

The Environment and Resource Management, Grade 12

University/College Preparation

CGR4M

This course investigates interactions between natural and human systems, with a particular emphasis on the impacts of human activity on ecosystems and natural processes. Students will use the geographic inquiry process, apply the concepts of geographic thinking, and employ a variety of spatial skills and technologies to analyse these impacts and propose ways of reducing them. In the course of their investigations, they will assess resource management and sustainability practices, as well as related government policies and international accords. They will also consider questions of individual responsibility and environmental stewardship as they explore ways of developing a more sustainable relationship with the environment.

Prerequisite: Any university, university/college, or college preparation course in Canadian and world studies, English, or social sciences and humanities

OVERVIEW

The course has five strands. Instruction and learning related to the expectations in strand A are to be interwoven with instruction and learning related to expectations from the other four strands. Strand A must not be seen as independent of the other strands. Student achievement of the expectations in strand A is to be assessed and evaluated *throughout* the course.

Strand A

A. Geographic Inquiry and Skill Development
Overall Expectations
A1. Geographic Inquiry: use the geographic inquiry process and the concepts of geographic thinking when investigating issues related to the environment and the management of natural resources
A2. Developing Transferable Skills: apply in everyday contexts skills, including spatial skills, developed through geographical investigation, and identify careers in which a background in geography might be an asset

(continued)

Overview *(continued)*

Throughout this course, when planning instruction, teachers should weave the expectations from strand A in with the expectations from strands B–E.

Strands B–E

Overall Expectations and Related Concepts of Geographic Thinking	Big Ideas*	Framing Questions*
B. Spatial Organization		
B1. Protecting Species and Spaces: assess various strategies used for protecting natural spaces and species, locally, nationally, and globally (FOCUS ON: <i>Spatial Significance; Interrelationships</i>)	Not all strategies are effective in protecting endangered spaces and species.	What might happen if relationships within ecosystems or between the earth's spheres and ecosystems were disturbed?
B2. Human Impacts: assess impacts of human population settlement on natural spaces and species (FOCUS ON: <i>Interrelationships; Geographic Perspective</i>)	Humans have had, and continue to have, a direct impact on the natural environment.	Why do solutions to many environmental protection issues require international strategies?
B3. The Earth's Ecosystems: analyse relationships between the spheres of the earth and the characteristics of ecosystems (FOCUS ON: <i>Spatial Significance; Interrelationships</i>)	Interrelationships within ecosystems and between the earth's spheres and ecosystems support life on Earth.	What kinds of barriers limit the effectiveness of protection strategies? How do you measure the impact that humans have on a natural environment?
C. Sustainability and Stewardship of Natural Resources		
C1. Policies and Strategies: analyse the roles and contributions of individuals, governments, and organizations with respect to the sustainable management of the world's natural resources (FOCUS ON: <i>Interrelationships; Geographic Perspective</i>)	Countries and companies must work together in order to manage natural resources sustainably.	How do stakeholders work together to develop international policies or strategies that will help manage shared resources effectively?
C2. Development of Natural Resources: analyse impacts of resource development on the natural and human environment, and assess ways of managing resource development sustainably (FOCUS ON: <i>Interrelationships; Geographic Perspective</i>)	Natural resource development can have social, economic, political, and environmental consequences.	How might competing interests and ideas affect the ability to develop a resource sustainably?
C3. Availability and Use of Natural Resources: assess the availability of various natural resources, and analyse factors affecting their exploitation and use (FOCUS ON: <i>Spatial Significance; Patterns and Trends</i>)	The spatial distribution of natural resources often determines how they are developed and used.	What strategies are needed to mitigate a possible conflict? Why does the method of resource development depend on where the resource is located? What risks are associated with that method of extraction or harvesting, and what risks are specific to that location?

* See page 17 for a discussion of the purpose of big ideas and framing questions.

Overall Expectations and Related Concepts of Geographic Thinking	Big Ideas*	Framing Questions*
D. Ecological Systems: Interconnections and Interdependence		
D1. Reducing Pollution: analyse challenges involved in reducing pollution from human activities, and assess the effectiveness of various methods of pollution reduction (FOCUS ON: <i>Interrelationships; Geographic Perspective</i>)	Governments, companies, and individuals must work together to reduce pollution.	Should the reduction of pollution be a top priority for all levels of government?
D2. Impacts of Pollution: evaluate impacts of various types of pollution on the natural environment and on human health (FOCUS ON: <i>Patterns and Trends; Interrelationships</i>)	Pollution affects the environment and human health in many different and sometimes unexpected ways.	Why does local pollution often have regional or global impacts? Why, if we know that our actions and choices harm the environment, do we continue to do what we are doing?
D3. Ecological Processes: describe key ecological and biological processes, and explain how they are affected by human activities (FOCUS ON: <i>Spatial Significance; Interrelationships</i>)	Human activity affects the earth's ecological processes directly and indirectly.	
E. Community Action		
E1. Developing Solutions: assess a variety of strategies for resolving environmental and natural resource management issues, locally, nationally, and/or globally (FOCUS ON: <i>Interrelationships; Geographic Perspective</i>)	Solutions must come from individuals and all levels of government working together.	Who, in the end, is responsible for the protection of the environment?
E2. Community Land Use and Infrastructure: assess impacts of community land use and infrastructure on humans and the natural environment, and assess ways of reducing these impacts (FOCUS ON: <i>Spatial Significance; Interrelationships</i>)	It is hard to balance the needs, wants, and actions of all people with sustainable community development.	How do our own choices and actions affect the environment? Why would people disagree about what strategies to use locally to reduce human impacts on the environment?
E3. Ecological Footprints: analyse impacts of various human behaviours on the natural environment, and assess the role of behaviour, ethics, and technology in reducing these impacts (FOCUS ON: <i>Patterns and Trends; Geographic Perspective</i>)	We all have a part to play in reducing our impact on the environment.	How should we balance differing ideas, values, and beliefs when trying to lessen human impacts on the environment?

A. GEOGRAPHIC INQUIRY AND SKILL DEVELOPMENT

OVERALL EXPECTATIONS

Throughout this course, students will:

- A1. Geographic Inquiry:** use the geographic inquiry process and the concepts of geographic thinking when investigating issues related to the environment and the management of natural resources;
- A2. Developing Transferable Skills:** apply in everyday contexts skills, including spatial skills, developed through geographical investigation, and identify careers in which a background in geography might be an asset.

SPECIFIC EXPECTATIONS

A1. Geographic Inquiry

Throughout this course, students will:

- A1.1** formulate different types of questions to guide investigations into issues related to the environment and natural resource management (e.g., factual questions: *Which gases are considered greenhouse gases?*; comparative questions: *Which open-pit rehabilitation strategies result in the least amount of environmental damage?*; causal questions: *How might a trade agreement have an effect on the natural environment?*)

- A1.2** select and organize relevant data and information on geographic issues from a variety of primary and secondary sources (e.g., primary: *raw data from fieldwork, both quantitative and qualitative; photographs; satellite images*; secondary: *published statistics, newspapers, books, atlases, geographic magazines, websites, graphs, charts, digital and print maps*), ensuring that their sources represent a diverse range of perspectives

Sample questions: “How might you use data on stream flow and sedimentation depth over time to determine the impact of a dam or pier? Where might you find this data and information?” “What type of data and information do you need to collect in order to assess the impact of a clear-cut forest harvest on a particular region?” “What types of maps and graphs will help you analyse vegetation type or heat emissions from an industrial source?”

- A1.3** assess the credibility of sources and information relevant to their investigations (e.g., *by considering how the data are constructed to support the author’s point of view, the possible bias of the author, the expertise of the author, the accuracy of the text and supporting data, the intended audience, the purpose of the messaging, the context in which the information was presented*)

Sample questions: “Whose point of view does this source represent? Is the source biased?” “What are the academic credentials of the author(s)?” “Have you analysed enough sources to understand the range of opinions on the issue and the quality of the evidence available? Have you consulted sources that represent other points of view?” “Which source is most credible and why?”

- A1.4** interpret and analyse data and information relevant to their investigations, using various tools, strategies, and approaches appropriate for geographic inquiry (e.g., *interpret diagrams illustrating the flow of leachate from waste sites; analyse graphs and charts of climate data to determine trends in global temperature; use decision-making templates to analyse points of view on an issue related to alternative energy sources; use graphic organizers to compare various perspectives on agricultural practices and/or wildlife culling*)

Sample questions: “What type of graphic organizer would you use to help analyse the environmental impact of offshore production on both the producing country and the consuming country?” “What types of information might

you use as a data layer in a geographic information system (GIS) to analyse which regions of the world have the highest production of greenhouse gases?" "What might explain the trend you have identified? Are there any other factors that might have influenced it?"

- A1.5** use the concepts of geographic thinking (i.e., spatial significance, patterns and trends, interrelationships, geographic perspective) when analysing and evaluating data and information and formulating conclusions and/or making judgements about issues related to the environment and natural resource management (e.g., *use the concept of spatial significance to analyse the choice of location for an oil refinery; use the concept of patterns and trends to analyse short- and long-term trends in population growth and the carrying capacity of urban centres; use the concept of interrelationships to determine ways in which various natural and human factors have contributed to inequalities in the availability of potable water; use the concept of geographic perspective to analyse the social, political, economic, and environmental impacts of a change in land use*)

Sample questions: "How might the concept of spatial significance help you determine whether a particular land use is 'environmentally friendly'?" "How might an understanding of interrelationships guide your examination of the connections between consumption patterns and the use of natural resources?" "How might an understanding of patterns and trends help you analyse the long-term impact of the melting of continental ice?" "How can geographic perspective help you analyse the implications of developing natural resources in areas inhabited by indigenous peoples?"

- A1.6** evaluate and synthesize their findings to formulate conclusions and/or make informed judgements or predictions about the issues they are investigating

Sample questions: "What does the evidence suggest is the most likely cause of species decline in this ecosystem? Do you need to qualify your conclusions in any way? Do trends in the causal factors you have identified and in species populations indicate how this issue will evolve in the future? Do your conclusions about causal factors also suggest ways of reducing their impacts?"

- A1.7** communicate their ideas, arguments, and conclusions using various formats and styles, as appropriate for the audience and purpose (e.g., *a debate for classmates on the use of water; a video for a Grade 9 class showing different*

points of view about the exploitation of the Alberta oil sands or another natural resource in Canada; a webcast or podcast for the general public on strategies for managing electronic waste; a photo essay for a local community group to promote environmental stewardship within the community and illustrate its potential benefits)

Sample questions: "What kind of information does your audience need? What do they already know? What opinions and concerns do they already have? How much detail and how much explanation do they need?" "What format and approach would be most effective in conveying your information to this particular audience?"

- A1.8** use accepted forms of documentation (e.g., footnotes, author/date citations, reference lists, bibliographies, annotated bibliographies, credits) to reference different types of sources (e.g., websites, blogs, books, articles, films, data)

- A1.9** use appropriate terminology when communicating the results of their investigations (e.g., *vocabulary specific to their inquiry; terminology related to geography and to the concepts of geographic thinking*)

A2. Developing Transferable Skills

Throughout this course, students will:

- A2.1** describe ways in which geographic investigation can help them develop skills, including spatial skills and the essential skills in the Ontario Skills Passport (e.g., *reading graphic texts, writing, graphing, computer use, use of spatial technologies, oral communication, numeracy, decision making, planning, management, finding information, problem solving*), that can be transferred to postsecondary opportunities, the world of work, and everyday life
- A2.2** apply in everyday contexts skills and work habits developed through geographic investigation (e.g., *use critical thinking, mapping, and graphing skills to analyse statistics and data in order to deepen their understanding of a global environmental issue; use listening skills to consider multiple perspectives when discussing an issue; use spatial skills to analyse relationships between people and the natural environment; apply work habits such as collaboration when working with a team to determine criteria that need to be considered when making a decision*)
- A2.3** apply the concepts of geographic thinking when analysing current events involving geographic issues (e.g., *use the concept of spatial*

significance to analyse the impact of melting ice caps; use the concept of patterns and trends to analyse the distribution of specific atmospheric pollutants; use the concept of interrelationships to analyse the connection between chemicals found in mothers' milk and the use of specific products; use the concept of geographic perspective to analyse the impact of a new development project on a community) in order to enhance their understanding of these issues and their role as informed citizens

A2.4 identify some careers in which a geography background might be an asset (*e.g., environmental scientist, engineer, lawyer, or technician; environmental consultant or coordinator for a resource company; risk assessment specialist; land surveyor; international aid worker; town planner; environmental or natural resource policy adviser; natural resource manager; civil engineer; geologist; hydrologist; GIS technician; park administrator*)

B. SPATIAL ORGANIZATION

OVERALL EXPECTATIONS

By the end of this course, students will:

- B1. Protecting Species and Spaces:** assess various strategies used for protecting natural spaces and species, locally, nationally, and globally (**FOCUS ON:** *Spatial Significance; Interrelationships*)
- B2. Human Impacts:** assess impacts of human population settlement on natural spaces and species (**FOCUS ON:** *Interrelationships; Geographic Perspective*)
- B3. The Earth's Ecosystems:** analyse relationships between the spheres of the earth and the characteristics of ecosystems (**FOCUS ON:** *Spatial Significance; Interrelationships*)

SPECIFIC EXPECTATIONS

B1. Protecting Species and Spaces

FOCUS ON: *Spatial Significance; Interrelationships*

By the end of this course, students will:

- B1.1** assess the role of government agencies, voluntary organizations, and international agencies (e.g., government agencies: *Parks Canada, Ontario Parks, Conservation Authorities of Ontario*; voluntary organizations: *Britain's National Trust, Nature Conservancy of Canada*; international agencies: *UNESCO, Global Protected Areas Programme of the International Union for Conservation of Nature*) in protecting spaces of natural and cultural significance

Sample questions: "What are the benefits of protecting the boreal forest or coral reefs or wetlands?" "What is the difference between preserving and conserving natural spaces?" "Should mining or logging be allowed in national or provincial parks?" "What characteristics of the Niagara Escarpment made it qualify for inclusion in UNESCO's World Network of Biosphere Reserves?" "What role do conservation authorities play within urban areas?" "Where are fragile environments already protected by limitations on human activity? Are there other environments that should be recognized as fragile or under threat?" "What are the organizations or agencies that, in your opinion, play the most important role in the protection of natural and cultural spaces?" "Where does the funding come from to pay for an agency's or organization's expenses related to protecting spaces of natural and cultural significance? How do changes in funding or government

affect the agency's or organization's ability to carry out its mandate?"

- B1.2** assess the role and effectiveness of various strategies for protecting plant and animal species

Sample questions: "What are some of the different ways in which natural spaces can be protected? How effective have these different kinds of protection been, and what challenges might they face in the future?" "How does the protection of spaces also help with the protection of species?" "What role do zoos play in protecting animals?" "How might requiring licences for hunting and fishing be considered a protection strategy?" "How important are monitoring activities and scientific studies for maintaining species populations and protecting species at risk?" "How do organizations such as the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the International Union for Conservation of Nature contribute to the protection of species?"

- B1.3** compare Canada's efforts to protect endangered spaces and species with those of another country

Using spatial skills: Students can support their investigations of environmental protection measures in another country by constructing an annotated map highlighting designated protection areas in that country. Labels can be used for each area to provide details of the spaces or species being protected and to note any special protection measures that are in place. Photographs of the spaces or species being protected can be linked to the map.

B2. Human Impacts

FOCUS ON: *Interrelationships; Geographic Perspective*

By the end of this course, students will:

B2.1 analyse differences in the views that various groups of people, including indigenous peoples, hold about the natural environment

Sample questions: “How do the environmental beliefs of Aboriginal groups in Canada compare with those of indigenous peoples in other parts of the world, such as the Maori of New Zealand or the Masai of Kenya?” “Why is it important to analyse the beliefs and values of different groups towards the natural environment when investigating a proposal to open a new mine in northern Ontario? Why might these groups’ attitudes and ideas differ? Which groups and stakeholders would you need to research?”

B2.2 describe ways in which human settlement and modifications of the natural landscape affect the environment (*e.g., loss of vegetation and related impacts on air quality, loss or fragmentation of habitat, changes in predator/prey relationships*)

Sample questions: “In what ways do humans modify natural landscapes? What are the costs and benefits of these modifications? Do humans have the right to modify the environment to suit their needs?” “How can landscape modifications contribute to the resilience and survival of species?” “What are the environmental implications of some current urban development activities in our local area?”

Using spatial skills: As a basis for their investigations of human impacts on the local environment, students can conduct a field study of a local wetland to identify the main plant and animal species that it supports. The results can be recorded on a thematic map and used to determine the potential impacts if the wetland were to be developed for human use. The field study could also be used as a starting point for an examination of the environmental assessment process.

B2.3 identify factors that contribute to the survival of a species within an ecosystem (*e.g., genetic characteristics, availability of habitat, population size*), and explain why selected species throughout the world are at risk from encroaching human populations

Sample questions: “In what regions of the world are plant and animal species most at risk? Why?” “Why are some species more at risk than others? What are the various categories used to indicate whether a plant or animal may be at risk of extinction?”

Using spatial skills: Students can use a world population base map and overlay various ecosystem regions and components to identify areas where ecosystems may be under direct stress from settlement or exploitation by humans.

B2.4 describe ways in which non-native species can enter ecosystems, and evaluate the impact of an introduced or invasive species on an ecosystem (*e.g., rabbits in Australia; predatory brown tree snakes on Guam; zebra mussels, purple loosestrife, and Asian long-horned beetles in Canada; giant rhubarb and grey squirrels in Ireland*)

Sample questions: “Why might people choose to introduce a foreign species to an ecosystem? Who should be consulted about introducing a foreign species?” “How might people inadvertently introduce foreign species to an ecosystem?” “Why is the Great Lakes Region vulnerable to invasive species?” “What conditions are needed for a non-native species to survive in a new environment? What conditions allow it to become a dominant component of the ecosystem? How does its presence change other relationships within the ecosystem? What species are threatened by its presence in the ecosystem?”

Using spatial skills: Students can create a global overview of invasive species problems by constructing maps highlighting countries in various parts of the world that have major concerns with invasive species and annotating details such as the species of concern in each country, their regions of origin, their mode of introduction, and their impacts on local ecosystems.

B3. The Earth’s Ecosystems

FOCUS ON: *Spatial Significance; Interrelationships*

By the end of this course, students will:

B3.1 describe the characteristics of the earth’s spheres (*e.g., biosphere, lithosphere, hydrosphere, atmosphere*), and explain how interactions between them support life

Sample questions: “How is the biosphere dependent on the lithosphere, hydrosphere, and atmosphere for the basic necessities of life?” “How do climate and soil conditions affect the type of life that can exist in a region? How do interactions between the atmosphere and hydrosphere affect regional climates, and how do they affect the creation of soils?” “How do processes within the biosphere affect the other spheres and their ability to support life?” “What challenges do humans face in trying to simulate the functions of the earth’s spheres in order to create an artificial life system that will

allow humans to thrive outside the earth's atmosphere?"

B3.2 explain the influence of physical factors (*e.g., climate, sunlight, soils, topography*) on the characteristics of various ecosystems (*e.g., boreal forest, desert, tundra, savannah, rainforest*), and analyse the relationship between the system's characteristics and the abundance and variety of life that it supports

Sample questions: "How does the shape of the earth influence the characteristics of various ecosystems?" "Should humans be considered components of ecosystems? Why or why not?" "Why do some ecosystems support a much greater abundance and diversity of life than others? How do the abundance and diversity of plant life in an ecosystem determine the amount of animal life it can support?" "What accounts for the diversity of life in a coral reef ecosystem?" "How does the vertical structure of a tropical rainforest contribute to biodiversity? Why do most organisms in a rainforest live in the tree canopy?" "What are some of the ways in which plants and animals have adapted to the heat and dryness of hot deserts? How have they adapted to the extreme cold of cold deserts, such as Canada's Arctic?" "Why are some ecosystems more fragile than others?"

B3.3 explain how interactions between the components of an ecosystem (*e.g., biotic components such as primary producers, consumers, and decomposers; abiotic components such as climate and soils*) contribute to its characteristics and affect its stability

Sample questions: "How do soil conditions determine the type of vegetation found in an ecosystem? How do decomposers contribute to soil production?" "How do predators contribute to the stability of ecosystems?" "How might the loss of sea ice and sea-ice algae as a result of climate change affect seal and polar bear populations in the Arctic?" "How would African savannahs change if elephants were no longer part of the ecosystem?"

B3.4 explain how and why ecosystems change over time

Sample questions: "What do we mean by primary succession and secondary succession?" "What can cause an ecosystem to change?" "What role does a forest fire play in the regeneration of forest ecology?" "How does a volcanic landscape become repopulated with flora and fauna?"

C. SUSTAINABILITY AND STEWARDSHIP OF NATURAL RESOURCES

OVERALL EXPECTATIONS

By the end of this course, students will:

- C1. Policies and Strategies:** analyse the roles and contributions of individuals, governments, and organizations with respect to the sustainable management of the world's natural resources (**FOCUS ON:** *Interrelationships; Geographic Perspective*)
- C2. Development of Natural Resources:** analyse impacts of resource development on the natural and human environment, and assess ways of managing resource development sustainably (**FOCUS ON:** *Interrelationships; Geographic Perspective*)
- C3. Availability and Use of Natural Resources:** assess the availability of various natural resources, and analyse factors affecting their exploitation and use (**FOCUS ON:** *Spatial Significance; Patterns and Trends*)

SPECIFIC EXPECTATIONS

C1. Policies and Strategies

FOCUS ON: *Interrelationships; Geographic Perspective*

By the end of this course, students will:

- C1.1** describe policies and strategies used in various countries to manage natural resources sustainably, and compare the levels of success of different countries in implementing selected sustainability options

Sample questions: “Why might some countries, such as Sweden, be more interested than others in implementing sustainable forestry management guidelines and practices?” “Why might alternative energy options that have been implemented successfully in some countries and regions be less effective in others? What, in your opinion, are the best alternative energy options for your area?” “What are some of the methods that various countries have implemented to provide fresh drinking water for their populations and manage water use?”

- C1.2** analyse issues related to the use and management of shared resources (*e.g., common-pool resources such as fish, water, the atmosphere, the oceans; boundary waters; rivers that pass through different political jurisdictions*), and assess the role of intergovernmental organizations and agreements in resolving and managing these issues (*e.g., International Joint Commission, Kyoto Protocol, UN Convention on the Law of the Sea*)

Sample questions: “Who owns common natural resources that flow between or across political boundaries?” “Why is international cooperation necessary to resolve issues relating to the global commons?” “Should fresh water be considered a commodity to be bought and sold, or should access to it be declared a fundamental human right?” “Should developing countries be held to the same environmental standards as developed countries, if doing so will impede their economic growth and their ability to improve their standard of living? Why or why not? Should new industrial powers such as China and India make binding commitments to reduce greenhouse gas emissions?” “Can Canada and the United States contribute effectively to international efforts to reduce greenhouse gas emissions if they are not parties to the Kyoto Protocol?” “Why was the Montreal Protocol successful in reducing the use of CFCs?” “Do you think the Antarctic Treaty will be successful in protecting the continent from future resource development?”

- C1.3** evaluate the contributions of selected individuals, environmental non-governmental organizations (ENGOS), and intergovernmental organizations (*e.g., individuals: Garrett Hardin, Barry Commoner, Rachel Carson, David Suzuki; ENGOS: Greenpeace, Sierra Club; intergovernmental organizations: Brundtland Commission, UNESCO, Intergovernmental Panel on Climate*

Change [IPCC]) to creating awareness of and implementing solutions for selected natural resource management issues

Sample questions: “What criteria might you use to determine the effectiveness of a particular individual’s or group’s contribution?” “How does the role of an intergovernmental organization like the IPCC differ from that of an international ENGO like Greenpeace?” “How can social enterprises help to resolve environmental problems?”

- C1.4** analyse Canada’s contribution to international efforts to resolve selected global environmental or resource management issues

Sample questions: “What was Canada’s role in drafting and implementing one of the following international accords: the Montreal Protocol on Substances that Deplete the Ozone Layer, the Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention), the Convention on Biological Diversity, the Convention on International Trade in Endangered Species of Wild Fauna and Flora? Why did Canada participate in the accord? What expertise might Canada have provided to the drafters of the accord? What were some of the laws and regulations that Canada introduced or changed in order to meet its obligations under the accord?”

C2. Development of Natural Resources

FOCUS ON: *Interrelationships; Geographic Perspective*

By the end of this course, students will:

- C2.1** analyse competing points of view about a natural resource development issue, using a geographic perspective

Sample questions: “How do we, as a society, make decisions about contentious resource-development issues when there are strongly competing interests and points of view?” “What criteria should be used to determine whose arguments should be given the most weight?” “What are the characteristics of a natural resource-based community? How does the discovery of a natural resource affect the residents of a community and the community’s development? What happens to a resource-dependent community when the resource is no longer profitable?” “What are the positions of various stakeholders on oil sands development (e.g., the oil companies; the Alberta, Saskatchewan, and federal governments; the community of Fort McMurray; Aboriginal communities along the Athabasca River; environmentalists; consumers; foreign importers)?”

- C2.2** analyse the environmental impacts of various resource extraction activities (e.g., ecological impacts of clear-cutting and forest monocultures; habitat disruption from pipeline construction, and potential impacts of pipeline leakage on watersheds and climate; ecosystem destruction, impacts on fish, changes in sediment transport patterns, and increases in greenhouse gas emissions from damming of waterways; impact of wind farms on migratory birds; air and water pollution and destruction of natural landscapes resulting from mining), and assess options for making these activities more sustainable

Sample questions: “What incentives do industries have to minimize the environmental impacts of their activities?” “What are some of the solutions that various industries have applied to reduce specific impacts from their activities? How effective have these been? How costly have they been to implement?” “If the current rate of extraction is maintained, how likely is it that we can continue to extract this resource? Could international pressure change the rate of extraction?”

Using spatial skills: Students can use annotated maps to plot the extent of the area affected by the BP oil spill in the Gulf of Mexico in 2010 and to document local impacts.

- C2.3** compare the economic, cultural, and social costs and benefits of selected resource development projects for various individuals or groups (e.g., indigenous peoples, businesses, farmers, tourists)

Sample questions: “How might a person who lives in a resource-based community and a person who does not differ in their attitudes towards resource extraction?” “What health concerns might a person living near this development have?” “How might different groups use the Ontario First Nations Environmental Assessment Toolkit when analysing an existing or proposed resource development project?” “How does one measure the cost of displacing a community in order to develop a resource? What were the social and economic costs of displacing Cree communities in northern Quebec to allow the development of the La Grande River power project or of displacing more than a million people along the Yangtze River to allow the development of the Three Gorges Dam project? What was the balance of costs and benefits for the people displaced? What was the balance of costs and benefits for Quebec or China?” “How are indigenous people being affected by logging activities in the Brazilian rainforest? What are the benefits and for whom? How might pharmaceutical companies seeking to develop new medicines be affected?”

C2.4 analyse the potential environmental impacts of a selected resource-related project or activity (e.g., *dam construction, farming, groundwater extraction, water diversion, landfills, expansion of a conservation area, an oil sands project, a diamond mine*), and assess the implications of these impacts for developing the project or managing the activity sustainably

Sample questions: “What criteria should be considered in an environmental assessment?” “What are some common environmental impacts associated with farming? What options do farmers have for managing these impacts?”

C3. Availability and Use of Natural Resources

FOCUS ON: *Spatial Significance; Patterns and Trends*

By the end of this course, students will:

C3.1 analyse the relationship between the availability and use of different kinds of natural resources and the changing needs of human populations

Sample questions: “Are all natural resources of equal importance? What criteria would you use to rate the importance of a natural resource to humans?” “Which natural resources are the most in demand at this time? How do you predict this might change?” “How might climate change affect the exploitation of oil and gas deposits in the Beaufort Sea or metallic minerals in the Northwest Territories?” “How might a shortage of natural resources such as copper or oil affect future industrial growth in China?”

Using spatial skills: Students can use a world base map with overlays showing the distribution of exploitable resources to illustrate the resource assets of different countries. Different colours can be used to indicate different resource categories, and depth of shading can be used to indicate the quantity of resources available. Students can also construct maps illustrating how changes in industrial needs over time have led to the development of new resources.

C3.2 describe the spatial distribution of selected natural resources, including fresh water, and assess the viability of developing these resources in particular locations

Sample questions: “Why is the availability of fresh water a concern when 75 per cent of the earth’s surface is water?” “How does the spatial distribution of a natural resource influence the viability of developing it?” “What transportation facilities would be needed to extract this resource and get it to market? What kind of technology would be needed to develop the resource in that location, and how expensive would the development be?” “Why have the abundant non-renewable resources of the Antarctic not been developed?” “Why has the boundary of the commercial forest in Canada shifted northward over time?”

C3.3 analyse global patterns and trends in the availability and use of various fossil-fuel resources, and assess the implications for the future development and use of fossil fuels and other energy sources

Sample questions: “Does the location of the resource pose environmental risks, transportation difficulties, or other problems? How might these affect decisions about developing the resource?” “How has the decline of easily accessible oil reserves and the need to tap resources in more difficult locations affected the price of oil? How might higher oil prices encourage the development and use of alternative energy sources or other fossil fuels?”

Using spatial skills: Students can identify areas where there are environmental or safety risks from the transportation of fossil fuels by overlaying a base map showing the location of coal, oil, and gas deposits with a map layer showing the routes taken to transport these resources from source to market. Points of particular environmental risk along these routes, such as rivers and lakes, can be identified, as can populated areas that face a safety risk. Another overlay could be created to show areas where fossil-fuel resources might be developed in the future.

D. ECOLOGICAL SYSTEMS: INTERCONNECTIONS AND INTERDEPENDENCE

OVERALL EXPECTATIONS

By the end of this course, students will:

- D1. Reducing Pollution:** analyse challenges involved in reducing pollution from human activities, and assess the effectiveness of various methods of pollution reduction (**FOCUS ON:** *Interrelationships; Geographic Perspective*)
- D2. Impacts of Pollution:** evaluate impacts of various types of pollution on the natural environment and on human health (**FOCUS ON:** *Patterns and Trends; Interrelationships*)
- D3. Ecological Processes:** describe key ecological and biological processes, and explain how they are affected by human activities (**FOCUS ON:** *Spatial Significance; Interrelationships*)

SPECIFIC EXPECTATIONS

D1. Reducing Pollution

FOCUS ON: *Interrelationships; Geographic Perspective*

By the end of this course, students will:

- D1.1** evaluate the effectiveness of selected strategies that have been used to reduce pollution from human activities (*e.g., bans on the use of polluting chemicals, such as DDT or CFCs; reformulation of products to eliminate harmful ingredients, such as phosphates in detergents; use of filtration devices, such as stack scrubbers or catalytic converters, to reduce pollutants in emissions; use of non-chemical alternatives to aerosol sprays, pesticides, and other products containing harmful chemicals*)

Sample questions: “What are some ways of protecting rivers and lakes from pollutants in urban and agricultural runoff? What promotional strategies have urban centres used to reduce the pollution of local water systems?” “Why should industrial companies include environmental factors in their research activities?” “How can we as individuals do our part to reduce pollution?” “How are environmental laws enforced?”

- D1.2** analyse some of the challenges associated with reducing various types of pollution

Sample questions: “Which is more difficult to treat, point source pollution or non-point source pollution, and why?” “Who pays for the cost of decontaminating a disused industrial site, such

as the Sydney Tar Ponds, when the company that owned the facility no longer exists?” “How can we end our dependence on fossil fuels, when they are crucial to the economy and a major source of jobs? How can we encourage a transition from fossil fuels to alternative energy sources, such as wind and solar, when the alternatives are more expensive?” “Why might it be difficult to persuade some members of the public to reduce their ecological footprints?”

- D1.3** assess the economic implications of pollution reduction and other environmental protection policies (*e.g., job creation or reduction; savings in health costs; reduction of losses from damage to crops, building materials, forests; costs of research, monitoring, enforcement, infrastructure changes*)

Sample questions: “Does protection of the environment always come at a cost to the economy, and vice versa? What suggestions do you have for making environmental protection and economic development mutually beneficial?”

D2. Impacts of Pollution

FOCUS ON: *Patterns and Trends; Interrelationships*

By the end of this course, students will:

- D2.1** explain how changes affecting the natural environment in one location (*e.g., nuclear accidents, acid precipitation, destruction of tropical*

rainforests, dumping of waste in the oceans, earthquakes, volcanic eruptions) may cause changes to the natural environment in other places around the world

Sample questions: “Why did the eruption of Mount Pinatubo in the Philippines in 1991 affect weather conditions around the world during the following year?” “Why would DDT be found in mothers’ milk in Arctic communities even though DDT was never used there?” “Why is the eradication of milkweed in Ontario gardens and pastures a threat to monarch butterflies in Mexico?” “Why is it wise to pay attention to water currents and flows when choosing where to fish near a community?”

- D2.2** describe different types of pollution (e.g., in water: *thermal pollution, biological and chemical substances that deplete oxygen, bacteria, nutrients, heavy metals and toxic chemicals*; in air: *particulates, ground-level ozone, heavy metals and toxic chemicals, ozone-depleting substances, acidifying gases, carbon monoxide, greenhouse gases; noise pollution; electromagnetic radiation pollution; light pollution*) and their impacts (e.g., water pollutants: *health effects in fish and fish-eating birds, animals, and humans; eutrophication*; air pollutants: *cardiorespiratory stress in humans, acidification of lakes, ozone layer depletion, climate change*; light pollution: *fatalities among migratory birds, detrimental confusion among sea turtle hatchlings*), and explain processes that affect the severity of some of these impacts (e.g., *bioaccumulation and biomagnification, acid buffering*)

Sample questions: “How do case studies help in assessing the possible effects of a pollutant? Why is it sometimes difficult to prove that a certain pollutant is the cause of the effects?” “Why is the solution to pollution not dilution?” “What impacts does acid precipitation have on plant and animal life in lakes? Why does acid precipitation have a greater impact in the shield regions of Canada and Russia than in other geological areas?” “What cancers may be related to environmental exposure to benzene?” “What role do air temperature and bright sunshine play in the formation of ground-level ozone?” “What is the relationship between poor air quality and respiratory problems?” “Why is noise pollution difficult to monitor?”

Using spatial skills: Students can construct an annotated map identifying “hot spots” for various types of pollution and make links to health concerns related to these areas. Students can also use data on carbon dioxide emissions by country to identify the twenty highest emitters and can plot the location of these countries

on an annotated map. They can then use an analysis of the patterns on the map to support suggestions for global strategies to reduce carbon dioxide emissions.

D3. Ecological Processes

FOCUS ON: *Spatial Significance; Interrelationships*

By the end of this course, students will:

- D3.1** describe how matter and energy flow through the lithosphere, atmosphere, hydrosphere, and biosphere (e.g., *through the carbon, nitrogen, and hydrologic cycles; photosynthesis; radiation; transfers of sensible and latent heat*)

Sample questions: “How is your diet a product of solar energy? How is that energy transferred to your body?” “What role does lightning have in the nitrogen cycle?” “How do greenhouse gases affect the flow of energy through the atmosphere? How does the hydrologic cycle transfer heat energy from the earth’s surface to the atmosphere?” “Why is an understanding of nutrient cycles and energy flows important to our understanding of the natural environment?”

Using spatial skills: Students can create flow diagrams to clarify their understanding of how the various components of key life-sustaining cycles interact.

- D3.2** identify various types and sources of pollutants that affect or interact with the hydrologic cycle, and explain their impacts on various components of the cycle

Sample questions: “How do greenhouse gases and climate change affect the hydrologic cycle?” “What role does the hydrologic cycle play in the acidification of lakes?” “What are some of the major pollutants that affect water quality in lakes and rivers, and how do they end up in the water?”

- D3.3** explain how various human activities (e.g., *burning of fossil fuels, deforestation*) affect the carbon/oxygen cycle

Sample questions: “Human activities account for only a very small part of the carbon in the carbon/oxygen cycle. Why do they have such a large effect on the amount of carbon in the atmosphere?” “How does deforestation increase the amount of carbon in the atmosphere?” “How much carbon from human sources do the oceans absorb? Can they continue to absorb as much in the future?”

E. COMMUNITY ACTION

OVERALL EXPECTATIONS

By the end of this course, students will:

- E1. Developing Solutions:** assess a variety of strategies for resolving environmental and natural resource management issues, locally, nationally, and/or globally (**FOCUS ON:** *Interrelationships; Geographic Perspective*)
- E2. Community Land Use and Infrastructure:** assess impacts of community land use and infrastructure on humans and the natural environment, and assess ways of reducing these impacts (**FOCUS ON:** *Spatial Significance; Interrelationships*)
- E3. Ecological Footprints:** analyse impacts of various human behaviours on the natural environment, and assess the role of behaviour, ethics, and technology in reducing these impacts (**FOCUS ON:** *Patterns and Trends; Geographic Perspective*)

SPECIFIC EXPECTATIONS

E1. Developing Solutions

FOCUS ON: *Interrelationships; Geographic Perspective*

By the end of this course, students will:

- E1.1** analyse the role of governments in protecting the environment, locally, nationally, and globally

Sample questions: “Can solutions to environmental problems be achieved voluntarily, or do they require government legislation or encouragement?” “Governments can pass and enforce laws to reduce pollution, but what are some other important ways in which they can act to protect the environment? How effective can activities such as environmental research, monitoring, and public education be without government participation? How can the tax system be used to encourage sustainability?” “Is the Experimental Lakes Area a good investment of public funds?” “Do governments have an obligation to provide the public with information about the state of the environment?” “Should Canada have an environmental bill of rights? What might it include?” “What responsibilities does each of the three levels of government in Canada have for environmental protection? What components of the environment can be protected only by international agreements?”

- E1.2** assess the contribution to environmental sustainability of selected locally implemented initiatives and personal choices (e.g., *waste-reduction initiatives, such as recycling, municipal waste fees, bring-your-own-bag programs; energy-conservation initiatives, such as time-of-use energy*

pricing, LEED certification; awareness initiatives, such as Earth Hour and environment days)

Sample questions: “What problems does this initiative address? What strategies does it apply to solve the problems? What results has it achieved?” “How can we encourage people to become more effective environmental stewards?”

- E1.3** analyse a local, national, or global environmental issue and a range of possible solutions, and create an action plan to address the issue

Sample questions: “What or who stands to benefit most from your plan of action?” “Can your action plan be implemented by one person, or does it require many people working together? What behaviours will people need to adopt or modify in order to make your action plan work?” “Will you need political backing for your plan?”

E2. Community Land Use and Infrastructure

FOCUS ON: *Spatial Significance; Interrelationships*

By the end of this course, students will:

- E2.1** analyse the impact of selected land uses within and near communities (e.g., *transportation corridors, residential areas, parks, agricultural production*) on humans and the natural environment

Sample questions: “How do residential buildings affect the natural environment? How does

infilling affect the environment? Is there a human cost to infilling?" "How are farm crops near a highway affected by vehicle emissions?" "How do different types of farm crops, including genetically modified crops such as fruit trees and corn, affect insects and birds? Why are these effects important?" "What are the potential costs and benefits of extending a highway through a wetland?"

- E2.2** analyse the advantages and disadvantages for humans and for natural systems of different transportation and energy supply options at the community level

Sample questions: "Which has more of an impact on the environment, electric cars or traditional petroleum-powered vehicles?" "What are the arguments for and against bicycle lanes?" "How can people be encouraged to use mass transit?" "What are the pros and cons of off-grid energy systems for the community and for the individuals using them?" "How might the decentralization of energy supply both promote and inhibit the adoption of alternative energy systems? Which alternative energy source is the most viable for where you live?"

Using spatial skills: Community maps showing transportation corridors can be analysed to identify opportunities for developing enhanced transit networks that could reduce motor vehicle use and related pollution emissions.

- E2.3** analyse issues related to the treatment and disposal of urban waste (e.g., *domestic sewage, stormwater runoff, household garbage, toxic waste*), and assess the advantages and disadvantages of various treatment and disposal options (e.g., *primary, secondary, and tertiary treatment for sewage; constructed wetlands for stormwater; recycling, composting, incineration, use of landfills for garbage; high-temperature incineration, use of secure landfills for toxic waste*)

Sample questions: "Should communities be allowed to ship their waste to other communities?" "What are some of the problems faced by cities with older sewer systems?" "What are some of the factors that determine the level of sewage treatment a community should have?" "What are some of the challenges that communities in permafrost regions face in providing safe drinking water and disposing of waste?"

Using spatial skills: Students can conduct a field study to explore how water and solid waste are treated in their community and identify areas of potential concern. Community maps showing utility pathways above and below ground can assist them in their investigations.

- E2.4** describe strategies for reducing the environmental impacts of buildings and other structures

Sample questions: "How can the orientation of a building help to save energy?" "What are some strategies that you could use to reduce the environmental impact of an existing structure?"

E3. Ecological Footprints

FOCUS ON: *Patterns and Trends; Geographic Perspective*

By the end of this course, students will:

- E3.1** assess the importance of behavioural and ethical factors (e.g., *reducing consumption, changing personal activities to reduce one's environmental impact, giving priority to values such as environmental sustainability and intergenerational equity in decision making*) in reducing the human impact on the environment

Sample questions: "What are our basic survival needs? Are they the same for everyone? Why or why not? What do we need to enjoy a reasonable standard of living? Is this the same for everyone? Why or why not?" "How do we persuade people to adopt behaviours that reduce their personal impact on the environment? Is it possible to persuade people to support government policies that impose personal costs on them in the present in order to avoid environmental harm in the future?" "How will our personal decisions now affect the quality of life of our great-grandchildren?"

- E3.2** describe various measurements of human impact on the environment (e.g., *water footprint, carbon footprint, ecological footprint*), and assess their implications for the sustainable development of human societies in the future

Sample questions: "Does the world have enough natural resources to support a North American standard of living indefinitely for everyone on the planet? Who determines what a comfortable standard of living is? What is a *sustainable* standard of living? Who decides this? How can we achieve a comfortable standard of living for all while sustaining the planet's ability to support future generations? How would future development have to proceed in developed countries and in developing countries in order for that to happen?"

- E3.3** calculate an ecological footprint for themselves or their class, based on their consumption of resources and production of waste, and compare it to the ecological footprints of people in other countries

Sample questions: "What accounts for the differences between your footprint and those

of people in some other countries?" "What area of consumption had the greatest effect on your footprint? How might you reduce this part of your footprint?"

E3.4 assess the role of technology in changing the impact that humans have on the natural environment

Sample questions: "How have various technological developments, such as the steam engine, the internal combustion engine, electric power generation, and the personal computer, affected our resource and energy needs and our resulting impact on the environment?" "How might technology help us reduce our impact on the environment? What are some developing technologies that might help to reduce impacts in areas such as climate change, forest harvesting, sewage treatment, and air and water quality?"