Curriculum Connections for re-energy.ca — Science, Grades 6 to 12

Alberta & Northwest Territories

SCIENCE 7

Heat and Temperature

Overall Outcomes:

- apply an understanding of heat and temperature in interpreting natural events and technological devices.
- analyze issues related to the selection and use of thermal technologies, and explain decisions in terms of advantages and disadvantages for sustainability.

Specific Outcomes:

- describe ways in which thermal energy is produced naturally *(e.g., solar radiation, combustion of fuels, living things, geothermal sources and composting).*
- describe examples of passive and active solar heating, and explain the principles that underlie them *(e.g., design of homes to maximize use of winter sunshine).*
- 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).*
- 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).*
- defend a given position on an issue, based on their findings *(e.g., defend the use of a particular renewable or nonrenewable source of heat energy in a particular application).*

SCIENCE 9

Electrical Principles and Technologies

Overall Outcomes:

- describe and discuss the societal and environmental implications of the use of electrical energy.

Specific Outcomes:

- identify and evaluate sources of electrical energy, including oil, gas, coal, biomass, wind and solar *(e.g., identify and evaluate renewable and nonrenewable sources for generating).*

SCIENCE 10

Energy Flow in Technological Systems

Overall Outcomes:

- analyze and illustrate how technologies based on thermodynamic principles were developed before the laws of thermodynamics were formulated.

Specific Outcomes:

- illustrate, by use of examples from natural and technological systems, that energy exists in a variety of forms *(e.g., mechanical, chemical, thermal, nuclear, solar).*
- describe, qualitatively, current and past technologies used to transform energy from one form to another, and that energy transfer technologies produce measurable changes in motion, shape or temperature *(e.g., hydroelectric and coal-burning generators, solar heating panels, windmills, fuel cells).*

SCIENCE 14

Understanding Energy Transfer Technologies

Overall Outcomes:

- describe and compare simple machines as devices that transfer energy and multiply forces or distances.

Specific Outcomes:

- explain the need to encourage and support the development of machines that are efficient and rely upon renewable energy sources *(e.g., solar-powered calculators, solar cookers).*

SCIENCE 24

Understanding Common Energy Conversion Systems

Overall Outcomes:

- investigate and interpret transformation and conservation of various forms of energy in physical and technological systems.
- investigate and analyze electrical energy conversion devices in terms of energy conversions, rate of energy transfer and efficiency.

Specific Outcomes:

- construct and evaluate a simple model or device that transforms energy from one form to another *(e.g., windmill, water wheel).*
- describe electrical power generation in terms of converting thermal/hydro/wind/solar/nuclear energy into electricity.

KNOWLEDGE AND EMPLOYABILITY SCIENCE 20-4

Understanding Common Energy Conversion Systems

Overall Outcomes:

- investigate and interpret the transformation and conservation of various forms of energy in physical and technological systems.

Specific Outcomes:

- design, construct and evaluate a simple model or device that transforms energy from one form to another *(e.g., windmill, water wheel).*

SCIENCE 30

Energy and the Environment

Overall Outcomes:

- explain the need for balancing the growth in global energy demands with maintaining a viable biosphere.
- describe the sun as Earth's main source of energy and explain the functioning of some conventional and alternative technologies that convert solar, nuclear, tidal and other energy sources into useable forms.

Specific Outcomes:

- 30–D1.4 explain the need to develop technologies that use renewable and nonrenewable energy sources to meet the increasing global demand.
- 30–D1.5k describe the environmental impact of developing and using various energy sources; i.e., solar power, wind power, biomass, hydroelectricity.
- 30–D1.3s evaluate the bias, reliability and validity of electronically accessed information on alternative and renewable energy sources; and assess policies intended to facilitate efficient use of energy and reliance on renewable energy sources.
- 30–D2.3k describe the conversion of solar energy into renewable forms *(e.g., wind, hydropower)* and further conversion into electrical and thermal energy.
- 30–D2.4k 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.
- 30–D2.1sts evaluate the environmental and economic implications of energy transformation technologies; *e.g., hydroelectric or wind in a risk-benefit analysis.*
- 30–D2.3s investigate, quantitatively, the efficiency of a device, using energy input and energy output data; *e.g., solar collector, photovoltaic cell, biomass burner, biogas generator.*
- 30–D2.4s *consult a wide variety of sources to evaluate varied perspectives on topics such as cogeneration, fuel efficiency, waste-energy recovery, electrical load scheduling and policies that facilitate energy efficiency and increase reliance on renewable energy sources.*

ATLANTIC CANADA
New Brunswick

SCIENCE 6

Physical Science: Electricity

Outcomes:

- identify and investigate various methods of generating electricity (past, present and future), and describe some ways in which these methods affect the environment.
- identify and explain sources of electricity as renewable or nonrenewable.

Elaborations:

- identify mechanical *(e.g., wind, falling water, steam)* and solar energy as forms of energy that can be converted into electrical energy where renewable sources of energy would be wind, water, tidal, solar, and non –renewable forms of energy would be fossil fuels and nuclear.
- connect solar cells in circuits to see solar energy being converted into electrical energy.

SCIENCE 7

Physical Science: Heat

Outcomes:

- describe the science underlying heat transfer in solar heating systems and central heating systems in houses.

Elaborations:

- investigate the historical development of heating devices such as stoves and/or more recent innovations such as solar heating and central heating systems.

SCIENCE 9

Physical Science: Characteristics of Electricity

Outcomes:

- give examples of the development of alternative sources of energy (such as wind generators and solar energy) that are a result of cost and the availability and properties of materials.
- explain the development of alternative sources of energy as constrained by several factors *(e.g., cost, availability of materials, properties of materials).*

Elaborations:

- examples of alternative sources of energy, such as windmills, solar panels, and wood chips, can be highlighted and discussed when investigating and exploring sources of electrical energy.

- the damming of rivers in Labrador could be used, for example, to evaluate evidence and sources of information from a variety of sources.

Newfoundland and Labrador

SCIENCE 6

Physical Science: Electricity

Outcomes:

- identify and investigate various methods of generating electricity (past, present and future), and describe some ways in which these methods affect the environment.
- identify and explain sources of electricity as renewable or nonrenewable.

Elaborations:

- identify mechanical *(e.g., wind, falling water, steam)* and solar energy as forms of energy that can be converted into electrical energy where renewable sources of energy would be wind, water, tidal, solar, and non –renewable forms of energy would be fossil fuels and nuclear.
- connect solar cells in circuits to see solar energy being converted into electrical energy.

SCIENCE 7

Physical Science: Heat

Outcomes:

- provide examples of heat technologies used past and present to heat homes in Newfoundland and Labrador *(e.g., geothermal, solar).*

Elaborations:

- have students brainstorm historic and modern methods of heating homes in Newfoundland and Labrador, which could include geothermal and solar heating.

SCIENCE 9

Electricity

Outcomes:

- give examples of the development of alternative sources of energy (such as wind generators and solar energy) that are a result of cost and the availability and properties of materials.

Elaborations:

- examples of alternative sources of energy, such as windmills, solar panels, and wood chips, can be highlighted and discussed when investigating and exploring sources of electrical energy.

Prince Edward Island

SCIENCE 6

Physical Science: Electricity

Outcomes:

- identify and investigate various methods of generating electricity (past, present and future), and describe some ways in which these methods affect the environment.
- identify and explain sources of electricity as renewable or nonrenewable.

Elaborations:

- identify mechanical *(e.g., wind, falling water, steam)* and solar energy as forms of energy that can be converted into electrical energy where renewable sources of energy would be wind, water, tidal, solar, and non –renewable forms of energy would be fossil fuels and nuclear.
- connect solar cells in circuits to see solar energy being converted into electrical energy.

SCIENCE 9

Physical Science: Characteristics of Electricity

Outcomes:

- give examples of the development of alternative sources of energy (such as wind generators and solar energy) that are a result of cost and the availability and properties of materials.

Elaborations:

- examples of alternative sources of energy, such as windmills, solar panels, and wood chips, can be highlighted and discussed when investigating and exploring sources of electrical energy.

Nova Scotia

SCIENCE 6

Physical Science: Electricity

Outcomes:

- explain various methods by which electricity is generated, including renewable and non-renewable.

Elaborations:

- identify mechanical *(e.g., wind, falling water, steam)* and solar energy as forms of energy that can be converted into electrical energy where renewable sources of energy would be wind, water, tidal, solar, and non –renewable forms of energy would be fossil fuels and nuclear.

British Columbia and Yukon

SCIENCE 6

Physical Science: Electricity

Prescribed Learning Outcomes:

- differentiate between renewable and non-renewable methods of producing electrical energy.

Planning for Assessment:

- research sources of energy that could be used more extensively in the future *(e.g., heat, tidal, solar, wind power, biomass energy).*

SUSTAINABLE RESOURCES 11

Energy

Prescribed Learning Outcomes:

- E1 analyze the environmental, social, and economic significance of energy generation and use at the local, provincial, and global levels.
- E2 describe the processes associated with the generation and use of energy resources.

Suggested Achievement Indicators:

- describe the social, economic, and environmental impacts of generating and transporting energy from renewable *(e.g., hydro, wind, geothermal, tidal sources, biofuels)* resources.
- distinguish between renewable (e.g., wind, solar, geo-thermal) and non-renewable *(e.g., fossil fuels, uranium)* energy resources.
- give examples of the efficiency of energy transformations *(e.g., solar, thermal).*
- describe the processes of generating and using various forms of energy *(e.g., electrical, thermal)* from renewable and non- renewable sources *(e.g., fossil fuels, uranium, solar, wind, water, biofuels).*

Manitoba

SCIENCE 6

Electricity

Specific Learning Outcomes:

- 6-3-16 identify renewable and non-renewable sources of electrical energy, and discuss advantages and disadvantages of each (*e.g., hydroelectric, wind, solar, fossil fuels, nuclear fission).*

SCIENCE 7

Particle Theory of Matter

Specific Learning Outcomes:

- 7-2-10 use the design process to construct a prototype that controls the transfer of heat energy *(e.g., solar oven).*

SCIENCE 9

Nature of Electriciy

Specific Learning Outcomes:

- S1-3-24 use the decision-making process to address an issue associated with the generation and transmission of electricity in Manitoba *(e.g., hydroelectric power, sustainability).*

Nunavut

SCIENCE 6

Expectations:

- demonstrate how electricity in circuits can produce light, heat, sound, motion and magnetic effects (materials – buzzers, lights, solar cells, motors, and electromagnets.
- identify and investigate various methods of generating electricity (past, present, and future), and describe some ways in which these methods affect the environment.
- identify and explain sources of electricity as renewable or nonrenewable.

SCIENCE 7

Expectations:

- describe the science underlying heat transfer in solar heating systems and central heating systems in houses.

SCIENCE 9

Expectations:

- give examples of the development of alternative sources of energy (such as wind generators and solar energy) that are a result of cost and the availability and properties of materials.

Ontario

SCIENCE & TECHNOLOGY 6

Electricity and Electrical Devices

Overall Expectations:

- evaluate the impact of the use of electricity on both the way we live and the environment;
- demonstrate an understanding of the principles of electrical energy and its transformation into and from other forms of energy.

Specific Expectations:

- 1.1 assess the short- and long-term environmental effects of the different ways in which electricity is generated in Canada *(e.g., hydro, wind, solar)*, including the effect of each method on natural resources and living things in the environment.

SCIENCE & TECHNOLOGY 7

Heat in the Environment

Overall Expectations:

- demonstrate an understanding of heat as a form of energy that is associated with the movement of particles and is essential to many processes within the earth's systems.

Specific Expectations:

- 1.2 assess the environmental and economic impacts of using conventional *(e.g., fossil fuel, nuclear)* and alternative forms of energy *(e.g., geothermal, solar, wind, wave, biofuel).*

SCIENCE 9

The Characteristics of Electricity (Academic)

Overall Expectations:

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

Specific Expectations:

- 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).*

Electrical Applications (Applied)

Overall Expectations:

- 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:

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

ENVIRONMENTAL SCIENCE 11

Scientific Solutions to Contemporary Environmental Challenges (University/College Preparation)

Overall Expectations:

- B1. analyze social and economic issues related to an environmental challenge, and how societal needs influence scientific endeavours related to the environment.

Specific Expectations:

- B1.2. analyze ways in which societal needs or demands have influenced scientific endeavours related to the environment *(e.g., research into alternative energy sources in response to demands to address the impact on climate change of burning fossil fuels).*

Conservation of Energy (University/College Preparation)

Overall Expectations:

- F1. assess the impact on society and the environment of the use of various renewable and non-renewable energy sources, and prose a plan to reduce energy consumption.

Specific Expectations:

- F1.1 evaluate the impact on the environment of renewable and non-renewable energy sources, and propose an environmentally friendly solution to reduce non-renewable energy consumption *(e.g., a plan for broader use of hybrid cars or solar panels).*

Energy Conservation (Workplace Preparation)

Overall Expectations:

- D3. Demonstrate an understanding of the basic principles of energy production, with reference to renewable and non-renewable sources, and methods of energy conservation.

Specific Expectations:

- D1.2 evaluate, on the basis of research, some of the advantages or disadvantages of technological innovations that contribute to the production of renewable energy and/or aid in conservation *(e.g. bio-oil, biodiesel, wind turbines).*

PHYSICS 11

Electricity and Magnetism (University Preparation)

Specific Expectations:

- F1.2 analyze the efficiency and the environmental impact of one type of electrical energy production (e.g., from hydroelectric, fossil fuel-burning, wind, solar, geothermal, or nuclear sources), and propose ways to improve the sustainability of electrical energy production.

CHEMISTRY 12

Energy Changes and Rates of Reaction (University Preparation)

Overall Expectations:

- D1. analyze technologies and chemical processes that are based on energy changes, and evaluate them in terms of their efficiency and their effect on the environment.

Specific Expectations:

- D1.1 analyze some conventional and alternative energy technologies *(e.g., hydro-powered generators, solar panels, wind turbines)*, and evaluate them in terms of their efficiency and impact on the environment.

PHYSICS 12

Energy Transformation (College Preparation)

Overall Expectations:

- E3. demonstrate an understanding of diverse forms of conservation of energy, and solve related problems.

Specific Expectations:

- E1.1 analyze an energy-transformation technology *(e.g. wind turbines)*, and evaluate its impact on society and the environment.
- E1.2 propose a course of practical action to improve the sustainability of an energy-transformation technology *(e.g., solar panels).*

Quebec, English

SCIENCE & TECHNOLOGY, ELEMENTARY CYCLES 2 & 3 (GRADES 3–6)

Energy

Essential Knowledge:

- forms of energy *(e.g., mechanical, electrical, chemical, heat, solar, sound, nuclear) and* sources of energy *(e.g., moving water, chemical reaction in a battery, sunlight).*
- consumption and conservation of energy by human beings *(e.g., electric meter, insulation)*
- sources of energy *(e.g., solar, hydraulic, wind, fossil fuels).*
- transformation of energy *(e.g., renewable and non-renewable).*

SCIENCE & TECHNOLOGY, SECONDARY CYCLE 1 (YEARS I & II)

The Earth and Space

Orientation:

- learn that on Earth, there are many natural energy sources that mostly emanate from the Sun and that can be harnessed by humans.

Compulsory Concepts:

- analyze the following: naturally energy sources; winds; water cycle; and renewable and nonrenewable energy resources.

The Technological World

Orientation:

- analyze the study of technological systems provides a good opportunity to observe concrete examples of energy and energy transformations and to design systems with sustainable development in mind.

Compulsory Concepts:

- learn about energy transformation.

SCIENCE & TECHNOLOGY, SECONDARY CYCLE 2 (YEAR II)

The Earth and Space

Orientation:

- learn that marine currents and tides create large quantities of energy and that tidal power plants use tides to produce electrical energy.
- learn how wind is also a resource and humans take advantage of wind energy by using sails and blades whose shapes, materials and dimensions vary depending on the application and how wind energy is an abundant source of soft energy.

- learn how the Sun emits a phenomenal amount of energy in every region of the electromagnetic spectrum, how humans have been using the Sun's heat to meet their needs for a very long time, and how photovoltaic sensors on solar panels transform radiation energy into electrical energy.
- learn how he gravitational pull of the Moon on the Earth's large surfaces of water is in large part responsible for the tides, how the energy of the tides is captured in tidal power plants, and how this is one of the means humans have of meeting their energy needs.

Compulsory Concepts:

- learn the following: energy resources; solar energy flow; and Earth-Moon system (gravitational effect).

APPLIED SCIENCE & TECHNOLOGY, SECONDARY CYCLE 2 (YEAR II)

The Earth and Space

Orientation:

- study the search for new energy sources and the use of renewable resources are both major concerns in today's world.

Compulsory Concepts:

- learn the following: energy resources.

ENVIRONMENTAL SCIENCE & TECH, SECONDARY CYCLE 2 (YEAR II)

The Earth and Space

Orientation:

- learn how wind is also a resource and humans take advantage of wind energy by using sails and blades whose shapes, materials and dimensions vary depending on the application and how wind energy is an abundant source of soft energy.
- learn how the Sun emits a phenomenal amount of energy in every region of the electromagnetic spectrum, how humans have been using the Sun's heat to meet their needs for a very long time, and how photovoltaic sensors on solar panels transform radiation energy into electrical energy.
- learn how he gravitational pull of the Moon on the Earth's large surfaces of water is in large part responsible for the tides, how the energy of the tides is captured in tidal power plants, and how this is one of the means humans have of meeting their energy needs.

Compulsory Concepts:

- learn the following: energy resources; solar energy flow; and Earth-Moon system (gravitational effect).

Saskatchewan

SCIENCE 6

Physical Science: Understanding Electricity

Outcomes:

- EL6.1 assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts.

Indicators:

- b. describe how electrical energy is generated from hydroelectric, coal, natural gas, nuclear, geothermal, biomass, solar, and wind sources and categorize these resources as renewable or non-renewable.

SCIENCE 9

Physical Science: Characteristics of Electricity

Outcomes:

- CE9.4 critique impacts of past, current, and possible future methods of small and large-scale electrical energy production and distribution in Saskatchewan.

Indicators:

- f. describe scientific, technological, societal, and environmental perspectives related to past, current, and proposed large-scale methods of electrical energy generation in Saskatchewan *(e.g., hydroelectric dams, wind turbines, solar energy, biomass).*
- g. evaluate evidence and sources of information created by different stakeholders related to various methods of electrical energy production in Saskatchewan, including alternative energy sources such as biomass.