



## **Ontario Canada Science Standards Alignment with Earth Force Process**

### **The Ontario Curriculum, Grades 9 and 10: Science, 2008**

Overall, the Earth Force Process supports the 3 overarching goals of the Ontario Science Program, the fundamental concept of Sustainability and Stewardship, the application of inquiry and problem-solving skills to the world beyond the classroom, and the involvement of community partners as a learning resource.

Of the five strands in the Science Curriculum for grades 9 and 10, Strand A- Scientific Investigation Skills is the one in which the Earth Force Process has the strongest alignment and support for the Ontario Canada Science Standards. The Process is an inquiry-driven Process throughout, and decisions that students must make along the way are based on their inquiry, research, and analysis of the information gathered. The Process relies on critical thinking and provides opportunities throughout for students to practice and develop their critical thinking skills.

Following are the specific components of the Ontario Science Curriculum for Grades 9 and 10 that can be addressed through the Earth Force Process.

### **Science, Grade 9, Academic**

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

##### *Overall Expectations*

A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);

A2. identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields.

##### *Specific Expectations*

A1. Scientific Investigation Skills

##### *Initiating and Planning [IP]\**

A1.1 formulate scientific questions about observe relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

A1.2 select appropriate instruments and materials for particular inquiries

A1.3 identify and locate print, electronic, and human sources that are relevant to research questions

*Performing and Recording [PR]\**

A1.6 gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams

A1.7 select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources using recommended formats and an accepted form of academic documentation.

*Analysing and Interpreting [AI]\**

A1.8 analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty.

A1.9 analyse the information gathered from research sources for reliability and bias

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

*Communicating [C]\**

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)

A1.12 use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units)

A1.13 express the results of any calculations involving data accurately and precisely

**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

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

### *Overall Expectations*

- 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;
- B2. investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems;
- 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.

### *Specific Expectations*

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

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]

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]

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

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 in-

formation 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 raccoons) [PR, AI, C]

### B3. Understanding Basic Concepts

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

### *Overall Expectations*

C1. assess social, environmental, and economic impacts of the use of common elements and compounds, with reference to their physical and chemical properties;

### *Specific Expectations*

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

C1.2 assess social, environmental, and economic impacts of the use of common elements or compounds [AI, C]

## E. Physics: The Characteristics of Electricity

### *Overall Expectations*

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;

### *Specific Expectations*

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

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]

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]

## **Science, Grade 9, Applied**

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

#### *Overall Expectations*

A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);

A2. identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields.

#### *Specific Expectations*

A1. Scientific Investigation Skills

##### *Initiating and Planning [IP]\**

A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

A1.3 identify and locate print, electronic, and human sources that are relevant to research questions

*Performing and Recording [PR]\**

A1.6 gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams

A1.7 select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., Statistics Canada publications, NASA or EnerGuide websites, personal interviews), using recommended formats and an accepted form of academic documentation

*Analysing and Interpreting [AI]\**

A1.8 analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty

A1.9 analyse the information gathered from research sources for reliability and bias

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

*Communicating [C]\**

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)

A1.12 use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units)

A1.13 express the results of any calculations involving data accurately and precisely

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

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

*Overall Expectations*

B1. analyse the impact of human activity on terrestrial or aquatic ecosystems, and assess the effectiveness of selected initiatives related to environmental sustainability;

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;

### *Specific Expectations*

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

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]

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]

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

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]

B2.4 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

B3.5 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**

#### *Overall Expectations*

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;

#### *Specific Expectations*

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

C1.2 assess the social and environmental impact of the production or use of a common element or simple compound [AI, C]

C2. Developing Skills of Investigation and Communication

C2.1 use appropriate terminology related to the exploration of matter, including, but not limited to: combustion, conductor, decomposition, lustrous, precipitate, reaction, and soluble [C]

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

#### *Overall Expectations*

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;

#### *Specific Expectations*

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

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]

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]

## Science, Grade 10, Academic

### A. Scientific Investigation Skills and Career Exploration

#### *Overall Expectations*

A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);

A2. identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields.

#### *Specific Expectations*

##### *Initiating and Planning [IP]\**

A1.1 formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

##### *Performing and Recording [PR]\**

A1.6 gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams

A1.7 select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., a website for a public health organization, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation

##### *Analysing and Interpreting [AI]\**

A1.8 analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty

A1.9 analyse the information gathered from research sources for reliability and bias

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

##### *Communicating [C]\**

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)

A1.12 use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units)

A1.13 express the results of any calculations involving data accurately and precisely

## 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.

## C. Chemistry: Chemical Reactions

### *Overall Expectations*

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.

### *Specific Expectations*

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

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]

## D. Earth and Space Science: Climate Change

### *Overall Expectations*

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;

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

D3. demonstrate an understanding of natural and human factors, including the greenhouse effect, that influence Earth's climate and contribute to climate change.

### *Specific Expectations*

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

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]

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]

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

#### *Overall Expectations*

E1. evaluate the effectiveness of technological devices and procedures designed to make use of light, and assess their social benefits

#### *Specific Expectations*

##### 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]

### **Science, Grade 10 Applied**

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

##### *Overall Expectations*

A1. demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);

A2. identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields.

### *Specific Expectations*

#### A1. Scientific Investigation Skills

##### *Performing and Recording [PR]\**

A1.7 select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., a website for a public health organization, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation

##### *Analysing and Interpreting [AI]\**

A1.9 analyse the information gathered from research sources for reliability and bias

A1.10 draw conclusions based on inquiry results and research findings, and justify their conclusions

##### *Communicating [C]\**

A1.11 communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models)

A1.12 use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units)

A1.13 express the results of any calculations involving data accurately and precisely

#### 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

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

#### *Overall Expectations*

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

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

#### *Overall Expectations*

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

- D2. investigate various natural and human factors that have an impact on climate change and global warming;
- D3. demonstrate an understanding of various natural and human factors that contribute to climate change and global warming

### *Specific Expectations*

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

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]

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]

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

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]

D2.7 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, A]

## **E. Physics: Light and Applications of Optics**

### *Overall Expectations*

- E1. analyse how properties of light and colour are applied in technology and the impact of these technologies on society;