluate, on the basis of research, ways in which different societies or cultures have used plants to sustain human populations while supporting environmental sustainability (e.g., sustainable agricultural practices in developing countries such as crop rotation and seed saving; traditional Aboriginal corn production practices) [IP, PR, AI, C]

**Sample issue:** Aboriginal peoples living near Canada's boreal forest rely on forest plants for food and medicine. Plants are harvested by traditional methods to maintain natural habitats and local biodiversity. However, these traditional practices are threatened as more areas are subject to development and commercial resource exploitation.

**Sample questions:** How are strategies for the conservation and sustainable use of medicinal plants being used by small communities and traditional healers in some developing countries? What effect does the re-establishment of wetland plants in agricultural settings have on the natural balance of the ecosystem? How are plants being used to clean wastewater from fish farms so that the water can go back into local streams?

### **F3. Understanding Basic Concepts**

- F3.5** explain the process of ecological succession, including the role of plants in maintaining biodiversity and the survival of organisms after a disturbance to an ecosystem

## **Biology, Grade 11, College Preparation (SBI3C)**

### **A. Scientific Investigation Skills and Career Exploration**

#### **A2. Career Exploration**

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., food science technologist, medical laboratory technologist, dental hygienist, outpost clinic/primary care nurse, respiratory therapist, veterinary technician, water or wastewater technician) and the education and training necessary for these careers

### **B. Cellular Biology**

#### **B1. Relating Science to Technology, Society, and the Environment**

- B1.** evaluate the impact of environmental factors and medical technologies on certain cellular processes that occur in the human body

- B1.2** analyse the effects of environmental factors on cellular processes that occur in the human body (e.g., the effect of lead on nerve cells; the effect of electromagnetic radiation on brain cells) [AI, C]

**Sample issue:** Vitamin D, essential to cellular processes that ensure the health of the bones and teeth, is not well absorbed by the human digestive system. It is manufactured by the body after exposure to the ultraviolet radiation of the sun. However, long-term exposure to the sun without proper UVA and UVB sunscreen protection can eventually lead to skin cancers, such as melanoma.

**Sample questions:** How might ingesting a high level of mercury by eating contaminated fish affect the nerve cells in our bodies? Which chemicals that are sometimes found in drinking water can affect the cells of the reproductive system? What are their possible effects? How can ultraviolet light from the sun affect the cells of the human eye? What types of toxins accumulate in human cells? What is their long-term effect on the body?

## **C. Microbiology**

### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** assess the effects of microorganisms in the environment, and analyse ethical issues related to their use in biotechnology
- C1.1** assess some of the effects, both beneficial and harmful, of microorganisms in the environment (e.g., decomposers break down waste, E. coli in water systems poses a severe risk to human health) [AI, C]

**Sample issue:** Adding beneficial microorganisms to compost at large-scale composting facilities aids in the decomposition of organic waste, and produces high-quality compost in a reduced amount of time. However, the microorganisms can leach into groundwater and run off into nearby water systems, where they can harm other organisms.

## **D. Genetics**

### **D1. Relating Science to Technology, Society, and the Environment**

- D1.** evaluate some social, ethical, and environmental implications of genetic research and related technologies
- D1.2** evaluate, on the basis of research, some of the effects of genetic research and biotechnology (e.g., genetically modified organisms [GMOs]) on the environment [IP, PR, AI, C]

**Sample issue:** Farmed salmon can be genetically modified to reach market size in half the time of normal fish, and cost half as much to feed. However, entire populations of wild fish could be endangered by mating with bioengineered fish that are released into the wild, with disastrous consequences for the ecosystem.

**Sample questions:** What are the risks of growing genetically modified crops near fields where traditional crops are growing? Why have some countries banned genetically modified food crops? What impact has the introduction of herbicide-tolerant plants had on local environments? In what ways can insect-resistant plants both improve agriculture and hurt biodiversity? What are some of the possible effects on the environment of releasing bioengineered insects into the wild?

## **F. Plants in the Natural Environment**

### **F1. Relating Science to Technology, Society, and the Environment**

**F1.** analyse the roles of plants in ecosystems, and assess the impact of human activities on the balance of plants within those ecosystems

**F1.1** analyse, on the basis of research, and report on ways in which plants can be used to sustain ecosystems [IP, PR, AI, C]

**Sample issue:** Urban areas place intense pressure on ecosystems. Some of the negative impact can be reduced by cultivating urban forests. These green spaces filter air, water, and sunlight; reduce the “urban heat island” effect; provide habitat for wildlife; and increase biodiversity. However, many cities do not set aside enough land for green spaces because of pressures for urban development.

**Sample questions:** What are some of the environmental and economic benefits of building urban green spaces on large commercial buildings? What role do native plant species in marshes play in filtering organic waste? How have traditional Aboriginal seed maintenance and distribution practices helped sustain ecosystems in Aboriginal communities?

**F1.2** assess the positive and negative impact of human activities on the natural balance of plants (e.g., crop rotation, the use of fertilizers and herbicides, the introduction of new species) [AI, C]

**Sample issue:** The greening of cities with a variety of native plant species helps to maintain biodiversity, restore natural landscapes, and provide food and habitat for local wildlife. However, many urban gardeners introduce non-native plants, which can compete with the native species and may not be hospitable to the local wildlife.

**Sample questions:** How has increased knowledge about plant growth been applied to improve the resistance of some plants to pests, and allowed those plants to be used in non-native areas? What are the positive and negative effects of such applications? In what ways does monoculture affect the natural balance of plants and the ecosystems they help sustain?

### **F2. Developing Skills of Investigation and Communication**

**F2.** investigate some of the factors that affect plant growth

**F2.1** use appropriate terminology related to plants in the environment, including, but not limited to: *xylem*, *phloem*, *chloroplast*, *pistil*, *stamen*, *nitrogen fixation*, and *tropism* [C]

**F2.3** investigate how chemical compounds (e.g., fertilizers, herbicides, pesticides) and physical factors (e.g., amount of sun and water, quality of soil, pH of soil) affect plant growth [PR, AI]

**F2.4** investigate plant tropism by growing and observing plants in a variety of natural and human-made environments [PR]

### **F3. Understanding Basic Concepts**

**F3.** demonstrate an understanding of the structure and physiology of plants and their role in the natural environment

**F3.4** explain the various roles of plants in the sustainability of the natural environment (e.g., in nutrient cycles, in the water cycle, in erosion control, in wildlife habitats)

## **Biology, Grade 12, University Preparation (SBI4U)**

### **A. Scientific Investigation Skills and Career Exploration**

#### **A2. Career Exploration**

**A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., scientific journalist, fisheries and wildlife officer, physician, infectious disease researcher, geneticist) and the education and training necessary for these careers

### **B. Biochemistry**

#### **B1. Relating Science to Technology, Society, and the Environment**

**B1.1** analyse technological applications related to enzyme activity in the food and pharmaceutical industries (e.g., the production of dairy products; breadmaking; the use of enzymes to control reaction rates in pharmaceuticals) [AI, C]

*Sample issue:* Natural enzymes are used in many food production processes to speed up chemical reactions, which reduces water usage and energy consumption. Scientists are now designing and producing synthetic enzymes that will be more efficient catalysts and allow new technological applications in medicine and industry.

### **C. Metabolic Processes**

#### **C1. Relating Science to Technology, Society, and the Environment**

**C1.1** analyse the role of metabolic processes in the functioning of and interactions between biotic and abiotic systems (e.g., specialized microbes and enzymes in biotechnological applications to treat wastewater in the pulp and paper industry; microbes and enzymes in bioremediation, such as in the cleanup of oil spills; energy transfer from producers to consumers) [AI, C]

*Sample issue:* Most restaurants dispose of cooking oil and grease in an environmentally sound way to avoid contaminating municipal sewer systems. One method they can use is bioaugmentation, which uses microorganisms to metabolize oils into bacterial biomass, carbon dioxide, and water. However, this process can create unpleasant odours, which are undesirable in a food service setting.

*Sample questions:* How do symbiotic bacteria use metabolic processes to produce biohydrogen from food waste? How are microbes used in the bioremediation of contaminated groundwater sites? What is the relationship between the position of a particular species in the food chain and the energy required to maintain that species?

### **D. Molecular Genetics**

#### **D1. Relating Science to Technology, Society, and the Environment**

**D1.2** analyse, on the basis of research, some key aspects of Canadian regulations pertaining to biotechnology (e.g., current or potential legislation for mandatory DNA fingerprinting, human cloning, ownership of a genome, patenting of genetically modified organisms), and compare them to regulations from another jurisdiction [IP, PR, AI, C]

**Sample issue:** Modern biotechnologies, such as selective breeding, are regulated under Health Canada’s Food and Drugs Act and the Canadian Environmental Protection Act. It is an ongoing challenge to ensure that our regulations keep up with advances in scientific knowledge and technologies, as well as with developments in other countries.

**Sample questions:** What is the role of the Canadian Food Inspection Agency with respect to biotechnology? What role does the Canadian Environmental Protection Act play in regulating biotechnology? Why was bovine growth hormone approved for use in dairy cattle in the United States but not in Canada? Why does Mexico have laws to limit the cultivation of genetically modified corn? ...

## **E. Homeostasis**

### **E1. Relating Science to Technology, Society, and the Environment**

**E1.** evaluate the impact on the human body of selected chemical substances and of environmental factors related to human activity

**E1.2** evaluate, on the basis of research, some of the human health issues that arise from the impact of human activities on the environment (e.g., the effects of synthetic estrogen compounds released into our water systems; the effects of leaching of compounds from plastic products into soil and water) [IP, PR, AI, C]

**Sample issue:** Human-produced biosolids are a low-cost source of nutrient-rich organic matter that is often spread on agricultural land rather than being sent for incineration or landfill disposal. Opponents of land application of biosolids are concerned about the potential health impact of heavy metals, bacteria, and drugs that may remain in the biosolids.

**Sample questions:** In what ways have mining, forestry, and hydroelectric developments affected the health of Aboriginal people in Northern Ontario? What are the links between air pollution and respiratory diseases such as asthma? What types of human activity have led to the thinning of the ozone? What human health conditions are related to this phenomenon? How can the dumping of chemicals down sinks and into storm sewers affect the incidence of skin conditions among swimmers at local beaches?

## **F. Population Dynamics**

### **F1. Relating Science to Technology, Society, and the Environment**

**F1.** analyse the relationships between population growth, personal consumption, technological development, and our ecological footprint, and assess the effectiveness of some Canadian initiatives intended to assist expanding populations

**F1.1** analyse the effects of human population growth, personal consumption, and technological development on our ecological footprint (e.g., the deforestation resulting from expanding development and demand for wood products causes the destruction of habitats that support biological diversity; the acidification of lakes associated with some industrial processes causes a decrease in fish populations) [AI, C]

**Sample issue:** Every day, millions of Canadians drive their vehicles to work, school, or entertainment venues, which creates greenhouse gases and consumes non-renewable resources. These behaviours, and many other consumption habits, all contribute to our

ecological footprint. Many experts believe that we are consuming more resources each year than Earth can produce.

**Sample questions:** How does the Living Planet Index (LPI) help a nation to assess its ecological footprint and sustain its population? How does the planned obsolescence of electronic devices and appliances contribute to our ecological footprint? What impact has rapid population growth into the suburbs had on the local environment? What is the environmental impact of using packaged infant formula instead of breastfeeding a baby for the first six months of life?

- F1.2** assess, on the basis of research, the effectiveness of some Canadian technologies and projects intended to nourish expanding populations (e.g., the risks and benefits of growing genetically modified canola; some of the sustainable development projects funded by the Canadian International Development Agency [CIDA]) [IP, PR, AI, C]

**Sample questions:** How are Canadian programs helping to reverse the effects of land degradation and promote sustainable farming in semi-arid and dry sub-humid areas? What is Canada's role in the Flour Fortification Initiative, and how effectively does this initiative meet its goal of nourishing expanding populations?

## **F2. Developing Skills of Investigation and Communication**

- F2.** investigate the characteristics of population growth, and use models to calculate the growth of populations within an ecosystem;

- F2.3** determine, through laboratory inquiry or using computer simulations, the characteristics of population growth of two different populations (e.g., the different population cycles of a predator and its prey; the population cycles of two populations that compete for food; ...) [PR, AI, C]

## **F3. Understanding Basic Concepts**

- F3.5** explain how a change in one population in an aquatic or terrestrial ecosystem can affect the entire hierarchy of living things in that system (e.g., how the disappearance of crayfish from a lake causes a decrease in the bass population of the lake; how the disappearance of beaver from an ecosystem causes a decrease in the wolf population in that ecosystem)

# **CHEMISTRY**

## **Chemistry, Grade 11, University Preparation (SCH3U)**

### **A. Scientific Investigation Skills and Career Exploration**

#### **A2. Career Exploration**

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., pharmacist, forensic scientist, chemical engineer, food scientist, environmental chemist, occupational health and safety officer, water quality analyst, atmospheric scientist) and the education and training necessary for these careers

## **B. Matter, Chemical Trends, and Chemical Bonding**

### **B1. Relating Science to Technology, Society, and the Environment**

- B1.** analyse the properties of commonly used chemical substances and their effects on human health and the environment, and propose ways to lessen their impact
- B1.1** analyse, on the basis of research, the properties of a commonly used but potentially harmful chemical substance (e.g., fertilizer, pesticide, a household cleaning product, materials used in electronics and batteries) and how that substance affects the environment, and propose ways to lessen the harmfulness of the substance (e.g., by reducing the amount used, by modifying one of its chemical components) or identify alternative substances that could be used for the same purpose [IP, PR, AI, C]  
*Sample issue:* Many commercial household cleaning products contain corrosive substances that can accumulate in the environment. There are now many “green” cleaners that do not contain these substances, although some of these products may not be as environmentally friendly as claimed.  
*Sample questions:* Why is it more environmentally friendly to use latex rather than oil-based paint? Why should paint never be poured down a drain? What properties of some common pharmaceuticals allow them to stay in water systems and influence the growth and development of organisms? What are some ways in which this impact can be reduced?
- B1.2** evaluate the risks and benefits to human health of some commonly used chemical substances (e.g., chemical additives in foods; pharmaceuticals; cosmetics and perfumes; household cleaning products) [AI, C]  
*Sample questions:* How can the use of non-stick cookware help reduce the amount of fat in our diet? What risks are associated with the use of such cookware? What are the risks and benefits of using sunscreens that contain PABA? What are the risks and benefits of using insect repellents that contain DEET?

## **C. Chemical Reactions**

### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** analyse chemical reactions used in a variety of applications, and assess their impact on society and the environment
- C1.1** analyse, on the basis of research, chemical reactions used in various industrial processes (e.g., pulp and paper production, mining, chemical manufacturing) that can have an impact on the health and safety of local populations [IP, PR, AI, C]  
*Sample issue:* Base metal smelting produces useful metals such as zinc, lead, copper, and nickel directly from their ores. However, during smelting, harmful compounds can be released into the environment, including cadmium, arsenic, sulphur dioxide, and mercury, all of which can endanger the health and safety of local populations.  
*Sample questions:* What are some chemical reactions used in the manufacture of paper? How might the reactants or products of the pulp and paper production process affect the health of people living near the plant? In what ways might the leaching of chemicals from tailing ponds affect the water quality in a local community? In what ways do toxic chemical fires affect local communities?



**C1.2** assess the effectiveness of some applications of chemical reactions that are used to address social and environmental needs and problems [AI, C]

**Sample issue:** Scrubber systems are a group of air pollution control devices used by industry to remove or neutralize acid exhaust gases before they reach the atmosphere. Scrubber technologies help to reduce acid precipitation, but there are many different scrubbing techniques with varying levels of effectiveness in controlling acid gas emissions.

**Sample questions:** How are chemical reactions used to remediate environments affected by chemical spills? How can tailing ponds be rehabilitated to lessen the effects of hazardous chemicals on plant populations? What types of chemical reactions can change a toxic chemical into one that is less toxic or non-toxic?

## **D. Quantities in Chemical Reactions**

### **D1. Relating Science to Technology, Society, and the Environment**

**D1.** analyse processes in the home, the workplace, and the environmental sector that use chemical quantities and calculations, and assess the importance of quantitative accuracy in industrial chemical processes

**D1.1** analyse processes in the home, the workplace, and the environmental sector that involve the use of chemical quantities and calculations (e.g., mixing household cleaning solutions, calculating chemotherapy doses, monitoring pollen counts) [AI, C]

**Sample questions:** ... How are carbon dioxide emissions calculated and why are they monitored?

**D1.2** assess, on the basis of research, the importance of quantitative accuracy in industrial chemical processes and the potential impact on the environment if quantitative accuracy is not observed [IP, PR, AI, C]

**Sample issue:** Errors in quantitative accuracy have played a role in many industrial chemical disasters worldwide. Failing to adjust the quantities of chemicals needed to produce different batch sizes of a product have created runaway reactions, resulting in huge explosions. Such industrial accidents can have devastating short- and long-term effects on the environment.

**Sample questions:** Why is it important to use the correct salt-sand mix on highways during winter storms? Why is it important to correctly measure the chemicals used in water treatment plants? How might incorrect measurements affect the environment? How and why are environmental contaminants monitored in soil, water, and air around a chemical manufacturing plant?

## **E. Solutions and Solubility**

### **E1. Relating Science to Technology, Society, and the Environment**

**E1.** analyse the origins and effects of water pollution, and a variety of economic, social, and environmental issues related to drinking water

**E1.1** analyse the origins and cumulative effects of pollutants that enter our water systems (e.g., landfill leachates, agricultural run-off, industrial effluents, chemical spills), and explain how these pollutants affect water quality [AI, C]

**Sample issue:** Golf courses use fertilizer and irrigation systems to sustain the vegetation. However, chemical substances, when combined with water, may run off and pollute local water systems.

**Sample questions:** What pollutants might be found in untreated wastewater from a chicken farm or a poultry-processing plant? How do leachates from old landfill sites enter our water system? How might they affect the water quality of local streams? What are some of the sources and effects of mercury in water systems? What impact might this contaminant have on Aboriginal communities that depend on fishing as a source of food?

- E1.2** analyse economic, social, and environmental issues related to the distribution, purification, or use of drinking water (e.g., the impact on the environment of the use of bottled water) [AI, C]

**Sample issue:** In developing countries, thousands of people, many of them children, die every year from drinking contaminated water. Many of these countries cannot afford to build water treatment plants. In North America, where safe water is generally available, we spend millions of dollars on bottled water, draining sources of fresh water and challenging waste-disposal systems.

**Sample questions:** What are the economic costs of building, maintaining, and monitoring water-purification plants? What are the social and environmental costs if these plants are not properly maintained and monitored? How effective are municipal wastewater treatment processes at removing pharmaceuticals such as hormones and antibiotics from our drinking water? What public health concerns are associated with the consumption of water bottled in plastic containers?

### **E3. Understanding Basic Concepts**

- E3.4** identify, using a solubility table, the formation of precipitates in aqueous solutions (e.g., the use of iron or aluminum compounds to precipitate and remove phosphorus from wastewater)

## **F. Gases and Atmospheric Chemistry**

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** analyse the cumulative effects of human activities and technologies on air quality, and describe some Canadian initiatives to reduce air pollution, including ways to reduce their own carbon footprint

- F1.1** analyse the effects on air quality of some technologies and human activities (e.g., smelting; driving gas-powered vehicles), including their own activities, and propose actions to reduce their personal carbon footprint [AI, C]

**Sample issue:** Gas-powered lawnmowers cut grass quickly and efficiently, but they emit greenhouse gases. However, there are several alternatives, including electric or push mowers or replacing lawn with a naturalized garden.

**Sample questions:** In what ways does our consumption of products imported from distant countries affect our carbon footprint? How might “eat local–buy local” initiatives help to reduce our carbon footprint? How effectively does the use of digital communications for business reduce our carbon footprint?

- F1.2** assess air quality conditions for a given Canadian location, using Environment Canada's Air Quality Health Index, and report on some Canadian initiatives to improve air quality and reduce greenhouse gases (e.g., Ontario's Drive Clean program to control vehicle emissions) [AI, C]

**Sample issue:** Historically, mining and smelting polluted the air, land, and water around Sudbury, Ontario. More recently, as a result of government regulations, industry has significantly reduced emissions, leading to an improvement in air quality and reversal in the acidification of local waterways.

**Sample questions:** How effective has Ontario's Drive Clean program been in reducing greenhouse gas emissions in the province? What are some industrial and geographic factors that might make air quality in some communities very different from that in others? What are some municipal governments doing to improve local air quality? How can public transit initiatives help improve air quality? What are the limitations of such initiatives?

### **F3. Understanding Basic Concepts**

- F3.1** identify the major and minor chemical components of Earth's atmosphere

## **Chemistry, Grade 12, University Preparation (SCH4U)**

### **A. Scientific Investigation Skills and Career Exploration**

#### **A2. Career Exploration**

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., food and drug analyst, chemical safety officer, nurse practitioner, consumer protection specialist, metallurgy technologist, environmental and waste management technician, geochemist) and the education and training necessary for these careers

### **B. Organic Chemistry**

#### **B1. Relating Science to Technology, Society, and the Environment**

- B1.** assess the social and environmental impact of organic compounds used in everyday life, and propose a course of action to reduce the use of compounds that are harmful to human health and the environment
- B1.1** assess the impact on human health, society, and the environment of organic compounds used in everyday life (e.g., polymers, nutritional supplements, food additives, pharmaceuticals, pesticides) [AI, C]

**Sample issue:** Organic solvents can dissolve many substances such as paint, oil, and grease. They are used to produce plastics, dyes, detergents, textiles, and pharmaceuticals. However, workers exposed to organic solvents may experience long-term effects on their health. Also, solvents from industrial spills and leaks can leach into soil and groundwater, posing serious health and environmental risks.

- B1.2** propose a personal course of action to reduce the use of compounds that are harmful to human health and the environment (e.g., weed lawns by hand rather than using herbicides, use cloth bags for shopping to reduce the number of plastic bags in landfill sites, choose fuel-efficient or hybrid vehicles to reduce fossil fuel emissions) [AI, C]  
*Sample issue:* Many Ontario communities have banned the use of pesticides. As a consequence of these by-laws, many homeowners are seeking alternative ways of controlling weeds in their lawns.  
*Sample questions:* How long does it take for plastic garbage bags to decompose in a landfill site? What biodegradable materials can be used to replace polystyrene as a packaging material? What are some technologies and features that are making new cars more fuel-efficient?

## **C. Structure and Properties of Matter**

### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** assess the benefits to society and evaluate the environmental impact of products and technologies that apply principles related to the structure and properties of matter
- C1.2** evaluate the benefits to society, and the impact on the environment, of specialized materials that have been created on the basis of scientific research into the structure of matter and chemical bonding (e.g., bulletproof fabric, nanotechnologies, superconductors, instant adhesives) [AI, C]  
*Sample issue:* Nanoparticles have many potential applications in medicine, including the improvement of drug delivery systems, the enhancement of diagnostic images, and use in surgical robotics, all of which could improve the effectiveness of our health care system. However, nanoparticle contamination can have a negative effect on the environment.  
*Sample questions:* ... What properties of disposable diapers enable them to hold so much liquid? What impact has the widespread use of such diapers had on the environment? ...

## **D. Energy Changes and Rates of Reaction**

### **D1. Relating Science to Technology, Society, and the Environment**

- D1.** analyse technologies and chemical processes that are based on energy changes, and evaluate them in terms of their efficiency and their effects on the environment
- D1.1** analyse some conventional and alternative energy technologies (e.g., fossil fuel-burning power plants, hydro-powered generators, solar panels, wind turbines, fuel cells), and evaluate them in terms of their efficiency and impact on the environment [AI, C]  
*Sample issue:* The cooling of homes and commercial buildings in summer requires more energy than heating in the winter at peak times. Brownouts are more likely in summer than in winter. However, new technologies use deep lake water cooling as an alternative to conventional air conditioning systems in office towers. This significantly reduces energy use and its environmental impact.  
*Sample questions:* What proportion of Ontario's energy needs is served by solar and wind technologies? What are the pros and cons of expanding the availability of these technologies? What types of chemical reactions occur in different types of fuel cells? What are the advantages and disadvantages, in terms of efficiency and environmental impact, of using corn to produce ethanol fuel?

- D1.2** analyse the conditions (e.g., temperature, pressure, presence of a catalyst) required to maximize the efficiency of some common natural or industrial chemical reactions (e.g., decomposition, combustion, neutralization), and explain how the improved efficiency of the reaction contributes to environmental sustainability [AI, C]

**Sample issue:** Bleaches such as hydrogen peroxide and chlorine are used when fibres are processed into paper or textiles. Concentrations of these substances can harm the environment, but if enzymes are added to these processes as biocatalysts, fewer chemicals are needed, less energy is consumed, and there is less environmental impact.

**Sample questions:** How can you increase the rate of decomposition in a home composter? What can be done to improve the efficiency of an automobile that runs entirely on fossil fuels? Why is just a very small quantity of catalyst required in industrial processes? Why is the ozone layer still deteriorating despite the banning of chlorofluorocarbons (CFCs)?

## **E. Chemical Systems and Equilibrium**

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.1** analyse the optimal conditions for a specific chemical process related to the principles of equilibrium that takes place in nature or is used in industry (e.g., the production of sulphuric acid, electrolyte balance in the human body, sedimentation in water systems) [AI, C]

**Sample issue:** The principle of dynamic equilibrium is used in industrial processes to maximize the concentration of products and minimize leftover reactants. Industrial chemists determine ideal pressure and temperature conditions, and proper catalysts, so that fewer materials and less energy are used.

- E1.2** assess the impact of chemical equilibrium processes on various biological, biochemical, and technological systems (e.g., remediation in areas of heavy metal contamination, ...) [AI, C]

## **F. Electrochemistry**

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** analyse technologies and processes relating to electrochemistry, and their implications for society, health and safety, and the environment

- F1.1** assess, on the basis of research, the viability of using electrochemical technologies as alternative sources of energy (e.g., fuel cells for emergency power generation or as power sources in remote locations), and explain their potential impact on society and the environment [IP, PR, AI, C]

**Sample issue:** Hydrogen fuel cells use hydrogen as the fuel and oxygen as the oxidant, and produce water, rather than environmentally harmful greenhouse gases, as waste. Although some cars run on such cells, practical problems must be resolved before this source of energy is commonly used in the transportation sector.

**Sample questions:** What is the capacity of a standard rechargeable battery before it has to be recharged? What methods should be used to dispose of depleted batteries? ...

- F1.2** analyse health and safety issues involving electrochemistry (e.g., corrosion of metal pipes in drinking water systems) [AI, C]

*Sample questions:* What health and safety hazards are associated with waste generated by electroplating companies? ... What are some of the toxic substances that can escape from electronic waste into the environment? What are the potential effects of these poisons on our health?

## **Chemistry, Grade 12, College Preparation (SCH4C)**

### ***A. Scientific Investigation Skills and Career Exploration***

#### **A2. Career Exploration**

**A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., environmental technologist, pharmacy technician, electroplating technician, green building or renewable energy technician, veterinary technician, biochemical technologist) and the education and training necessary for these careers

### ***B. Matter and Qualitative Analysis***

#### **B1. Relating Science to Technology, Society, and the Environment**

**B1.** evaluate the effects of chemical substances on the environment, and analyse practical applications of qualitative analysis of matter

**B1.1** evaluate the risks and benefits to the environment of some commonly used chemical substances (e.g., substances used in fireworks, fire extinguishers, “green” cleaning products) [AI, C]

*Sample issue:* Numerous synthetic fertilizers are available for residential lawns and gardens, all of which claim good results based on their chemical composition. Although these fertilizers provide nutrients that are essential for healthy plants and soil, they may also contain harmful chemicals that can pose risks to the environment.

*Sample questions:* What chemical substances can be removed from drinking water by household water purification systems? What impact do chemical substances used in drive-through car washes have on the local environment? Why are packing chips that are made from cornstarch better for the environment than those made from polystyrene?

**B1.2** analyse, on the basis of research, applications of qualitative analysis of matter in various fields of endeavour (e.g., ... in the manufacture of food products) [IP, PR, AI, C]

*Sample questions:* What substances do environmental chemists test for in the soil of industrial sites that have been rezoned for residential use? What different chemical compounds are used to create some of the desired effects in fireworks? What types of particulate matter do air quality testers measure when there is the potential for a smog alert?

### ***C. Organic Chemistry***

#### **C1. Relating Science to Technology, Society, and the Environment**

**C1.** evaluate the impact on society, human health, and the environment of products made using organic compounds

**C1.1** identify various materials and products used in everyday life that are made from organic compounds (e.g., synthetic fabrics, drugs, pesticides, cosmetics, organic solvents, car parts, artificial hearts), and assess the benefits of those products for society, as well as the health hazards they pose [AI, C]

*Sample questions:* ... What are the benefits, and potential health risks, to farmers of spraying pesticides on their crops? ...

**C1.2** research a useful product made from one or more organic substances (e.g., CDs, made from crude oil), and assess the environmental impact of the production, use, and disposal of the product [IP, PR, AI, C]

*Sample issue:* We depend on plastics in every area of our lives, from food packaging to construction materials to DVDs. However, the manufacture of plastics involves the release of chemical pollutants and greenhouse gases into the environment, and huge quantities of plastic trash are now being found in our oceans.

*Sample questions:* What is the environmental impact of the production, use, and disposal of plastic water bottles? What impact does the vulcanization of rubber have on the environment? What are the risks and benefits to the environment of the production of synthetic fibres for the textile industry?

## **D. Electrochemistry**

### **D1. Relating Science to Technology, Society, and the Environment**

**D1.** analyse technological applications or processes relating to oxidation-reduction reactions, and assess their impact on the environment

**D1.1** analyse, on the basis of research, a technological application that is based on the oxidation-reduction (redox) reaction that occurs in galvanic cells (e.g., in cardiac pacemakers, batteries, electroplating) [IP, PR, AI, C]

*Sample issue:* Hydrogen fuel cells use a redox reaction that produces water, rather than environmentally harmful greenhouse gases, as waste. Although some cars could run on fuel cells, practical problems, such as the storage and cost of producing hydrogen, currently limit the usefulness of this technology in the transportation sector.

**D1.2** analyse, on the basis of research, the causes of metal corrosion, and assess the environmental impact of some techniques used to protect metals from corrosion (e.g., rustproofing, painting, cathodic protection, galvanization) [IP, PR, AI, C]

*Sample issue:* The maintenance of large spanbridges over salt water has always been challenging, because the salt water spray causes corrosion. Newer bridges use support structures that have been protected from corrosion, but long-term studies have not been done on the impact of these methods on the environment.

*Sample questions:* What are some of the techniques used to protect metals from corrosion? What are the benefits and risks to the environment of the electroplating of metals? ...

## **E. Chemical Calculations**

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.** analyse processes in the home, the workplace, or the environmental sector that use chemical quantities and calculations, and assess the importance of accuracy in chemical calculations
- E1.1** analyse processes in the home, the workplace, or the environmental sector that require an understanding of accurate chemical calculations (e.g., ... testing water quality in a public pool) [AI, C]  
*Sample issue:* Farmers use fertilizers that contain nitrogen and phosphorus to fertilize their crops. Although these nutrients are needed by the crops for growth, too much fertilizer can harm crops and potentially run off into water systems and contribute to the eutrophication of ponds and lakes.  
*Sample questions:* What are the potential effects of adding too much or too little chlorine to drinking water at a water purification plant or private well? ...

## **F. Chemistry in the Environment**

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** evaluate the importance of government regulations, scientific analyses, and individual actions in improving air and water quality, and propose a personal plan of action to support these efforts
- F1.1** evaluate, on the basis of research, the effectiveness of government initiatives or regulations (e.g., the Great Lakes Action Plan), and the actions of individuals (e.g., use of public transportation), intended to improve air and water quality, and propose a personal action plan to support these efforts [IP, PR, AI, C]  
*Sample issue:* The Yellow Fish Road is a nationwide program in which volunteers paint yellow fish symbols by storm drains to remind people that material poured into the drains flows directly into our local waterways, and that they should not pour hazardous substances down the drains. However, not everyone is aware of the symbolism of the fish, so the program may not be as effective as it could be.  
*Sample questions:* How can your personal actions influence the air or water quality in your local area? Why have government initiatives, such as mass transit in urban areas, not been readily accepted by everyone? What can be done to encourage more people to use mass transit? What plans do local conservation authorities have to improve water quality in lakes, rivers, and streams in your local area? How effective are these plans?
- F1.2** evaluate the importance of quantitative chemical analysis in assessing air and water quality (e.g., the use of Environment Canada’s Air Quality Index to determine when smog advisories need to be issued; systems to monitor the quality of drinking water), and explain how these analyses contribute to environmental awareness and responsibility [AI, C]  
*Sample issue:* Traditional stationary monitoring stations may not be able to supply sufficient data to reflect the differences in air quality from one location to another. However, researchers in Ontario now use mobile air quality monitors to measure vehicle emissions in high traffic areas and “hot spots” where vehicles idle for long periods of time. These data can be used to develop more precise air quality indices.



**Sample questions:** How can increased monitoring and reporting of air and water pollution influence the actions of individuals? Why are present chemical analyses not sufficient to detect and quantify all organic and inorganic contaminants in the water supply? How does WHMIS aid in minimizing damage to the environment and ensuring the safety of individuals in a case of an industrial accident?

## **F2. Developing Skills of Investigation and Communication**

**F2.1** use appropriate terminology related to chemical analysis and chemistry in the environment, including, but not limited to: *ozone, hard water, titration, pH, ppm, and ppb* [C]

## **F3. Understanding Basic Concepts**

**F3.** demonstrate an understanding of chemical reactions that occur in the environment as a result of both natural processes and human activities

**F3.1** identify major and minor chemical components of Earth's atmosphere

**F3.2** identify gases and particulates that are commonly found in the atmosphere, and explain how they affect air quality (e.g., greenhouse gases, tropospheric and stratospheric ozone, carbon monoxide, chlorofluorocarbons, soot)

**F3.5** identify the gas emissions that are the major contributors to acid precipitation, and explain the steps in the formation of acid rain

# **EARTH AND SPACE SCIENCE**

## **Earth and Space Science, Grade 12, University Preparation (SES4U)**

### ***C. Planetary Science (Science of the Solar System)***

#### **C1. Relating Science to Technology, Society, and the Environment**

**C1.** analyse political, economic, and environmental issues related to the exploration and study of the solar system, and how technology used in space exploration can be used in other areas of endeavour

**C1.1** analyse political considerations related to, and economic and environmental consequences (actual and/or potential) of, exploration of the solar system (e.g., ... the ability to monitor environmental conditions from space) [AI, C]

**Sample issue:** As we deplete Earth's natural resources, researchers are studying the feasibility of supplementing those resources through space mining. Asteroids and other bodies in the solar system are potentially rich sources of minerals and other valuable substances, but their exploitation raises a range of legal, economic, environmental, and technological questions.

**C1.2** analyse, on the basis of research, a specific technology that is used in space exploration and that has applications in other areas of research or in the environmental sector (e.g., Canadian satellites and robotics, spacecraft technologies, ground base and orbital telescopes, devices to mitigate the effects of the space environment on living organisms), and communicate their findings [IP, PR, AI, C]

**Sample issue:** The Canadarms were developed for space shuttle missions and the International Space Station. However, the robotic arms have other applications, including inspecting and cleaning up hazardous substances, servicing nuclear power plants, repairing pipelines on the ocean floor, mining in areas too inhospitable for humans, and conducting remote or microsurgery.

**Sample questions:** How are Landsat and radar from space shuttles used in archaeological research, costal studies, and the monitoring of natural disasters? How can technologies developed for space travel be used in water purification and waste treatment on Earth? How is remote sensing used to monitor atmospheric changes, such as changes in the ozone layer? How is remote sensing used to monitor changes to ecosystems?

## **D. Recording Earth's Geological History**

### **D1. Relating Science to Technology, Society, and the Environment**

**D1.** analyse, with reference to geological records, the relationship between climate, geology, and life on Earth, and evaluate contributions to our understanding of changes in Earth systems over geological time

**D1.1** analyse the relationship between climate and geology, and, using geological records, assess the impact of long-term climate change on life on Earth [AI, C]

**Sample issue:** Geological records provide scientists with important evidence about climate change and changes in life on Earth. Not all scientists agree about the significance and meaning of geological evidence, however, and there is disagreement about the accuracy of some dating techniques.

**Sample questions:** What do changes in atmospheric conditions recorded throughout the geological record tell us about past and present environmental conditions? How have the patterns of ocean currents changed as a result of continental drift, and how has this affected Earth's climate? What environmental and evolutionary changes are seen from the Devonian period to the Carboniferous period?

**D1.2** evaluate the significance of contributions, including Canadian contributions, to our understanding of geological time and of changes in Earth systems over time (e.g., the contributions of Raymond A. Price; the Canadian contribution to the development of Landsat) [AI, C]

**Sample questions:** What contributions have Canadian scientists made to the study of sediment and glacial records, and how have these contributions increased our understanding of long-term changes in Earth systems? What role have Canadians played in the development or use of technological applications such as Radarsat, and how have these applications contributed to our knowledge of Earth systems?

## **D2. Developing Skills of Investigation and Communication**

**D2.7** investigate interactions over time between physical, chemical, and biological processes, and explain how they have affected environmental conditions throughout Earth's geological history (e.g., the impact of increasing amounts of atmospheric oxygen on stromatolites; the impact of increasing amounts of atmospheric carbon dioxide on global warming; the influence of plants on the water cycle, other life forms, the atmosphere, weathering, and erosion) [PR, AI, C]

## **D3. Understanding Basic Concepts**

**D3.2** describe various kinds of evidence that life forms, climate, continental positions, and Earth's crust have changed over time (e.g., evidence of mass extinction, of past glaciations, of the existence of Pangaea and Gondwanaland)

## **E. Earth Materials**

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.** analyse technologies used to explore for and extract Earth materials, and assess the economic and environmental impact of the exploitation of such materials
- E1.2** analyse technologies and techniques used to explore for and extract natural resources, and assess their actual or potential environmental repercussions [AI, C]  
*Sample issue:* Mountaintop removal is a coal-mining technique proposed for use near the headwaters of the Flathead River in British Columbia. Mining companies favour the technique because the coal can be removed more cheaply than in conventional mining. However, the process devastates the local environment, causing erosion, loss of terrestrial and aquatic habitat, and air and water pollution.  
*Sample questions:* Why has there been so much protest against the proposed Mackenzie Valley pipeline in the Canadian North? What mining techniques have the greatest and the least impact on local water systems? ... What impact has the extraction of oil from the Alberta oil sands had on the local environment?

### **E2. Developing Skills of Investigation and Communication**

**E2.7** investigate a geological setting in their local area (e.g., a river/stream bed or lakeshore; a rock outcrop), and identify and classify rock samples collected from that area [PR, AI]

### **E3. Understanding Basic Concepts**

**E3.5** describe the role of Earth materials in the safe disposal of industrial and urban waste and toxic materials (e.g., the low permeability of clays makes them suitable material for barriers in waste disposal sites)

## **F. Geological Processes**

### **F1. Relating Science to Technology, Society, and the Environment**

**F1.3** analyse the relationship between human activities and various geological structures and processes (e.g., the relationship between the location of deposits and the extraction/use of resources; the relationship between urban development and/or building codes and the

probability of earthquakes or volcanic activity), and propose ways in which the relationships can be effectively or sustainably managed [AI, C]

**Sample questions:** What impact do stream erosion and alluvial deposits have on agriculture along a river? What are some ways in which humans can exploit mineral resources without depleting them or harming the environment? What negative effects can construction projects have on surface water or groundwater systems? How can these effects be reduced?

## **ENVIRONMENTAL SCIENCE**

### **Environmental Science, Grade 11, University/College Preparation (SVN3M)**

#### **A. Scientific Investigation Skills and Career Exploration**

##### **A1. Scientific Investigation Skills**

**A1.2** select appropriate instruments (e.g., probes, moisture meters, rain gauges), and materials (e.g., water-sampling kits, soil-testing kits), and identify appropriate methods, techniques, and procedures, for each inquiry

##### **A2. Career Exploration**

**A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., organic chemist, landscaper, conservationist, air quality technician, personal support worker, environmental lawyer) and the education and training necessary for these careers

#### **B. Scientific Solutions to Contemporary Environmental Challenges**

##### **B1. Relating Science to Technology, Society, and the Environment**

**B1.** analyse social and economic issues related to an environmental challenge, and how societal needs influence scientific endeavours related to the environment

**B1.1** analyse, on the basis of research, social and economic issues related to a particular environmental challenge (e.g., overfishing, deforestation, acid rain, melting of the polar ice cap) and to efforts to address it [IP, PR, AI, C]

**Sample issue:** Greenhouse gas emissions from motor vehicles are a major contributor to global warming. The use of ethanol and other biofuels in motor vehicles reduces these emissions. However, diverting crops from food production to fuel production can increase prices and decrease the supply of food.

**Sample questions:** What are some of the social and economic challenges associated with cleaning up and conserving fresh water supplies? What are some alternative energy sources? What social and economic challenges are associated with their development? In what ways can consuming locally grown foods help the local economy, society, and the environment?

- B1.2** analyse ways in which societal needs or demands have influenced scientific endeavours related to the environment (e.g., the development of drought- and pest-resistant crops to address the rising global need for food; research into alternative energy sources in response to demands to address the impact on climate change of burning fossil fuels) [AI, C]

**Sample issue:** Because of unstable oil prices and the environmental damage caused by motor vehicle emissions, many consumers have been demanding more environmentally friendly vehicles. As a result, car companies are devoting greater resources towards the development of more fuel-efficient engines, hybrid vehicles, and cars powered by electricity or other types of energy.

**Sample questions:** How and why do demands by environmentally conscious consumers affect the types of products developed by corporations? What impact have the energy needs of remote communities had on innovations in the development of off-grid energy sources? What types of products have been developed in response to the health threats resulting from ozone depletion?

## **B2. Developing Skills of Investigation and Communication**

- B2.** investigate a range of perspectives that have contributed to scientific knowledge about the environment, and how scientific knowledge and procedures are applied to address contemporary environmental problems
- B2.1** use appropriate terminology related to the application of scientific knowledge and procedures to environmental issues, including, but not limited to: *fact, inference, paradigm, objectivity, and causality* [C]
- B2.2** plan and conduct a laboratory inquiry to test a scientific procedure used to address a contemporary environmental problem (e.g., an oil spill, acid precipitation) [IP, PR, AI]
- B2.3** investigate, through research or using case studies or computer simulation, how scientific knowledge and procedures are applied to address a particular contemporary environmental issue (e.g., scientific data on the needs and habits of endangered species are used to develop plans to protect threatened species; life-cycle assessments are conducted to determine the total environmental impact of a consumer product) [PR, AI]
- B2.4** use a research process to investigate how evidence, theories, and paradigms reflecting a range of perspectives have contributed to our scientific knowledge about the environment (e.g., with respect to debates about climate change; regarding the relationship between the cod moratorium and seal populations in Atlantic Canada), and communicate their findings [IP, PR, AI, C]
- B2.5** use a research process to locate a media report on a contemporary environmental issue (e.g., climate change, melting of the polar ice cap, deforestation), summarize its arguments, and assess their validity from a scientific perspective [IP, PR, AI, C]

## **B3. Understanding Basic Concepts**

- B3.** demonstrate an understanding of major contemporary environmental challenges and how we acquire knowledge about them
- B3.1** identify some major contemporary environmental challenges (e.g., global warming, acid precipitation), and explain their causes (e.g., deforestation, carbon and sulfur emissions) and effects (e.g., desertification, the creation of environmental refugees, the destruction of aquatic and terrestrial habitats)

- B3.2** describe how scientists use a variety of processes (e.g., environmental impact assessments, environmental scans) to solve problems and answer questions related to the environment
- B3.3** explain how new evidence affects scientific knowledge about the environment and leads to modifications of theory and/or shifts in paradigms (e.g., the impact of evidence of the effects of carbon dioxide emissions on theories of global warming)
- B3.4** explain how an environmental challenge has led to advances in science or technology (e.g., scrubbers on smokestacks to decrease sulphur dioxide emissions, hybrid cars)
- B3.5** describe a variety of human activities that have led to environmental problems (e.g., burning fossil fuels for transportation or power generation; waste disposal) and/or contributed to their solution (e.g., the development of renewable sources of energy; programs to reduce, reuse, and recycle)

### ***C. Human Health and the Environment***

#### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** analyse initiatives, both governmental and non-governmental, that are intended to reduce the impact of environmental factors on human health
- C1.1** analyse grassroots initiatives that are intended to reduce the impact of environmental factors on human health (e.g., community cleanup of local aquatic or terrestrial environments; class action lawsuits against major polluters) [AI, C]
 

*Sample issue:* People from the Grassy Narrows Reserve in Northern Ontario were experiencing chronic health problems. They commissioned a study, which found that many animals and fish that were part of a traditional diet were contaminated with mercury and heavy metals. Guidelines were proposed to limit consumption of the affected animals, and thereby improve people's health.

*Sample questions:* Are there any grassroots groups in your community concerned with the state of the environment and its impact on human health? What types of actions do they take? What action has been taken by the Bulkley Valley and Lakes District Airshed Management Society to help reduce the impact of particulate matter in air on the health of local people? What is the Yellow Fish Road program, and how does it try to reduce the number of contaminants in local water sources?
- C1.2** evaluate the effectiveness of government initiatives that are intended to reduce the impact of environmental factors on human health (e.g., Ontario Ministry of the Environment smog advisories; provincial laws regulating drinking water; WHMIS regulations on hazardous material) [AI, C]
 

*Sample questions:* Why does the Ontario Ministry of the Environment issue smog advisories? Why are there concerns about the water quality in many First Nations communities in Canada? Why did the water treatment plant in Kashechewan, in Northern Ontario, fail to protect the community from contaminated water?

#### **C2. Developing Skills of Investigation and Communication**

- C2.** investigate environmental factors that can affect human health, and analyse related data
- C2.1** use appropriate terminology related to human health and the environment, including, but not limited to: *contaminants, heavy metals, air pollution, and pesticide* [C]

- C2.2** analyse longitudinal data to determine the impact of various environmental factors that affect human health (e.g., air temperature, atmospheric greenhouse gases, contaminants in drinking water) [AI]
- C2.3** investigate, through laboratory inquiry or field study, water samples from natural and disturbed environments (e.g., tap water; pond, river, or lake water from disturbed and undisturbed areas; water from an outdoor pool), and analyse the resulting data [PR, AI]
- C2.4** analyse, on the basis of a laboratory inquiry, computer simulation, or field study, particulate matter in air (e.g., an air sample from an exhaust pipe or air vent, particles in a filter that cigarette smoke has passed through, particles caught on sticky paper set up in an open area) [PR, AI]
- C2.5** investigate health standards for buildings and methods to retrofit or otherwise improve structures to reduce their negative impact on human health (e.g., the use of materials that do not contain volatile organic compounds, the use of biological air and water filters), and communicate their findings [PR, C]

### **C3. Understanding Basic Concepts**

- C3.** demonstrate an understanding of various environmental factors that can affect human health, and explain how the impact of these factors can be reduced
- C3.1** identify the main pollutants and environmental contaminants that can affect human health (e.g., air pollutants such as sulfur dioxide, nitrous oxide, and particulates; noise pollution; heavy metals such as lead and mercury; DDT; PCBs; mould; volatile organic compounds such as acetone and chlorinated solvents)
- C3.2** describe the effects of a variety of environmental factors on human health (e.g., air pollutants are associated with disorders such as asthma; consumption of fish products from contaminated water may lead to increased levels of heavy metals in the human body; the thinning of the ozone layer may lead to increased incidence of skin cancer; noise pollution may impair hearing)
- C3.3** describe ways in which a variety of environmental contaminants (e.g., volatile organic compounds in paints, carpets, and cleaning products; mercury in fish; E. coli in the water at public beaches) can enter the human body (e.g., inhalation, ingestion, absorption)
- C3.4** describe measures that can reduce exposure to environmental contaminants (e.g., wearing protective clothing or sunscreen, or remaining indoors during peak UV hours, to prevent exposure to ultraviolet rays; avoiding the use of paints, solvents, and cleaning agents that contain volatile organic compounds)
- C3.5** identify a variety of populations who are particularly vulnerable to the effects of environmental factors, and explain why these populations are vulnerable (e.g., seniors are vulnerable to extreme temperatures because the ability to regulate body temperature diminishes as people age; Inuit who follow a traditional diet are vulnerable to contaminants that accumulate in the fatty tissue of sea mammals because these animals are their main food source)

## ***D. Sustainable Agriculture and Forestry***

### **D1. Relating Science to Technology, Society, and the Environment**

- D1.** evaluate the impact of agricultural and forestry practices on human health, the economy, and the environment

**D1.1** evaluate, on the basis of research, a variety of agricultural and forestry practices (e.g., companion planting, biological pest control, the use of genetically modified seed, forest fire control) with respect to their impact on the economy and the environment (e.g., the use of nematodes eliminates crop damage from grubs, thus contributing to better harvests, while reducing the use of toxic chemical pesticides; under some circumstances, forest thinning can help prevent or reduce the seriousness of forest fire, and its economic and environmental consequences) [IP, PR, AI, C]

**Sample issue:** The recycling of animal waste as fertilizer is economical and is generally considered an environmentally sustainable practice. However, care must be taken that the manure does not run off into water sources, as it can contaminate them with *E. coli* and other bacteria.

**Sample questions:** What are the economic and environmental pros and cons of growing crops that are genetically modified to be herbicide resistant? Why is organic produce more expensive than conventionally grown produce? What are the economic advantages of monoculture, both on farms and in forestry operations? How can monocultural practices lead to environmental degradation? What types of forestry practices can be implemented to maintain features of old-growth ecosystems while harvesting trees?

**D1.2** evaluate, on the basis of research, the impact, including the long-term impact, of agricultural and forestry practices on human health (e.g., the use of chemical fertilizers and pesticides; the use of growth hormones and antibiotics in livestock; the use of feed containing animal by-products; the clear-cutting of forests) [IP, PR, AI, C]

**Sample issue:** The toxins in pesticides can accumulate in the human body over the years. Although the immediate effects of exposure to pesticide may be unnoticeable, the chemicals build up in body fat and organs and can lead to a variety of cancers.

**Sample questions:** What was the source of contamination of well water in Walkerton, Ontario, in 2000? What are the immediate and long-term health effects of exposure to *E. coli*? What is known about the long-term effects of consuming genetically modified food? What impact could the spraying of forest canopies to prevent gypsy moth infestations have on human health?

## **D2. Developing Skills of Investigation and Communication**

**D2.** investigate conditions necessary for plant growth, including the soil components most suitable for various species, and various environmentally sustainable methods that can be used to promote growth

**D2.1** use appropriate terminology related to sustainable agriculture and forestry, including, but not limited to: *bioremediation, crop rotation, companion planting, organic product, humus, compost, mulch, silviculture, and naturalization* [C]

**D2.2** test samples of a variety of types of soil (e.g., clay, loam, commercial potting soil) to determine their nutrients and composition (e.g., pH; the percentage of nitrogen, phosphorus, and potassium; porosity; moisture) [PR, AI]

**D2.3** use an inquiry process to investigate the nutrients in and composition of a variety of compost samples (e.g., nutrients such as nitrogen, phosphorus, potassium; composition with respect to pH, porosity), and analyse the findings to determine appropriate uses for each sample [IP, PR, AI]



- D2.4** prepare a soil mixture (e.g., using compost, manure, vermiculite, black earth, top soil, peat moss, loam, and/or sand) for a selected plant species, based on analysis of the criteria for optimal growth for that species (e.g., cactus, tomato plants, wheat, jack pine) [PR, AI]
- D2.5** use a research process to investigate environmentally sustainable methods of managing and maintaining healthy and productive agricultural zones and forests (e.g., companion planting, crop rotation, selective tree-harvesting, planting a diverse canopy) [IP, PR]
- D2.6** design a landscaping project for their local area (e.g., a rooftop garden, a plot in a community garden, a riparian restoration), taking into account local conditions (e.g., zone hardiness, soil composition, amount of sunlight and rainfall), and propose a course of action to ensure the sustainability of the project and its healthy interaction with the surrounding environment (e.g., companion gardening, the use of compost to fertilize the soil, the use of native plants, the inclusion of plants that attract birds or butterflies) [IP, PR, AI]

### **D3. Understanding Basic Concepts**

- D3.** demonstrate an understanding of conditions required for plant growth and of a variety of environmentally sustainable practices that can be used to promote growth
- D3.4** explain different ecologically sound practices for improving and maintaining soil structure and fertility (e.g., crop rotation, fallowing, adding compost or manure, inter-seeding grains and legumes, mulching, tree harvesting using a shelterwood system)
- D3.5** explain agricultural techniques and forestry practices that aim to maintain both biodiversity and long-term productivity (e.g., growing a variety of species, inter-planting crops, planting native and heritage varieties instead of hybrids or transgenic species, saving seeds, maintaining some older trees and snags for animal habitat)
- D3.6** describe sustainable water-management practices in agricultural and forestry settings (e.g., regulating the frequency of watering, planting species suited to local precipitation levels, limiting run-off and erosion)

## ***E. Reducing and Managing Waste***

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.** analyse economic, political, and environmental considerations affecting waste management strategies
- E1.1** analyse, on the basis of research, the impact of economic and political considerations on the development of waste management practices or strategies (e.g., incineration of hazardous waste; biological filtration and reuse of greywater; user fees for garbage disposal; vermicomposting) [IP, PR, AI, C]
 

**Sample issue:** The use of landfill sites has been a long-time strategy for disposal of garbage. As local sites fill up, some municipalities are shipping their garbage to distant sites. This strategy is often politically unpopular and, with high fuel prices, is increasingly expensive, so local politicians are under pressure to implement new strategies.

**Sample questions:** What are the costs of recycling compared to the costs of using landfill sites or incinerating garbage? Why is garbage incineration a controversial political issue? Why do municipal recycling programs recycle only a limited number of items?

- E1.2** evaluate the short- and long-term impact on the environment of a specific type of waste (e.g., waste products from animal farming; plastic shopping bags; tailings from mines) [AI, C]

**Sample issue:** Non-rechargeable batteries can be convenient, but their disposal presents problems. Batteries contain heavy metals and corrosive substances that can contaminate landfill sites and leach into surrounding soil or water. Ontario municipalities designate batteries as hazardous waste, yet some people continue to throw them in the garbage.

**Sample questions:** What impact do disposable diapers have on the environment? What effects does the dumping of solid waste into lakes, rivers, or oceans have on aquatic life? How long does it take polystyrene, widely used to make food and drink containers, to break down? What environmental challenges are associated with nuclear waste?

## **E2. Developing Skills of Investigation and Communication**

- E2.** investigate the effectiveness of various waste management practices

- E2.1** use appropriate terminology related to waste management, including, but not limited to: *solid, liquid, and gaseous waste; toxic waste; heavy metal; chlorinated hydrocarbons; and polychlorinated biphenyls (PCBs)* [C]

- E2.2** plan and conduct an inquiry in a microenvironment to treat a solid, liquid, or gaseous waste (e.g., reduce the acidity in a closed bog system in an aquarium; use a vermicomposter to recycle solid organic matter) [IP, PR]

- E2.3** use a research process to investigate the waste generated throughout the life cycle of a product (e.g., the waste associated with all the materials and energy that go into the development and disposal of a computer or a running shoe) [IP, PR]

- E2.4** plan and conduct a waste audit within their school, and propose a plan of action for waste reduction based on their findings (e.g., review the school's policy regarding paper and plastic recycling, monitor actual practices, and propose strategies to improve them) [IP, PR, AI, C]

- E2.5** investigate a local, regional, national, or global waste management practice (e.g., local practices such as recycling or charging for residential and/or commercial garbage bags; shipping garbage to landfill sites in another region; disposal of nuclear waste; dumping raw sewage into rivers, lakes, oceans), and communicate their findings [PR, C]

## **E3. Understanding Basic Concepts**

- E3.** demonstrate an understanding of the nature and types of waste and strategies for its management

- E3.1** describe different categories of waste (e.g., biodegradable, recyclable, toxic, organic, inorganic)

- E3.2** explain some current waste remediation practices used with substances or products that are not environmentally friendly (e.g., “Toxic Taxi” for pick-up of household hazardous waste; the recycling of plastic to make furniture and “lumber”)

- E3.3** describe the scientific principles involved in processing solid, liquid, and gaseous waste (e.g., combustion, decomposition, pyrolysis)

- E3.4** explain common strategies and technologies used in the collection and storage of waste (e.g., strategies such as recycling, composting, dumping in landfill sites; technologies such as compactors, enzyme digesters, flocculation tanks)

- E3.5** explain how scientific knowledge and technological processes have been applied in the development of environmentally sound waste management strategies (e.g., accelerated waste aeration, bioremediation)

## **F. Conservation of Energy**

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** assess the impact on society and the environment of the use of various renewable and non-renewable energy sources, and propose a plan to reduce energy consumption
- F1.1** evaluate the impact on the environment of renewable and non-renewable energy sources, and propose an environmentally friendly solution to reduce non-renewable energy consumption (e.g., a plan for broader use of hybrid cars or solar panels) [AI, C]  
**Sample issue:** In some remote areas that are off the electrical grid, generators that run on fossil fuels are used to generate electricity. However, these devices are inefficient, and they produce carbon dioxide, which contributes to global warming, and noise pollution.  
**Sample questions:** What impact can hydroelectric dams and generating stations have on the local environment? What effects do coal mining and the use of coal-burning power plants have on the local, regional, and global environment? How can the use of ethanol reduce the amount of petroleum needed to run cars?
- F1.2** assess the costs and benefits to society of the use of renewable and non-renewable energy sources, using a variety of criteria (e.g., associated health concerns, reliability, ability to meet demand, start-up and production costs) [AI, C]  
**Sample issue:** The extraction, processing, and burning of fossil fuels damage the environment. However, some fossil fuels, such as coal, are plentiful and therefore a reliable source of energy. Some alternative energy sources, such as wind and solar power, are less reliable, and their unit costs are much higher.  
**Sample questions:** How do the costs of coal and geothermal power compare? Do these costs change when environmental costs and benefits of the two sources are factored in? What are the health concerns associated with nuclear power? Why are wind and solar power less reliable than fossil fuel sources? How could that change?

### **F2. Developing Skills of Investigation and Communication**

- F2.** investigate various methods of conserving energy and improving energy efficiency
- F2.1** use appropriate terminology related to energy conservation, including, but not limited to: *renewable resource*, *non-renewable resource*, and *R-value*
- F2.2** investigate energy consumption and costs in their household over a given period of time, and suggest ways in which their household could conserve energy [PR, AI, C]
- F2.3** plan and conduct an energy audit of a home or business, and propose ways to improve its energy efficiency [IP, PR, AI, C]
- F2.4** design and construct a working model of a device that uses an alternative energy source (e.g., a wind generator, a solar-powered car, a “fan boat”) [IP, PR]
- F2.5** plan and conduct an inquiry to evaluate the effectiveness of various insulation materials and/or techniques (e.g., straw, foam, fibreglass, blown cellulose) [IP, PR, AI]

### **F3. Understanding Basic Concepts**

- F3.** demonstrate an understanding of energy production, consumption, and conservation with respect to a variety of renewable and non-renewable sources
- F3.1** explain the historical significance of a variety of energy sources (e.g., whale oil, coal), and describe their long-term impact on the environment
- F3.2** describe the characteristics of a sustainable energy system (e.g., equitable access to the source, long-term availability, limited environmental impact)
- F3.3** explain the basic principles and characteristics of various types of renewable (e.g., tidal, geothermal, solar, wind) and non-renewable (e.g., coal, oil, gas) energy production and their impact on the environment
- F3.4** describe methods of energy production and conservation intended to reduce greenhouse gas emissions (e.g., energy production methods at the Prince Edward Island Wind-Hydrogen Village; charging higher prices for energy used during peak hours)
- F3.5** describe technological advances aimed at reducing energy consumption (e.g., programmable thermostats, improved R-value in insulation, compact fluorescent light bulbs, rechargeable batteries, “smart meters”)

## **Environmental Science, Grade 11, Workplace Preparation (SVN3E)**

### ***A. Scientific Investigation Skills and Career Exploration***

#### **A2. Career Exploration**

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., hydro meter reader, hospitality employee, waste management operator, custodian) and the education and training necessary for these careers

### ***B. Human Impact on the Environment***

#### **B1. Relating Science to Technology, Society, and the Environment**

- B1.** analyse selected current environmental problems in terms of the role human activities have played in creating or perpetuating them, and propose possible solutions to one such problem
- B1.1** propose possible solutions, on the basis of research, to a current practical environmental problem that is caused, directly or indirectly, by human activities [IP, PR, AI, C]  
*Sample issue:* Car emissions contribute to smog as well as global warming. Road tolls and increased use of public transit to cut down on the number of cars on the road, and the implementation and enforcement of idling by-laws, could significantly cut these emissions.  
*Sample questions:* How can various kinds of chemical spills in local ecosystems (e.g., fields, rivers, streams) be cleaned up? In what ways does improper sewage treatment or agricultural run-off threaten local water supplies, and how can these dangers be addressed or averted? What can be done to minimize the effect of an invasive species (e.g., purple loosestrife) on a native species (e.g., milkweed)?

- B1.2** analyse the risks and benefits to the environment of human recreational activities and the leisure industry [AI, C]

**Sample issue:** Ecotourism attempts to reduce the waste and environmental damage associated with mass tourism. Although responsible ecotourism seeks to conserve local ecosystems through sustainable practices, and can, for example, help reduce deforestation and animal poaching rates, any human intrusion can damage fragile ecosystems.

**Sample questions:** What are the risks to the environment of herbicide use and water consumption on golf courses? What are some of the risks and benefits to the environment of landscaping? In what ways can hunters and fishers damage the environment? In what ways can they contribute to its sustainability? What rules are needed to ensure that visitors to a protected area do not harm that ecosystem?

## **B2. Developing Skills of Investigation and Communication**

- B2.** investigate air, soil, and water quality in natural and disturbed environments, using appropriate technology

- B2.1** use appropriate terminology relating to the environmental impact of human activity, including, but not limited to: *carbon footprint*, *carbon neutral*, *biodegradable*, *biodiversity*, *carrying capacity*, *sustainability*, and *invasive and native species* [C]

- B2.2** plan and conduct an inquiry, using appropriate technology, to compare soil quality in natural and disturbed environments (e.g., compare the phosphorous content, pH, organic matter content, water content, water-holding capacity, nutrient content, porosity, and/or bulk density of soil from a forest or meadow and soil from a garden or farmer's field that has been treated with chemical fertilizer) [IP, PR, AI]

- B2.3** plan and conduct an inquiry, using appropriate technology, to compare water quality in natural and disturbed environments (e.g., compare the pH, ion content, temperature, dissolved oxygen content, hardness, turbidity, biological oxygen demand [BOD], and/or fecal coliform of tap water, water from a pond or stream, and water from a drainage ditch) [IP, PR, AI]

- B2.4** analyse and interpret data on particulate matter in air samples from several different regions of Canada, using prepared data from a variety of sources (e.g., the Ontario Ministry of the Environment – Air Quality Ontario, Environment Canada) [AI]

- B2.5** plan and conduct a waste audit of their home or school [IP, PR]

## **B3. Understanding Basic Concepts**

- B3.** demonstrate an understanding of some of the ways in which human activities affect the environment and how the impact of those activities is measured and monitored

- B3.1** identify the basic components of soil, water, and air, and describe some of the effects of human activity on soil, water, and air quality (e.g., the effects of industrial or vehicle emissions on air quality; of chemical spills on soil quality; of chlorination on water quality)

- B3.2** explain the concept of the cycling of substances in ecosystems (e.g., fertilizers made from biosolids leach into ground water or run off into rivers and streams, where the chemicals are absorbed by aquatic life, which is in turn consumed by humans)

- B3.3** explain common methods of sampling soil, water, and air for analysis (e.g., soil core sampling, depth integrated sampling, stack sampling systems) and of monitoring soil, water, and air quality over time

- B3.4** explain the concept of a “carbon footprint” and how it is used to measure the impact on the environment of a range of human activities
- B3.5** explain the effects of human activity on an aquatic or terrestrial ecosystem (e.g., the impact of fertilizer run-off, acid precipitation, or an oil spill on an aquatic ecosystem)
- B3.6** explain how human activities (e.g., agriculture, travel, the purchase of exotic pets, importing and exporting, releasing domesticated fish into fresh water environments, the use of live bait) have led to the introduction of invasive species, and why it is important to measure and monitor the impact of invasive species on native species

## **C. Human Health and the Environment**

### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** analyse the effects on human health of environmental contaminants and a significant environmental phenomenon
  - C1.1** assess, on the basis of research, the effects on human health of a significant environmental phenomenon (e.g., the ice storm of 1998 in central Canada, the European heatwave of 2003), and communicate their findings [IP, PR, AI, C]
 

*Sample issue:* In August 2005, Hurricane Katrina destroyed the levees surrounding New Orleans. Hundreds of people were drowned in the resulting floods. Many survivors contracted skin and gastro-intestinal diseases from contaminated water.

*Sample questions:* What impact did the 2003 drought in the Okanagan Valley have on the health and well-being of local populations? How did the 2003 tsunami in the Indian Ocean affect the health of people in that region?
  - C1.2** analyse how environmental contaminants can affect the health of different populations in Canada (e.g., mercury contamination in streams and rivers in Northern Ontario where Aboriginal people fish, toxins in Arctic sea mammals hunted by Inuit, smog in large cities) [AI, C]
 

*Sample issue:* When the U.S. government abandoned its Cold War military bases in the Canadian North, it left behind a variety of contaminants, including large amounts of polychlorinated biphenyls (PCBs). Exposure to these chemicals can affect the nervous system and the immune system and can cause cancer.

*Sample questions:* How does the use of biosolids as fertilizer on Canadian farms affect the health of local populations? What short- and long-term health problems can be traced to the chemicals in the tar ponds in Sydney, Nova Scotia?

### **C2. Developing Skills of Investigation and Communication**

- C2.** investigate how different environmental factors can affect people’s health and their lifestyle choices
  - C2.1** use appropriate vocabulary related to human health and the environment, including, but not limited to: *smog, environmental contaminants, pathogens, inhalation, ingestion, and absorption* [C]
  - C2.2** investigate, using a research process, and report on an environmental factor that can have an impact on human health (e.g., smog, ultraviolet [UV] rays, bacteria, pesticide residue), and explain how their personal lifestyle choices can affect its impact (e.g., avoiding strenuous physical activity on days when there is a smog alert can reduce the severity of

respiratory ailments; lying on the beach without sunscreen or sun protective clothing during peak UV hours can increase the risk of skin cancer) [IP, PR, AI, C]

- C2.3** investigate the characteristics of a personal protective device or substance (e.g., sunscreen, mosquito repellent, respiratory mask, sun protective clothing) and whether the device or substance is effective in protecting a person from an environmental factor that can affect human health [PR, AI]

### **C3. Understanding Basic Concepts**

- C3.** demonstrate an understanding of the ways in which environmental factors can affect human health and how their impact can be reduced
- C3.1** describe common environmental factors, including pollution and environmental contaminants (e.g., air, noise, soil, and water pollution; UV rays; heat; heavy metals; workplace chemicals; pathogens), and explain how they can affect human health
- C3.2** describe various ways in which environmental contaminants can enter the human body (e.g., inhalation, ingestion, absorption)
- C3.3** explain how the human body can react to exposure to a variety of environmental factors (e.g., rashes, asthma, mercury poisoning, hearing loss, diseases such as malaria and cancer)
- C3.4** describe medical and non-medical ways to protect oneself from the effects of harmful environmental factors (e.g., vaccination or medication, washing of fruits and vegetables, use of sunscreen or insect repellent, use of personal protective devices)
- C3.5** describe good personal hygiene and household cleanliness practices that reduce health risks resulting from environmental contaminants (e.g., thorough hand washing, use of air filters, reduced use of household chemicals)

## **D. Energy Conservation**

### **D1. Relating Science to Technology, Society, and the Environment**

- D1.** evaluate initiatives and technological innovations related to energy consumption and conservation, and assess their impact on personal lifestyles, social attitudes, and the environment
- D1.1** assess, on the basis of research, the impact that initiatives for reducing energy consumption and waste have on personal lifestyles, societal attitudes, and the environment (e.g., local, provincial, or national initiatives by government, business, or non-governmental organizations) [IP, PR, AI, C]
- Sample issue:** Home energy audit and retrofit rebate programs have been established by many provincial governments to help homeowners reduce their energy bills. Although these programs raise awareness of the environmental impact of wasting energy and provide practical ways of reducing waste, not all homeowners take advantage of them.
- Sample questions:** What types of incentives exist to encourage consumers to purchase energy-efficient products and services? How effective are such incentives? What methods do energy companies use to encourage consumers to conserve energy? What are some of the non-governmental organizations in Canada that raise awareness of the environmental costs of energy consumption? Are there any groups in your local community that focus on energy conservation? How effective are they?

**D1.2** evaluate, on the basis of research, some of the advantages or disadvantages of technological innovations that contribute to the production of renewable energy and/or aid in conservation (e.g., bio-oil, biodiesel, wind turbines, improved insulation, programmable thermostats) [IP, PR, AI, C]

**Sample issue:** Tankless water heaters heat water only when it is needed. They save energy over traditional water heaters, which keep a large tank of water hot at all times. However, tankless water heaters may not be able to supply enough hot water for multiple uses.

**Sample questions:** What technologies are used to produce biofuels? How do these fuels help to reduce use of non-renewable energy? What problems might be associated with the use of agricultural crops for fuel rather than food? In what ways has the design of wind farm technology improved over the years? What are the advantages and disadvantages of replacing old appliances with more energy-efficient ones?

## **D2. Developing Skills of Investigation and Communication**

**D2.** investigate various methods of conserving energy and improving energy efficiency

**D2.1** use appropriate terminology related to energy conservation and consumption, including, but not limited to: *conventional source, alternative source, efficiency, watt, kilowatt-hour [kWh], joule, BTU, gas meter, electric meter, thermostat, and EnerGuide* [C]

**D2.2** determine the energy consumption of their household over a given time period by reading and interpreting gas and/or electric meters, calculate the cost of consumption (e.g., the number of kWh  $\times$  cost per kWh, cubic metres of gas  $\times$  cost per cubic metre), and suggest ways in which the household could conserve energy [PR, AI, C]

**D2.3** use a research or inquiry process to compare the efficiency of different types or brands of a common household appliance (e.g., different brands of kettles, fans, or refrigerators; natural gas and electric water heaters) or of audio-visual equipment (e.g., different types of computer monitors), and report their findings [IP, PR, AI, C]

**D2.4** conduct a risk-benefit analysis of different types of electricity generation (e.g., fossil fuel, hydro, nuclear, wind, and/or solar power) [PR, AI]

## **D3. Understanding Basic Concepts**

**D3.** demonstrate an understanding of the basic principles of energy production, with reference to both renewable and non-renewable sources, and of various methods of energy conservation

**D3.1** explain the basic principles and characteristics of various types of power generation from non-renewable sources (e.g., coal, oil, natural gas, nuclear) and renewable sources (e.g., hydroelectric, tidal, geothermal, solar, wind, hydrogen fuel cells)

**D3.2** compare and contrast renewable and non-renewable energy sources, using criteria such as availability, cost, and environmental impact (e.g., compare a fossil fuel and geothermal energy, using a graphic organizer)

**D3.3** describe methods of energy conservation (e.g., the replacement of incandescent bulbs with compact fluorescent bulbs, the replacement of a manual thermostat with a programmable one, the installation of more energy-efficient windows) and some policies that are intended to manage energy demand in the home and the workplace (e.g., variable pricing, which increases the price of electricity during peak hours)



- D3.4** describe several criteria used in the construction of energy-efficient buildings (e.g., “smart homes”, in which the use of light, heat, and power for equipment can be programmed; R-2000 homes; straw-bale houses)

## ***E. Natural Resource Science and Management***

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.** assess the environmental impact of the harvesting and/or extraction of resources, including ways of reducing this impact, and analyse threats to the sustainability of natural resources

- E1.1** assess the environmental impact of industrial practices related to the extracting or harvesting of natural resources, and describe ways in which that impact can be monitored and minimized [AI, C]

**Sample issue:** As a result of overfishing, several marine species are endangered. Bottom-trawling drag nets drown sea life, including mammals and turtles, who become entangled in them, and destroy seafloor habitat. In an effort to allow endangered species to recover, governments monitor populations, sometimes limiting catches or declaring moratoriums, and some countries have banned bottom trawling.

**Sample questions:** What impact can mine tailings have on local water? What practices can be used to reduce this impact? What impact does clear-cutting have on local ecosystems? What impact does large-scale deforestation have on the environment? What harvesting practices can the forestry industry use to minimize the effects of clear-cutting and deforestation?

- E1.2** analyse, on the basis of research, the impact that an environmental contaminant, parasite, or bacteria has on the sustainability of a natural resource in Canada (e.g., the effects of PCBs on Arctic sea mammals, of sea lice on farmed and wild salmon, of *E. coli* on water resources) [IP, PR, AI, C]

**Sample issue:** As a result of warmer winters and a policy of fire suppression, the mountain pine beetle has decimated coniferous forests in British Columbia, killing millions of lodgepole pines, the most widely harvested tree in the province. There are fears that the beetle will expand into Alberta and could eventually harm pine forests across the country.

**Sample questions:** How have mercury levels in fish affected the local fishing industry in Northern Ontario? How has mange affected the fox population and people who depend on trapping? What impact has increased bacteria levels in inland waterways had on duck populations?

### **E2. Developing Skills of Investigation and Communication**

- E2.** investigate methods scientists use to classify and monitor natural resources, and conduct investigations using those methods

- E2.1** use appropriate terminology related to natural resources and resource management, including, but not limited to: *population, bioamplification, sampling size, sustainability, ore, mineral, tailings, and succession* [C]

- E2.2** identify and classify a variety of natural resources found in Canada, using appropriate classification systems (e.g., dichotomous keys, botanical keys, tree identification guides, wildlife guides, mineral tests) [PR, AI]

- E2.3** investigate, through laboratory inquiry, field study, or simulations, some of the methods and procedures used by scientists to monitor biodiversity in different environments (e.g., making plant tallies in forests; tagging or marking ground vegetation species in fields; tagging and tracking wildlife with the global positioning system in remote areas; using aquatic dip nets for sampling organisms in shallow ponds or streams) [PR]
- E2.4** conduct an inventory of a local environment (e.g., a field, a pond), using appropriate techniques and methods (e.g., plant tallies, tags, keys), and display the results graphically [PR, C]

### **E3. Understanding Basic Concepts**

- E3.** demonstrate an understanding of the sustainable use of resources and its relationship to the biodiversity and sustainability of ecosystems
- E3.1** describe the main types of natural resources found in Canada (e.g., forests, minerals, fisheries, wildlife, water, fossil fuels)
- E3.2** describe the characteristics and properties that make a natural resource viable for use (e.g., the size, type, and location of trees; the value, location, and extraction and processing costs of minerals), and explain the importance of managing natural resources to ensure sustainability and biodiversity
- E3.3** describe a variety of methods used to extract or harvest natural resources (e.g., drag nets, strip mining, selective cutting of forests)
- E3.4** explain how a variety of sampling techniques (e.g., quadrant sampling, catch-and-release, core sampling to measure tree rings, counting annuli in scales to measure the age of fish) are used to gather information about natural resources
- E3.5** explain the importance of biodiversity to the sustainability of life within an ecosystem (e.g., variability among biotic and abiotic factors within an ecosystem decreases the chance that any organism within that ecosystem will become extinct)
- E3.6** describe some methods that scientists use to monitor biodiversity in aquatic and terrestrial environments (e.g., field data collection, aerial and satellite imagery)

## ***F. The Safe and Environmentally Responsible Workplace***

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** assess workplace situations with respect to safety and environmental issues, and propose a course of action to address unsafe working conditions
- F1.2** analyse, on the basis of research, and report on the environmental impact of unsafe handling, storage, and disposal of hazardous and non-hazardous workplace materials associated with a particular job [IP, PR, AI, C]  
*Sample issue:* Home construction workers use a range of materials that can harm the environment. Spills of stains and solvents, improper disposal of paint and other chemical substances, the particulate matter created when wall board is cut or insulation is blown, and improper storage of combustible or corrosive materials can contaminate the air, water, and soil.

**Sample questions:** What impact does the improper storage and disposal of cooking oils in fast-food restaurants have on the environment? In what ways can improper handling or disposal of medical materials (e.g., pharmaceuticals, medical isotopes, disinfectants) in a hospital affect the environment? What is the environmental impact if fast-food restaurants do not separate their waste into compostable, recyclable, and non-recyclable materials?

## **F2. Developing Skills of Investigation and Communication**

- F2.** investigate a variety of safe and environmentally responsible workplace practices
- F2.1** use appropriate terminology related to safety and environmental responsibility in the workplace, including, but not limited to: *Möbius loop*, *Material Safety Data Sheet (MSDS)*, *Hazardous Household Product Symbols (HHPS)*, *hazardous material*, and *personal protective equipment (PPE)* [C]
- F2.4** use appropriate techniques for handling, storing, and disposing of teacher-selected materials, drawing on Material Safety Data Sheets and Canadian Environmental Protection Act regulations (e.g., use appropriate personal protective equipment), and outline proper procedures for handling those materials in the workplace [PR, C]
- F2.5** design and report on a plan for reusing, recycling, reducing the volume of, or disposing of a hazardous material found in the workplace (e.g., disposing of batteries, reusing motor or cooking oils for a different purpose) [IP, C]
- F2.6** investigate the effectiveness of a personal protective device or environmental protection device for use in the workplace (e.g., compare two different spill kits for absorbing spills; test the key features of a mask for protection from airborne particulate matter; identify the appropriate types of eye protection for different situations) [PR, AI]

## **F3. Understanding Basic Concepts**

- F3.** demonstrate an understanding of general workplace safety procedures and environmentally responsible practices
- F3.1** describe some of the ways in which implementation of the 4Rs (reduce, reuse, recycle, and recover) in the workplace protects the environment (e.g., by reducing the production of garbage and recycling materials for daily use), and explain the meaning of different symbols used to promote these strategies (e.g., different representations of the Möbius loop [the international recycling symbol])
- F3.2** compare some of the features, uses, and environmental implications of Hazardous Household Product Symbols and WHMIS hazard symbols
- F3.3** identify and describe common types of biological, physical, and chemical hazards in the workplace (e.g., hazards posed by bacteria, noise, work at dangerous heights, use of chemicals and other hazardous materials) and associated accident-prevention methods (e.g., sterilization, soundproofing, use of five-point safety harnesses, use of safe storage cabinets, safe disposal of chemicals)
- F3.4** explain how the use of personal protective equipment (e.g., aluminized gloves, a welding shield, ear plugs, a self-contained breathing apparatus, an air-purifying mask) minimizes exposure to hazardous materials that can enter the body through ingestion, inhalation, absorption, and injection

- F3.5** identify some current workplace procedures, practices, and protocols that help to protect the environment (e.g., garbage separation, paper recycling, use of recycled products, “telecommuting” to workplaces, practices that conserve water and energy)

## **PHYSICS**

### **Physics, Grade 11, University Preparation (SPH3U)**

#### ***B. Kinematics***

##### **B1. Relating Science to Technology, Society, and the Environment**

- B1.** analyse technologies that apply concepts related to kinematics, and assess the technologies’ social and environmental impact
- B1.2** assess the impact on society and the environment of a technology that applies concepts related to kinematics (e.g., photo radar helps prevent vehicular accidents and reduces fuel consumption associated with excessive speeding) [AI, C]

**Sample issue:** The use of the global positioning system (GPS) increases accuracy in mapping, surveying, navigation, monitoring earthquakes, and tracking the movement of oil spills and forest fires, among other benefits. However, its extensive use raises concerns about privacy and human rights.

**Sample questions:** How are satellites used to track animal species in remote areas? How can scientists and environmentalists use this information to help protect vulnerable species? What is the impact of the use of speed limiters and tracking devices in the trucking industry? What effect do lower truck speeds have on highway safety and vehicle emissions?

#### ***C. Forces***

##### **C1. Relating Science to Technology, Society, and the Environment**

- C1.** analyse and propose improvements to technologies that apply concepts related to dynamics and Newton’s laws, and assess the technologies’ social and environmental impact
- C1.2** evaluate the impact on society and the environment of technologies that use the principles of force ... [AI, C]

**Sample questions:** ... What are the advantages and disadvantages for the environment of various methods of using the natural forces from tidal currents to generate energy?

#### ***D. Energy and Society***

##### **D1. Relating Science to Technology, Society, and the Environment**

- D1.** analyse technologies that apply principles of and concepts related to energy transformations, and assess the technologies’ social and environmental impact
- D1.1** analyse, using the principles of energy transformations, a technology that involves the transfer and transformation of thermal energy (e.g., a power station, an air conditioner, a fuel cell, a laser printer) [AI, C]

**Sample questions:** How do vertical or rooftop gardens help insulate structures? In what ways have refrigeration technologies changed since their initial development? When they are designed efficiently, how do homes with solar-powered cells use the energy from the sun? How do ground-source heat pumps reduce the need for traditional heating and cooling systems?

- D1.2** assess, on the basis of research, how technologies related to nuclear, thermal, or geothermal energy affect society and the environment (e.g., thermal regulating units, radiopharmaceuticals, dry-steam power plants, ground-source heat pumps) [IP, PR, AI, C]

**Sample issue:** With the rising economic and environmental costs of heating homes using conventional methods, geothermal technologies are an increasingly popular alternative. However, tapping geothermal heat sources involves placing kilometres of tubing containing antifreeze in the ground, which constitutes a potential environmental hazard.

**Sample questions:** How is the nuclear technology known as receptor binding assay used to monitor the toxicity of shellfish? How does this technology benefit consumers? How can nuclear technology be used to sterilize insects? If used widely, what impact would such a pest-control technique have on society and the environment? ...

## **E. Waves and Sound**

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.** analyse how mechanical waves and sound affect technology, structures, society, and the environment, and assess ways of reducing their negative effects
- E1.2** analyse the negative impact that mechanical waves and/or sound can have on society and the environment, and assess the effectiveness of a technology intended to reduce this impact [AI, C]

**Sample issue:** Noise pollution from industrial, transportation, entertainment, and other sources can increase stress, lead to hearing loss, disrupt ecosystems, and alter animal behaviour. Noise pollution can be reduced by using mufflers, sound barriers, baffles, and earplugs, and by turning down the volume on devices such as cellphones and headsets.

**Sample questions:** What impact can tsunamis have on coastal regions? How effective is tsunami-monitoring equipment in reducing death tolls and property destruction? How do the noise levels produced by different types of jet engines compare with each other? How effective are the sound baffles erected on the sides of highways that run through residential areas?

## **F. Electricity and Magnetism**

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** analyse the social, economic, and environmental impact of electrical energy production and technologies related to electromagnetism, and propose ways to improve the sustainability of electrical energy production
- F1.1** analyse the social and economic impact of technologies related to electromagnetism (e.g., particle accelerators, mass spectrometers, magnetic levitation [maglev] trains, magnetic resonance imaging [MRI], electromagnetic pulses after nuclear explosions) [AI, C]

**Sample questions:** What are the benefits of electromagnetic medical technologies? What impact does the cost of acquiring these technologies, and the need for specialized technicians to operate them, have on equitable access to health care in all regions of Canada? What harmful effects do solar flares have on our atmosphere, satellites orbiting the earth, and electrical systems?

- F1.2** analyse the efficiency and the environmental impact of one type of electrical energy production (e.g., from hydroelectric, fossil fuel–burning, wind, solar, geothermal, or nuclear sources), and propose ways to improve the sustainability of electrical energy production [AI, C]

**Sample issue:** Compared to oil, coal is relatively inexpensive and plentiful, and, globally, the number of coal-burning electrical plants is expanding. Yet, coal power is inefficient, and the mining and burning of coal produce a great deal of pollution. Although technology is available to make coal cleaner, it is costly and has been implemented to only a limited extent.

**Sample questions:** How efficient are the small and large-scale solar-power systems used in individual homes and industrial settings? What is the environmental impact of the generation of solar power? What technologies are being used to improve the efficiency of energy sources such as coal and biofuel? What impact does the increasing use of biofuels have on air quality, land use, and agricultural practices?

## Physics, Grade 12, University Preparation (SPH4U)

### B. Dynamics

#### B1. Relating Science to Technology, Society, and the Environment

- B1.** analyse technological devices that apply the principles of the dynamics of motion, and assess the technologies' social and environmental impact

- B1.2** assess the impact on society and the environment of technological devices that use linear or circular motion (e.g., projectile weapons, centrifuges, elevators) [AI, C]

**Sample issue:** Satellites, which use principles of circular motion to revolve around Earth, support communications technologies and are used by governments to gather intelligence. They also provide information on the movement of animal populations and forest fires, and on changes in weather systems or the atmosphere. But satellites use huge amounts of fuel, and old satellites often become space junk.

**Sample questions:** How are large-scale centrifuges used in wastewater treatment? How do windmills use the principles of dynamics to generate power? What is the environmental impact of wind power and wind farms? How are linear actuators used to make the workplace more ergonomic, reducing work days lost to strain and injury?

### C. Energy and Momentum

#### C1. Relating Science to Technology, Society, and the Environment

- C1.** analyse, and propose ways to improve, technologies or procedures that apply principles related to energy and momentum, and assess the social and environmental impact of these technologies or procedures

- C1.2** assess the impact on society and the environment of technologies or procedures that apply the principles of energy and momentum (e.g., crumple zones, safety restraints, strategic building implosion) [AI, C]

**Sample issue:** Hydroelectricity is produced by using the potential energy of dammed water to drive turbines and generators. Although hydroelectricity is renewable and generates no greenhouse gases, the damming of waterways can create massive flooding upstream and reduce flows downstream, affecting aquatic and terrestrial ecosystems and people living near the water source.

**Sample questions:** ... What is the environmental impact of the chemicals whose combustion produces the effects in fireworks displays?

## **D. Gravitational, Electric, and Magnetic Fields**

### **D1. Relating Science to Technology, Society, and the Environment**

- D1.** analyse the operation of technologies that use gravitational, electric, or magnetic fields, and assess the technologies' social and environmental impact
- D1.2** assess the impact on society and the environment of technologies that use gravitational, electric, or magnetic fields (e.g., satellites used in surveillance or storm tracking, particle accelerators that provide high-energy particles for medical imaging) [AI, C]
- Sample issue:** The radiation produced by the magnetic and electric fields of electron accelerators is used to treat tumours. In conjunction with other therapies, radiation increases the survival rate of cancer patients, but safeguards are needed to ensure that patients receive safe doses of radiation and that medical personnel and the immediate environment are not contaminated.
- Sample questions:** ... What is the effect on human health of long-term exposure to the electrical fields created by high-voltage lines? How could zero-gravity experiments on agricultural products benefit society and the environment? What are the environmental benefits of using technology involving gravitational fields to search for mineral deposits?

## **E. The Wave Nature of Light**

### **E1. Relating Science to Technology, Society, and the Environment**

- E1.** analyse technologies that use the wave nature of light, and assess their impact on society and the environment
- E1.2** assess the impact on society and the environment of technologies that use the wave nature of light (e.g., DVDs, polarized lenses, night vision goggles, wireless networks) [AI, C]
- Sample questions:** ... In what ways can posting magazines or newsletters on the Internet, rather than printing and distributing them, benefit the environment?

## Physics, Grade 12, College Preparation (SPH4C)

### A. Scientific Investigation Skills and Career Exploration

#### A2. Career Exploration

- A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., alternative energy advocate, sustainable energy technician, electrician, mechanic) and the education and training necessary for these careers

### B. Motion and Its Applications

#### B1. Relating Science to Technology, Society, and the Environment

- B1.** analyse selected technologies that are used to move objects or track their motion, and evaluate their impact on society and the environment, including their contribution to scientific knowledge
- B1.1** analyse the design and uses of a transportation technology (e.g., snowmobiles, automobiles, motorized personal water craft), and evaluate its social and environmental impact, including the impact on risk behaviour and accident rates [AI, C]  
*Sample issue:* All-terrain vehicles (ATVs), designed to be driven off-road, are used in occupations requiring access to remote areas and for recreational purposes. However, ATVs can lack stability on uneven surfaces, which can result in serious accidents, particularly for inexperienced drivers. The vehicles can also cause damage when they are driven in environmentally sensitive areas.
- B1.2** analyse how technologies are used to track the motion of objects, and outline various kinds of scientific knowledge gained through the use of such technologies (e.g., data on animal populations and migrations, on changes in ocean currents related to global warming, on the behaviour of celestial objects) [AI, C]  
*Sample questions:* How are motion-related technologies used to monitor wildlife populations? What type of information do these technologies provide, and how is it used? How are satellites used to track weather systems? What are the uses of the information gathered?

### C. Mechanical Systems

#### C1. Relating Science to Technology, Society, and the Environment

- C1.** analyse common mechanical systems that use friction and applied forces, and evaluate their effectiveness in meeting social or environmental challenges
- C1.2** evaluate, on the basis of research, the effectiveness of a common mechanical system in addressing a social or environmental challenge (e.g., ... high-efficiency heating and cooling systems) [IP, PR, AI, C]  
*Sample questions:* ... How have integrated mechanical systems such as programmable thermostats improved energy efficiency in homes?



## **D. Electricity and Magnetism**

### **D1. Relating Science to Technology, Society, and the Environment**

**D1.** analyse the development of selected electrical and electromagnetic technologies, and evaluate their impact on society and the environment

**D1.1** evaluate, on the basis of research, the impact on society and the environment of the evolution of an electrical technology (e.g., electric cars or buses, electric appliances) [IP, PR, AI, C]

*Sample questions:* What impact has the development and evolution of refrigeration technologies had on society and the environment? Are trains powered by electricity an improvement over trains powered by steam or diesel engines? Why or why not? What impact does the use of electric buses, streetcars, and subway trains by the Toronto Transit Commission have on local residents and the environment?

**D1.2** assess the impact of an electromagnetic technology that is used for the benefit of society or the environment (e.g., devices for diagnosing and treating diseases, technologies for treating seeds to increase the rate of germination) [AI, C]

*Sample questions:* ... What are some of the uses of electromagnetic technologies in health care? What are the benefits of using electromagnetic sensors to detect metal concentrations in brown-field developments? What are the advantages of maglev trains over conventional transportation technologies?

## **E. Energy Transformations**

### **E1. Relating Science to Technology, Society, and the Environment**

**E1.** evaluate the impact on society and the environment of energy-transformation technologies, and propose ways to improve the sustainability of one such technology

**E1.1** analyse an energy-transformation technology (e.g., wind turbines, refrigerators, telephones, steam engines, coal-fired electrical plants), and evaluate its impact on society and the environment [AI, C]

*Sample issue:* Fax machines allow documents to be transmitted quickly and securely. Most fax machines use ink cartridges, which can end up in landfill sites. By contrast, thermal fax machines use heat resistors to convert electricity into usable heat. They then apply this heat through a print head onto chemically treated paper to print a document.

*Sample questions:* What types of energy transformations take place in an air conditioner? What impact does the widespread use of air conditioners have on society and the environment? What types of energy transformations occur in incandescent and fluorescent light bulbs? What impact does the difference in energy transformations in these two types of bulbs have on the environment?

**E1.2** propose a course of practical action to improve the sustainability of an energy-transformation technology (e.g., solar panels, internal combustion engines, fuel cells, air conditioners) [PR, AI, C]

*Sample issue:* Although wind is a renewable source of energy, many windmills are needed to generate a useful amount of energy, and large wind farms can have a negative impact on wildlife and local residents. Researchers are experimenting with modifications to the blades to increase the efficiency of each windmill.

*Sample questions:* Why are ice-cooling systems more energy efficient than traditional air conditioners? How could solar panels be modified to enable them to capture solar energy on a cloudy day? How could a speaker system be improved to maximize its energy use? What modifications could be made to an internal combustion engine so that it used less gasoline?

### **E3. Understanding Basic Concepts**

- E3.4** compare the efficiency of various systems that produce electricity (e.g., wind farms, hydroelectric generators, solar panels), using the law of conservation of energy, and outlining the transformations, transmissions, and energy losses involved
- E3.5** describe a variety of renewable and non-renewable sources of energy (e.g., solar energy, fossil fuels, hydroelectric energy, energy generated from biomass), and identify the strengths and weaknesses of each

## ***F. Hydraulic and Pneumatic Systems***

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** analyse the development of technological applications related to hydraulic and pneumatic systems, and assess some of the social and environmental effects of these systems

# **SCIENCE**

## **Science, Grade 12, University/College Preparation (SNC4M)**

### ***C. Pathogens and Disease***

#### **C3. Understanding Basic Concepts**

- C3.6** describe some of the means used by international non-governmental organizations (e.g., Médecins sans Frontières, Oxfam, Ryan’s Well Foundation, UN agencies, the Stephen Lewis Foundation) to control the spread of disease (e.g., distribution of vaccines, medication, malaria nets; installing wells so people have access to clean water; public education on strategies for transmission prevention)

### ***E. Science and Public Health Issues***

#### **E3. Understanding Basic Concepts**

- E3.3** explain the impact of various threats to public health, including infectious diseases (e.g., hepatitis, HIV/AIDS, tuberculosis, malaria, sexually transmitted diseases), chronic diseases (e.g., cardiovascular disease, diabetes, asthma), and environmental factors (e.g., climate change, air pollution, chemical pollutants, radiation)
- E3.4** explain a variety of social factors that can promote the rapid spread of infectious diseases (e.g., global population growth, international travel, poor sanitation, lack of clean drinking water)

## **F. Biotechnology**

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** analyse a variety of social, ethical, and legal issues related to applications of biotechnology in the health, agricultural, or environmental sector
- F1.1** analyse social issues related to an application of biotechnology in the health, agricultural, or environmental sector (e.g., issues related to the uses of genetically modified organisms ...) [AI, C]

*Sample issue:* The promise of genetically modified (GM) crops was that they would be resistant to pests and would produce more abundant harvests. However, GM crops can crossbreed with crops in adjoining fields, thus contaminating traditional food sources, reducing biodiversity, changing farming practices, and limiting the choices available to consumers.

- F1.2** analyse, on the basis of research, ethical and legal issues related to an application of biotechnology in the health, agricultural, or environmental sector ... [IP, PR, AI, C]

*Sample questions:* ... Who determines whether genetically modified foods are safe? How might the testing/regulation process be open to abuse? What are the legal and ethical implications of introducing into an ecosystem a species engineered through biotechnology?

### **F3. Understanding Basic Concepts**

- F3.** demonstrate an understanding of biological processes related to biotechnology and of applications of biotechnology in the health, agricultural, and environmental sectors
- F3.3** describe applications of biotechnology in the health (e.g., genomics, gene therapy, xenotransplantation, in vitro fertilization), agricultural (e.g., genetically modified crops, biopesticides, cloning), and environmental sectors (e.g., bioremediation, phytoremediation)

## **Science, Grade 12, Workplace Preparation (SNC4E)**

### **B. Hazards in the Workplace**

#### **B1. Relating Science to Technology, Society, and the Environment**

- B1.** assess common workplace settings with respect to hazards, and analyse selected legislation that is in place to protect workers and the environment from these hazards
- B1.1** assess a workplace setting, either real or simulated, with respect to hazards that could affect workers or the environment, using appropriate criteria (e.g., a checklist for a health and safety audit) [AI, C]
- Sample questions:* What hazardous substances are used in the workplace being assessed? Are warnings posted as to the dangers they pose? How are the substances handled, stored, and disposed of? ...
- B1.2** analyse and summarize the requirements of selected sections of workplace safety and/or environmental protection legislation related to a career of personal interest (e.g., regulations applying to mining in the Occupational Health and Safety Act; regulations applying to waste management in the Ontario Environmental Protection Act) [AI, C]

**Sample issue:** Section 91.1 of the Ontario Environmental Protection Act requires employers to prevent or reduce the risk of spills of pollutants and, if such a spill does occur, to provide the appropriate equipment, personnel, and material to clean it up. This section covers a range of workplaces where spills of environmental contaminants may occur.

**Sample questions:** What types of jobs are affected by regulations under the Ontario Environmental Protection Act? ...

## **C. Chemicals in Consumer Products**

### **C1. Relating Science to Technology, Society, and the Environment**

**C1.** analyse chemical products used in the home and workplace, and issues related to their safe and environmentally responsible use and disposal

**C1.2** assess the environmental consequences of improper disposal of chemical products commonly used in the home (e.g., pouring paint down the drain; dumping batteries in garbage destined for landfill sites) [AI, C]

**Sample issue:** Some batteries contain lithium or cadmium, which are toxic heavy metals. If such batteries are tossed into the regular garbage, these metals can leach into the soil or run off into water systems. Batteries can also overheat and cause a fire or other kind of chemical reaction.

**Sample questions:** What happens when pharmaceuticals are poured down the drain? Why should containers of flammable substances such as turpentine or corrosive substances such as drain cleaner not be thrown in the regular garbage?

**C1.3** evaluate the appropriateness of current disposal practices in their home, at school, or in the community, with particular reference to the disposal of chemical waste [AI, C]

**Sample issue:** Many commonly used chemicals can damage the environment if they are not properly disposed of. Some chemicals are combustible, produce toxic vapours, or are corrosive. Some otherwise safe chemicals can become toxic if combined with another chemical. Safe disposal methods must take the properties of each chemical into account.

**Sample questions:** What is the proper method for disposing of solvent-soaked rags? What sorts of items are considered to be household hazardous waste (HHW)? Are there HHW depots in your community? What happens to the waste once it arrives at such a depot?

### **C2. Developing Skills of Investigation and Communication**

**C2.6** investigate a variety of consumer products within a given category (e.g., shampoo, window cleaner, disinfectant), focusing on products claiming to be environmentally friendly, and analyse them with respect to selected factors (e.g., cost, effectiveness, impact on the environment) [PR, AI, C]

## **E. Electricity at Home and Work**

### **E1. Relating Science to Technology, Society, and the Environment**

**E1.** assess electrical hazards in the home and workplace, and the social and environmental impact of electrical technologies

- E1.1** assess the social and environmental impact of electrical technologies, including the impact associated with the manufacture and disposal of electronic devices (e.g., the impact of electrical devices used in the health care field, such as pacemakers or respirators; the impact of energy generation needed to power electrical devices and appliances) [AI, C]

**Sample issue:** Electronics play an important part in our everyday lives. However, disposal of used electronic equipment is a huge problem. Globally, we generate 30 to 50 million tonnes of electronic waste each year. Much of this waste is shipped to developing countries, where it is incinerated or dumped in landfill sites, practices that release toxic chemicals into the air or soil.

**Sample questions:** How often do you replace an electronic device because something newer, faster, or more powerful has been developed? What do you do with the older devices? ...

## **F. Nutritional Science**

### **F1. Relating Science to Technology, Society, and the Environment**

- F1.** assess the environmental implications of a variety of food choices, and evaluate and propose ways to improve the nutritional content of a menu

- F1.1** assess the environmental implications of food choices available in a variety of situations (e.g., in the school cafeteria, a fast-food restaurant, a supermarket, a local farmers' market, an organic meat shop), and propose ways to minimize the environmental impact of their food choices [AI, C]

**Sample issue:** Supermarkets commonly sell imported produce, distributed through large warehouses, even when the same types of food are in season locally and are available from local farmers. Importing foods generates greater carbon emissions but may be seen as more efficient if local farmers lack a reliable distribution system.

**Sample questions:** What is the environmental impact of organic farming compared to traditional farming methods? What are the advantages and disadvantages of buying certified organic foods from a local farmer? What are the environmental costs of purchasing a pizza? Why is the environmental footprint associated with consuming a hamburger different from that associated with eating a veggie burger?

# **SOCIAL SCIENCES AND HUMANITIES, GRADES 9 AND 10 (1999) AND GRADES 11 AND 12 (2000)**

*See the Preface for important information on the organization of the following material.*

The different subjects represented in the social sciences and humanities curriculum provide opportunities to consider environmental topics from a variety of perspectives, from responsible consumerism in Family Studies to the role of the natural environment in various belief systems in World Religions. In many of the strands in these courses, the development of environmental understanding can be fostered through the learning context (e.g., a topic or issue related to the environment).

## ***FAMILY STUDIES***

### **Food and Nutrition, Grade 9 or 10, Open (HFN10/HFN20)**

#### ***Self and Others***

- categorize the reasons why people eat the foods they eat (e.g., cultural, emotional, environmental, nutritional, religious, social)

#### ***Personal and Social Responsibilities***

- identify consumer responsibility in the investigation of current food issues

*Note:* This expectation provides an opportunity to examine environmental issues related to agriculture and the processing of foods.

#### ***Diversity, Interdependence and Global Connections***

- select and use regional and seasonal foods to plan and produce a Canadian food product or meal
- complete an assessment of the influence of geography on food supply and production
- explain the importance of policy decisions as applied to global food issues (e.g., how personal and family decisions can affect our world)

*Note:* These expectations provide opportunities to examine the environmental and economic benefits of eating locally grown and produced foods, as well as to explore other food-related environmental issues.

### **Individual and Family Living, Grade 9 or 10, Open (HIF10/HIF20)**

#### ***Social Challenges***

- compare individual and family lifestyles now and in the past, considering the effect of social, cultural, economic, technological, and environmental change

- describe the impact of economic, social, technological, environmental, and health factors on lifestyle decisions (e.g., whether to purchase a product, use a service, or participate in an activity)

## **Living and Working With Children, Grade 11, College Preparation (HPW3C)**

### ***Growth and Development***

- demonstrate an understanding of the multifaceted nature of and the various influences on child development
  - demonstrate an understanding of age-appropriate learning environments for preschoolers and primary-school pupils
  - create activities or educational experiences that meet the physical, intellectual, social, and emotional needs of children at different stages of development

*Note:* These expectations provide opportunities to discuss the importance for healthy child development of experiences in an unpolluted natural environment

### ***Socialization of Children***

- evaluate various global influences on children and families
  - explain the influence of war, famine, overcrowding, poverty, child labour, and malnutrition on the lives of children

*Note:* Environmental considerations are relevant with respect to the factors to be explored in connection with these expectations.

### ***Social Challenges***

- demonstrate an understanding of issues and challenges that concern parents, care-givers, and others who interact with children in society
  - demonstrate an understanding of the universal rights of children (e.g., the right to food, shelter, safety, a peaceable existence)

*Note:* These expectations provide opportunities to examine environmental concerns.

## **Managing Personal and Family Resources, Grade 11, College Preparation (HIR3C)**

### ***Personal and Social Responsibilities***

- analyse the role that responsible consumerism plays in independent and family living
  - explain the process of making wise consumer decisions (e.g., comparison shopping, reading labels, checking warranties) for a variety of purposes (e.g., purchasing food and clothing, choosing housing or modes of transportation)

- plan for a specific major purchase (e.g., refrigerator, computer, entertainment system), using wise consumer techniques

**Note:** Responsible consumerism involves consideration of factors related to the environment (e.g., environmentally friendly development and production of goods; environmental impact of products/services; energy efficiency of products).

### ***Preparing for the Challenges of the Future***

- analyse how families are affected by global disparities in wealth and resources
  - identify resources that influence the wealth or poverty of communities and nations (e.g., natural resources, agricultural yield, education)
  - explain the impact that the availability of these resources has on family life

**Note:** Environmental factors should be considered in the context of these expectations.

### ***Social Structures***

- explain the effects of economic and business trends on the family
  - investigate and analyse the spending patterns of various socio-economic classes as documented by Statistics Canada
  - determine how demographic changes (e.g., those associated with the aging of the baby-boomers) affect the production of goods and services

**Note:** These expectations provide opportunities to examine various aspects and influences of the environmentalist movement.

## **Managing Personal Resources, Grade 11, Workplace Preparation (HIP3E)**

### ***Self and Others***

- explain strategies for coping with issues of personal and public safety (e.g., be aware of safety organizations that provide protection, understand the use of safety equipment and safety features on the job, be aware of worker-protection protocols such as drills for response to fire and other emergencies)

**Note:** Environmental safety should be considered in the context of this expectation (e.g. safe disposal of hazardous materials in the workplace)

### ***Personal Responsibilities***

- identify influences on buying decisions (e.g., advertising, status, convenience) and describe guidelines for becoming a wise and responsible consumer (e.g., comparison shopping, reading labels, checking warranties)
- plan the purchase of specific items for personal use (e.g., clothing, appliances, entertainment equipment), using wise consumer techniques



**Note:** Responsible consumerism involves consideration of factors related to the environment (e.g., environmentally friendly development and production of goods; environmental impact of products/services; energy efficiency of products).

## **Fashion and Creative Expression, Grade 11, Open (HNC30)**

### ***The Apparel Industry***

- identify the factors that contribute to the cost of goods produced in Canada and abroad (e.g., standard of living, climatic factors, transportation, market size, design, unionization of workforce, government regulation of industry)
- analyse the influence of current events on men’s and women’s fashion
- identify countries that are major producers of fibres and fabrics (e.g., China, Egypt, England, Scotland)

**Note:** These expectations provide opportunities to examine how measures to protect the environment affect cost of production in Canada and abroad, as well as how growing environmental consciousness is influencing the fashion industry.

### ***Textiles***

- explain the role of the environment in relation to the textile industry, and describe how the textile industry affects the environment

## **Living Spaces and Shelter, Grade 11, Open (HLS30)**

### ***Functions of Living Spaces and Shelter***

- identify the ways in which living spaces and shelter meet individual and family needs
  - summarize the ways in which different forms of shelter satisfy various individual and family needs and functions, such as: ... 6. lifestyle needs (e.g., those related to activities, interests, life-cycle events, community services); 7. special considerations (e.g., storage space, noise pollution, transportation, maintenance requirements, local demand for technologies and utilities; private and personal spaces)

**Note:** These expectations provide opportunities to examine the need for energy-efficient housing to meet people’s financial needs, as well as environmentally friendly building practices to address their interest in protecting the environment.

### ***Shelter for Everyone***

- demonstrate an understanding of social realities related to living spaces and shelter in Canada and abroad
  - summarize the laws and regulations pertaining to such factors as zoning, pollution, and ownership and maintenance of property; building and development; expropriation; and conservation of energy

- identify the ways in which political, social, economic, and technological trends, as well as psychological factors, affect available types of shelter
  - summarize how living spaces and shelter requirements are affected by social norms and pressures (e.g., those resulting from demographic changes)
  - identify how families are affected by new trends in household technologies (e.g., modular housing, the computerized home, the ecological house, new energy sources, new trends in appliances and household equipment)

*Note:* These expectations address environmental considerations explicitly and also afford the opportunity to explore the effect on housing trends of “social norms and pressures” such as those resulting from growing consciousness of the need to protect the environment.

### ***Considerations in Acquiring Shelter and Designing Living Spaces***

- demonstrate an understanding of ways of enhancing personal spaces (e.g., by creating household accessories), using environmentally friendly materials (e.g., recycled materials, garage-sale purchases, non-toxic building materials and wall and floor coverings)
- describe home furnishings and equipment requirements as influenced by family composition, living patterns, changing needs throughout the stages of life, cultural traditions, economic and human resources, and energy costs

## **Parenting, Grade 11, Open (HPC3O)**

### ***Diversity and Universal Concerns***

- demonstrate an understanding of the common experiences of young children across cultures

*Note:* Common experiences include the ability to experience natural environments with or without the threat of health hazards, depending on environmental factors in different areas of the world.

## **Food and Nutrition Sciences, Grade 12, University/College Preparation (HFA4M)**

### ***Self and Others***

- identify the ways in which physical factors influence food choices (e.g., geographical location, regional growing seasons, availability of food markets, home storage capacity)
- plan menus for, select, and prepare foods, taking into consideration economic, geographical, and seasonal factors that affect the availability of ingredients

### ***Personal and Social Responsibilities***

- determine the relationship among nutrition, lifestyle, health, and disease

*Note:* The expectation provides the opportunity to examine environmental factors, such as polluted well water and pesticide use.

### ***Diversity, Interdependence, and Global Connections***

- identify the economic, political, and environmental factors that affect food production and supply throughout the world
- identify the factors that are critical to achieving and maintaining food security and eliminating hunger
  - describe policies necessary to protect the health and safety of food producers (e.g., against the risk of contaminants), and to protect land and water quality, and biodiversity

### ***Social Challenges***

- describe noticeable trends in food-consumption patterns

*Note:* Trends in food-consumption patterns, such as the trend towards consuming locally grown and produced foods, are influenced by environmental factors.

## **Individuals and Families in a Diverse Society, Grade 12, University/College Preparation (HHS4M)**

*Note:* The content of this course does not lend itself readily to the incorporation of environmental education.

## **Issues in Human Growth and Development, Grade 12, University/College Preparation (HHG4M)**

### ***Socialization and Human Development***

- identify and evaluate the various ways in which the media can be seen as agents of socialization
  - demonstrate an understanding of how the media influence people’s lives (e.g., making lifestyle changes, stereotyping), and evaluate the effectiveness of media censorship

*Note:* The media’s role with respect to popularizing the environmentalist movement and bringing attention to climate change are examples of the connection that can be made in the context of this expectation.

### ***Diversity, Interdependence, and Global Connections***

- demonstrate an understanding of the diverse influences that shape human growth and development

*Note:* Among the influences addressed in the context of this expectation could be the influence of the natural and built environments.

## **Parenting and Human Development, Grade 12, Workplace Preparation (HPD4E)**

### ***Personal and Social Responsibilities***

- demonstrate an understanding of how the parental responsibility for the nutritional well-being of children and adolescents is best fulfilled

*Note:* Parental consideration of the use of pesticides or hormones in the foods their children consume is an environmental connection in the context of this expectation.

## **The Fashion Industry, Grade 12, Open (HNB4O)**

### ***The Canadian Fashion Industry***

- describe entrepreneurial opportunities in the fashion industry in terms of social, technological, political, and economic changes, with a focus on community needs, financial resources, and demographic patterns

*Note:* An environmental connection can be made in the context of this expectation, in that environmental concerns today are involved in all of the types of changes listed in the expectation.

### ***Fibres and Textiles***

- identify the raw materials and processes that are appropriate for the production of particular fibres and fabrics
  - demonstrate an understanding of the relationships between fabric construction methods and specific end uses, between fabric performance and garment construction, and between chemicals used and ecological concerns

## **GENERAL SOCIAL SCIENCE**

### **Introduction to Anthropology, Psychology, and Sociology, Grade 11, University/College Preparation (HSP3M)**

#### ***Self and Others***

- identify and assess the major influences that contribute to an individual's personal and social development (e.g., heredity, environment, race, gender)
- explain why behaviour varies depending on context and on the individuals involved (e.g., at work, within a family, in sports, in a crowd, in a large city or small town)

## **Challenge and Change in Society, Grade 12, University/College Preparation (HSB4M)**

### ***Social Change***

- describe key features of major theories from anthropology, psychology, and sociology that focus on change
  - identify conditions for change (e.g., objectification, advocacy, personality) and impediments to change (e.g., cost, penalty, functional repercussions), as revealed in studies of anthropology, psychology, or sociology

**Note:** These expectations provide an opportunity to examine the change of attitude with respect to the natural environment.

- analyse the ways in which ecological knowledge resulting from advances in technology (e.g., improved tools, irrigation systems) influences indigenous approaches to resource management and land tenure

### ***Social Challenges***

- appraise the differences and similarities in the approaches taken by anthropology, psychology, and sociology to the study of social challenges pertaining to health, social injustice, and global concerns
  - evaluate, from a psychological perspective, the role of perception in Canadians' understanding of themselves, their families, and their local and global communities

**Note:** Global concerns today include environmental concerns.

## **PHILOSOPHY**

### **Philosophy: The Big Questions, Grade 11, Open (HZB30)**

#### ***Applications of Philosophy to Other Subjects***

- identify philosophical theories and presuppositions in natural science, history, art, social science and humanities, and other subjects

**Note:** This strand offers opportunities to explore environmental connections. Questions that could involve environmental education include “What is a meaningful life? What makes a society just?”.

## **Philosophy: Questions and Theories, Grade 12, University Preparation (HZT4U)**

### ***Logic and the Philosophy of Science***

- demonstrate an understanding of how philosophical questions apply to disciplines such as physics, mathematics, and psychology
- evaluate the strengths and weaknesses of the responses to some questions of natural and social sciences defended by some of the major philosophers and schools of philosophy, and defend their own responses
  - explain how philosophical theories (e.g., atomism, phenomenology) have influenced the development of the natural and social sciences

*Note:* These expectations provide opportunities to explore environmental contexts.

### ***Ethics***

- demonstrate an understanding of how philosophical theories of ethics are implicit in other subjects
  - use critical and logical thinking skills to defend their own ideas about ethical issues (e.g., the nature of the good life) and to anticipate counter-arguments to their ideas

*Note:* These expectations can be applied to environmental issues.

## **WORLD RELIGIONS**

### **World Religions: Beliefs, Issues, and Religious Traditions, Grade 11, University/College Preparation (HRT3M)**

#### ***Social Structures***

- review the political, economic, social, ideological, or geographic impact of religion on at least one culture
- demonstrate an understanding of how religious beliefs influence the development of the policies and practices of social institutions

*Note:* Various religions emphasize respect for the natural environment, and the policies of the social institutions influenced by them will affect social attitudes towards the environment.

#### ***Religion and the Human Experience***

- demonstrate an understanding of a variety of belief systems (e.g., secular humanism, materialism, agnosticism, atheism)
- analyse how positive and negative attitudes within religious traditions have been used to justify local and global prejudices and biases

*Note:* These expectations provide opportunities to explore the valuing of, or attitude towards, the natural environment in various belief systems and religious traditions.

## **World Religions: Beliefs and Daily Life, Grade 11, Open (HRF3O)**

### ***Religion and Daily Life***

- analyse the role of practices and rituals in the daily lives of believers from various religious traditions
  - identify some areas in which relationships between people of different beliefs, traditions, and practices can create conflict (e.g., Aboriginal peoples' response to the encroachment of development on sacred sites)

**Note:** Differences in various religions with respect to attitudes to the natural environment can be explored in the context of these expectations.

# TECHNOLOGICAL EDUCATION, GRADES 9 AND 10 (2009) AND GRADES 11 AND 12 (2009)

## Exploring Technologies, Grade 9, Open (TIJ10)

### A. Technology Fundamentals

#### A1. Planning and Development

**A1.4** incorporate appropriate technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication/building/creation, function, innovation, material, mechanism, power and energy, safety, structure, systems*) in the design, fabrication or delivery, and evaluation of a product or service ...

#### A3. Product or Service Evaluation

**A3.1** evaluate a product or service, and processes associated with its development, on the basis of a set of criteria relevant to that product or service (*e.g., adherence to specifications, ease of use, attractive appearance, ruggedness, clean joints, acceptable weld bead, uniform colour, adherence to forest management plan, nutritional value*)

**A3.2** suggest improvements to a product or service on the basis of a set of criteria relevant to that product or service (*e.g., durability, reliability, ease of use, eco-friendliness, appearance, safety, customer satisfaction*)

### C. Technology, the Environment, and Society

#### C1. Technology and the Environment

**C1.** demonstrate an awareness of the effects of various technologies on the environment

**C1.1** describe how various technologies (*e.g., integrated pest management, water purification, mass transit, agricultural technologies, resource extraction*) affect the environment, and identify important environmental considerations associated with different areas of technology (*e.g., how to deal with ozone-depleting chemicals or hazardous wastes; how to increase opportunities for recycling, conservation, use of sustainable methods or materials*)

**C1.2** identify technological solutions that have been designed in response to environmental concerns (*e.g., catalytic converter, wind turbines, solar-powered signs, biofuels, non-toxic and hypoallergenic products, recyclable and reusable packaging*)

**C1.3** follow proper procedures for the safe storage and disposal of materials and waste products (*e.g., keep flammable solvents, paints, and varnishes in non-combustible cabinets; recycle used motor oil*)

#### C2. Technology and Society

**C2.2** describe how society is being affected today by various new and emerging technologies (*e.g., electronic messaging, Global Positioning System [GPS], wireless access, hybrid vehicles, nanotechnology, biotechnology*)



- C2.3** describe economic, ecological, social, and safety considerations facing consumers when they make choices between particular products or services (*e.g., natural versus synthetic materials, renewable versus non-renewable resources; ...*)
- C2.5** describe how social and economic factors influence the development and use of technology (*e.g., ... rotating blackouts speed the development of energy alternatives, ...*)

## **Communications Technology, Grade 10, Open (TGJ20)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** describe the impact of communications media technologies and activities on the environment and identify ways of reducing their harmful effects
- C1.1** describe the effects of current communications technologies on the environment (*e.g., effects related to paper consumption, energy use, light and sound pollution, disposal of obsolete equipment*)
- C1.2** identify sustainable practices that are currently used or can be used to minimize the impact of communications technologies on the environment (*e.g., recycling of paper, recycling or reuse of electronic components, use of energy-efficient equipment, use of sleep mode when computers are temporarily unused*)

## **Computer Technology, Grade 10, Open (TEJ20)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** identify harmful effects of the widespread use of computers and associated technologies on the environment, as well as agencies that reduce these effects
- C1.1** identify harmful effects of computer use on the environment (*e.g., resources used and wastes created during production; disposal of old computers in landfill*)
- C1.2** identify government agencies and community partners that provide resources and guidance for environmentally sound production, use, and recycling of computer equipment (*e.g., recycling centres that accept old computers and/or batteries, companies that recycle printer cartridges or refurbish computers for resale*)

## **Construction Technology, Grade 10, Open (TCJ20)**

### ***B. Design, Layout, and Planning Skills***

#### **B1. Design and Problem Solving**

- B1.3** apply appropriate technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material,*

*mechanism, power and energy, structure, safety, systems*) as they work through design and/or problem-solving processes ...

## **D. Technology, the Environment, and Society**

### **D1. Technology and the Environment**

By the end of this course, students will:

- D1.** demonstrate an understanding of ways in which the construction industry affects the environment
- D1.1** describe the major effects of the construction industry on the environment (*e.g., non-sustainable logging causing deforestation; water and air pollution released during the production of manufactured building materials; landfills required for the disposal of construction waste; energy required to produce and transport construction materials*)
- D1.2** identify the environmental impact of producing and using natural and manufactured construction materials (*e.g., deforestation and loss of animal habitat; release of arsenic from pressure-treated wood and formaldehyde from oriented-strand board [OSB] and medium-density fibreboard [MDF]*)
- D1.3** identify ways of reducing the environmental impact of a structure (*e.g., ground-source heating and cooling, improved insulation, building-envelope systems, technologies to reduce light and noise pollution, energy-conserving lighting, non-toxic building materials, use of local materials*)
- D1.4** apply best practices for sustainable construction and building (*e.g., use efficient cutting patterns to minimize waste; reduce, reuse, or recycle materials*)

### **D2. Technology and Society**

- D2.1** identify the economic and social effects of the construction industry on society (*e.g., ... effects of logging on traditional hunting by Aboriginal communities*)

## **Green Industries, Grade 10, Open (THJ2O)**

### **A. Green Industry Fundamentals**

#### **A1. Basic Biology**

- A1.** demonstrate an understanding of plant and/or animal biology and species classification as they relate to the green industries
- A1.1** describe the key distinguishing characteristics of different plant and/or animal groups (*e.g., shrubs, trees, annuals, flowers, animal breeds*)
- A1.2** identify the basic components of common plants and/or animals and describe their functions (*e.g., leaves, flowers, bark, internal organs*)
- A1.3** describe important physiological processes in plants and/or animals (*e.g., germination, photosynthesis, reproduction, digestion*)

#### **A2. Factors Affecting Growth**

- A2.** describe the factors affecting the growth and care of plants and/or animals

- A2.1** describe environmental factors that affect growth and post-harvest quality (*e.g., light, temperature, soils, nutrients, water, wind*)
- A2.2** describe biological factors that affect growth and post-harvest quality (*e.g., plant type, photosynthesis, genetics*)
- A2.3** identify a variety of pests and diseases (*e.g., Asian long-horned beetle, thrips, grubs, moles, Dutch elm disease, mastitis, hoof-and-mouth disease*) and describe their effects on plants and/or animals

### **A3. Designs, Processes, and Systems**

- A3.3** demonstrate an understanding of a variety of processes used in plant and/or animal care (*e.g., plant growth experiments, propagation, pruning, sheep shearing*)

## **B. Green Industry Skills**

### **B1. Design and Production**

- B1.2** demonstrate competence in applying techniques related to the propagation and growth of plants and/or the breeding and growth of animals (*e.g., seeding, hatching eggs, making cuttings*)
- B1.4** apply techniques relating to the maintenance, care, and handling of plants and/or animals, using environmental best practices (*e.g., mulching gardens, feeding and watering, product processing, visual inspection*)

### **B2. Technical Skills**

- B2.1** complete a variety of green industry projects and tasks using appropriate tools, equipment, and materials (*e.g., ... prune a tree, scale a log, transplant a shrub, create a walkway, design a butterfly garden*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** identify the impact of green industries on the environment and describe ways of minimizing harmful effects
- C1.1** identify ways in which green industry activities affect the environment (*e.g., contamination of water by fertilizers, pesticides, and manure; emission of greenhouse gases from animals, tilled soils, and equipment; emission of air pollutants from gasoline- and diesel-powered machinery; noise pollution; high energy demand*)
- C1.2** identify best management practices, environmentally sustainable practices, and technologies that can be used to reduce the harmful effects of green industry operations (*e.g., composting, recycling, use of renewable energy sources, land retirement, minimal use of fertilizers and pesticides*)

### **C2. Technology and Society**

- C2.1** describe the societal and economic implications of recent innovations and trends in the green industries (*e.g., mechanization and its effects on productivity and employment, expanded distribution systems and their consequences for consumer choice and local production, transgenic plants and their effects on food cost and availability*)

### **C3. Local Industries**

- C3.2** describe the relationships between a variety of local green industries and their local outlets (*e.g., garden centre and nursery, vegetable production and farmers' market, maple syrup production and specialty food store, flower producer and florist*)
- C3.3** describe the effects of local green industries on the community (*e.g., effects on employment, water and air quality, leisure opportunities, aesthetics; availability of locally produced specialty products*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.3** identify potential hazards (*e.g., trip hazards, environmental conditions, danger zones*) related to the materials, site conditions, and equipment used in the work environment

### **D2. Career Opportunities**

- D2.1** describe career opportunities in a variety of sectors in the green industries (*e.g., landscape architect, arborist, forester, florist, horticulturalist, farmer, herder*) and the education, training, and certification required for employment in green industry occupations (*e.g., training in first aid, CPR, and WHMIS; driver's licence; cut skid certification*)

## **Hairstyling and Aesthetics, Grade 10, Open (TXJ2O)**

### **C. Industry Practices, the Environment, and Society**

#### **C2. Industry Practices and the Environment**

- C1.** describe ways in which hairstyling and aesthetics products and activities can affect the environment, and ways to reduce harmful effects
- C1.1** identify some environmental effects of various products used in the hairstyling and aesthetics industry (*e.g., **toxic substances:** peroxide, chemical relaxers, lighteners; **nonbiodegradable substances:** plastic; **organic/natural substances:** facial masks, olive oil*)
- C1.2** describe how salons and spas can help to protect the environment (*e.g., purchase sustainable products, such as refillable containers, products with natural ingredients, non-toxic cleaning products, and energy-saving products; adopt environmentally friendly methods of managing waste, such as recycling and waste-reduction programs*)

#### **C2. Industry Practices and Society**

- C2.1** describe some key social issues that are of concern to the hairstyling and aesthetics industry (*e.g., ... the use of natural versus synthetic ingredients in product development; demand for scent-free and hypoallergenic products; ...*)

## Health Care, Grade 10, Open (TPJ2O)

### A. Health Care Fundamentals

#### A2. Personal Health

**A2.1** identify factors that affect the personal health and well-being of children and adolescents (*e.g., environmental conditions, diet, food safety, food security, adequate shelter, amount of daily exercise, amount of daily rest, recreation opportunities, work/life balance, stress*)

#### A3. Conventional and Complementary Therapies

**A3.1** compare conventional and complementary approaches to health care in terms of the therapeutic approaches used (*e.g., pharmaceutical medications versus herbal/natural remedies*) and the types of practitioners offering the services (*e.g., physicians versus homeopaths or Aboriginal healers*)

### C. Health Care, the Environment, and Society

#### C1. Health Care and the Environment

**C1.** demonstrate an understanding of environmental issues related to health care and personal well-being

**C1.1** identify current environmental issues and describe their implications for human health and well-being (*e.g., air quality and respiratory disease, water quality and gastrointestinal problems, toxic substances and cancer or birth defects*)

**C1.2** describe the impact of health-related choices on the environment, and create a plan for improving personal health and fitness that also benefits the environment (*e.g., walking or biking rather than driving; eating more locally produced fruits and vegetables and less meat and processed food*)

#### C2. Health Care and Society

**C2.2** describe current issues related to the delivery of health care services in Canada (*e.g., ... lack of health care support, sanitation, and clean water in remote communities*)

**C2.3** identify current child and adolescent health issues in developing countries from recent media coverage (*e.g., malnutrition, lack of effective immunization programs, lack of clean water*)

## Hospitality and Tourism, Grade 10, Open (TFJ2O)

### A. Hospitality and Tourism Fundamentals

#### A1. Services and Products of the Tourism Industry

**A1.5** identify the types of tourist attractions associated with the various geographic regions of Ontario (*e.g., wineries in the Niagara region, ecotourism in northern Ontario, museums and art galleries in Ottawa, sporting events and conventions in major urban areas*)

- A1.6** identify province-wide tourist activities and attractions in Ontario (*e.g., seasonal festivals, cultural events, areas of natural beauty, historical sites, fishing and hunting, Aboriginal powwows*)

## **B. Hospitality and Tourism Skills**

### **B4. Planning an Event or Activity**

- B4.2** design a tourism event or activity (*e.g., reception, ski vacation, fishing trip, catered event*) that meets a customer's specific needs

## **C. Industry Practices, the Environment, and Society**

### **C1. Industry Practices and the Environment**

- C1.** demonstrate an understanding of ways in which various aspects of the tourism industry affect the environment, and ways in which harmful effects can be reduced
- C1.1** describe ways in which various aspects of the tourism industry affect the environment (*e.g., use of pesticides and fertilizers on golf courses may cause water pollution; air travel causes increased greenhouse gas emissions through the burning of jet fuel; Aboriginal lands and traditions may be affected by ecotourism; high water consumption by hotels may put a strain on the local environment*)
- C1.2** identify ways of reducing the harmful effects that various aspects of the tourism industry have on the environment (*e.g., create wildlife sanctuaries; support conservation projects; ensure that tourist facilities do not exceed the carrying capacity of the area or region; invest in carbon offsets such as planting a diversity of native trees*)
- C1.3** describe and apply appropriate conservation measures (*e.g., reduce, reuse, recycle*)
- C1.4** describe, on the basis of research, codes of ethics and/or guidelines for sustainable tourism, and use them to assess a tourism product, facility, or service

### **C2. Industry Practices and Society**

- C2.1** explain the economic and social impact of the tourism industry (*e.g., developing tourist facilities creates jobs; tourism can cause road congestion, pollution, and/or degradation of the environment; tourists bring money into the community*)

## **Manufacturing Technology, Grade 10, Open (TMJ2O)**

### **A. Manufacturing Technology Fundamentals**

#### **A1. The Manufacturing Industry**

- A1.1** describe major differences between primary manufacturing industries (*e.g., iron and steel, lumber, paper, petroleum*) and secondary manufacturing industries (*e.g., automotive, aerospace, chemicals, plastics, textiles*)
- A1.4** describe ways in which manufacturing technology affects people's daily lives (*e.g., by providing improved consumer products, developing new diagnostic equipment in health care, creating more energy-efficient means of transport*)

## **A2. Design Fundamentals**

**A2.2** identify technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) ... and particular environmental concerns (*e.g., pollution, disposal of waste, packaging, recycling*) that are important considerations in product design

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of ways in which the manufacturing industry affects the environment
- C1.1** identify ways in which manufacturing affects the environment today (*e.g., through the demand for raw materials, creation of greenhouse gases, disposal of waste materials*), and predict how the effects will change in the future
- C1.2** explain the importance of “reduce, reuse, and recycle” and life cycle assessment (LCA) when designing, manufacturing, and marketing a product
- C1.3** use proper storage and disposal techniques of materials and waste products, ensuring that there is a minimal effect on the environment
- C1.4** explain the need for environmental stewardship and describe how the manufacturing industry can act in an environmentally responsible way (*e.g., by harvesting raw materials in a sustainable manner, using energy from renewable sources, making products that can be recycled, ensuring ethical treatment of people affected by manufacturing activities*)

### **C2. Technology and Society**

- C2.1** describe the past and present effects of manufacturing on society (*e.g., changes in work environments and lifestyle brought about by the Industrial Revolution, rising standards of living, widespread availability of consumer goods, effect of resource extraction on Aboriginal communities, effect on developing countries that accept industrialized countries' waste*), and predict how manufacturing will affect society in the future
- C2.3** evaluate from various perspectives (*e.g., safety, technical, financial, environmental, ethical*) the effects of new and emerging manufacturing technologies ... on culture and society

## **Technological Design, Grade 10, Open (TDJ2O)**

### **A. Technological Design Fundamentals**

#### **A1. Design Process**

**A1.1** describe the purpose of design for a given project (*e.g., cleaner energy, cost-efficient products, smaller living spaces*) in terms of key technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) ...

## **B. Technological Design Skills**

### **B1. Research, Planning, and Organization**

**B1.1** gather and use pertinent information (*e.g., on existing products, available materials, and other resources*) for a variety of design challenges (*e.g., ... birchbark canoe, tikinagan, or other item made from local renewable resources*)

### **B3. Making and Testing Models and Prototypes**

**B3.3** assess models and/or prototypes on the basis of prescribed criteria (*e.g., aesthetics, ergonomics, safety, efficiency, environmental impact*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

**C1.** demonstrate an understanding of environmentally responsible practices, and apply them throughout the technological design process

**C1.1** identify environmental issues that affect technological design (*e.g., global climate change, resource depletion, conservation, toxins*)

**C1.2** describe and apply best practices for conserving energy and other resources during the design process (*e.g., use wood glue instead of hot glue, plan projects to make efficient use of materials and equipment, reuse and recycle prototype material*)

### **C2. Technology and Society**

**C2.** describe how society influences technological innovation and how technology affects society

**C2.1** describe how society influences the development and use of technology (*e.g., traffic congestion spurs development of compact vehicles; increasing population density leads to the construction of taller buildings; environmental awareness leads to increased use of alternative energy sources*)

**C2.2** describe how various technological innovations have affected quality of life (*e.g., pesticides, internal combustion engines, plastics, on-demand water heaters, catalytic converters, nanotechnology, wireless communication*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

**D1.** apply appropriate health, safety, and environmental practices throughout the design process

**D1.2** demonstrate an understanding of and follow personal and environmental health and safety procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and related activities (*e.g., use protective equipment; set tool and equipment guards properly; ensure adequate ventilation and ergonomic seating and other workplace arrangements; follow safe operating procedures; keep work areas clean and organized; store materials and dispose of wastes properly*)



## **Transportation Technology, Grade 10, Open (TTJ2O)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of ways in which various aspects of the transportation industry affect the environment and ways in which harmful effects can be remedied or reduced
  - C1.1** research and report on ways in which the transportation industry affects the environment and on efforts being made to remedy or reduce harmful effects (*e.g., improved production methods, automotive parts recycling*), including ways of disposing of waste products (*e.g., used oil, used batteries, used paint/thinners*)
  - C1.2** describe the pros and cons of using environmentally friendly products (*e.g., biodegradable cleaners*) and procedures (*e.g., recycling of materials*) when servicing and/or maintaining vehicles and/or craft
  - C1.3** describe the environmental impact of various modes of transportation (*e.g., tail-pipe emissions, noise pollution, water contamination and habitat degradation, bird and animal strikes*)

#### **C2. Technology and Society**

- C2.2** describe recent technological innovations (*e.g., related to performance, comfort, driveability, fuel economy, recycling of parts*) in vehicles and/or craft

### ***D. Professional Practice and Career Opportunities***

#### **D1. Health and Safety**

- D1.2** demonstrate good housekeeping and safety practices in the work environment (*e.g., cleaning up spills and leaks, proper disposal of waste, keeping areas clean and clear of obstructions*)

## **COMMUNICATIONS TECHNOLOGY**

### **Communications Technology, Grade 11, University/College Preparation (TGJ3M)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** describe the impact of current communications media technologies and activities on the environment and identify ways of reducing harmful effects
  - C1.1** describe the impact of current communications media technologies on the environment (*e.g., increased energy consumption, disposal of electronic equipment and batteries, noise pollution, electromagnetic interference, RF pollution, chemical and other wastes associated with paper production*)

- C1.2** describe environmentally responsible practices that can be used to reduce the impact of communications technologies on the environment (*e.g., recycling or finding new uses for obsolete equipment, disposal of batteries as toxic waste, using energy-efficient equipment and turning off equipment that is not being used, recycling of toner cartridges, use of recycled paper*)

## **Communications Technology: Broadcast and Print Production, Grade 11, Open (TGJ3O)**

### **A. Communications Technology Fundamentals**

#### **A1. Core Concepts, Techniques, and Skills**

- A1.1** demonstrate an understanding of technological concepts (*e.g., aesthetics, control, environmental sustainability, ergonomics, fabrication/building/creation, function, innovation, material, mechanism, power and energy, safety, structure, systems*) and their relevance to the design and creation of media projects ...

### **C. Technology, the Environment, and Society**

#### **C1. Technology and the Environment**

- C1.** describe the impact of communications media technologies and activities on the environment, and identify ways of reducing their harmful effects
- C1.1** describe the effects of current audio, video, broadcast journalism, graphic arts, and printing technologies on the environment (*e.g., increased energy consumption, waste and disposal problems created by rapid obsolescence, toxic wastes, noise pollution, electromagnetic interference, RF pollution*)
- C1.2** describe ways in which environmental problems are being or can be addressed by the audio, video, broadcast journalism, graphic arts, and printing industries (*e.g., using energy-efficient equipment, upgrading rather than replacing obsolete equipment, recycling equipment slated for disposal, using environmentally friendly inks and environmentally responsible press cleanup methods, using the persuasive power of the media to promote environmental stewardship, environmental certification of operations [EcoLogo, ISO 14001]*)

## **Communications Technology, Grade 12, University/College Preparation (TGJ4M)**

### **C. Technology, the Environment, and Society**

#### **C1. Technology and the Environment**

- C1.** analyse the environmental impact of recent advances in communications technology, and describe ways of reducing harmful effects

- C1.1** analyse the environmental costs and benefits, local and global, of recent innovations in communications technology (*e.g., costs and benefits related to resource usage, energy demand, waste disposal, toxic substances, radiation, air and water pollution*)
- C1.2** describe ways of minimizing or avoiding harmful environmental effects caused by communications technologies and media activities (*e.g., upgrade products rather than dispose of them; turn off equipment that is not being used; treat dead batteries as toxic waste; recycle used paper and printer cartridges*)

## **Communications Technology: Digital Imagery and Web Design, Grade 12, Open (TGJ40)**

### **A. Communications Technology Fundamentals**

#### **A1. Core Concepts, Techniques, and Skills**

- A1.1** demonstrate an understanding of technological concepts (*e.g., aesthetics, control, environmental sustainability, ergonomics, fabrication/building/creation, function, innovation, material, mechanism, power and energy, safety, structure, systems*) and their relevance to the design and creation of media projects ...

### **C. Technology, the Environment, and Society**

#### **C1. Technology and the Environment**

- C1.** describe the environmental impact of communications media technologies, and identify ways of minimizing their harmful effects
- C1.1** describe the effects of current photographic, digital imaging, animation, 3D modelling, and web design technologies on the environment (*e.g., paperless publication, increased energy consumption, battery disposal, waste and disposal problems created by rapid obsolescence of equipment*)
- C1.2** describe ways in which environmental problems are being or can be addressed by the photographic, digital imaging, animation, 3D modelling, and web design industries (*e.g., use of rechargeable batteries; reduction of packaging; recycling of paper, toner and ink cartridges; use of energy-efficient equipment; upgrading rather than replacing obsolete equipment; recycling equipment slated for disposal; environmental certification of operations [EcoLogo, ISO 14001]*)

# **COMPUTER TECHNOLOGY**

## **Computer Engineering Technology, Grade 11, University/College Preparation (TEJ3M)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** describe environmental issues related to the widespread use of computers and associated technologies
- C1.1** describe the effects of computer and electronic technology on the environment (*e.g., accumulation of electronic waste, including lead and other toxic materials used in computers; release of ozone-destroying chemicals used to wash soldering flux from circuit boards; energy consumed by computers left in standby mode; fuel consumption and air pollution reduced by computerized traffic-control systems*)
- C1.2** outline how community partners and government agencies apply the reduce/reuse/recycle concept to computer technology

## **Computer Technology, Grade 11, Workplace Preparation (TEJ3E)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** describe environmental issues related to the widespread use of computer technology
- C1.1** describe the effects of computer technology on the environment (*e.g., accumulation of electronic waste, use of lead and other toxic materials in computers, use of ozone-destroying chemicals to wash soldering flux from circuit boards, energy consumed by computers left in standby mode, energy saved by use of programmable thermostats*)
- C1.2** outline how community partners and government agencies apply the reduce/reuse/recycle concept to computer technology

## **Computer Engineering Technology, Grade 12, University/College Preparation (TEJ4M)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** analyse environmental issues related to the widespread use of computers and associated technologies, and apply strategies to reduce environmental harm from computer use
- C1.1** assess the effects of computer and electronics technology on the environment (*e.g., hazardous materials contained in computer components, use of energy and other resources, fuel consumption and air pollution reduced by computerized traffic-control systems*)

**C1.2** outline and apply strategies to recycle or reuse computers and computer components (*e.g., develop a local recycle/reuse program, create an in-school public awareness campaign*)

**C2. Technology and Society**

**C2.1** assess the benefits of computer and electronic technology for society (*e.g., ... software that can help monitor or predict changes in wetland area, deforestation, and climate*)

**D. Professional Practice and Career Opportunities**

**D2. Ethics and Security**

**D2.2** outline a purchasing policy for computers, taking ethical issues into account (*e.g., the environment, human rights, child labour*)

**Computer Technology, Grade 12, Workplace Preparation (TEJ4E)**

**C. Technology, the Environment, and Society**

**C1. Technology and the Environment**

**C1.** describe environmental issues related to the widespread use of computer technology, and apply strategies to reduce environmental harm from computer use

**C1.1** assess the effects of computer technology on the environment (*e.g., leakage of hazardous substances from obsolete computers dumped in landfills or improperly recycled; increased energy use; benefits of computer-controlled heating and cooling systems*)

**C1.2** outline and apply strategies to recycle and reuse computer components (*e.g., build computers using used components and donate to a community partner, offer a service where computers can be upgraded using used components*)

**C1.3** describe and apply strategies and devices that help reduce the energy used by computers at home and in the workplace (*e.g., software that throttles drive speed and CPU speed, monitors that turn off automatically, more efficient processors, lower-speed hard drives, diskless computers, virtualization to eliminate extra computers*)

**C2. Technology and Society**

**C2.1** analyse the benefits of computer technology for society (*e.g., ... use of computers to help monitor and predict long-term environmental changes*)

# **CONSTRUCTION TECHNOLOGY**

## **Construction Engineering Technology, Grade 11, College Preparation (TCJ3C)**

### **A. Construction Technology Fundamentals**

#### **A2. Building Codes, Regulations, and Standards**

**A2.6** identify organizations that promote sustainable building practices, and related standards (*e.g., Canada Green Building Council, Leadership in Energy and Environmental Design [LEED®] certification standards*)

#### **A4. Design Considerations**

**A4.3** identify components of an environmentally friendly house (*e.g., solar water heater, energy-efficient heating and cooling systems, recycled building materials*)

### **D. Technology, the Environment, and Society**

#### **D1. Technology and the Environment**

**D1.** demonstrate an understanding of the environmental effects of construction projects, and ways of reducing harmful effects

**D1.1** plan projects and processes to minimize waste (*e.g., use efficient cutting patterns, reuse and recycle leftover materials*)

**D1.2** identify and describe environmentally friendly building practices (*e.g., high-efficiency heating and cooling, renewable energy technologies, reuse of grey water, use of materials produced from sustainable resources*)

**D1.3** describe the environmental effects of using natural and manufactured construction materials (*e.g., energy use, release of toxic chemicals, disposal of manufacturing and construction waste, effects on water supply and quality*)

**D1.4** describe ways of reducing and/or managing energy consumption in the home (*e.g., smart meters, energy-efficient lighting, timers, heat-recovery ventilators*)

**D1.5** describe the life cycle of a construction product (*e.g., manufacture; installation; reuse, recycling, or disposal*)

#### **D2. Technology and Society**

**D2.2** describe factors affecting the quality of life of the occupants of residential buildings (*e.g., air quality; allergens; ...*)

### **E. Professional Practice and Career Opportunities**

#### **E2. Career Opportunities**

**E2.1** identify careers in construction technology (*e.g., civil or construction engineer, architectural draftsman, renovation technician or technologist, indigenous environmental technician, project manager*), and describe the education and training required for these careers

## **Construction Technology, Grade 11, Workplace Preparation (TCJ3E)**

### ***D. Technology, the Environment, and Society***

#### **D1. Technology and the Environment**

- D1.** demonstrate an understanding of the environmental effects of construction projects, and ways of reducing harmful effects
- D1.1** compare the efficiency and environmental effects of a variety of energy sources used in residential dwellings (*e.g., solar, ground source, pellets, propane, wood, oil, natural gas, wind*)
- D1.2** plan projects and processes to minimize waste (*e.g., use efficient cutting patterns, reuse and recycle leftover materials*)
- D1.3** identify ways of reducing energy consumption in the home (*e.g., heat recovery ventilator, tankless water heater, timers, energy-efficient lighting*)
- D1.4** identify programs provided by community partners and government agencies to reduce construction waste and to reuse or recycle construction materials (*e.g., drywall, wood, refrigerants*)
- D1.5** research and identify sources and certifications for construction materials that have been manufactured using sustainable practices

#### **D2. Technology and Society**

- D2.3** identify the economic and social effects of the construction industry on a community or region (*e.g., direct and indirect effects on employment, waste disposal, land use, water supply, Aboriginal land claims and traditional hunting*)

## **Custom Woodworking, Grade 11, Workplace Preparation (TWJ3E)**

### ***D. Technology, the Environment, and Society***

#### **D1. Technology and the Environment**

- D1.** demonstrate an understanding of the environmental effects of the woodworking industry, and ways of reducing harmful effects
- D1.1** describe the major effects of the woodworking industry on the environment (*e.g., costs and benefits related to forest management; non-sustainable logging that causes deforestation, destruction of old-growth forests, and/or loss of wilderness habitat for endangered species; water and air pollutants released during the production of manufactured materials; energy required to produce and transport materials for woodworking*)
- D1.2** identify the environmental effects of using and disposing of specific natural and manufactured materials (*e.g., landfill or incineration of woodworking waste; harmful emissions from some types of paints, adhesives, and manufactured materials, which contribute to “sick building syndrome”*)

- D1.3** identify ways of reducing environmental harm through the choice of particular materials (*e.g., sustainably produced products, products that have a minimal ecological footprint, non-toxic products*)
- D1.4** plan projects and use materials to minimize waste (*e.g., use efficient cutting patterns, reuse or recycle leftover materials*)
- D1.5** identify various certifications and/or standards for sustainable practices (*e.g., Forest Stewardship Council Canada standards*)

## **D2. Technology and Society**

- D2.3** describe how societal needs and client preferences (*e.g., budget restraints; cultural, religious, and environmental choices; ease of use by persons with physical disabilities*) affect custom woodworking projects

# **Construction Engineering Technology, Grade 12, College Preparation (TCJ4C)**

## **A. Construction Technology Fundamentals**

### **A4. Design Considerations**

- A4.3** describe factors affecting the design of a foundation (*e.g., drainage, soil type, load, frost penetration*)
- A4.4** describe the weather-related loads and stresses that a building must be designed to withstand (*e.g., force of wind, snow load on roofs, expansion and contraction due to changes in temperature and humidity*)

## **D. Technology, the Environment, and Society**

### **D1. Technology and the Environment**

- D1.** identify and evaluate measures that can be taken to conserve resources on construction projects
- D1.1** plan projects and construction processes to minimize waste (*e.g., use efficient cutting patterns, reuse leftover material*)
- D1.2** describe the costs and benefits of environmentally friendly building practices (*e.g., high-efficiency heating and cooling, renewable energy technologies, reuse of grey water, use of materials produced from sustainable resources*)
- D1.3** compare ways of reducing the environmental footprint of construction projects through the choice of energy sources (*e.g., solar, geothermal, wind*), building design (*e.g., extra insulation, high-efficiency heating systems, green roof*), and construction processes (*e.g., use of recycled material, fuel-efficient equipment*)
- D1.4** outline strategies to reduce, reuse, and recycle construction materials, and identify methods for implementing sustainable building practices (*e.g., work with a community partner or government agency, help develop local programs, create a public awareness campaign*)



**D1.5** research and describe strategies for implementing sustainable building practices (*e.g., Canada Green Building Council guidelines, Forest Stewardship Council Canada standards*)

## **D2. Technology and Society**

**D2.1** research and assess the economic and social effects of the construction industry (*e.g., creation of primary and secondary jobs, transport of materials, land use, resource management, encroachment on Aboriginal lands*)

**D2.2** describe the factors affecting the quality of life of the occupants of residential and/or light commercial buildings (*e.g., air quality, allergens, carcinogens, aesthetics, access to transit and other services*)

**D2.4** identify factors to consider in community planning (*e.g., population density, ecology, culture*)

# **Construction Technology, Grade 12, Workplace Preparation (TCJ4E)**

## ***B. Design, Layout, and Planning Skills***

### **B4. Building Skills**

**B4.1** identify and describe the factors that affect the design and installation of foundations for construction projects (*e.g., drainage, soil conditions, frost penetration, ...*)

## ***D. Technology, the Environment, and Society***

### **D1. Technology and the Environment**

**D1.** demonstrate an understanding of the environmental effects of construction projects, and ways of reducing harmful effects

**D1.1** assess environmentally friendly alternatives for building systems (*e.g., heating with solar energy, heat pumps, or geothermal systems; reusing grey water; harvesting rainwater; chlorine-free treatment of storm water and sewage*)

**D1.2** assess the environmental and health effects of using manufactured construction materials (*e.g., pressure-treated wood, oriented-strand board, medium-density fibreboard, cultured stone*)

**D1.3** compare ways of reducing and/or managing energy consumption in homes and businesses (*e.g., smart meters, timers, skylights, heat recovery, energy-efficient lighting*)

**D1.4** research and describe strategies for implementing sustainable building practices (*e.g., Canada Green Building Council guidelines, Forest Stewardship Council Canada standards*)

### **D2. Technology and Society**

**D2.1** identify the economic and social effects of the construction industry (*e.g., waste disposal, land use, labour supply and cost, water supply, local infrastructure*)

**D2.2** identify factors to consider in community planning (*e.g., population density, culture, the environment*)

## Custom Woodworking, Grade 12, Workplace Preparation (TWJ4E)

### ***D. Technology, the Environment, and Society***

#### **D1. Technology and the Environment**

- D1.** demonstrate an understanding of the environmental effects of the woodworking industry, and ways of reducing harmful effects
- D1.1** describe ways to improve air quality in a living or working space through the choice of materials for woodworking projects (*e.g., lumber, plastics, medium-density fibreboard, paint, varnish*)
- D1.2** assess the environmental effects of using scarce and/or exotic woods (*e.g., destruction of rainforest and old-growth boreal forests, displacement of Aboriginal peoples, loss of wildlife habitat*) and the extent to which sustainable forestry practices can reduce environmental degradation
- D1.3** plan projects and apply strategies to minimize or mitigate degradation of the environment (*e.g., use efficient cutting patterns, reuse and recycle leftover materials, select sustainably produced products, contribute to restoration plans, purchase carbon offsets*)
- D1.4** assess various certifications and/or standards used to recognize sustainable practices (*e.g., Forest Stewardship Council Canada standards*)

#### **D2. Technology and Society**

- D2.1** assess how consumer trends and technological innovations have affected employment in the custom woodworking industry (*e.g., use of exotic or old-growth woods, sale of prefabricated furniture and cabinets in large retail outlets, use of computer assisted design [CAD] and CNC machines*)
- D2.2** assess economic and societal issues related to the custom woodworking industry (*e.g., waste disposal, labour supply, logging near Aboriginal communities, imports and exports, use of renewable and non-renewable resources*)

## ***GREEN INDUSTRIES***

### **Green Industries, Grade 11, University/College Preparation (THJ3M)**

#### ***A. Green Industry Fundamentals***

##### **A1. Species Classification and Geographical Regions**

- A1.** demonstrate an understanding of species classification and identification and relationships between species and geographical regions
- A1.1** distinguish between different plant and/or animal groups on the basis of key identification characteristics, and identify species using both common names and scientific classifications (*e.g., annuals and perennials; native and non-native plants; major types, species, and varieties of trees, shrubs, flowering plants, and crops; animal breeds*)

- A1.2** identify geographical regions on the basis of classification criteria relevant to the green industries (*e.g., forest type, hardiness, agricultural use, ease of cultivation, water features*)
- A1.3** explain the relationships between the characteristics of different geographical regions and the key desirable characteristics of plant and/or animal groups within them (*e.g., relationship of plant and animal characteristics to available heat, moisture, light, shelter, and food*)

## **A2. Factors Affecting Growth and Product Quality**

- A2.** demonstrate an understanding of the effects of biotic and abiotic factors on growth and product quality
- A2.1** describe how abiotic factors (*e.g., air quality, temperature, nutrients, water, topography, handling procedures*) affect the growth of various plant and/or animal species and the quality of products derived from them
- A2.2** explain biological processes that are essential to the propagation, development, and health of plants and/or animals and the quality of products derived from them (*e.g., reproduction, respiration, photosynthesis, transpiration, post-harvest physiology*)
- A2.3** identify a variety of pests and diseases (*e.g., bacteria, viruses, moulds, fungi, insects, animals*) and explain their effects on the health of plants and/or animals and the quality of products derived from them

## **A3. Designs and Processes**

- A3.1** demonstrate an understanding of and apply the steps in a design process ... to a variety of requirements in the green industries (*e.g., creation of forest management plans, environmental farm plans, urban landscape designs, hydroponic system designs*)
- A3.2** explain fundamental operational processes that are commonly used in the green industries (*e.g., single animal management, crop location and rotation, crop scheduling, event planning, nutrient and waste management, composting, select cutting, timber cruise*)
- A3.4** demonstrate an understanding of correct procedures for the care and handling of plants and/or animals (*e.g., propagating, pruning, transporting, watering, feeding, fertilizing, removing bark*)

## **A4. Technological and Mathematical Literacy and Communication Skills**

- A4.1** demonstrate an understanding of terminology used in the green industries and use it correctly in oral and written communication (*e.g., sustainability, coniferous, massing flower, flagstone, organic*)

# **B. Green Industry Skills**

## **B1. Design and Production**

- B1.1** implement a production process or procedures according to a design or plan (*e.g., timber cruise, stand inventory, landscape construction, crop rotation, mixed animal farming, selective breeding*)
- B1.2** utilize a management plan for a specific application related to the green industries (*e.g., forest management plan, nutrient management plan, site layout plan, crop rotation plan, annual work plan, business plan, five-year operational plan*)

- B1.3** demonstrate an understanding of and apply techniques related to the propagation and maintenance of a variety of plant and/or animal species and the post-harvest handling of plant products (*e.g., techniques related to crop, mammal, and poultry production, sexual and asexual plant production, shrub rejuvenation, rose processing, care of selected local tree species*)
- B1.4** demonstrate an understanding of and apply techniques or processes that promote biodiversity, increase ecosystem function, and reduce maintenance requirements (*e.g., planting native species, mulching, establishing natural habitat*)

## **B2. Plant and Animal Management Strategies**

- B2.** apply management strategies for assessing and controlling biotic and abiotic factors that affect plant and/or animal quality
- B2.1** apply a variety of methods to monitor and assess biotic factors that affect plant and/or animal quality (*e.g., weed identification, regular animal health inspections, plant quality inspections, pest scouting, post-harvest tracking of product freshness and quality*)
- B2.2** apply a variety of methods to monitor and assess abiotic factors that affect plant and/or animal quality (*e.g., nutrient balance analysis, soil testing, plant tissue analysis, monitoring growing degree days [GDDs], form defect analysis, water testing*)
- B2.3** apply a variety of techniques to control pests and reduce plant and/or animal defects (*e.g., maintenance or enhancement of natural barriers to control pest migration, animal quarantine, log hydration, integrated pest management*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** analyse the impact of the green industries on the environment and describe ways of minimizing harmful effects
- C1.1** demonstrate an understanding of ecological relationships and processes (*e.g., food webs, symbiotic relationships, ecological succession, nutrient flows and cycles, habitat and species diversity*) that can affect or be affected by green industry operations
- C1.2** analyse the effects of green industry activities on the environment in the past and in the present (*e.g., logging practices, irrigation, fertilization, pest control, nutrient and waste management*)
- C1.3** assess the advantages and disadvantages of using natural rather than manufactured materials or products in green industry activities (*e.g., natural fertilizers and pest control methods rather than chemical fertilizers and pesticides, real flowers rather than artificial flowers, real grass rather than artificial turf, untreated rather than pressure-treated lumber*)
- C1.4** identify sustainable practices and guidelines that are currently applied within the green industries or may be applied in the future (*e.g., environmental farm planning, integrated pest management, xeriscaping, forest regeneration, low-till cultivation*)
- C1.5** explain the environmental implications (*e.g., effects on landfill lifespan and water and air quality*) of using particular materials, products, processes, and disposal methods (*e.g., recycling, reusing, composting, growing genetically modified crops, organic farming, various disposal methods for invasive plants*)

## **C2. Technology and Society**

**C2.2** analyse societal issues relating to the green industries, and identify ways of resolving them, taking a variety of perspectives into account (*e.g., effects on Aboriginal hunting and harvesting territories, land use conflicts such as parkland versus commercial development, property rights and municipal landscape management, animal welfare, rights of migrant workers, fair trade concerns relating to imported agricultural or floral products, fuel ethanol versus food production*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

**D1.2** demonstrate an understanding of environmental and site-related hazards (*e.g., land conditions; weather conditions; crew competence and organization; presence of utility lines, glass structures, hanging limbs, chicots*) and apply appropriate safety measures for avoiding them (*e.g., roping off an area, setting up caution signs, removing hazards, implementing traffic control measures*)

### **D3. Career Opportunities**

**D3.1** describe careers in the green industries (*e.g., landscape architect, forest manager, horticulturalist, farm manager, turf manager, botanist, veterinarian*) and the education, training, and certification required for entry into these occupations

## **Green Industries, Grade 11, Workplace Preparation (THJ3E)**

### **A. Green Industry Fundamentals**

#### **A1. Species Classification and Geographical Regions**

- A1.** demonstrate an understanding of species classification and identification and of relationships between species and geographical regions
- A1.1** distinguish between different plant and/or animal groups and identify them by key characteristics and desirable features (*e.g., annuals and perennials; native and non-native plants; major types, species, and varieties of trees, shrubs, flowering plants, and crops; animal breeds*)
- A1.2** identify geographical regions on the basis of classification criteria relevant to the green industries (*e.g., forest type, hardiness, soil type*)
- A1.3** explain the relationships between geographical regions and the key characteristics and desirable features of plant and/or animal groups within them (*e.g., relationship of plant and animal characteristics to available heat, moisture, light, shelter, and food*)

#### **A2. Factors Affecting Growth and Product Quality**

- A2.** demonstrate an understanding of the effects of biotic and abiotic factors on growth and product quality
- A2.1** identify the main abiotic factors that affect growth and post-harvest quality (*e.g., temperature, sunlight, soil composition, rainfall and soil moisture*)

- A2.2** describe biological processes that are essential to the propagation, development, and health of plants and/or animals and the quality of products derived from them (*e.g., photosynthesis, respiration, reproduction, transpiration, post-harvest physiology, digestion*)
- A2.3** identify a variety of pests and diseases (*e.g., bacteria, viruses, moulds, fungi, insects, animals*) that may affect the health of plants and/or animals and the quality of products derived from them

### **A3. Designs and Processes**

- A3.1** describe the steps in a design or planning process ... and demonstrate an understanding of their application to a variety of requirements in the green industries (*e.g., preparing environmental farm plans, urban forestry management plans, landscape designs; designing water gardens, mass arrangements*)
- A3.2** describe common operational processes that are used in the green industries (*e.g., single animal management, crop location and rotation, crop scheduling, event planning, waste management, composting, select cutting*)

## **B. Green Industry Skills**

### **B1. Design and Production**

- B1.1** implement a production process or procedures according to a design or plan (*e.g., harvest a crop, construct a landscape, grow and cultivate plants, make floral arrangements*)
- B1.2** demonstrate an understanding of and apply techniques for the propagation and care of plants and animals and for ensuring the quality of products derived from them (*e.g., plant/tree regeneration, animal reproduction, cut flower processing, crop production, tree planting*)
- B1.3** demonstrate an understanding of and apply techniques and processes that promote biodiversity, increase ecosystem function, and reduce maintenance requirements (*e.g., planting of native species, mulching, naturalizing gardens, using local cut flowers*)

### **B2. Plant and Animal Management Strategies**

- B2.** apply management strategies for assessing and controlling biotic and abiotic factors that affect plant and/or animal quality
- B2.1** apply a variety of methods to monitor biotic factors that affect plant and/or animal quality (*e.g., pest scouting, regular health inspections of animals, weed identification, post-harvest tracking of product freshness and quality*)
- B2.2** apply a variety of methods to monitor abiotic factors that affect plant and/or animal quality (*e.g., nutrient balancing, soil testing, monitoring indoor and outdoor environmental conditions*)
- B2.3** apply a variety of pest and disease control techniques (*e.g., crop rotation, greenhouse sanitation, enhancement of natural barriers, disinfection of equipment*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** identify the impact of the green industries on the environment and describe ways of minimizing harmful effects
- C1.1** describe the effects of green industry activities on the environment in the past and in the present (*e.g., destruction of habitat, increased energy use for long-distance shipping of floral products, pesticide and fertilizer contamination, greenhouse gas emissions from tillage and sheep and cattle, noise and air pollution from gasoline- and diesel-powered machinery*)
- C1.2** describe the advantages and disadvantages of using natural rather than manufactured materials or products in the green industries (*e.g., natural fertilizers and pest control methods rather than chemical fertilizers and pesticides, real flowers rather than artificial flowers, real grass rather than artificial turf, untreated rather than pressure-treated lumber*)
- C1.3** identify sustainable practices and guidelines that are currently applied within the green industries or may be applied in the future (*e.g., environmental farm planning, sustainable forest management, integrated pest management, sustainable golf course maintenance, select spraying, energy-efficient greenhouse production*)
- C1.4** describe the environmental implications (*e.g., effects on landfill lifespan and water and air quality*) of using particular materials, products, processes, and disposal methods (*e.g., chemically treated wood products; recycling, reusing, composting; using correct disposal methods for invasive plants*)

### **C2. Technology and Society**

- C2.2** describe societal issues relating to the green industries and identify ways of resolving them (*e.g., effects on Aboriginal hunting and harvesting territories, land use conflicts such as parkland versus commercial development, property rights and municipal landscape management, animal welfare, rights of migrant workers, fair trade concerns relating to imported agricultural or floral products*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.2** demonstrate an understanding of environmental and site-related hazards (*e.g., land conditions, weather conditions, dangerous plants and animals, utility lines, glass structures, hanging limbs, chicots*) and apply appropriate safety measures for avoiding them (*e.g., roping off danger areas, removing hazards, setting up traffic controls*)

### **D2. Career Opportunities**

- D2.1** describe careers (*e.g., aborist, florist, herder, greenhouse worker, forester*) in the sectors of the green industries and the education, training, and certification required for entry into these occupations

# Green Industries, Grade 12, University/College Preparation (THJ4M)

## A. Green Industry Fundamentals

### A1. Species Classification and Geographical Regions

- A1. demonstrate an understanding of species classification and identification and explain relationships between species and geographical regions
- A1.1 distinguish between different plant and/or animal groups on the basis of key identification characteristics (*e.g., native and non-native species, dairy and beef cattle, deciduous and coniferous shrubs, monocotyledonous and dicotyledonous plants*), and identify species using both common and scientific names (*e.g., white birch [also known as paper birch or canoe birch] [Betula papyrifera] and Mountain paper birch [Betula cordifolia], euonymus [gen. Euonymus] and Emerald Gaiety [Euonymus fortunei ‘Emerald Gaiety’]*)
- A1.2 identify geographical regions in Canada on the basis of classification criteria relevant to the green industries (*e.g., plant hardiness, growing degree days, elevation, soil type, soil moisture*), and explain how geographical factors determine the distribution of species in these regions
- A1.3 compare different kinds of ecosystems in terms of their biodiversity (*e.g., a climax forest versus a rejuvenated forest, natural versus managed land, a cultivated field versus a greenhouse*), and explain how biodiversity affects the stability of ecosystems (*e.g., monocultures versus diversified ecosystems*)

### A2. Factors Affecting Growth and Product Quality

- A2. analyse the effects of biotic and abiotic factors on growth and post-harvest quality
- A2.1 analyse the effects of abiotic factors on growth and post-harvest quality (*e.g., effects of differences in soil composition, climate, water quality and quantity, topography*)
- A2.2 analyse the effects of biotic factors on growth and post-harvest quality (*e.g., physiological effects of pests and diseases, invasive species, genetic variations*)
- A2.3 assess the effects of interactions between abiotic, biotic, and cultural factors on a variety of ecosystems (*e.g., forests in various stages of natural succession, golf courses, fish farms, organic farms, riparian zones*)
- A2.4 compare the effectiveness of different integrated pest management techniques for a variety of applications (*e.g., cultural [tilling and mulching], physical [crop rotation], environmental [introduction of beneficial insects], biological [fungi, nutrients], chemical [pheromones, chemical pesticides]*)

### A3. Designs and Processes

- A3.1 explain the steps required to create designs or plans for a variety of applications in the green industries (*e.g., timber cruising, surveying, perennial gardens, farms, environmental assessments*)
- A3.2 explain advanced systems, processes, and techniques relating to the propagation, maintenance, and care of plants or animals (*e.g., irrigation systems, tree support and protection systems, plantation tending, prescribed burning, regeneration*)



**A3.3** evaluate the appropriateness and effectiveness of a management process (*e.g., environmental impact assessment, tree or crop loss assessment, herd health evaluation, growth and yield monitoring*)

#### **A4. Technological and Mathematical Literacy and Communication Skills**

**A4.1** demonstrate an understanding of terminology used in the green industries and use it correctly in oral and written communication (*e.g., biodiversity, tendrils, balance, pergola, tilling*)

### **B. Green Industry Skills**

#### **B1. Design and Production**

**B1.1** develop a design and/or process that fulfills a specific functional or aesthetic requirement (*e.g., a graphic design, a barn design, a specialty garden design, an urban forest regeneration schedule, an advertising brochure; specialty pruning techniques*)

**B1.2** design and implement a management plan or site layout for a specific application (*e.g., a natural disturbance response and restoration plan, a site survey and construction implementation plan for a landscape design, a growing system for plant production and distribution, plant selection and schedule for crop rotation, animal housing, an urban forest development plan*)

**B1.3** demonstrate competence in the use of biological techniques for propagating and maintaining a variety of species (*e.g., cone selection, transplanting large trees, reforestation, insect control, hybridization, grafting, artificial insemination*)

**B1.4** create plans or designs for green industry projects that enhance biodiversity (*e.g., moisture conservation, xeriscaping, integrating diverse native plants, sustainable water gardening*)

#### **B2. Plant and Animal Management Strategies**

**B2.** develop and apply management strategies for assessing and controlling biotic, abiotic, and cultural factors that affect plant and/or animal quality

**B2.1** analyse biotic conditions affecting the health of plants and/or animals and the quality of products derived from them, using a variety of diagnostic procedures (*e.g., pest counts, pest determination, microscopic investigation, visual inspection, blood testing, cavity assessment*)

**B2.2** analyse abiotic conditions affecting the health of plants and/or animals and the quality of products derived from them, using a variety of diagnostic procedures (*e.g., nutrient balance testing, soil and water testing, form defect analysis, air quality assessment*)

**B2.3** apply a variety of pest and disease control techniques (*e.g., integrated pest management, crop rotation, animal inoculation, instituting invasive species controls*), and assess their effects on plant and/or animal stock and the environment

**B2.4** develop and apply best management practices for enhancing environmental sustainability within the green industries (*e.g., herd management, native species selection and placement, forest certification, cut selection, local purchasing, composting, integrated pest management, water management, biogas production from wastes*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** assess options for achieving environmental sustainability in green industry operations
- C1.1** evaluate green industry operations and processes in terms of their impacts on environmental sustainability (*e.g., global floral sourcing and greenhouse gas emissions, by-product management and water quality, monocultures and biodiversity, genetically modified products and effects on pesticide use and biodiversity*)
- C1.2** analyse ways of reducing negative or enhancing positive environmental consequences through the use of particular materials, products, processes, and disposal methods (*e.g., nutrient recycling, spot spraying for insects and fungus, using organic fertilizer, composting, xeriscaping*)
- C1.3** describe methods used in the green industries to balance economic sustainability with environmental responsibilities (*e.g., selective breeding, selective cutting, organic production methods, restricted cattle crossings and buffer zones to prevent water contamination, environmental best management practices*)
- C1.4** describe the benefits of alternative practices that reduce the environmental impact of green industry operations (*e.g., living walls, naturalscaping, xeriscaping, forest certification, tree marking guidelines, fibre crops, armatures and grid work, alternative animal housing systems*)
- C1.5** describe legislation, regulations, standards, and guidelines relating to environmental protection that affect operations in the green industries (*e.g., Greenbelt Act, Fisheries Act, Crown Forest Sustainability Act, Nutrient Management Act, Forest Fires Prevention Act, pest control regulations*)

### **C2. Technology and Society**

- C2.2** assess the economic importance of linkages between the green industries and related industries and technologies (*e.g., **agriculture**: food processing industry, farm implement industry; **horticulture**: shipping industry, event-related businesses [funeral homes, wedding planners]; **landscaping**: recreational industries, small-engine industry; **forestry**: heavy equipment industry, paper-consuming industries such as newspapers*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.3** demonstrate the ability to make appropriate safety decisions for personnel on the basis of environmental and site conditions (*e.g., weather conditions, presence of poisonous plants or dangerous gases, hazardous trees, reliability of communications in remote areas, access to emergency services*) and level of crew training and experience

### **D2. Business and Regulatory Environment**

- D2.1** identify industry associations, government departments, and non-governmental organizations that are involved with matters that affect the green industries (*e.g., local growers' associations; provincial and federal agriculture, health, environment, and resource departments; environmental NGOs*)

### **D3. Career Opportunities**

**D3.3** investigate areas of specialization within the green industries (*e.g., lighting systems, water features, irrigation systems, GIS analysis, robotics, automation, entomology, pathology, tissue culture, agronomy, marketing, environmental management, farm management*)

## **Green Industries, Grade 12, Workplace Preparation (THJ4E)**

### **A. Green Industry Fundamentals**

#### **A1. Species Classification and Geographical Regions**

**A1.** demonstrate an understanding of species classification and identification and of relationships between species and geographical regions

**A1.1** use common classification schemes and key identification characteristics to distinguish between different plant and/or animal groups (*e.g., annuals versus perennials, deciduous versus coniferous trees and shrubs, oaks versus birches, Holsteins versus Ayrshires*)

**A1.2** identify geographical regions on the basis of classification criteria relevant to the green industries (*e.g., plant hardiness, growing degree days, elevation, soil type, soil moisture*), and describe how geographical factors determine the distribution of species in these regions

**A1.3** compare different kinds of ecosystems in terms of their biodiversity (*e.g., a climax forest versus a rejuvenated forest, natural versus managed land, a cultivated field versus a greenhouse*)

#### **A2. Factors Affecting Growth and Product Quality**

**A2.** demonstrate an understanding of the effects of biotic and abiotic factors on growth and product quality

**A2.1** describe the effects of abiotic factors (*e.g., light, temperature, soils, nutrients, topography, moisture, climate change, ethylene gas*) on plant and/or animal growth and post-harvest quality (*e.g., a southern exposure may increase yields by increasing available light; too little moisture may stunt growth and reduce yields; too much moisture may encourage growth of mould and mildew; ethylene gas acts as a ripening agent for picked fruits*)

**A2.2** describe the effects of biotic factors (*e.g., pests, diseases, weeds*) on plant and/or animal growth and post-harvest quality (*e.g., form defects, stunted growth, reduced yields, damaged fruit*)

**A2.3** describe the effects of interactions between abiotic, biotic, and cultural factors in a variety of environments (*e.g., gardens, greenhouses, barns, florists' coolers, fields, forest stands*)

**A2.4** describe a variety of integrated pest management techniques (*e.g., cultural [tilling and mulching], physical [crop rotation], environmental [introduction of beneficial insects], biological [fungi, nutrients], chemical [pheromones, chemical pesticides]*), and identify situations in which they can be applied effectively

### **A3. Designs and Processes**

- A3.1** describe how design or planning processes are used in a variety of green industry applications (*e.g., preparation of species prescriptions, crop rotation plans, environmental assessments, site layouts, event plans*)
- A3.2** explain processes and techniques relating to the propagation, maintenance, and care of plants and/or animals (*e.g., animal breeding, taking cuttings, seeding, irrigation, pruning, clipping, feeding, clearing*)

## **B. Green Industry Skills**

### **B1. Design and Production**

- B1.1** develop a design or process for a green industry application (*e.g., a landscape design, a crop production plan, a herd management procedure, a plant propagation schedule*)
- B1.2** devise an effective management plan or site layout for a specific application (*e.g., a forest prescription, a herd management plan, an event plan, a landscape construction plan, a block layout and harvesting plan, animal housing*)
- B1.3** demonstrate an understanding of and apply techniques related to the propagation, maintenance, and post-harvest handling of a variety of species (*e.g., pruning, scarification of forest floor, artificial insemination, transplanting large trees, cut flower conditioning*)
- B1.4** demonstrate an understanding of and apply designs and production processes that promote biodiversity, increase ecosystem function, and reduce maintenance requirements (*e.g., mulching, sustainable water gardening, rooftop gardening, naturalizing landscapes*)

### **B2. Plant and Animal Management Strategies**

- B2.** apply management strategies for assessing and controlling biotic and abiotic factors that affect plant and/or animal quality
  - B2.1** perform a variety of procedures (*e.g., pest counts, microscopic investigations, visual inspections, estrous cycle monitoring*) to assess biotic conditions that affect plant and/or animal quality
  - B2.2** perform a variety of procedures (*e.g., soil and air temperature measurement, water analysis, form defects analysis, air quality assessment, nutritional assessment, monitoring ethylene gas concentrations*) to assess or measure abiotic conditions that affect plant and/or animal quality
  - B2.3** apply techniques for controlling pests and disorders of plants and/or animals (*e.g., fogging, density planting, encouraging beneficial insects, constructing barriers, setting live traps, inoculations, animal tagging*)
  - B2.4** demonstrate an understanding of and apply management techniques that enhance environmental sustainability within the green industries (*e.g., sustainable herd management practices, measures that enhance forest succession, preferential use of native species*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** assess the impact of the green industries on the environment and describe ways of enhancing environmental sustainability
- C1.1** assess the environmental sustainability of various practices and procedures used in the green industries (*e.g., harvesting methods, wood product manufacturing methods, naturalized landscaping, global floral sourcing, environmental farm plans, crop rotation, large-scale farming*)
- C1.2** describe ways of reducing negative or enhancing positive environmental consequences through the use of particular materials, products, processes, and disposal methods (*e.g., nutrient recycling, spot spraying for insects and fungus, using organic fertilizer, composting, xeriscaping*)
- C1.3** describe methods used in the green industries to balance economic sustainability with environmental responsibilities (*e.g., selective breeding, selective cutting, organic production methods, environmental best management practices*)
- C1.4** describe the benefits of alternative practices that reduce the environmental impact of green industry operations (*e.g., living walls, naturalscaping, forest certification, tree marking guidelines, fibre crops, armatures and grid work, alternative animal housing systems*)
- C1.5** identify legislation, regulations, standards, and guidelines relating to environmental protection that affect operations in the green industries (*e.g. Clean Water Act, Nutrient Management Act, species importation regulations, tree-cutting bylaws, pest control regulations*)

## **D. Professional Practice and Career Opportunities**

### **D3. Career Opportunities**

- D3.1** identify careers in the green industries (*e.g., arborist, florist, herder, greenhouse worker, forester*), and describe the nature and scope of the work involved

# **HAIRSTYLING AND AESTHETICS**

## **Hairstyling and Aesthetics, Grade 11, Workplace Preparation (TXJ3E)**

### **C. Industry Practices, the Environment, and Society**

#### **C1. Industry Practices and the Environment**

- C1.** describe the environmental impact of practices and products in the hairstyling and aesthetics industry, and identify safe practices and environmentally friendly solutions to problems

- C1.1** identify and explain environmental and health issues related to various products used in the hairstyling and aesthetics industry (*e.g., the need for biodegradable products and refillable containers; the need for warnings/controls for carcinogenic/toxic ingredients; the need for proper ventilation in salons/spas*)
- C1.2** describe and apply practices for the recycling and responsible disposal of waste from salon/spa operations (*e.g., routines to reduce, reuse, and recycle; techniques for safe handling*), and identify some sustainable purchasing practices for the hairstyling and aesthetics industry (*e.g., purchasing products available in refillable containers, products with natural ingredients, non-toxic cleaning products, energy-saving products*)

## **Hairstyling and Aesthetics, Grade 12, Workplace Preparation (TXJ4E)**

### ***C. Industry Practices, the Environment, and Society***

#### **C1. Industry Practices and the Environment**

- C1.** evaluate practices and products in the hairstyling and aesthetics industry in terms of their impact on the environment
- C1.1** summarize best practices for the safe handling, recycling, and disposal of waste (*e.g., use of biodegradable products and refillable containers, proper methods for storing and disposing of products and chemicals*) and develop a method (*e.g., a checklist*) for evaluating/monitoring the practices of individual salons/spas
- C1.2** evaluate the hairstyling and aesthetics industry in terms of its use/non-use of environmentally friendly practices and products (*e.g., use of recycling programs for mannequins; use of non-toxic versus carcinogenic/toxic ingredients; use of energy-saving products*)

## **HEALTH CARE**

### **Health Care, Grade 11, University/College Preparation (TPJ3M)**

#### ***C. Health Care, the Environment, and Society***

##### **C1. Health Care and the Environment**

- C1.** describe the impact of health care industry activities on the environment and identify ways of minimizing their harmful consequences
- C1.1** describe the potential impact on the environment of biohazardous waste from health care facilities (*e.g., body fluid and human tissue, sharps containing bacteria or viruses*)
- C1.2** identify safe methods for the handling, storage, and disposal of waste and biohazardous materials (*e.g., use of checklists, sharps containers, double wrapping, proper labelling*)
- C1.3** describe good environmental practices that can be applied in the health care industry (*e.g., using energy-efficient lighting; reducing, reusing, or recycling packaging material; storing information electronically instead of on paper*)

## Health Care, Grade 11, College Preparation (TPJ3C)

### ***C. Health Care, the Environment, and Society***

#### **C1. Health Care and the Environment**

- C1.** describe the impact of health care industry activities on the environment and identify ways of minimizing their harmful consequences
- C1.1** describe the potential impact on the environment of biohazardous wastes from health care facilities (*e.g., body fluid and human tissue, sharps containing bacteria or viruses*)
- C1.2** identify safe methods for the handling, storage, and disposal of wastes and biohazardous materials (*e.g., use of checklists, sharps containers, double wrapping, proper labelling*)
- C1.3** describe good environmental practices that can be applied in the health care industry (*e.g., using energy-efficient lighting; reducing, reusing, or recycling packaging material; storing information electronically instead of on paper*)

## Health Care, Grade 12, University/College Preparation (TPJ4M)

### ***C. Health Care, the Environment, and Society***

#### **C1. Health Care and the Environment**

- C1.** assess the impact of the health care industry on the environment, and identify legal requirements and guidelines for protecting the environment from harmful consequences
- C1.1** describe the environmental impact of technological advances in the health care field (*e.g., single-use devices create end disposal issues, as incineration results in heavy metal toxicity and landfilling creates biohazardous leachate; because of the increased use of pharmaceuticals, traces of prescription drugs are now being found in surface water*)
- C1.2** research and report on laws, regulations, guidelines, and information sources pertaining to the disposal of medical waste (*e.g., Atomic Energy Control Board – radioactive materials; Workplace Hazardous Materials Information System [WHMIS] – chemical hazards*)
- C1.3** identify some environmental impacts of a health care product over its complete life cycle (*e.g., use of harmful chemicals in manufacturing the product, energy consumption for manufacturing and transportation of raw materials and completed products, packaging waste, impact of the product when disposed of, impact of drug residues in human body wastes*)

## Health Care, Grade 12, College Preparation (TPJ4C)

### ***C. Health Care, the Environment, and Society***

#### **C1. Health Care and the Environment**

- C1.** describe the impact of the health care industry on the environment, and identify legal requirements and guidelines for protecting the environment from harmful consequences

- C1.1** identify the environmental impact of technological advances in the health care field (*e.g., single-use devices create end disposal issues, as incineration results in heavy metal toxicity and landfilling creates biohazardous leachate; because of the increased use of pharmaceuticals, traces of prescription drugs are now being found in surface water*)
- C1.2** research and report on laws, regulations, guidelines, and information sources pertaining to the disposal of medical waste (*e.g., Atomic Energy Control Board – radioactive materials; Workplace Hazardous Materials Information System [WHMIS] – chemical hazards; Ontario Regulation 102/94 – waste management*)
- C1.3** identify some environmental impacts of a health care product over its complete life cycle (*e.g., use of harmful chemicals in manufacturing the product, energy consumption for manufacturing and transportation of raw materials and completed products, packaging waste, impact of the product when disposed of, impact of drug residues in human body wastes*)

## **Child Development and Gerontology, Grade 12, College Preparation (TOJ4C)**

### ***C. Health Care, the Environment, and Society***

#### **C1. Health Care and the Environment**

- C1.** analyse how environmental factors affect children and older adults, and how products and services related to the care of these groups may affect the environment
- C1.1** analyse the environmental impact of products developed to meet the needs of children and the elderly (*e.g., landfill issues – throw-away toys, batteries, disposable diapers, plastic baby bottles*) and identify more sustainable alternatives with respect to the use of such products
- C1.2** analyse the impact of a degraded environment and other environmental hazards on children and the elderly (*e.g., increased rates of respiratory problems, detrimental effects of lead paint, effects of environmental estrogens*)

## **Health Care: Support Services, Grade 12, Workplace Preparation (TPJ4E)**

### ***C. Health Care, the Environment, and Society***

#### **C1. Health Care and the Environment**

- C1.** identify the impact of medical wastes on the environment, and describe ways of protecting the environment from these hazards
- C1.1** identify the environmental impact of technological advances in the health care field (*e.g., single-use devices create end disposal issues, as incineration results in heavy metal toxicity and landfilling creates biohazardous leachate; because of the increased use of pharmaceuticals, traces of prescription drugs are now being found in surface water*)



- C1.2** research and report on laws, regulations, guidelines, and information sources pertaining to the disposal of medical waste (*e.g., Atomic Energy Control Board – radioactive materials; Workplace Hazardous Materials Information System [WHMIS] – chemical hazards; Ontario Regulation 102/94 – waste management*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.3** describe and apply safe methods for the handling, storage, and disposal of waste and biohazardous materials (*e.g., use of a sharps container*)

# **HOSPITALITY AND TOURISM**

## **Hospitality and Tourism, Grade 11, College Preparation (TFJ3C)**

### **A. Hospitality and Tourism Fundamentals**

#### **A1. The Tourism Industry**

- A1.2** explain how various types of services, events, and activities from around the province (*e.g., youth hostels, air transportation, ecotourism, weddings, guided tours*) are associated with one or more sectors of the tourism industry
- A1.6** explain the effect of the weather and seasonal changes on the availability, pricing, and quality of products and services within the tourism industry

#### **A3. Culinary Knowledge**

- A3.7** describe the effects of climate and season on the availability, quality, price, and nutritional value of food products and services

### **C. Industry Practices, the Environment, and Society**

#### **C1. Industry Practices and the Environment**

- C1.** demonstrate an understanding of factors that affect the relationship between the tourism industry and the environment
- C1.1** explain the need for environmentally friendly waste management in the various sectors of the tourism industry (*e.g., with regard to disposal of cooking oil and garbage, recycling of plastic and glass, composting of organic waste*)
- C1.2** define environmental sustainability as it applies to the various sectors of the tourism industry (*e.g., staying within the carrying capacity of environmentally sensitive areas; using energy-efficient buildings, equipment, and transportation; reusing and/or recycling waste products*)

- C1.3** explain how the relationship between food producers and food consumers affects the environment (*e.g., production of organic foods in response to consumer demand results in less use of chemical fertilizers and pesticides; the Slow Food movement supports local food production and the continuing use of traditional food products; culinary tourism increases consumer awareness of and helps to support traditional food producers in many parts of the world*)
- C1.4** assess the ecological footprint of an event or activity

## **C2. Industry Practices and Society**

- C2.3** describe the social responsibility of companies and workers in the tourism industry (*e.g., with regard to equal employment opportunities, conservation and preservation of the environment, relations with local communities*)

# **Hospitality and Tourism, Grade 11, Workplace Preparation (TFJ3E)**

## ***C. Industry Practices, the Environment, and Society***

### **C1. Industry Practices and the Environment**

- C1.** demonstrate an understanding of ways in which various practices of the food and beverage services sector of the tourism industry affect the environment
- C1.1** describe environmentally friendly disposal procedures for waste food products and food packaging (*e.g., composting, recycling*)
- C1.2** create a plan to implement an environmentally friendly disposal procedure for waste food products and/or food packaging (*e.g., a plan to set up a composting or recycling program in the school cafeteria, a plan to encourage the use of biodegradable containers for take-out food*)
- C1.3** explain how the food and beverage services sector can support the achievement of environmentally responsible goals (*e.g., goals of ecotourism, conservation goals, preservation goals*)
- C1.4** assess the ecological footprint of an event or activity

### **C2. Industry Practices and Society**

- C2.1** describe the social and economic impact of new products and technologies used in the food and beverage services sector (*e.g., marketing of organic and genetically modified foods has raised consumer awareness of health and environmental issues; use of combination ovens has reduced labour costs and product wastage; ...*)

## Hospitality and Tourism, Grade 12, College Preparation (TFJ4C)

### ***A. Hospitality and Tourism Fundamentals***

#### **A1. Management Techniques and Strategies**

**A1.4** summarize the necessity for policies and procedures (*e.g., ... procedures for dealing with environmental issues such as waste*) to support management objectives in the tourism industry

### ***C. Industry Practices, the Environment, and Society***

#### **C1. Industry Practices and the Environment**

**C1.** demonstrate an understanding of factors that affect the relationship between the tourism industry and the environment

**C1.1** explain why the tourism industry has a responsibility to protect the environment and encourage the sustainable use of natural resources (*e.g., by reducing, reusing, and recycling waste; by using energy efficiently; by using biodegradable cleaning products*)

**C1.2** analyse how tourism has affected the environment within or outside the local community (*e.g., the effects of increased tourist traffic, increased water use, rising property values*)

**C1.3** identify, through research, an appropriate code of ethics and/or guidelines for sustainable tourism and describe how they could be applied locally and globally

**C1.4** identify and describe ways in which the tourism industry could offset its impact on the environment (*e.g., develop or support a tree planting program, develop or contribute to a carbon offset fund*)

#### **C2. Industry Practices and Society**

**C2.1** describe, on the basis of research, how the tourism industry has changed in recent years (*e.g., growth in tourist numbers, greater variety of tourist destinations, growing popularity of eco/adventure tourism and culinary tourism*) and explain how these changes have affected local and provincial communities and their economies

## Hospitality and Tourism, Grade 12, Workplace Preparation (TFJ4E)

### ***A. Hospitality and Tourism Fundamentals***

#### **A2. Planning Nutritious Meals**

**A2.4** identify the differences (*e.g., with respect to yield, nutrition, freshness, taste*) between locally grown and/or organically grown fruits and vegetables and those grown using traditional cultivation techniques (*e.g., use of fertilizer and pesticides*) and/or harvested unripe and transported long distances

### **A3. Food Handling and Storage**

**A3.4** demonstrate effective management of resources and inventory (*e.g., in terms of portion control, waste management, and energy conservation*)

## **C. Industry Practices, the Environment, and Society**

### **C1. Industry Practices and the Environment**

**C1.** demonstrate an understanding of how various practices connected with the tourism industry in general and the food and beverage services sector specifically affect the environment, and how these effects can be reduced

**C1.1** identify the effects that the tourism industry has on the environment (*e.g., undeveloped areas exploited for commercial gain, environmentally sensitive areas affected by pollution and waste disposal, infrastructure expanded and upgraded, areas of natural beauty preserved as tourist attractions*)

**C1.2** describe how the food and beverage services sector can both protect the environment and encourage the sustainable use of natural resources (*e.g., by choosing new locations on or near existing infrastructure to reduce the need for new infrastructure, providing guests with the option not to have linens washed daily, composting organic waste from restaurants, reusing cooking oil as a biofuel, using locally grown produce to reduce the need for long-distance transportation*)

**C1.3** identify, through research, an appropriate code of ethics and/or guidelines for sustainable tourism and describe how they could be applied to the operation of local food and beverage services facilities

**C1.4** identify ways in which the food and beverage services sector could offset its impact on the environment (*e.g., develop or support a tree planting program, develop or contribute to a carbon offset fund*)

## **MANUFACTURING TECHNOLOGY**

### **Manufacturing Engineering Technology, Grade 11, University/College Preparation (TMJ3M)**

#### **A. Manufacturing Technology Fundamentals**

##### **A1. Design Process**

**A1.3** explain why technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) are important considerations in the design process ...

**A1.4** explain how the application of technological concepts in design or other problem-solving processes can result in products that better meet human needs or wants (*e.g., a ramp to replace a stairway, a lever-type door handle to replace a round knob, a remote control to operate a television, energy-efficient devices to replace inefficient ones*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of ways in which the manufacturing industry affects the environment
- C1.1** analyse the effects that various manufacturing activities have on the environment (*e.g., the effects of waste disposal, power consumption, processing of raw materials; effects on Aboriginal hunting and gathering grounds*)
- C1.2** explain the benefits of using environmentally friendly processes and products in the manufacturing process
- C1.3** explain how various sources of power generation (*e.g., coal, nuclear, wind, solar, geothermal*) and transportation methods (*e.g., truck, rail, ship*) used in manufacturing affect the environment

### **C2. Technology and Society**

- C2.2** explain how the manufacturing industry affects the local and provincial economy (*e.g., with respect to job creation, standards of living, sustainability and conservation of the environment, impact on First Nation communities*)
- C2.3** describe recent trends in the local manufacturing industry (*e.g., globalization, rise in energy costs, increase in environmental awareness*) and their effect on the local community or the province as a whole, and predict future trends

## **Manufacturing Technology, Grade 11, College Preparation (TMJ3C)**

### **A. Manufacturing Technology Fundamentals**

#### **A1. Design Process**

- A1.3** explain why technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) are important considerations in the design process ...

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of ways in which the manufacturing industry affects the environment
- C1.1** describe the benefits of using environmentally friendly products in the manufacturing process (*e.g., the benefits of water-based versus solvent-based adhesives*)
- C1.2** identify a variety of alternative fuels (*e.g., biodiesel, ethanol, hydrogen, electric power in hybrid systems*) and energy sources (*e.g., wind power, solar power, waste-to-energy*) and explain how use of these fuels and energy sources can reduce the environmental impact of the manufacturing industry

- C1.3** explain how various sources of power generation used in manufacturing (*e.g., coal, nuclear, solar, wind, hydrogen fuel cell, tidal, geothermal*) affect the environment (*e.g., construction of large hydroelectric dams can affect animal habitats and patterns of behaviour*)
- C1.4** describe environmentally responsible practices that can be followed during the design and manufacture of a product (*e.g., minimize waste, consider using renewable or recyclable materials, design and manufacture products that last or can be repaired as opposed to throw-away products, use processes that have minimal impact on workers and the local environment*)
- C1.5** demonstrate the use of proper techniques for the disposal of waste products

## **C2. Technology and Society**

- C2.1** explain how the manufacturing industry affects the local and provincial economy (*e.g., with respect to job creation, standards of living, sustainability and conservation of the environment, impact on First Nation communities*)

# **Manufacturing Technology, Grade 11, Workplace Preparation (TMJ3E)**

## **A. Manufacturing Technology Fundamentals**

### **A2. Design Process**

- A2.4** explain why technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) are important considerations in the design process ...

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of ways in which the manufacturing industry affects the environment
  - C1.1** explain the importance of the proper storage, disposal, and recycling of obsolete and waste products in manufacturing
  - C1.2** describe the benefits of using environmentally friendly products in the manufacturing process (*e.g., the benefits of water-based versus solvent-based chemicals*)
  - C1.3** explain how various sources of power generation used in manufacturing (*e.g., coal, nuclear, solar, wind, hydrogen fuel cell, tidal, geothermal*) affect the environment
  - C1.4** identify conservation strategies that the manufacturing industry could employ (*e.g., minimize water usage, convert to energy-efficient lighting, exploit transportation efficiencies, reduce paper usage by communicating electronically*)

## **C2. Technology and Society**

**C2.3** identify ways in which the manufacturing industry affects the culture and society of a community or region (*e.g., ... increasing industrial activity in the community/region, which some people may see as a threat to their way of life and/or the environment*)

# **Manufacturing Engineering Technology, Grade 12, University/College Preparation (TMJ4M)**

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

**C1.** demonstrate an understanding of ways in which the manufacturing industry affects the environment, and make informed decisions based on this understanding

**C1.1** identify potentially harmful consequences of manufacturing activities for the environment (*e.g., waste disposal, greenhouse gas emissions, water and energy consumption, the depletion of non-renewable resources*), and formulate alternatives to reduce the severity of these consequences

**C1.2** assess and compare energy sources (*e.g., renewable – water, wind, solar, geothermal; non-renewable – coal, oil and gas, nuclear*) used in manufacturing, and identify ways of increasing environmentally friendly energy use

**C1.3** assess the carbon footprint of a manufactured product

**C1.4** explain the benefits of developing an environmentally friendly product (*e.g., a windmill that develops energy from wind power*) and assess its potential effectiveness

### **C2. Technology and Society**

**C2.2** explain the importance of demographics, geography, and strategic plant location as factors to be considered in setting up a successful manufacturing facility, and describe possible short-term and/or long-term societal implications locally and beyond (*e.g., regional or provincial planning issues, effects on the indigenous population, ecosystem and/or habitat considerations*)

# **Manufacturing Technology, Grade 12, College Preparation (TMJ4C)**

## **A. Manufacturing Technology Fundamentals**

### **A1. Design Process**

**A1.3** explain why technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) are important considerations in the design process ...

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of the importance of using sustainable and environmentally friendly manufacturing practices
- C1.1** demonstrate the proper selection and disposal of oils, fluids, and materials used in manufacturing
- C1.2** explain how the three Rs (reduce, reuse, recycle) can minimize the effect the manufacturing industry has on the environment
- C1.3** explain the advantages and disadvantages of using various renewable and sustainable energy sources (*e.g., solar, hydrogen fuel cell, wind, geothermal, tidal*) in manufacturing
- C1.4** assess the benefits of using environmentally friendly products and processes in manufacturing (*e.g., long-term cost savings, creation of positive company image by establishing “green” credentials*)
- C1.5** follow environmentally responsible practices during the design and manufacture of a product (*e.g., minimize waste, consider using renewable or recyclable materials, design and manufacture products that last or can be repaired as opposed to throwaway products, use processes that have minimal impact on workers and the local environment*)

## **Manufacturing Technology, Grade 12, Workplace Preparation (TMJ4E)**

### **A. Manufacturing Technology Fundamentals**

#### **A2. Design Process**

- A2.5** demonstrate a working knowledge of ways in which technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) are important considerations in the design process ...

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of the importance of using sustainable and environmentally friendly manufacturing practices
- C1.1** demonstrate an understanding and application of the three Rs in a manufacturing facility (*e.g., reduction of waste through efficient selection and conversion of materials, reuse of materials when possible, effective collection and recycling of materials and/or fluids*)
- C1.2** demonstrate the use of proper techniques for the disposal of obsolete and/or waste products
- C1.3** describe the advantages and disadvantages of using various renewable and sustainable energy sources (*e.g., solar, hydrogen fuel cell, wind, geothermal, tidal*) and alternative fuels (*e.g., biodiesel, ethanol*) in manufacturing



**C1.4** follow environmentally responsible practices during the design and manufacture of a product (*e.g., minimize waste, consider using renewable or recyclable materials, design and manufacture products that last or can be repaired as opposed to throwaway products, use processes that have minimal impact on workers and the local environment*)

## **C2. Technology and Society**

**C2.2** explain how the globalization of manufacturing industries affects Canadian society locally, provincially, and/or nationally (*e.g., explain the effects of trade agreements, worker health and safety standards or the lack of such standards, environmental standards or the lack of such standards*)

# **TECHNOLOGICAL DESIGN**

## **Technological Design, Grade 11, University/College Preparation (TDJ3M)**

### **A. Technological Design Fundamentals**

#### **A1. Design Process**

**A1.1** describe ways in which society, the environment, and the economy inspire and/or affect technological design (*e.g., need for barrier-free access or alternative-energy vehicles*), with reference to key technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) ...

### **C. Technology, the Environment, and Society**

#### **C1. Technology and the Environment**

**C1.** demonstrate an understanding of environmentally responsible design practices, and apply them in the technological design process and related activities

**C1.1** demonstrate an understanding of environmental issues that affect the design of products and/or processes (*e.g., gasoline consumption, pollution, greenhouse gases, habitat loss, extinction of species, depletion of natural resources*)

**C1.2** describe, advocate, and apply best practices for conserving energy and other resources when designing a product or process (*e.g., reuse or recycle lumber and other materials; use materials with recycled content; use wood glue instead of hot glue; use renewable energy sources, high-efficiency motors and appliances, and passive heating and cooling of buildings*)

**C1.3** describe ways to reduce the waste produced by the manufacture and use of products (*e.g., cutting patterns that minimize leftover materials, use of materials that are easily recycled, energy management controls in electronic equipment*), and apply such practices when developing and building prototypes

## **C2. Technology and Society**

- C2.1** research and compare technological eras (*e.g., agricultural, industrial, information*), and describe ways in which societal needs influenced these eras
- C2.3** demonstrate an understanding of ways in which history, trends, culture, and geography have inspired technological design

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.** describe and apply health, safety, and environmental practices related to technological design
- D1.2** adhere to appropriate personal and environmental health and safety standards and procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and when performing related activities (*e.g., ... ensure adequate ventilation and ergonomic seating and other workplace arrangements; ... store materials and dispose of wastes properly*)

## **Technological Design and the Environment, Grade 11, Open (TDJ30)**

### **A. Technological Design Fundamentals**

#### **A1. Design Process**

- A1.** describe the design process, and identify ways in which technological design can address an environmental need or challenge
- A1.1** describe the purpose of design for a given project (*e.g., cleaner energy, reduced carbon footprint, less manufacturing waste*) in terms of key technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*)  
...
- A1.2** describe the need for technological designs that take environmental factors into account (*e.g., fuel-efficient vehicles, non-toxic paints and pesticides, renewable energy sources, sustainable production of materials*)

#### **A2. Research, Planning, and Organization**

- A2.** describe and apply strategies, techniques, and tools for researching, planning, and organizing projects to meet a specific environmental or other need
- A2.1** identify and apply strategies for gathering information from various sources (*e.g., books, Ministry of the Environment website, interview with a naturalist*) for a design project that meets an environmental need
- A2.3** plan ways to apply the principles of sustainability and minimize environmental harm throughout the design process for a project (*e.g., plan to use recycled materials, limit the use of energy-consuming equipment*)

#### **A4. Making and Testing Models and Prototypes**

**A4.3** identify criteria for assessing the environmental friendliness of a design and of the processes required to produce it (*e.g., by-products, waste, energy consumption, reuse and/or recycling of materials, biodegradability*)

#### **A5. Reporting and Presenting**

**A5.** demonstrate an understanding of the technical and environmental terminology and the communication methods and formats used in the design process

**A5.1** demonstrate an understanding of technical and environmental terminology used in the design process (*e.g., drafting versus drawing, scale versus ruler, greenhouse gases, parts per billion, fossil fuel*)

### **B. Technological Design Skills**

#### **B1. Research, Planning, and Organization**

**B1.** use appropriate tools and strategies to research, plan, and organize design projects that have environmentally sound designs and production processes

**B1.1** gather and summarize relevant information for developing various designs (*e.g., Canadian Standards Association [CSA] publications, Ontario Building Code, environmental criteria*)

**B1.2** investigate and describe economic and environmental factors that should be considered during the design process

**B1.3** select and apply effective planning and organizational tools and strategies (*e.g., sequence chart, time sheet, swatch book, checklists, file management*) to develop environmentally sound design projects

#### **B3. Making and Testing Models and Prototypes**

**B3.3** test models and/or prototypes, and evaluate designs using student-generated criteria (*e.g., by-products, waste, energy consumption, biodegradability, reliability, durability*)

#### **B4. Reporting and Presenting**

**B4.** report on the progress, environmental rationale, and results of the design process, using appropriate formats and styles

**B4.1** present a report summarizing the design choices, progress, and results of the design project, with an emphasis on how the design deals with environmental concerns, using a variety of tools (*e.g., presentation software, interactive white board, web pages, word-processing software*)

### **C. Technology, the Environment, and Society**

#### **C1. Technology and the Environment**

**C1.** demonstrate an understanding of environmentally responsible design practices and strategies, and apply them in the technological design process and related activities

**C1.1** identify environmental issues that affect technological design (*e.g., pollution, greenhouse gases, resource use, ozone depletion*)

- C1.2** describe and apply best practices for conserving energy and other resources when designing a product or process (*e.g., reuse or recycle materials, use wood glue instead of hot glue, use energy management systems for computers*)
- C1.3** research and report on organizations and/or community partners that foster environmentally friendly design practices (*e.g., Ontario Centre for Environmental Technology Advancement, other Canadian environmental technology advancement centres*)
- C1.4** describe innovative technological designs (*e.g., alternative energy sources, more efficient automobiles, ways of reducing manufacturing waste*) that were developed in response to changes in the environment (*e.g., global warming, pollution, rainforest destruction*)
- C1.5** compare the environmental impact of various products that are used for the same purpose (*e.g., plastic bags versus paper bags or reusable cloth bags, paper cups versus polystyrene foam cups*)

## **C2. Technology and Society**

- C2.1** research and report on how society influences technology (*e.g., higher energy costs spur development of more efficient vehicles, increasing population density leads to the construction of taller buildings, environmental awareness leads to development of alternative energy sources*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.** describe and apply appropriate health, safety, and environmental practices and standards throughout the design process
- D1.1** investigate and describe health, safety, and environmental laws, regulations, standards, and agencies that can affect technological design (*e.g., Ontario Environmental Bill of Rights, Clean Water Act, Canadian Standards Association [CSA] standards, Workplace Hazardous Materials Information System [WHMIS]*)
- D1.2** demonstrate an understanding of and follow personal and environmental health and safety procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and when performing related activities (*e.g., ... ensure adequate ventilation and ergonomic seating and other workplace arrangements; ... store materials and dispose of wastes properly*)

### **D2. Career Opportunities**

- D2.1** identify a variety of career opportunities related to technological design (*e.g., civil engineer, architect, mechanical engineering technician, environmental technologist, landscape designer, fashion designer, interior designer*)

# Technological Design, Grade 12, University/College Preparation (TDJ4M)

## A. Technological Design Fundamentals

### A1. Design Process

**A1.1** describe environmental and societal needs (*e.g., barrier-free access, alternative-energy vehicles*) that influence product designs, with reference to key technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) ...

### A2. Research and Project Management

**A2.2** describe strategies for organizing, planning, and managing the human, material, and financial resources for a design project and related activities, with an emphasis on advocacy of design ideas and rationales, diplomacy in dealing with clients and suppliers, and marketing of design solutions (*e.g., ... advocating for environmentally sound materials, ...*)

## B. Technological Design Skills

### B3. Making and Testing Models and Prototypes

**B3.3** analyse products and/or processes on the basis of student-justified criteria (*e.g., aesthetics, ergonomics, performance, functionality, cost, environmental stewardship*), with an emphasis on marketability

## C. Technology, the Environment, and Society

### C1. Technology and the Environment

- C1.** demonstrate an understanding of environmentally responsible design practices, and apply them in the technological design process and related activities
- C1.1** identify and analyse environmental effects of a particular industry or technological system (*e.g., mass transit system, strip mining, sewer system*), and recommend practices that are economically and environmentally sustainable
- C1.2** describe ways in which environmental issues influence the design of products and/or processes
- C1.3** describe, advocate for, and apply best practices for conserving energy and other resources when designing a product or process (*e.g., reuse or recycle lumber and other materials; use materials with recycled content; use wood glue instead of hot glue; use renewable energy sources, high-efficiency motors and appliances, and passive heating and cooling of buildings*)
- C1.4** describe ways to reduce the waste produced by the manufacture and use of products (*e.g., cutting patterns that minimize leftover materials, use of materials that are easily recycled, energy management controls in electronic equipment*), and apply such practices when developing and building prototypes

## **C2. Technology and Society**

- C2.1** independently research and report on political, economic, cultural, and/or environmental issues that affected technological innovations in the past (*e.g., traffic congestion spurred development of compact vehicles, increasing population density led to the construction of taller buildings*)
- C2.2** describe examples of how culture, economics, and politics could influence the future design of products and/or processes (*e.g., environmental awareness and rising costs for fossil fuels could increase the development and use of alternative energy sources*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.** describe and apply personal and environmental health and safety standards and practices related to technological design
- D1.2** adhere to and promote personal and environmental health and safety standards and procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and when performing related activities (*e.g., ... ensure adequate ventilation and ergonomic workplace arrangements; ... store materials and dispose of wastes properly; ...*)

## **Technological Design in the Twenty-first Century, Grade 12, Open (TDJ40)**

### **A. Technological Design Fundamentals**

#### **A1. Design Process**

- A1.1** describe the purpose of design for a given project (*e.g., technological convergence, cost-efficient products, smaller living spaces*) with reference to key technological concepts (*e.g., aesthetics, control, environmental sustainability/stewardship, ergonomics, fabrication, function, innovation, material, mechanism, power and energy, structure, safety, systems*) ...
- A1.2** describe ways in which societal needs, including environmental and economic factors, influence technological design (*e.g., need for products that are smaller, lighter, faster, safer, and/or easier to use*)

### **B. Technological Design Skills**

#### **B1. Research, Planning, and Organization**

- B1.2** investigate and report on societal factors that influence technological design (*e.g., news media, politics, religion, environment, gender, cultural and ethnic diversity*)
- B1.4** research and identify relevant design criteria and constraints relating to societal influences (*e.g., ... use of environmentally friendly materials, ...*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of environmentally responsible design practices and strategies, and apply them in the technological design process and related activities
- C1.1** demonstrate an understanding of environmental issues that affect product design (*e.g., finite non-renewable resources, pollution, wastes, greenhouse gases, climate change, ozone depletion, life cycle of products*)
- C1.2** describe, promote, and apply design practices that conserve energy and other resources (*e.g., reuse or recycle lumber and other materials, use materials with recycled content, use wood glue instead of hot glue, use energy-management software for computers and other electronic equipment, use renewable energy, use high-efficiency motors and appliances*)
- C1.3** demonstrate an understanding of technological, political, and social strategies for managing the relationship between society and the environment (*e.g., technological developments to improve energy efficiency and/or reduce emissions, lobbying governments for regulations and/or funding to improve the environment, education about environmental issues*)
- C1.4** explain how good design can reduce the wastes produced by the manufacture and use of products

### **C2. Technology and Society**

- C2.2** describe how society influences technology (*e.g., higher energy costs spur development of more efficient vehicles, increasing population density leads to the construction of taller buildings, environmental awareness leads to development of alternative energy sources*)

## **D. Professional Practice and Career Opportunities**

### **D1. Health and Safety**

- D1.** describe and apply appropriate health, safety, and environmental practices and standards throughout the design process
- D1.2** adhere to personal and environmental health and safety standards and procedures with respect to processes, materials, tools, equipment, and facilities throughout the design process and related activities (*e.g., ... ensure adequate ventilation and ergonomic seating and other workplace arrangements; ... store materials and dispose of wastes properly*)

# **TRANSPORTATION TECHNOLOGY**

## **Transportation Technology, Grade 11, College Preparation (TTJ3C)**

### ***C. Technology, the Environment, and Society***

#### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of environmental issues related to the use of materials and procedures in the service, repair, and recycling of vehicles or craft
- C1.1** describe the legislative requirements concerning the use of environmentally friendly products in the repair and service of vehicles or craft, and explain the costs and benefits of using such products
- C1.2** explain the importance of the proper processing of waste products (*e.g., batteries, used oil, antifreeze, refrigerant, tires*) as a means of minimizing the environmental impact of the transportation industry
- C1.3** describe appropriate actions to be taken in the event of a spill of waste products (*e.g., gasoline, antifreeze*), and demonstrate the ability to safely implement such actions (*e.g., outline the steps described in an emergency action plan and carry them out*)

#### **C2. Technology and Society**

- C2.2** describe the effects that increasing transportation costs (*e.g., rising fuel costs, highway tolls, environmental taxes*) have on society
- C2.3** explain how current societal needs and preferences influence transportation technology (*e.g., by creating a greater demand for vehicles with improved safety features, fuel efficiency, and emission levels*)

## **Transportation Technology: Vehicle Ownership, Grade 11, Open (TTJ3O)**

### ***A. Vehicle Ownership Fundamentals***

#### **A2. Vehicle Registration and Ownership**

- A2.2** describe the conditions that must be met to register a vehicle (*e.g., safety standards inspection, emissions test, proof of insurance*)

### ***D. Technology, the Environment, and Society***

#### **D1. Technology and the Environment**

- D1.** explain how vehicle ownership affects the environment and how vehicle owners can remedy or reduce harmful effects
- D1.1** outline the legal requirements and environmental reasons for emission standards and for testing when required



- D1.2** describe the options that vehicle owners have to choose environmentally friendly products (*e.g., biodegradable cleaners*) and procedures (*e.g., recycling of antifreeze*) in the repair and service of vehicles
- D1.3** describe a vehicle owner's responsibilities with respect to recycling and/or disposing of waste products (*e.g., used oil, used batteries*) appropriately
- D1.4** explain the importance of vehicle maintenance from an environmental perspective (*e.g., keeping tires properly inflated helps to maximize fuel efficiency and reduce emissions*)

## **D2. Technology and Society**

- D2.2** describe the economic, environmental, and social effects that various aspects of the transportation industry have on a community (*e.g., ... **environmental:** pollution caused by exhaust emissions and road salting; ...*)
- D2.3** assess from a consumer's point of view the pros and cons (*e.g., cost, availability, performance, reliability, emission levels*) of various types of fuel/energy sources used to power vehicles (*e.g., gasoline, propane, diesel, electrical/battery power, biodiesel, hybrid powerplant*)

# **Transportation Technology, Grade 12, College Preparation (TTJ4C)**

## **A. Transportation Technology Fundamentals**

### **A1. Understanding Engine Management Systems**

- A1.4** explain how environmentally harmful gases are produced through combustion and how the engine management systems control the level of emissions in the exhaust gas (*e.g., through after-treatment of exhaust gases, exhaust gas recirculation, vapour recovery, positive crankcase ventilation, variable valve timing*)

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of environmental issues in the transportation industry, and use best practices to remedy or reduce the environmental effects of using specific products or processes
- C1.1** demonstrate an understanding of ways in which the transportation industry affects the environment and of efforts being made to remedy or reduce harmful effects (*e.g., improved production methods, automotive parts recycling*), including ways of disposing of waste products (*e.g., used oil, used batteries, used paints/thinners*)
- C1.2** describe appropriate actions to be taken in the event of a spill of waste products (*e.g., gasoline, antifreeze*) and demonstrate the ability to safely implement such actions (*e.g., implement an emergency action plan to contain and clean up the spill*)
- C1.3** identify the procedures required to prevent the release of ozone-depleting materials and other harmful substances (*e.g., electrolyte, antifreeze, gasoline*) during the servicing of vehicle or craft systems

## **C2. Technology and Society**

- C2.4** assess the pros and cons of various types of fuel/energy sources (*e.g., gasoline, propane, diesel, electrical/battery power, biodiesel, hybrid powerplant, hydrogen power cells*) used to power vehicles or small-engine products, taking into account a variety of perspectives (*e.g., consumer's perspective: cost to purchase, cost to operate, performance, emission levels; service/repair perspective: training, safety issues, new tools/equipment required*)

# **Transportation Technology: Vehicle Maintenance, Grade 12, Workplace Preparation (TTJ4E)**

## **C. Technology, the Environment, and Society**

### **C1. Technology and the Environment**

- C1.** demonstrate an understanding of ways in which various aspects of the transportation industry affect the environment, and ways in which harmful effects can be remedied or reduced
- C1.1** demonstrate an understanding of ways in which the transportation industry affects the environment and of efforts being made to remedy or reduce harmful effects (*e.g., improved production methods, automotive parts recycling*), including ways of disposing of waste products (*e.g., used oil, used batteries, used paints/thinners*)
- C1.2** explain the pros and cons of using environmentally friendly products (*e.g., biodegradable cleaners*) and procedures (*e.g., recycling of antifreeze*) in the repair and service of vehicles or small-engine products
- C1.3** describe appropriate actions to be taken in the event of a spill of waste products (*e.g., used oil, antifreeze, fuel*), and demonstrate the ability to safely implement such actions (*e.g., outline the steps described in an emergency action plan and carry them out*)

### **C2. Technology and Society**

- C2.2** assess the pros and cons of various types of fuel/energy sources (*e.g., gasoline, propane, diesel, electrical/battery power, biodiesel, hybrid powerplant, hydrogen power cells*) used to power vehicles or small-engine products, taking into account a variety of perspectives (*e.g., consumer's perspective: cost to purchase, cost to operate, performance, emission levels; service/repair perspective: training, safety issues, new tools/equipment required*)
- C2.3** explain how current trends in transportation technology (*e.g., extended maintenance schedules, improved emission standards and testing, use of high-tech components, emphasis on fuel efficiency, manufacturers' efforts to increase the amount of recyclable material in vehicles and small-engine products*) are related to societal attitudes and behaviour



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