Department of Education and Early Childhood Development

Core Science Curricula Climate Change Education Entry-Points

Companion Document

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Contents

Introduction

Context Science:

Global climate change and its impacts on the planet, people and resources pose serious challenges. The actions taken today will influence future greenhouse gas emissions and the extent of warming; they will also affect our ability to mitigate and adapt to change, and to reduce the vulnerability of people and places subjected to the impacts.

The existing science curricula (circa 2002) presents many opportunities for educators to enact the prescribed curricula in an integrated way and create developmentally appropriate learning opportunities to explore climate systems and the science observed effects through the lens of Science, Technology, Society and Environment (STSE). The progression of learning for the core (grades K to 10) science curricula contain numerous culminating (exit), enabling and discrete outcomes connected to climate systems, climate science and climate change concepts. In fact, exit outcomes are explicitly stated in grades 2, 5, 8 and 10 for the following units:

- Air and Water in the Environment
- Factors that Impact Weather
- Water Systems
- Weather Dynamics

Beyond the core science, students in high school can pursue advanced studies pertaining to climate systems, climate change, climate impacts and mitigation, in Environmental Science 110 220, Humanities, as well as various Local Options courses offered by districts.

Re-envisioning the existing curriculum is one constructive measure towards building awareness of New Brunswickers about the global energy balance, climate systems, climate impacts and sustainable societies. The curriculum renewal work underway in the Anglophone Sector for all subject areas will enable teachers to better identify these alignments and prepare facilitate instruction within the New Brunswick Global Competencies framework. The Global Competencies provide six on-ramps for exploring complex topics as climate systems, climate change and climate impacts and mitigations. One competency, Sustainability *and Global Citizenship* will provide multiple entries points, for students to explore local challenges while learning about climate science and climate change, and propose solutions to mitigate climate impacts that have global significance.

Learners will be expected to:

- explain elements of climate and analyse Earth's energy balance
- identify various sources of evidence used to record climate and apply evidence to determine the contributing causes
- analyze the impact of climate change (local, regional and global) on natural environments and societal systems
- compare climate mitigation and climate adaptations strategies (macro and micro) considering these environmental, societal and economic impacts
- use data and evidence to justify claims relating to climate, climate change and mitigation

The Department will need to work with the districts, and education partners, to develop the instructional supports required to provide on-going, relevant, and timely professional development for

teachers to build background knowledge in scientific literacy and confidence in teaching topics integral to climate science at the elementary levels.

Core Science Entry Points to Climate Change Science

In the Anglophone Sector, topics relating to **climate science** (weather, climate, energy balance, greenhouse gases/effect, sustainability, etc.) **and climate change** are addressed in an age appropriate manner in Grades Kindergarten through 10 in the Science (2002, 2005) curricula.

Grades Kindergarten to 2

Grades	Outcomes	Content/Elaborations	Unit Title	Page(s)
K – 2 Common Outcomes: Appreciation of Science Stewardship	*From entry Kindergarten through grade 2, it is expected that students will be encouraged to:* • *recognize the role and contribution of science in their understanding of the world [400]* • *be sensitive to the needs of other people, other living things, and the local environment [407]*			
Students will be expected to:				
Kindergarten	demonstrate an awareness of safety in the community. [K 4.2]	-reasons environments/situations are safe/unsafe and how to deal with this.	Unit 4: Place and Community	You and Your World (2005, p. 50)
	identify connections between their community and other communities (local, national, global). [K 4.4]	-Exploring interdependence -Identify places where products originate -Examine the labels and identify the origin of the food on the globe	Unit 4: Place and Community	You and Your World (2005, p. 54)
1	describe how plants and animals meet their needs in a given environment. [1.2.1]	-Recognize that living things depend on a healthy environment -Explore ways that animals respond to changes in temperature (e.g., hibernation, migration) and ways that various animals move (e.g., flying, swimming, running) to help them live in their environment	Unit 2: Our Environment	You and Your World (2005, p. 72)
	plan and conduct investigations that explore similarities and	-Ask students to describe an experiment that would compare the growth of plants under	Unit 2: Our Environment	You and Your World (2005, p.75)

	differences between plants and animals. [1.2.2]	different conditions (e.g., amount of water, sunlight, heat).		
	observe and describe how living things respond to changes in solar energy that occur on a daily and seasonal cycle. [1.2.3]	-Describe changes in heat and light from the sun -Describe ways to measure and record environmental changes related to the varying intensity of solar energy -Investigate and describe changes that occur daily in behaviours and location of living things resulting from the solar cycle -Investigate the changes that occur seasonally in the characteristics, behaviours and location of living things resulting from the solar cycle -Describe how humans prepare for seasonal changes -Identify the necessity for appropriate sun protection	Unit 2: Our Environment	You and Your World (2005, p. 76)
	to record observations and display data to explain seasonal changes. [1.2.4]	-Observe and record weather conditions at a consistent time each day -Records may be done for a month, a season or the whole school year; the greater the length of time, the easier it is to see and make comparisons among seasons -Discuss the use of appropriate symbols to represent weather conditions	Unit 2: Our Environment	You and Your World (2005, p. 78)

		-Students to make a statement about any patterns or generalizations they note		
	describe how people depend upon and interact with different natural environments. [1.2.5]	-Recognise that our way of life and our environment are affected by presence and use of natural resource-give examples of how environments influence human activities (local, national, global)	Unit 2: Our Environment	You and Your World (2005, p.80)
2	describe how air and water interact in the environment and how these elements impact on people and places. [2.5.1]	-Describe how water / moisture may change form and location -Describe the effects of weather conditions, and how objects can be protected from different moisture conditions -Understand the importance of conserving water and having clean water for our use	Unit 5: Change and the Physical Environment	You and Your World (2005, p. 144)
	compare properties of familiar liquids and solids and investigate how they interact. [2.5.3]	-The interaction of water and ice, and their exchange of heat energy, are important concepts to introduce -Heat energy is transferred from water to ice in order to melt the ice	Unit 5: Change and the Physical Environment	You and Your World (2005, p. 146)
	describe how people's interactions with the environment have changed over time. [2.5.3]	-Describe how people depend on their environment to survive, and to build communities -Describe how their local environment has changed over time as people's needs and wants have changed	Unit 5: Change and the Physical Environment	You and Your World (2005, p. 148)

	Demonstrate an understanding of sustainable development and its importance for our future. [2.5.4]	-Identify various physical environments and natural resources (local, national, and global) -Discuss sustainability issues -Describe the impact humans have on the environment Plan, carry out and evaluate a conversation activity	Unit 5: Change and the Physical Environment	You and Your World (2005, p. 148)

Grades 3 to 5

Grades	Outcomes	Content/Elaborations	Unit Title	Page(s)
3 – 5 **Common Outcomes:** **Appreciation of Science** **Stewardship**	*From grades 3 through 5 it is expected that students will be encouraged to:* • *appreciate the role and contribution of science and technology in their understanding of the world. [409]* • *realise that the applications of science and technology can have both intended and unintended effects [410]* • *be sensitive to and develop a sense of responsibility for the welfare of other people, other living things, and the environment*			
Students will be expected to:				
3	identify and investigate life needs of plants and describe how plants are affected by the conditions in which they grow. [100-29]	*STSE / Knowledge outcomes*	Plant Growth and Changes	Science 3 (2002, p. 19)
	describe ways in which plants are important to living things and the environment. [102-12]	-Students, in groups or individually, could explore a use for plants, and present their findings to the class. -This activity reinforces social studies outcomes on sustainability.	Plant Growth and Changes	Science 3 (2002, p. 26)
Students will be expected to:				
4	describe how personal actions help conserve natural resources and care for living things and their habitats. [108-3]	-Students should realize care for the environment starts with individuals like themselves, and that they have important decisions to make about how to treat the organisms in their environment	Habitats	Science 4 (2002, p. 22)
	identify their own and their family's impact on natural resources. [108-6]	-During course of filed studies students develop a sensitivity about how their actions; directly or indirectly impact other organisms	Habitats	Science 4 (2002, p.23)

		-What impact do you and other organisms have on the habitat you investigated?		
	use appropriate terminology to compare the structural features of plants that enable them to thrive in different kinds of places. [300-2, 104-6]	-Investigate the variety of structural features for different plants and how these adaptations enable them to thrive in their habitat	Habitats	Science 4 (2002, p. 30)
	predict how the removal of a plant or animal population affects the rest of the community. [301-1]	-Students should predict the consequences of what happens when one type of organism in a food chain is removed completely by natural population controls and/or human activity. -Students could participate in a population simulation illustrating the roles of predators and prey, the importance of a suitable habitat to the survival of an organism, and how the removal of one organism affects others within that habitat. -Why is the living thing endangered? What must be done to help save the organism?	Habitats	Science 4 (2002, p. 32)
	relate habitat loss to the endangerment or extinction of plants and animals. [301-2]	-Create their own habitat and organisms, and cause human or natural disasters to occur	Habitats	Science 4 (2002, p. 32)
	identify examples of positive and negative effects of technological developments on natural habitats. [108-1]	-Focus once more on how they can affect natural habitats. -The focus is how human use of technological products can affect natural habitats	Habitats	Science 4 (2002, p. 34)

		-Engage in discussions about ways in which their use of technological products may impact a habitat and result in the endangerment or extinction of plants and animals -Human impact on habitats and populations can be illustrated through music. Songs such as "The Last of the Great White Whales" by the Irish Descendants tie in many of the concepts addressed throughout the unit		
	identify ways of conserving energy through conservative use of home lighting. [108-1]	-At this stage restricted to ways to conserve electrical energy and reduce cost -Discuss ways to reduce the use of home lighting and how this will help to conserve energy	Light	Science 4 (2002, p. 42)
	describe how personal actions help conserve natural resources and care for living things and their habitats. [108-3]	-Students can research some environmental problems associated with mining and smelting -Help students realize that the applications of science and technology can have both intended and unintended effects. -Encourages students to be sensitive to and develop a responsibility for the welfare of other people, living things, and the environment	Rocks, Minerals and Erosion	Science 4 (2002, p. 73)

	use appropriate terms to describe positive and negative effects of the extraction and/or utilization of rocks and mineral. [104-6, 108-1]	-Students can go on a field trip to a local mine to see how ores are retrieved. -Students can research some environmental problems associated with mining and smelting. -Students could focus on the positive and negative effects of earth products or structures	Rocks, Minerals and Erosion	Science 4 (2002, p. 80)
	demonstrate a variety of methods of weathering and erosion. [301-5]	-Highlight local areas that have evidence of coastline erosion and glacial deposits (erosion) and areas where glaciers have carved out sections of land (weathering)	Rocks, Minerals and Erosion	Science 4 (2002, p. 84)
	describe natural phenomena that cause rapid and significant changes to the landscape. [301-7]	-Students should look around their own region to see if they can identify features of the land that may have been caused by drastic events (i.e. natural disasters like tidal waves, flash floods, hurricanes, mud slides, and tornadoes) can cause a dramatic change in the landscape. -Students could focus, in part, on the preventative action taken before the disaster to reduce its impact.	Rocks, Minerals and Erosion	Science 4 (2002, p. 90)
Students will be expected to:				
	be sensitive to and develop a sense of responsibility for the welfare of other people, other	*Attitude outcomes / Key stage outcome*	Front material	Science 5 (2002, p. 12)

5	living things, and the environment. [419]			
	observe and identify physical changes that affect the form or size of the material in the object without producing any new materials. [301-9, 205-5]	-Understand in some cases a physical change is obvious, while in others, it is not readily apparent -Changes such as phase changes (e.g., boiling or freezing water), or dissolving materials in water are not obvious physical changes, because in these cases the change yields materials having different properties	Properties and Changes in Materials	Science 5 (2002, p. 40)
	identify and describe some physical changes that are reversible and some which are not. [301-10]	-Some physical changes are reversible, and some are not	Properties and Changes in Materials	Science 5 (2002, p. 40)
	identify and describe chemical changes to materials that are reversible and some which are not. [301-10]	-Students should explore chemical changes of different materials.	Properties and Changes in Materials	Science 5 (2002, p. 42)
	demonstrate the importance of using the languages of science and technology to communicate ideas, processes, and results. [104-7]	*Social and Environmental contexts of Science and Technology*	Weather	Science 5 (2002, p. 65)
	describe and compare tools, techniques, and materials used by different people in their community and region to meet their needs. [107-2]	*Social and Environmental contexts of Science and Technology*	Weather	Science 5 (2002, p. 65)
	Identify positive and negative effects of familiar technologies. [108-1]	*Social and Environmental contexts of Science and Technology*	Weather	Science 5 (2002, p. 65)

	identify, construct, and use instruments to measure weather information. [204-8, 205-4, 205-10]	-Construct and /or collect instruments for measuring weather information -Develop an illustrated glossary of terms related to the study of weather	Weather	Science 5 (2002, p. 66)
	record observations using instruments to describe weather in terms of temperature, wind speed, wind direction, precipitation, and cloud cover. [205-7, 300-13]	- Record their observations and measurements in charts or tables, to describe the weather	Weather	Science 5 (2002, p. 66)
	use a variety of sources to gather information to describe the key features of a variety of weather systems. [205-8, 302-11]	- Examples of weather systems include hurricanes, tornadoes, sleet storms, and thunderstorms	Weather	Science 5 (2002, p. 68)
	estimate weather measurements for various times of the day, week, or for specific weather systems. [205-6]	- gathered from the variety of sources to estimate wind speed, amounts and types of precipitation, and when various weather systems are forecast to occur both locally and globally.	Weather	Science 5 (2002, p. 68)
	identify weather-related technological innovations and products that have been developed by various cultures in response to weather conditions. [107-14]	-Use a variety of electronic media (e.g., television, Internet), as well as print resources, to identify -Weather-related products such as storm doors, weather proof clothing, Sou'wester hats, snow fences, dams and dikes in flood zones, hurricane shutters, igloos, snowshoes and sloped roofs	Weather	Science 5 (2002, p. 68)
	relate the transfer of energy from the sun to weather conditions.	-Explain how solar energy provides energy to evaporate	Weather	Science 5 (2002, p. 70)

	[303-21]	water, and energy to warm the Earth's lands and oceans -Sun plays an important role in the water cycle and in determining weather conditions. It is the energy from the sun that warms the water and land -Discover that when more heat is given to water, evaporation takes place faster		
	identify and use appropriate tools and/or materials to measure the temperature of soil and water which have been exposed to light and draw conclusions about the temperature readings. [204-8, 205-4, 206-5]	- Investigate the temperature change of soil and water when exposed to a lamp for equal periods of time -As the temperature of the water and the land rises, so does the temperature of the air above them -Land and bodies of water do not warm up at the same rate, there will be temperature differences over land and water - Differences, which cause wind convections	Weather	Science 5 (2002, p. 70)
	draw a conclusion, based on evidence gathered through research and observation, about the patterns of air and/or water flow that result when two air or water masses of different temperature meet. [206-5]	-Demonstrate that air expands when heated or contracts when cooled is to submerse a tube or bottle in water until it is partly filled with water, and the rest is air -Air and water are considered fluids and behave similarly investigations regarding air flow patterns	Weather	Science 5 (2002, p. 72)

		-Circular pattern, called a convection, holds in air: warm air rises, and cool air sinks and moves over to displace the warm air		
	relate the constant circulation of water on Earth to the processes of evaporation, condensation, and precipitation. [301-13]	- Revisit the effect of the sun on weather conditions -Investigate the water cycle by making clouds in a jar, distilling water, exploring the evaporation of water; phase changes	Weather	Science 5 (2002, p. 74)
	compile and display weather data collected over a period of time in table and/or graph format, and identify or suggest explanations for patterns or discrepancies in the data. [206-2, 206-3]	- Continue to collect weather data but should begin to analyze the data, looking for patterns -Look at how weather forecasts are made and how they have developed over the years	Weather	Science 5 (2002, p. 76)
	ask various people in the community and region for advice on how to predict weather; compare the tools and techniques they use to make predictions. [107-2, 107-10, 207-4]	-Gain the sense there is a range of indicators that can be used to predict weather -Illustrate the degree of uncertainty in weather forecasting, students may wish to record forecasts both short- and long-term); compare the forecasts to the actual weather as it occurs	Weather	Science 5 (2002, p. 76)
	provide examples of ways that weather forecasts are used by various people in their community. [107-5]	-Make weather forecasts based on indicators and sayings they have collected and compiled they will be able to see only some patterns and be able to explain some of these based on the theory investigated	Weather	Science 5 (2002, p. 76)

	describe and predict patterns of change in local weather conditions. [204-3, 301-14]	- Will find they can make short-term forecasts with a fair degree of accuracy using the indicators and sayings, but their ability to make long-range forecasts will be limited	Weather	Science 5 (2002, p. 76)
	identify examples of weather phenomena that are currently being studied. [105-1]	-Weather phenomena that can be studied are the effects thought to be caused by the Green House Effect or Global Warming, acid rain, and El Niño/La Niña -Gain awareness of some current weather and climate related issues -Introduced to the causes and the effects of global warming, depletion of the ozone layer, and acid rain -Weather/environmental issues such as volcanic emissions, and deforestation can also be addressed	Weather	Science 5 (2002, p. 78)
	identify positive and negative effects of technologies that affect weather and the environment. [108-1]	-Investigate the positive and negative effects of technologies that contribute to air pollution -Explore solutions or products that have been developed to reduce the effect of air pollution or other environmental problems -Learn what local, provincial and federal governments, and well as international organizations, are doing to find solutions	Weather	Science 5 (2002, p. 78)

	describe how studies of the depletion of the ozone layer, global warming and the increase in acid rain have led to new inventions and stricter regulations on emissions from cars, factories, and other polluting technologies. [106-4]	- Foster a realization that the applications of science and technology can have both intended and unintended effects	Weather	Science 5 (2002, p. 78)

Grade 6 to 8

Grades	Outcomes	Content/Elaborations	Unit Title	Page(s)
6 – 8 **Common outcomes:** **Appreciation of Science** **Stewardship**	*From grades 6 through 8 it is expected that students will be encouraged to:* • *appreciate the role and contribution of science and technology in their understanding of the world. [422]* • *realise that the applications of science and technology can have advantages and disadvantages [423]* • *be sensitive and responsible in maintaining a balance between the needs of humans and a sustainable environment [432]* • *project, beyond the personal, consequences of proposed actions [433]*			
Students will be expected to:				
6	compare the adaptations of closely related animals living in different parts of the world and discuss reasons for any differences. [301-15]	-Explore similar organisms that live in different parts of the world and inquire about the structural differences in these organisms, and how these structural differences help them in their environment -Inquire into the conditions that have led to the endangerment of various species -Investigate local and global examples to see how information about population size is determined, and what efforts are being made to ensure the survival of these species	Diversity of Life	Science 6 (2002, p,32)
	identify changes in animals over time, using fossils. [301-16]	- Explore what types of fossils have been found and theories that exist about what caused particular organisms	Diversity of Life	Science 6 (2002, p,32)
	describe how personal actions help conserve natural resources and protect the environment in their region. [108-5]	- *Unit Overview: Social and Environmental Contexts of Science and Technology*	Electricity	Science 6 (2002, p,34, 35)

	compare past and current needs, and describe some ways in which science and technology have changed the way people work, live, and interact with the environment. [107-9]	- *Unit Overview: Social and Environmental Contexts of Science and Technology*	Electricity	Science 6 (2002, p. 35)
	describe how knowledge of electricity has led to many new inventions that have changed the way we live, and describe ways in which we have become increasingly dependent on electricity over the years. [107-9, 106-4]	-Identify and describe the uses of electricity in everyday life -Think about the many electrical inventions they use and how they depend on electricity is to describe their experiences when the power goes out	Electricity	Science 6 (2002, p. 46)
	identify and explain sources of electricity as renewable or non-renewable. [303-29]	-Identify chemical, mechanical and solar energy as forms of energy that can be converted into electrical energy -Energy can be converted from chemical, mechanical, solar and nuclear to electrical energy -Some forms of chemical energy would be batteries and fossil fuel combustion -Sources of energy would be wind, water, tidal, solar, and nuclear -Renewable forms of energy would be wind, solar, water and tidal -Non-renewable forms of energy are fossil fuels and nuclear energy -Research project on how the various ways of generating electricity affect the environment	Electricity	Science 6 (2002, p. 50)

	identify and explain different factors that could lead to a decrease in electrical energy consumption in the home and at school. [108-5, 303-30]	-Opportunity to see the effects of their effort to conserve energy by collecting data about the consumption before and after they try to reduce electrical usage -Propose ways that consumption can be decreased -Investigate how the damming of a river affects a local environment, or how fossil fuel energy sources contribute to greenhouse gases	Electricity	Science 6 (2002, p,52)
	demonstrate how Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons. [301-19]	- Investigate the effect of the angle of the Sun's rays on temperature -Note the differences in temperature at various times of the day and relate these differences to the angle of the sun	Space	Science 6 (2002, p. 70)
Students will be expected to:				
7	provide examples of problems that arise at home, in an industrial setting, or in the environment that cannot be solved using scientific and technological knowledge. [112-8]	Unit overview Curriculum Outcomes Social and Environmental Contexts of Science and Technology	Interactions Within Ecosystems	Science 7 (2002, p. 19)
	describe interactions between biotic and abiotic factors in an ecosystem. [306-3]	-Use instruments: magnifying glasses, field binoculars, and hand-held microscopes to closely observe organisms in the ecosystem. -Thermometers to compare temperatures at different locations in the area being investigated -Light meters can to investigate any differences in light intensities	Interactions Within Ecosystems	Science 7 (2002, p. 20)

		-Classify the features and components of the ecosystem they observed which may lead to an emergent understanding of the biotic and abiotic factors in the area studied		
	describe how energy is supplied to, and how it flows through, a food web. [306-2]	-Flow of energy in the various relationships can be discussed -Recognize the fact that energy is transformed into other types of energy	Interactions Within Ecosystems	Science 7 (2002, p. 24)
	use various print and electronic sources to research individuals or groups in Canada interested in protecting the environment. [112-4, 112-8, 209-5]	-Extrapolation to regional, national, and perhaps even global exemplars related to the local habitat scenario will permit students to identify and associate environmental conservation groups, federal and/or provincial government departments, and even Canadians who are well known for being responsible for or interested in the environment	Interactions Within Ecosystems	Science 7 (2002, p. 30)
	describe examples of how scientific knowledge has evolved in light of new evidence. [110-4]	*STSE Nature Science of Technology*	Earth's Crust	Science 7 (2002, p. 35)
	compare some of the catastrophic events, such as earthquakes or volcanic. eruptions, that occur on or near Earth's surface. [311-4]	-General discussion about these phenomena; critically examine the events these events occur in present day and their impacts – people and planet (hydrosphere, lithosphere and atmosphere)	Earth's Crust	Science 7 (2002, p. 36)
	organise and analyse data on the geographical and chronological distribution of catastrophic events to	-Models and videos can be used so that students can explore and understand these processes / system interactions	Earth's Crust	Science 7 (2002, p. 38)

	determine patterns and trends. [209-4, 210-6, 311-5]			
	identify some positive and negative effects and intended and unintended consequences of a particular science or technological development. [113-1]	-Mining activity in the province, technology used in geological surveys, and /or uses of minerals -Investigate commercial or other human uses of rocks	Earth's Crust	Science 7 (2002, p. 48)
	suggest solutions to problems that arise from applications of science and technology, taking into account potential advantages and disadvantages. [113-7]	-Mining activity in the province, technology used in geological surveys, and /or uses of minerals -Exploration of Earth's crust is done for economic reasons	Earth's Crust	Science 7 (2002, p. 48)
	explain how each state of matter reacts to changes in temperature. [308-3]	-Understand both the relationship between heat and temperature and the concept of heat capacity on a qualitative level (IMPT CONCEPT for understanding energy transfer within/between earth systems)	Heat	Science 7 (2002, p. 56)
	explain changes of state, using the particle model of matter. [308-4]	-Reflection on the effect that temperature has on air, as demonstrated in the construction of an air thermometer, will help students conceptualize what is happening at the particle level in gases. -Determine the general relationship between temperature changes and volumes of solids, liquids, and gases	Heat	Science 7 (2002, p. 56)
	compare transmission of heat by conduction, convection, and radiation. [308-5]	-Experience how thermal energy is transferred from one object to another	Heat	Science 7 (2002, p. 58)

		-Encouraged to investigate various technologies that reduce heat transfer -Understand that conduction can occur in all three states of matter but decreases in efficiency from solids to liquids to gases -Radiant energy is heat energy that is transmitted by electromagnetic waves that do not need matter to travel -Radiant energy from the sun is the source of energy for much of the conduction and convection of heat energy on earth		
	compare in qualitative terms the heat capacities of some common materials. [308-7]	- Different substances have different capacities for storing internal energy -The rate of heat loss or gain, also depends on the shape and surface area of the substance	Heat	Science 7 (2002, p. 60)
Students will be expected to:				
	apply the concept of systems as a tool for interpreting the structure and interactions of natural and technological systems. [111-6]	*STSE Relationships between Science and Technology*	Curriculum Outcomes	Science 8 (2002, p.19)
	describe possible positive and negative effects of a particular scientific or technological development, and explain how different groups in society may have different needs and desires in relation to it. [113-2]	*STSE Societal and environmental contexts of science and technology*	Curriculum Outcomes	Science 8 (2002, p.19)

8	describe the interactions of the ocean currents, winds, and regional climates. [311-9]	-Understand that surface currents carry tropical heat to various parts of the ocean -Influence the ocean has on climate, economy, and lifestyles -El Niño and La Niña and their impact on the world's climates can be a context for discussion and investigation	Water Systems on Earth	Science 8 (2002, p.18, 26)
	apply the concept of systems to show how changes in one component of a body of water causes change in other components in that system. [111-6]	-Interactions among the atmosphere, the ocean and the land are complex and necessary for most life forms to occur -Investigate how the salinity of a body of water affects the types of organisms that live in a region -See the relationship between water temperature and it ability to hold dissolved gases permit them to better understand a particular relationship -Investigate relationships such as changes in water temperature and species distribution or how the local climate might be affected	Water Systems on Earth	Science 8 (2002, p. 26)
	analyse factors that affect productivity and species distribution in marine and fresh water environments (i.e. temperature, pollution, overfishing, upwelling). [311-8]	-Abiotic factors that create ocean currents and influence environments also have an impact on types of organisms that inhabit our waters -Investigate how factors as water temperature, salinity, ocean currents, pollution, and upwelling affect productivity and species	Water Systems on Earth	Science 8 (2002, p. 26)

		distribution in marine environments and freshwater environments -El Niño and La Niña and their impact on the world's climates can be a context for discussion and investigation -Investigation how oceans influence onshore breezes can be compared and contrasted to offshore breezes which are prevalent in our coastal communities		
	describe factors that affect glaciers and polar icecaps, and describe their consequent effects on the environment. [311-2]	-Context also permits an investigation into aspects associated with oceans that can neither be controlled nor solved using present scientific and technological knowledge, such as influencing iceberg drifts, polar icecap fluctuations and preventing hurricanes -Rising global temperatures are associated with a rise in sea level and regional climatic changes. -Come to realize that sea levels rise because of thermal expansion of water and the melting of glaciers and icefields	Water Systems on Earth	Science 8 (2002, p. 30)
	Identify new questions that arise from the study of glaciers and polar ice caps. [201-16]	-Investigate past historical and geological events that have illustrated the results of ocean-level fluctuations over long periods of time	Water Systems on Earth	Science 8 (2002, p. 30)

		-Global warming and cooling trends can be associated with this investigation		

Grades	Outcomes	Content/Elaborations	Unit Title	Page(s)
9 and 10 **Common outcomes:** **Appreciation for Science** **Stewardship**	*From grades 9 through 12 it is expected that students will be encouraged to:* • *value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not. [436]* • *appreciate that the applications of science and technology and science can raise ethical dilemmas. [437]* • *have a sense of personal and shared responsibility for maintaining a sustainable environment. [446]* • *project the personal, social, and environmental consequences of proposed action. [447]* • *want to take action for maintaining a sustainable environment. [448]*			
Students will be expected to:				
	determine quantitatively the efficiency of an electrical appliance that converts electrical energy to heat energy. [308-19]	-Electrical energy is converted to heat energy, some is converted to other forms such as light energy, and some is lost to the surroundings -Determine the efficiency of an electrical appliance, given the energy used and the energy of the system -Associate the use and efficiency of electrical appliances with their impact on our environment and our way of life	Characteristics of Electricity: Use of electrical energy	Science 9 (2002, p. 58)
	describe the transfer and conversion of energy from a generating station to the home. [308-20]	-Electrical energy that is used by homes and industry originates in electric generators in which a revolving magnet generates the electrical energy	Characteristics of Electricity: Electricity and the Environment	Science 9 (2002, p. 60)
	evaluate evidence and sources of information when conducting research on electrical energy production and its impact on the	- Investigate how electrical energy is produced and transported to their community	Characteristics of Electricity: Electricity and the Environment	Science 9 (2002, p. 60)

	environment. [210-8]			
	select recent data while conducting research on the environmental problems associated with various types of electrical energy production. [113-6, 210-8]	-Identify and propose a course of action that reduces electrical energy consumption either at home or in society in general -Substantiate their course of action with evidence gathered or constructed throughout the course of study	Characteristics of Electricity: Electricity and the Environment	Science 9 (2002, p. 60)
	propose a course of action that reduces the consumption of electrical energy. [113-9, 113-13]	-Modify behaviour with regard to energy usage and consumption as this behaviour is related to the attitudinal outcome of stewardship	Characteristics of Electricity: Electricity and the Environment	Science 9 (2002, p. 60)
	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. [109-6]	-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 -Compare / contrast sources in terms of cost, efficiency, and impact on the environment -Availability of energy resources in a region usually dictates the types of energy used in that region	Characteristics of Electricity: Electricity and the Environment	Science 9 (2002, p. 60)
	describe the effects of solar phenomena on Earth: -sun spots; -solar flares; and -solar radiation. [312-6]	-Students should become aware of the fact that the Sun influences almost all natural phenomena on Earth; from being the source of energy for green plants to impacting weather systems on Earth (explored in greater detail in grade 10)	Space Exploration: Composition and Characteristics of the Solar System	Science 9 (2002, p. 70)

Students will be expected to:				
10	explain how a paradigm shift can change scientific world views in understanding sustainability, explore and develop a concept of sustainability. [114-1]	-Explore their own paradigms related to the environment -What is sustainability? -Are they willing to sacrifice something to ensure sustainability? -Is the economy one of growth and expansion at any environmental cost? -Does this lead to sustainable practices? -What are sustainable practices in your home? -How do we know when they are present?	Sustainability of Ecosystems	Science 10 (2002, p. 22)
	communicate questions, ideas, and intentions and receive, interpret, understand, support, and respond to the ideas of others with respect to environmental attitudes. [215-1]	-Use case studies to discuss: Has the old-world view that the earth and all things on it exist for the sole benefit of humans changed? Has western civilization been created on the premise of the unlimited exploitation of the earth? Overall, has the focus shifted to environmental issues and concerns? Are we (individuals, provinces, countries, continents, global community) now shifting toward the concept of sustainability? Is the shift real or perceived?	Sustainability of Ecosystems	Science 10 (2002, p. 22)

		-Examine issues such as ocean dumping, resource management, and waste management for evidence of the effect of old world views, the paradigm shift that has occurred, and the government and business policies that reflect this shift		
	explain how biodiversity of an ecosystem contributes to its sustainability. [318-6]	- Research the pathways along which energy and matter flow through ecosystems, students should diagram the cycling of carbon, nitrogen, and oxygen in their ecosystem	Sustainability of Ecosystems	Science 10 (2002, p. 24)
	plan changes to, predict the effects of, and analyse the impact of external factors on an ecosystem. [331-6, 213-8, 212-4]	-Link to chemistry and weather units -Pose questions that require students to predict the effects of external factors on the ecosystem	Sustainability of Ecosystems	Science 10 (2002, p. 24)
	analyse the impact of external factors on the ecosystem. [331-6]	-Ecosystem which is significant to your community should be selected to form the context -Develop a way of assessing human impact; identify the external factors; What baseline data must be gathered? And How will the impact be determined?	Sustainability of Ecosystems	Science 10 (2002, p. 26)
	select, compile, and display evidence and information from various sources, in different formats, to support a given view in a presentation about ecosystem change. [214-3, 213-7]	-Examine actual reports from public meetings or Environmental Impact Assessments (EIA) on local issues -Think about the ecosystem you are going to study: What things do	Sustainability of Ecosystems	Science 10 (2002, p. 26)

		you value about it? What would you hate to see disappear or destroyed		
	propose and defend a course of action on a multi-perspective social issue. [118-9, 215-4, 118-5]	-Debate or a simulated hearing about the introduction of a new, or the expansion of an existing enterprise -Research and present information about discussion in the scientific community regarding the viability of and support for the project -Interview of a local scientist to discuss the importance of peer review in their studies of environmental issue -Consider the changes that take place in attitudes	Sustainability of Ecosystems	Science 10 (2002, p. 28)
	analyze meteorological data for a given time span and predict future weather conditions, using appropriate technologies and methodologies. [331-5]	- Use this evidence to form conclusions about and explain large scale heat energy transfer within the atmosphere -Observe how large bodies of water influence weather patterns that pass across them	Weather Dynamics: How are changes in the atmosphere and hydrosphere observed and measured?	Science 10 (2002, p. 36)
	identify questions to investigate that arise from considering the energy transferred within the water cycle. [212-1]	-Consider the following: How does the water cycle influence the seasonal high/low temperatures for inland and coastal communities? Why is the arrival of a snowstorm normally linked to a rise in air temperature? What mutual interactions occur	Weather Dynamics: What energy source drives the water cycle?	Science 10 (2002, p. 38)

		between the atmosphere and large bodies of water such as the ocean or lakes? -Research and present for discussion possible explanations		
	describe examples that illustrate that the atmosphere and hydrosphere are heat sinks in the water cycle. [331-3]	-Hydrosphere is a heat sink, and the energy stored in the ocean influences many systems -Identify and explain examples of new knowledge in such areas as changing fish stocks in given areas, the timing and routes of wildlife migrations, possible cash crops grown in microclimates, patterns of coastal erosion, transport in "iceberg alley," airborne pollution and its effects	Weather Dynamics: What energy source drives the water cycle?	Science 10 (2002, p. 38)
	apply scientific theory, illustrate and explain heat energy transfers that occur in the water cycle. [115-2, 331-1]	-Demonstrate the significant difference in energy between specific heat for water and its latent heat -Recognize the importance of fusion, condensation, and vaporization in the water cycle and its influence on weather	Weather Dynamics: What energy source drives the water cycle?	Science 10 (2002, p. 40)
	compile and display data, using these to support conclusions, from experiments which investigate heat energy storage by, and heat exchange between, water and air masses. [214-3, 214-11]	-Compare heat storage/exchange data measured in controlled, small-scale experiments to those quantities estimated to be in naturally occurring, large-scale weather systems -Observe how weather patterns change as they pass over large bodies of water, and having access	Weather Dynamics: What energy source drives the water cycle?	Science 10 (2002, p. 40)

		to values of water temperature, draw conclusions about heat exchange within bodies of water, their effects on currents, and the magnitude of heat exchanges between bodies of water and the air above them		
	use weather data to describe and explain heat transfers in the hydrosphere and atmosphere, showing how these affect air and water currents. [214-3, 331-2]	-Obtain data from a source such as Environment Canada about temperatures and flow directions for air and water for a weather system moving across a large body of water	Weather Dynamics: Heat energy, its transfer, and weather dynamics – is there a connection?	Science 10 (2002, p. 42)
	select and integrate information about weather from a variety of sources. Compile and display this information to illustrate a particular hypothesis about weather in the Atlantic region. [213-7, 214-3, 215-5]	-Intense weather events have human or societal impact -Investigate the relationship between habitation patterns in the region and weather patterns, or trends in sectors of the economy of our region and weather events	Weather Dynamics: Heat energy, its transfer, and weather dynamics – is there a connection?	Science 10 (2002, p. 42)
	use scientific theory, describe and explain heat transfer and its consequences in both the atmosphere and hydrosphere, relating this science to natural phenomena. [115-2, 331-2]	-Identify and describe the principal characteristics of layers found in the atmosphere, particularly the lower layers. -Identity and distribution of common gases (oxygen, nitrogen, water vapour, carbon dioxide)	Weather Dynamics: What is the evidence for movement of heat energy and matter in global systems?	Science 10 (2002, p. 44)
	describe and explain the effects of heat transfer on the development, severity, and movement of weather systems. [331-4]	- Demonstrations of radiation, conduction, and convection as each applies to one or more of the following: - movement of heat energy	Weather Dynamics: What is the evidence for movement of heat energy and	Science 10 (2002, p. 44)

		- unique micro-climates at high altitudes - the effect of atmospheric pressure on air movement - transfer of weather systems, - transfer of airborne pollution - consequences in the atmosphere of ash from volcanoes and smoke from large, forest fires, etc.	matter in global systems?	
	describe the limitations of scientific knowledge and technology in making predictions related to weather. [118-7]	-Forecasting weather conditions accurately is a challenge -Discover and appreciate the limits to accuracy caused by our location on the North American continent	Weather Dynamics: Accurate weather forecasting – what is its impact?	Science 10 (2002, p. 46)
	identify the impact of severe weather systems on economic, social and environmental conditions. [118-2]	-Analyse its effects of a severe weather event on a selected community	Weather Dynamics: Accurate weather forecasting – what is its impact?	Science 10 (2002, p. 46)
	work cooperatively with a team to research and describe the relationship between domestic and industrial technologies and the formation of acid rain. [116-5, 215-6, 116-3] propose alternative solutions to the problem of acid precipitation, assess each, and select one as the basis for a plan of action, defending the decision. [214-5, 118-5] identify and describe science and technology based careers related	- An optional independent project -Research the sources (for example, automobile emissions and coal-burning emissions) and degree of acid precipitation in their local area by collecting various water samples and testing for pH over an extended period of time -Use this information and library research to write a balanced (that is, presenting all sides) report on the subject, based on information gathered, which includes reference to causes, possible	Chemical Reactions: What are some of the effects of industrialization and associated pollution?	Science 10 (2002, p. 62)

	to airborne pollution (i.e. NO_x, SO_x, and CO_2). [117-7] compare examples where society has used the presence of airborne pollution to influence decisions concerning science and technology. [117-1]	remedies, and the career potential for people working in this field - Defend their position with relevant arguments from different perspectives, and include examples of how society supports and influences science and technology -Identify examples where technologies were developed on the basis of scientific understanding.		

Conclusion

There is little doubt that climate change is a significant global issue. Climate change is a complex topic that requires a solid foundation of conceptual knowledge, and understanding of facts, before students can think about it critically and effectively. In 2012, the National Research Council published, *A Framework for K–12 Science Education*, in which they recommended that foundational climate change science concepts be included as part of a high-quality K–12 science education program. Further, in their 2018 position statement, the National Science Teachers Association (NSTA) acknowledged that the solid scientific foundation on which climate change science rests, and advocates for quality, evidence-based science, to be taught in science classrooms in grades K–12.

Given the multidimensional nature of climate change, it is important that teachers realise that there are many perspectives; beyond the domain of science, through which students can gain a greater understanding, and begin to unravel the complexities. Engaging students in climate science education from the perspective of the humanities would bring the cultural dimension to discussion surrounding climate change and climate science; helping learners to think about societies role, the connectedness of local, regional and global drivers, and potential mitigation solutions in terms of the built environment and the cultural and historical dimensions.

We have seen an increase in the number of student groups acting on a global scale to question existing policies and demand that society and policymakers do better, and act towards a sustainable future by explicitly including climate change education into existing programs of study. Teaching about, and acting on climate change may not be as difficult as it seems; all it takes is a starting point. The Core Science Climate Change Education Companion document was created with the expressed purpose of identifying on-ramps for instructional planning for climate science and climate awareness in classrooms.

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References

The following Canadian organizations offer climate change education resources and/or services* that address Science concepts outlined in the New Brunswick core science curricula:

Title	Website URL
Canadian Network for the Detection of Atmospheric Change (CNDAC)	http://www.candac.ca/candac/Outreach/CANDACcollaboration/index.php/en/teacher-resources/activities-and-lesson-plans/68-teacher-links
Climate Change Connection	http://climatechangeconnection.org/resources/climate-friendly-schools/resources-for-schools/
Climate Change Education	https://cbeen.ca/climate-change/
Climate Change Education Org	http://climatechangeeducation.org/international/na/canada/index.html
Gaia Project*	https://thegaiaproject.ca/en/about/
Ingenium: Let's Talk Energy	https://energy.techno-science.ca/en/resources/climate-change-lesson-plans.php
Ingenium: Climate Change 101	https://energy.techno-science.ca/en/climate-101.php
Learning for a Sustainable Future	http://lsf-lst.ca/en/projects/teacher-resources
Resources for Rethinking	http://www.resources4rethinking.ca/en/
Science: Climate and Weather	http://science.gc.ca/eic/site/063.nsf/eng/h_5869E485.html