

## Energy and Climate Change Related Concepts in Alberta Curriculum

*Examples of learning outcomes from Alberta programs of study that refer to energy or climate are listed below by subject/discipline area.*

Science
<b>Grade 1, 2: Attitudes</b> <ul style="list-style-type: none"><li>• <i>Students will show growth in acquiring a sense of responsibility for actions taken.</i></li></ul>
<b>Grade 3, 4: Attitudes</b> <ul style="list-style-type: none"><li>• <i>Students will show growth in acquiring a sense of responsibility for personal and group actions.</i></li></ul>
<b>Grade 5, 6: Attitudes</b> <ul style="list-style-type: none"><li>• <i>Students will show growth in acquiring a sense of personal and shared responsibility for actions taken.</i></li></ul>
<b>Grade 5: Electricity and Magnetism</b> <ul style="list-style-type: none"><li>• <i>Students will interpret and explain efficiency labels on electrical appliances.</i></li></ul>
<b>Grade 5: Weather Watch</b> <ul style="list-style-type: none"><li>• <i>Students will recognize that human actions can affect climate, and identify human actions that have been linked to the greenhouse effect.</i></li></ul>
<b>Grade 7–8–9: Attitudes</b> <p><i>Students will be encouraged to:</i></p> <ul style="list-style-type: none"><li>• <i>Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds.</i></li><li>• <i>Develop responsibility in the application of science and technology in relation to society and the natural environment.</i></li><li>• <i>Be encouraged to demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment.</i></li></ul>
<b>Grade 7: Heat and Temperature</b> <p><i>Students will:</i></p> <ul style="list-style-type: none"><li>• <i>Identify examples of personal and societal choices in using energy resources and technology (e.g., identify choices that affect the amount of hot water used in their daily routines; identify choices in how that water is heated).</i></li><li>• <i>Investigate and describe practical problems in controlling and using thermal energy (e.g., heat losses, excess energy consumption, damage to materials caused by uneven heating, risk of fire).</i></li></ul>
<b>Grade 7: Heat and Temperature</b> <p><i>Students will:</i></p> <ul style="list-style-type: none"><li>• <i>Analyze issues related to the selection and use of thermal technologies, and explain decisions in terms of advantages and disadvantages for sustainability</i><ul style="list-style-type: none"><li>○ <i>Identify and evaluate different sources of heat and the environmental impacts of their use (e.g., identify advantages and disadvantages of fossil fuel use; compare the use of renewable and nonrenewable sources in different applications).</i></li><li>○ <i>Compare the energy consumption of alternative technologies for heat production and use, and identify related questions and issues (e.g., compare the energy required in alternative cooking technologies, such as electric stoves, gas stoves, microwave ovens and solar cookers; identify issues regarding safety of fuels, hot surfaces and combustion products).</i></li></ul></li><li>• <i>Identify positive and negative consequences of energy use, and describe examples of energy conservation in their home or community.</i></li></ul>
<b>Grade 7: Structures and Forces</b> <p><i>Students will:</i></p> <ul style="list-style-type: none"><li>• <i>Analyze and evaluate a technological design or process on the basis of identified criteria, such as costs, benefits, safety and potential impact on the environment.</i></li></ul>

**Grade 8: Mechanical Systems**

Students will:

- Evaluate the design and function of a mechanical device in relation to its efficiency and effectiveness, and identify its impacts on humans and the environment.
- Develop and apply a set of criteria for evaluating a given mechanical device, and defend those criteria in terms of relevance to social and environmental needs.
- Illustrate how technological development is influenced by advances in science, and by changes in society and the environment.

**Grade 9: Electrical Principles and Technologies**

Students will describe and discuss the societal and environmental implications of the use of electrical energy:

- Identify and evaluate sources of electrical energy, including oil, gas, coal, biomass, wind and solar (e.g., identify and evaluate renewable and non-renewable sources for generating electricity; evaluate the use of batteries as an alternative to internal combustion engines).
- Describe the by-products of electrical generation and their impacts on the environment (e.g., identify by-products and potential impacts of coal-fired electricity generation).
- Identify example uses of electrical technologies, and evaluate technologies in terms of benefits and impacts (e.g., identify benefits and issues related to the use of electrical technologies for storing and transmitting personal information).
- Identify concerns regarding conservation of energy resources, and evaluate means for improving the sustainability of energy use.

**Science 10: Attitudes**

- Students will be encouraged to demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment.

**Science 10: Energy and Matter in Chemical Change**

- Students will outline the issues related to personal and societal use of potentially toxic or hazardous compounds (e.g., health hazards due to excessive consumption of alcohol and nicotine; exposure to toxic substances; environmental concerns related to the handling, storage and disposal of heavy metals, strong acids, flammable gases, volatile liquids).

**Science 10: Energy Flow in Technological Systems**

- Students will compare the energy content of fuels used in thermal power plants in Alberta, in terms of costs, benefits, efficiency and sustainability.
- Students will explain the need for efficient energy conversions to protect our environment and to make judicious use of natural resources (e.g., advancement in energy efficiency; Aboriginal perspectives on taking care of natural resources).

**Science 10: Energy Flow in Global Systems**

Students will:

- Describe and explain the greenhouse effect, and the role of various gases—including methane, carbon dioxide and water vapour—in determining the scope of the greenhouse effect identify the potential effects of climate change on environmentally sensitive biomes (e.g., impact of a reduction in the Arctic ice pack on local species and on Aboriginal societies that rely on traditional lifestyles).
- Investigate and interpret the role of environmental factors on global energy transfer and climate change:
  - Investigate and identify human actions affecting biomes that have a potential to change climate (e.g., emission of greenhouse gases, draining of wetlands, forest fires, deforestation) and critically examine the evidence that these factors play a role in climate change (e.g., global warming, rising sea level(s)).
  - Assess, from a variety of perspectives, the risks and benefits of human activity, and its impact on the biosphere and the climate (e.g., compare the Gaia hypothesis with traditional Aboriginal perspectives on the natural world; identify and analyze various perspectives on reducing the impact of human

*activity on the global climate).*

**Science 14–24: Attitudes**

*Students will be encouraged to demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment.*

**Science 14: Understanding Energy Transfer Technologies**

*Students will explain the need to encourage and support the development of machines that are efficient and rely upon renewable energy sources.*

**Science 14: Investigating Matter and Energy in the Environment**

*Students will:*

- *Assess the costs and benefits of technological developments that produce materials the ecosystem cannot recycle.*
- *Compare the recycling of matter by society with the natural cycling of matter through ecosystems.*
- *Assess the impact of modern agricultural technology on the natural pathways of recycling matter.*
- *Identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences.*
- *Explain how various factors influence the size of populations; i.e., immigration and emigration, birth and death rates, food supply, predation, disease, reproductive rate, number of offspring produced, and climate change.*
- *Describe the relationship between land use practices and altering ecosystems.*
- *Trace the development of a technological application that has altered an ecosystem.*

**Science 24: Understanding Common Energy Conversion Systems**

*Students will:*

- *Devise a plan for making more efficient use of household energy conversion devices.*
- *Assess the impact of fossil fuel based technologies on the environment.*
- *Describe the importance of combustion reactions to a modern industrial society, and describe the implications of depleting fossil fuel reserves.*

**Science 20–30, Biology 20–30, Physics 20–30, Attitudes-Stewardship**

*Students will be encouraged to demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment; e.g.,*

- *Assume part of the collective responsibility for the impact of humans on the environment.*
- *Participate in civic activities related to the preservation and judicious use of the environment and its resources.*
- *Encourage their peers or members of their community to participate in a project related to sustainability.*
- *Consider all perspectives when addressing issues, weighing scientific, technological and ecological factors.*
- *Discuss both the positive and negative effects on human beings and society of environmental changes caused by nature and by humans.*
- *Participate in the social and political systems that influence environmental policy in their community.*
- *Promote actions that are not injurious to the environment.*
- *Make personal decisions based on a feeling of responsibility toward less privileged parts of the global community and toward future generations.*
- *Be critical-minded regarding the short- and long-term consequences of sustainability.*

**Science 20–30, Biology 20–30, Chemistry 20–30, Physics 20–30, Science, Technology and Society**

- *Students will discuss the appropriateness, risks and benefits of technologies, assessing each potential application from a variety of perspectives, including sustainability.*
- *Students will explain that society and technology have both intended and unintended consequences for humans and the environment.*
- *Students will explain that the appropriateness, risks and benefits of technologies need to be assessed for each potential application from a variety of*

*perspectives, including sustainability.*

- *Students will explain that the goal of technology is to provide solutions to practical problems and that the appropriateness, risks and benefits of technologies need to be assessed for each potential application from a variety of perspectives, including sustainability.*
- *Students will explain that the products of technology are devices, systems and processes that meet given needs and that the appropriateness, risks and benefits of technologies need to be assessed for each potential application from a variety of perspectives, including sustainability.*

### **Science 20: Chemical Changes**

*Students will describe the properties of simple hydrocarbons and describe hydrocarbon-based industrial processes that are important in Alberta.*

### **Science 30: Energy and the Environment**

*Students will:*

- *Apply the concept of sustainable development to increasing the efficient use of energy; e.g., efficient use of energy in the home, in industry and in transportation.*
- *Explain the need to develop technologies that use renewable and nonrenewable energy sources to meet the increasing global demand.*
- *describe the environmental impact of developing and using various energy sources; i.e., conventional oil, oil sands, solar power, wind power, biomass, hydroelectricity, coal-burning power, nuclear power, geothermal.*
- *Describe how the Aboriginal perspective of an interconnected environment demonstrates the need to balance resource extraction with environmental impact.*
- *Investigate and assess the need for strategies (e.g., co-generation, waste-energy recovery, electrical load scheduling) and policies to increase energy efficiency as a means of balancing global energy demands with maintaining a viable biosphere.*
- *Describe the conversion of solar energy into renewable forms (e.g., wind, hydropower, chemical potential energy by photosynthesis) and nonrenewable forms (e.g., coal, oil and gas) and further conversion into electrical and thermal energy.*
- *Describe the functioning of renewable energy technologies and assess their advantages and disadvantages, including active and passive solar-heating technologies, wind turbines, hydroelectric power, biomass energy, geothermal energy, hydrogen fuel cells.*
- *Evaluate the environmental and economic implications of energy transformation technologies; e.g., nuclear, geothermal, fossil fuel, hydroelectric, wind, tidal power or hydrogen-cell power in a risk-benefit analysis.*

### **Biology 20: Energy and Matter in the Biosphere**

*Students will:*

- *Describe the geologic evidence (stromatolites) and scientific explanations for change in atmospheric composition, with respect to oxygen and carbon dioxide, from anoxic conditions to the present, and describe the significance to current biosphere equilibrium.*

### **Chemistry 20: Attitudes-Stewardship**

*Students will be encouraged to demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment; e.g.,*

- *Remain critical-minded regarding the short- and long-term consequences of human actions.*
- *Consider a variety of perspectives when addressing issues, weighing scientific, technological, economic, political and ecological factors.*
- *Evaluate the contributions of technological innovations to quality of life and care of the environment.*

### **Chemistry 30: Attitudes, Stewardship**

*Students will be encouraged to demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment; e.g.,*

- *Consider a variety of perspectives when addressing issues related to energy use, weighing scientific, technological and ecological factors.*

- *Develop a sense of responsibility toward the use of energy.*
- *Develop a sense of responsibility regarding the use and disposal of chemicals and materials.*
- *Identify and evaluate ways of using chemical potential energy sources efficiently.*
- *Develop awareness that the application of technology has risks and benefits.*
- *Evaluate the contributions of technological innovations to quality of life and care of the environment.*
- *Evaluate the choices that scientists and technologists make when carrying out controversial research.*

#### **Physics 20: Circular Motion, Work and Energy**

- *Students will evaluate whether Canadian society supports scientific research and technological development to facilitate a sustainable society, economy and environment.*

## **Social Studies**

#### **Grade 4, Alberta: A Sense of Land**

*Students will value Alberta's physical geography and natural environment:*

- *appreciate the diversity of elements pertaining to geography, climate, geology and paleontology in Alberta*
- *appreciate how Alberta's fossil heritage contributes to the province's unique character*
- *appreciate the variety and abundance of natural resources in Alberta*
- *appreciate the environmental significance of national and provincial parks and protected areas in Alberta*
- *appreciate how land sustains communities and quality of life*
- *demonstrate care and concern for the environment through their choices and actions*

#### **Grade 4, Alberta: A Sense of Land**

*Students will examine, critically, the physical geography of Alberta by exploring and reflecting upon the following questions and issues:*

- *What are the significant natural resources in Alberta, and where are they located (e.g., mineral deposits, coal, natural gas and oil, forests)?*
- *How are Alberta's provincial parks and protected areas and the national parks in Alberta important to the sustainability of Alberta's natural environment?*

*Students will analyze how Albertans interact with their environment by exploring and reflecting upon the following questions and issues:*

- *In what ways do the physical geography and natural resources of a region determine the establishment of communities?*
- *How are natural resources used by Albertans (i.e., agriculture, oil and natural gas, forests, coal)?*
- *How do Albertans deal with competing demands on land use (e.g., conservation, solar and wind power, recreation, agriculture, oil exploration, forestry)?*

*Whose responsibility should it be to ensure the preservation of national parks, provincial parks and protected areas in Alberta?*

#### **Social Studies 10-1: To what extent should we embrace globalization?**

*Students will:*

- *explore multiple perspectives regarding the relationship among people, the land and globalization (spirituality, stewardship, sustainability, resource development)*
- *evaluate actions and policies associated with globalization that impact the environment (land and resource use, resource development agreements, environmental legislation)*
- *analyze multiple perspectives on sustainability and prosperity in a globalizing world*
- *recognize and appreciate the importance of human rights in determining quality of life accept political, social and environmental responsibilities associated with global citizenship*

## Career and Technology Foundations (CTF)

CTF is an optional program and has the potential to address the area of sustainable development based on the type of project that a teacher might choose to create. It provides the flexibility for this important theme to be incorporated into a CTF project, if a teacher chooses to include this area as part of the learning experience being created.

The CTF Program of Studies is based on 14 learning outcomes and through these learning outcomes the CTF learning process promotes the development of literacy and numeracy, and competencies while exploring a variety of occupational areas belonging to five clusters: Business, Communication, Human Services, Resources and Technology.

### CTF Learning Outcomes related to energy and climate

- *I use occupational area skills, knowledge and technologies.*
- *I demonstrate environmental stewardship associated with occupational areas.*
- *I plan in response to challenges.*
- *I make decisions in response to challenges.*
- *I adapt to change and unexpected events.*
- *I solve problems in response to challenges.*
- *I create products, performance or services in response to challenges.*
- *I appraise the skills, knowledge and technologies used to respond to challenges.*
- *I communicate my learning.*
- *I collaborate to achieve a common goal.*

**Resources Cluster:** Agriculture, Environmental Stewardship, Forestry, Primary Resources and Wildlife.

### Environmental Stewardship

- *Examine the management and conservation of the environment and propose actions that foster the sustainable development and use of resources.*

### Primary Resources

- *Examine mineral industries and technologies that support sustainable development and efficient use of mineral resources.*

## Career and Technology Studies (CTS)

### Environmental Stewardship Occupational Area

Students will:

- *propose shared and personal actions that foster sustainable management of the environment;*
- *analyze the potential environmental and economic impacts of a variety of current and future renewable and non-renewable energy sources; and*
- *present a plan for the sustainable development and integrated use of a land resource.*

### Primary Resources Occupational Area

Students will:

- *explain the social, economic and environmental significance of hydrocarbon and mineral resources in Alberta;*
- *explain current and potential contributions of renewable hydrocarbons to sustainable energy development;*
- *explain environmental assessment and management practices conducted by the oil/gas industry throughout exploration operations; and*
- *explain environmental assessment and management practices conducted by the oil/gas industry throughout recovery and production operations.*