Evidence for Climate Change

Curriculum Connections

ALBERTA, NORTHWEST TERRITORIES, NUNAVUT—Science 10: Energy Flow in Global Systems

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

Science 10 Curriculum Connections (2005, updated 2014)	**Mathematics 10C Curriculum Connections** (2008)
Activity 1: Carbon Dioxide	
Unit D: Energy Flow in Global Systems **Outcomes for Science, Technology and Society (STS) and Knowledge** 4. Investigate and interpret the role of environmental factors on global energy transfer and climate change • describe and evaluate the role of science in furthering the understanding of climate and climate change through international programs *(e.g., World Meteorological Organization, World Weather Watch, Global Atmosphere Watch, Surface Heat Budget of the Arctic Ocean (SHEBA) project, The Intergovernmental Panel on Climate Change (IPCC); the study of paleoclimates and models of future climate scenarios)* • describe the role of technology in measuring, modelling and interpreting climate and climate change *(e.g., computer models, devices to take measurements of greenhouse gases, satellite imaging technology)* • describe the limitations of scientific knowledge and technology in making predictions related to climate and weather *(e.g., predicting the direct and indirect impacts on Canada's agriculture, forestry and oceans of climate change, or from changes in energy transfer systems, such as ocean currents and global wind patterns)* **Skills Outcomes** **Initiating and Planning** Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues • identify questions to investigate that arise from practical problems and *issues (e.g., develop questions related to climate change, such as "How will global warming affect Canada's northern biomes?"; "How will a species be affected by an increase or decrease in average temperature?")*	***10C: Relations and Functions*** 1. Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] [ICT: C6–4.3, C7–4.2] 3. Demonstrate an understanding of slope with respect to: • rise and run • line segments and lines • rate of change • parallel lines • perpendicular lines. [PS, R, V]

- design an experiment, and identify specific variables *(e.g., investigate the heating effect of solar energy, using variables, such as temperature, efficiency and materials used)*

Performing and Recording

Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information

- compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data *(e.g., organize data to prepare climatographs for comparing biomes)*
- use library and electronic research tools to collect information on a given topic *(e.g., research sources of greenhouse gases; research protocols to control human sources of greenhouse gases)*
- select and integrate information from various print and electronic sources or from several parts of the same source *(e.g., collect weather and climate data, both historic and current, from the Internet)*

Analysing and Interpreting

Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables *(e.g., analyze a graph of mean monthly temperatures for cities that are at similar latitudes but have different climates)*
- identify limitations of data, evidence or measurement *(e.g., list the limitations of data and evidence of past climate changes, evaluate the validity of interpolations and extrapolations, use significant digits appropriately)*
- state a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis *(e.g., summarize an analysis of the relationship between human activity and changing biomes)*
- explain how data support or refute a hypothesis or a prediction *(e.g., provide evidence for or against the hypothesis that human activity is responsible for climate change)*

Attitude Outcomes

Scientific Inquiry

Seek and apply evidence when evaluating alternative approaches to investigations, problems and *issues (e.g., view a situation from different perspectives, propose options and compare them when making decisions or taking action; evaluate inferences and conclusions with a critical mind and without bias, being cognizant of the many factors involved in experimentation)*

Communication and Teamwork Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results **Safety** Show concern for safety in planning, carrying out and reviewing activities *(e.g., demonstrate concern for self and others in planning and carrying out experimental activities involving the heating of materials; select safe methods for collecting evidence and solving problems)*	
Activity 2: Climate Modelling	
Unit D: Energy Flow in Global Systems **Outcomes for Science, Technology and Society (STS) and Knowledge** 1. Describe how the relationships among input solar energy, output terrestrial energy and energy flow within the biosphere affect the lives of humans and other species • explain how climate affects the lives of people and other species, and explain the need to investigate climate change *(e.g., describe the responses of human and other species to extreme climatic conditions; describe housing designs, animal habitats, clothing and fur in conditions of extreme heat, cold, dryness or humidity, wind)* • 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 2. Analyze the relationships among net solar energy, global energy transfer processes—primarily radiation, convection and hydrologic cycle—and climate. • describe, in general terms, how thermal energy is transferred through the atmosphere (i.e., global wind patterns, jet stream, Coriolis effect, weather systems) and through the hydrosphere (i.e., ocean currents, large bodies of water) from latitudes of net radiation surplus to latitudes of net radiation deficit, resulting in a variety of climatic zones *(e.g., analyze static and animated satellite images)* • investigate and describe, in general terms, the relationships among solar energy reaching Earth's surface and time of year, angle of inclination, length of daylight, cloud cover, albedo effect and aerosol or particulate distribution • explain how thermal energy transfer through the atmosphere and hydrosphere affects climate • investigate and interpret how variations in thermal properties of materials can lead to uneven heating and cooling 4. Investigate and interpret the role of environmental factors on global energy transfer and climate change	***10C: Relations and Functions*** 1. Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] [ICT: C6–4.3, C7–4.2] 3. Demonstrate an understanding of slope with respect to: • rise and run • line segments and lines • rate of change • parallel lines • perpendicular lines. [PS, R, V]

- describe the role of technology in measuring, modelling and interpreting climate and climate *change (e.g., computer models, devices to take measurements of greenhouse gases, satellite imaging technology)*
- describe the limitations of scientific knowledge and technology in making predictions related to climate and weather *(e.g., predicting the direct and indirect impacts on Canada's agriculture, forestry and oceans of climate change, or from changes in energy transfer systems, such as ocean currents and global wind patterns)*
- 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)*

Skills Outcomes

Performing and Recording

Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information

- compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data *(e.g., organize data to prepare climatographs for comparing biomes)*
- use library and electronic research tools to collect information on a given topic *(e.g., research sources of greenhouse gases; research protocols to control human sources of greenhouse gases)*

Analysing and Interpreting

Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- compile and display, by hand or computer, evidence and information in a variety of formats, including diagrams, flow charts, tables, graphs and scatterplots *(e.g., construct climate graphs to compare any two of the following biomes: grassland, desert, tundra, taiga, deciduous forest, rain forest)*
- identify and apply criteria for evaluating evidence and sources of information, including identifying bias *(e.g., investigate the issue of global climate change)*
- interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables *(e.g., analyze a graph of mean monthly temperatures for cities that are at similar latitudes but have different climates)*
- explain how data support or refute a hypothesis or a prediction *(e.g., provide evidence for or against the hypothesis that human activity is responsible for climate change)*

Attitude Outcomes **Interest in Science** Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., expand their inquiries beyond the classroom and into their everyday lives; show interest in careers related to climate and the environment)* **Scientific Inquiry** Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., view a situation from different perspectives, propose options and compare them when making decisions or taking action; evaluate inferences and conclusions with a critical mind and without bias, being cognizant of the many factors involved in experimentation)* **Communication and Teamwork** Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results • develop, present and defend a position or course of action, based on findings *(e.g., a strategy to reduce greenhouse gas emissions caused by the transportation of people and goods)* **Stewardship** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that human actions today may affect the sustainability of biomes for future generations; identify, without bias, potential conflicts between responding to human wants and needs and protecting the environment)*	
Activity 3: A Warming World	
Unit D: Energy Flow in Global Systems **Outcomes for Science, Technology and Society (STS) and Knowledge** 1. Describe how the relationships among input solar energy, output terrestrial energy and energy flow within the biosphere affect the lives of humans and other species • explain how climate affects the lives of people and other species, and explain the need to investigate climate change *(e.g., describe the responses of human and other species to extreme climatic conditions; describe housing designs, animal habitats, clothing and fur in conditions of extreme heat, cold, dryness or humidity, wind)* 2. Analyze the relationships among net solar energy, global energy transfer processes—primarily radiation, convection and hydrologic cycle—and climate	

- describe, in general terms, how thermal energy is transferred through the atmosphere (i.e., global wind patterns, jet stream, Coriolis effect, weather systems) and through the hydrosphere (i.e., ocean currents, large bodies of water) from latitudes of net radiation surplus to latitudes of net radiation deficit, resulting in a variety of climatic zones *(e.g., analyze static and animated satellite images)*

3. Relate climate to the characteristics of the world's major biomes, and compare biomes in different regions of the world
   - 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)*
4. 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))*
   - describe and evaluate the role of science in furthering the understanding of climate and climate change through international programs *(e.g., World Meteorological Organization, World Weather Watch, Global Atmosphere Watch, Surface Heat Budget of the Arctic Ocean (SHEBA) project, The Intergovernmental Panel on Climate Change (IPCC); the study of paleoclimates and models of future climate scenarios)*
   - describe the role of technology in measuring, modelling and interpreting climate and climate change *(e.g., computer models, devices to take measurements of greenhouse gases, satellite imaging technology)*
   - describe the limitations of scientific knowledge and technology in making predictions related to climate and weather *(e.g., predicting the direct and indirect impacts on Canada's agriculture, forestry and oceans of climate change, or from changes in energy transfer systems, such as ocean currents and global wind patterns)*
   - 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)*

Skills Outcomes

Initiating and Planning

Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues

- identify questions to investigate that arise from practical problems and issues *(e.g., develop questions related to climate change, such as "How will global warming affect Canada's northern biomes?"; "How will a species be affected by an increase or decrease in average temperature?")*

Performing and Recording

- carry out procedures, controlling the major variables and adapting or extending procedures where required *(e.g., perform an experiment to determine the ability of various materials to absorb or reflect solar energy)*

Analyzing and Interpreting

Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- compile and display, by hand or computer, evidence and information in a variety of formats, including diagrams, flow charts, tables, graphs and scatterplots *(e.g., construct climate graphs to compare any two of the following biomes: grassland, desert, tundra, taiga, deciduous forest, rain forest)*
- interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables *(e.g., analyze a graph of mean monthly temperatures for cities that are at similar latitudes but have different climates)*
- State a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis *(e.g., summarize an analysis of the relationship between human activity and changing biomes)*
- explain how data support or refute a hypothesis or a prediction *(e.g., provide evidence for or against the hypothesis that human activity is responsible for climate change)*

Communication and Teamwork

Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

- identify multiple perspectives that influence a science-related decision or issue *(e.g., consult a wide variety of electronic sources that reflect varied viewpoints and economic, social, scientific and other perspectives on global warming and climate change)*

Attitude Outcomes **Scientific Inquiry** Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., view a situation from different perspectives, propose options and compare them when making decisions or taking action; evaluate inferences and conclusions with a critical mind and without bias, being cognizant of the many factors involved in experimentation)* **Stewardship** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that human actions today may affect the sustainability of biomes for future generations; identify, without bias, potential conflicts between responding to human wants and needs and protecting the environment)* **Safety** Show concern for safety in planning, carrying out and reviewing activities *(e.g., demonstrate concern for self and others in planning and carrying out experimental activities involving the heating of materials; select safe methods for collecting evidence and solving problems)*	
Activity 4: The Impact of Transportation	
Unit D: Energy Flow in Global Systems **Outcomes for Science, Technology and Society (STS) and Knowledge** 4. 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)* **Skills Outcomes** **Performing and Recording** Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information	***10C: Relations and Functions*** 1. Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] [ICT: C6–4.3, C7–4.2]

- use library and electronic research tools to collect information on a given topic *(e.g., research sources of greenhouse gases; research protocols to control human sources of greenhouse gases)*
- select and integrate information from various print and electronic sources or from several parts of the same source *(e.g., collect weather and climate data, both historic and current, from the Internet)*

Analyzing and Interpreting

Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- explain how data support or refute a hypothesis or a prediction *(e.g., provide evidence for or against the hypothesis that human activity is responsible for climate change)*
- propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan *(e.g., design a home for a specific climate; analyze traditional Aboriginal home designs for their suitability in particular climates)*

Communication and Teamwork

Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

- identify multiple perspectives that influence a science-related decision or issue *(e.g., consult a wide variety of electronic sources that reflect varied viewpoints and economic, social, scientific and other perspectives on global warming and climate change)*
- develop, present and defend a position or course of action, based on findings *(e.g., a strategy to reduce greenhouse gas emissions caused by the transportation of people and goods)*

Attitude Outcomes

Mutual Respect

Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds *(e.g., appreciate Aboriginal clothing and home designs of the past and present that use locally-available materials to adapt to climate; recognize that science and technology develop in response to global concerns, as well as to local needs; consider more than one factor or perspective when making decisions on Science, Technology and Society [STS] issues)*

Interest in Science

Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., expand their inquiries beyond the classroom and into their everyday lives; show interest in careers related to climate and the environment)*

Scientific Inquiry Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., view a situation from different perspectives, propose options and compare them when making decisions or taking action; evaluate inferences and conclusions with a critical mind and without bias, being cognizant of the many factors involved in experimentation)* **Collaboration** Work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., choose a variety of strategies, such as active listening, paraphrasing and questioning, in order to understand other points of view; consider a variety of perspectives and seek consensus before making decisions)* **Stewardship** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that human actions today may affect the sustainability of biomes for future generations; identify, without bias, potential conflicts between responding to human wants and needs and protecting the environment)*	
Activity 5: How Much Carbon Is in That Tree?	
Unit D: Energy Flow in Global Systems **Outcomes for Science, Technology and Society (STS) and Knowledge** **Skills Outcomes** **Performing and Recording** Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information • carry out procedures, controlling the major variables and adapting or extending procedures where required *(e.g., perform an experiment to determine the ability of various materials to absorb or reflect solar energy)* • use instruments, effectively and accurately, to collect data *(e.g., use a barometer, rain gauge, thermometer, anemometer)* • compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data *(e.g., organize data to prepare climatographs for comparing biomes)* **Analysing and Interpreting** Analyze data and apply mathematical and conceptual models to develop and assess possible solutions • compile and display, by hand or computer, evidence and information in a variety of formats, including diagrams, flow charts, tables, graphs	***10C: Measurement*** ***1. Solve problems that involve linear measurement, using:*** • ***SI and imperial units of measure*** • ***estimation strategies*** • ***measurement strategies.*** ***[ME, PS, V]*** 4. Develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles. [C, CN, PS, R, T, V] ***Relations and Functions*** 9. Solve problems that involve systems of linear equations in two variables, graphically and algebraically. [CN, PS, R, T, V] [ICT: C6–4.1]

and scatterplots *(e.g., construct climate graphs to compare any two of the following biomes: grassland, desert, tundra, taiga, deciduous forest, rain forest)*

- state a conclusion based on experimental data, and explain how evidence gathered supports or refutes the initial hypothesis *(e.g., summarize an analysis of the relationship between human activity and changing biomes)*
- explain how data support or refute a hypothesis or a prediction *(e.g., provide evidence for or against the hypothesis that human activity is responsible for climate change)*

Communication and Teamwork

Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

Attitude Outcomes

Interest in Science

Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., expand their inquiries beyond the classroom and into their everyday lives; show interest in careers related to climate and the environment)*

Scientific Inquiry

Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., view a situation from different perspectives, propose options and compare them when making decisions or taking action; evaluate inferences and conclusions with a critical mind and without bias, being cognizant of the many factors involved in experimentation)*

Collaboration

Work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., choose a variety of strategies, such as active listening, paraphrasing and questioning, in order to understand other points of view; consider a variety of perspectives and seek consensus before making decisions)*

Stewardship

Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that human actions today may affect the sustainability of biomes for future generations; identify, without bias, potential conflicts between responding to human wants and needs and protecting the environment)*

10-3: Algebra

1. Solve problems that require the manipulation and application of formulas related to:
   – perimeter
   – area
   – the Pythagorean theorem
   – primary trigonometric ratios
   – income.
   [C, CN, ME, PS, R]

Safety Show concern for safety in planning, carrying out and reviewing activities *(e.g., demonstrate concern for self and others in planning and carrying out experimental activities involving the heating of materials; select safe methods for collecting evidence and solving problems)*	
Activity 6: When Does It Make Sense to Switch?	
Unit D: Energy Flow in Global Systems **Outcomes for Science, Technology and Society (STS) and Knowledge** 4. 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))* • describe the role of technology in measuring, modelling and interpreting climate and climate change *(e.g., computer models, devices to take measurements of greenhouse gases, satellite imaging technology)* • 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)* **Skills Outcomes** **Communication and Teamwork** Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results **Attitude Outcomes** **Interest in Science** Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., expand their inquiries beyond the classroom and into their everyday lives; show interest in careers related to climate and the environment)* **Scientific Inquiry** Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., view a situation from different perspectives, propose options and compare them when making decisions*	***10C: Relations and Functions*** 1. Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] [ICT: C6–4.3, C7–4.2] 9. Solve problems that involve systems of linear equations in two variables, graphically and algebraically. [CN, PS, R, T, V] [ICT: C6–4.1]

or taking action; evaluate inferences and conclusions with a critical mind and without bias, being cognizant of the many factors involved in experimentation) **Collaboration** Work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., choose a variety of strategies, such as active listening, paraphrasing and questioning, in order to understand other points of view; consider a variety of perspectives and seek consensus before making decisions)* **Stewardship** Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that human actions today may affect the sustainability of biomes for future generations; identify, without bias, potential conflicts between responding to human wants and needs and protecting the environment)*	
Design Challenge: Climate in a Container	
Unit D: Energy Flow in Global Systems **Outcomes for Science, Technology and Society (STS) and Knowledge** 1. Describe how the relationships among input solar energy, output terrestrial energy and energy flow within the biosphere affect the lives of humans and other species • explain how climate affects the lives of people and other species, and explain the need to investigate climate change *(e.g., describe the responses of human and other species to extreme climatic conditions; describe housing designs, animal habitats, clothing and fur in conditions of extreme heat, cold, dryness or humidity, wind)* • identify the Sun as the source of all energy on Earth • 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 2. Analyze the relationships among net solar energy, global energy transfer processes—primarily radiation, convection and hydrologic cycle—and climate. • explain how thermal energy transfer through the atmosphere and hydrosphere affects climate 3. Relate climate to the characteristics of the world's major biomes, and compare biomes in different regions of the world • describe a biome as an open system in terms of input and output of energy and matter and exchanges at its boundaries *(e.g., compare and contrast cells and biomes as open systems)*	

4. Investigate and interpret the role of environmental factors on global energy transfer and climate change
    - describe the role of technology in measuring, modelling and interpreting climate and climate change *(e.g., computer models, devices to take measurements of greenhouse gases, satellite imaging technology)*

Skills Outcomes

Communication and Teamwork

Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

Attitude Outcomes

Interest in Science

Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields *(e.g., expand their inquiries beyond the classroom and into their everyday lives; show interest in careers related to climate and the environment)*

Scientific Inquiry

Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues *(e.g., view a situation from different perspectives, propose options and compare them when making decisions or taking action; evaluate inferences and conclusions with a critical mind and without bias, being cognizant of the many factors involved in experimentation)*

Collaboration

Work collaboratively in carrying out investigations and in generating and evaluating ideas *(e.g., choose a variety of strategies, such as active listening, paraphrasing and questioning, in order to understand other points of view; consider a variety of perspectives and seek consensus before making decisions)*

Stewardship

Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment *(e.g., recognize that human actions today may affect the sustainability of biomes for future generations; identify, without bias, potential conflicts between responding to human wants and needs and protecting the environment)*

Evidence for Climate Change

Curriculum Connections

BRITISH COLUMBIA AND YUKON—Science 10

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

* This compilation could be used to support outcomes in Grade 11 Earth Science and Grade 11 Environmental Science

Science 10 Curriculum Connections (March 2018)	Mathematics 10: Foundations of Mathematics Curriculum Connections	Mathematics 10: Workplace Mathematics Curriculum Connections
Activity 1: Carbon Dioxide		
Curricular Competencies **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest • Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting** • Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative) • Ensure that safety and ethical guidelines are followed in their investigations	***Curricular Competencies*** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Big Idea—Elaborations*** • **situations:** – Why are trends important? ***Curricular Competencies—Elaborations*** • **inquiry:** – determining what is needed to make sense of and solve problems	***Curricular Competencies*** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Content*** • create, interpret, and critique **graphs** ***Content—Elaborations*** • **graphs:** – including a variety of formats, such as line, bar, and circle graphs, as well as histograms, pictographs, and infographics

Processing and analyzing data and information • Seek and analyze patterns, trends, and connections in data, including describing relationships between variables (dependent and independent) and identifying inconsistencies • Construct, analyze, and interpret graphs (including interpolation and extrapolation), models, and/or diagrams • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence • Analyze cause-and-effect relationships **Evaluating** • Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and secondary sources • Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations and to evaluate claims in secondary sources • Consider social, ethical, and environmental implications of the findings from their own and others' investigations **Applying and innovating** • Contribute to care for self, others, community, and world through individual or collaborative approaches • Transfer and apply learning to new situations • Contribute to finding solutions to problems at a local and/or global level through inquiry	• **discussions:** – partner talks, small-group discussions, teacher-student conferences ***Content—Elaborations*** • **functions and relations:** – communicating domain and range in both situational and non-situational contexts – connecting graphs and context • **linear functions:** – connections between representations: graphs, tables, equations	

• Consider the role of scientists in innovation **Communicating** • Communicate scientific ideas, claims, information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations ***Curricular Competencies—Elaborations*** • **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output ***Content*** • **transformation of energy** • local and global **impacts of energy transformations** from technologies ***Big Ideas—Elaborations*** • **Energy** – *Where does energy come from and what happens to it?* – *How does energy in the form of radiation affect living things?* – *How do energy transformations affect the environment?* ***Content—Elaborations*** • **transformation of energy** – *transfer of energy in closed and open systems* • **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output		

Activity 2: Climate Modelling		
Curricular Competencies **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest • Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting** • Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative) **Processing and analyzing data and information** • Seek and analyze patterns, trends, and connections in data, including describing relationships between variables (dependent and independent) and identifying inconsistencies • Construct, analyze, and interpret graphs (including interpolation and extrapolation), models, and/or diagrams • Analyze cause-and-effect relationships **Evaluating** • Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled • Demonstrate an awareness of assumptions, question information given, and identify	***Curricular Competencies*** **Reasoning and modelling** • **Estimate reasonably** and demonstrate **fluent, flexible, and strategic thinking** about number • **Model** with mathematics in **situational contexts** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Content*** • **Functions and relations:** connecting data, graphs, and situations ***Big Ideas—Elaborations*** • **proportional reasoning:** – comparisons of relative size or scale instead of numerical difference • **situations:** – Why are trends important? ***Curricular Competencies—Elaborations*** • **technology:** – mathematical modelling • **situational contexts:** – including real-life scenarios and open-ended challenges that connect mathematics with everyday life	***Curricular Competencies*** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Content*** • create, interpret, and critique **graphs** ***Big Ideas—Elaborations*** • **Proportional reasoning:** – Reasoning about comparisons of relative size or scale instead of numerical difference • **Representing and analyzing data:** – How do we choose the most appropriate graph to represent a set of data? – How do graphs help summarize and analyze data? – How can investigating trends help us make predictions – Why are graphs used to represent data? – Why do we graph data? ***Curricular Competencies—Elaborations*** • **Visualize:** – create and use mental images to support understanding – Visualization can be supported using dynamic materials (e.g., graphical relationships, simulations),

bias in their own work and secondary sources
- Consider the changes in knowledge over time as tools and technologies have developed
- Connect scientific explorations to careers in science
- Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations and to evaluate claims in secondary sources

Applying and innovating

- Contribute to finding solutions to problems at a local and/or global level through inquiry
- Consider the role of scientists in innovation

Communicating

- Communicate scientific ideas, claims, information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations
- Express and reflect on a variety of experiences, perspectives, and world views through **place**

Big Ideas—Elaborations

- **Energy**
  - *Where does energy come from and what happens to it?*
  - *How does energy in the form of radiation affect living things?*
  - *How do energy transformations affect the environment?*
- **solve problems:**
  - interpret a situation to identify a problem
  - apply mathematics to solve the problem
  - analyze and evaluate the solution in terms of the initial context
- **Represent:**
  - connecting meanings among various representations
- **discussions:**
  - partner talks, small-group discussions, teacher-student conferences
- **Reflect:**
  - Share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions

Content—Elaborations

- **Functions and relations:**
  - Communicating domain and range in both situational and non-situational contexts
  - connecting graphs and context
- **linear functions:**
  - slope: positive, negative, zero and undefined
  - connections between representations: graphs, tables, equations

concrete materials, drawings, and diagrams
- **Explain and justify:**
  - use mathematical arguments to convince

Content—Elaborations

- **graphs:**
  - including a variety of formats, such as line, bar, and circle graphs, as well as histograms, pictographs, and infographics

Content—Elaborations • **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output		
Activity 3: A Warming World		
Curricular Competencies **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest • Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting** • Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative) • Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods and those of others • Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data • Ensure that safety and ethical guidelines are followed in their investigations **Processing and analyzing data and information** • Seek and analyze patterns, trends, and connections in data, including describing	***Curricular Competencies*** **Communicating and representing** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Big ideas—Elaborations*** • **situations:** – Why are trends important? ***Curricular Competencies—Elaborations*** • **situational contexts:** – including real-life scenarios and open-ended challenges that connect mathematics with everyday life • **discussions:** – partner talks, small-group discussions, teacher-student conferences	

relationships between variables (dependent and independent) and identifying inconsistencies • Construct, analyze, and interpret graphs (including interpolation and extrapolation), models, and/or diagrams • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence • Analyze cause-and-effect relationships **Evaluating** • Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions • Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled • Consider the changes in knowledge over time as tools and technologies have developed • Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations and to evaluate claims in secondary sources • Consider the changes in knowledge over time as tools and technologies have developed **Applying and innovating** • Contribute to care for self, others, community, and world through individual or collaborative approaches • Transfer and apply learning to new situations		

- Generate and introduce new or refined ideas when problem solving
- Contribute to finding solutions to problems at a local and/or global level through inquiry

Communicating

- Formulate physical or mental theoretical models to describe a phenomenon
- Communicate scientific ideas, claims, information, and perhaps a suggest course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language conventions, and representations
- Express and reflect on a variety of experiences, perspectives, and worldviews through **place**

Content

- **transformation of energy**
- local and global **impacts of energy transformations** from technologies

Big Ideas—Elaborations

- **Energy**
  - *Where does energy come from and what happens to it?*
  - *How does energy in the form of radiation affect living things?*
  - *How do energy transformations affect the environment?*

Content—Elaborations

- **transformation of energy**
  - *transfer of energy in closed and open systems*
  - heat ($Q = mc\Delta T$)

• **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output		
Activity 4: The Impact of Transportation		
Curricular Competencies **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting** • Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods and those of others **Processing and analyzing data and information** • Experience and interpret the local environment • Apply **First Peoples perspectives and knowledge**, other **ways of knowing**, and local knowledge as sources of information • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence • Analyze cause-and-effect relationships **Evaluating** • Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled • Demonstrate an awareness of assumptions, question information given, and identify	***Curricular Competencies*** **Reasoning and modelling** • **Estimate reasonably** and demonstrate **fluent, flexible, and strategic thinking** about number • **Model** with mathematics in **situational contexts** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Big Ideas—Elaborations*** • **situations:** – Why are trends important? ***Curricular Competencies—Elaborations*** • **Model:** – use mathematical concepts and tools to solve problems and make decisions (e.g., in real-life and/or abstract scenarios) • **situational contexts:** – including real-life scenarios and open-ended challenges that connect mathematics with everyday life	***Curricular Competencies*** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • Represent mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom **Connecting and reflecting** • **Incorporate** First Peoples worldviews, perspectives, **knowledge**, and **practices** to make connections with mathematical concepts ***Big Ideas—Elaborations*** • **Proportional reasoning:** – reasoning about comparisons of relative size or scale instead of numerical difference • **measuring:** – What measurement is the most important for examining 3D objects? – Why is it important to understand the components of a formula? • **Representing and analyzing data:** – How can investigating trends help us make predictions?

bias in their own work and secondary sources
- Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations and to evaluate claims in secondary sources
- Consider social, ethical, and environmental implications of the findings from their own and others' investigations

Applying and innovating

- Contribute to care for self, others, community, and world through individual or collaborative approaches
- Transfer and apply learning to new situations
- Generate and introduce new or refined ideas when problem solving
- Contribute to finding solutions to problems at a local and/or global level through inquiry
- Consider the role of scientists in innovation

Communicating

- Communicate scientific ideas, claims, information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations
- Express and reflect on a variety of experiences, perspectives, and worldviews through **place**

Content

- **transformation of energy**
- local and global **impacts of energy transformations** from technologies

- **flexible and strategic approaches:**
  - deciding which mathematical tools to use to solve a problem
- **solve problems:**
  - interpret a situation to identify a problem
  - apply mathematics to solve the problem
  - analyze and evaluate the solution in terms of the initial context
- **discussions:**
  - partner talks, small-group discussions, teacher-student conferences
- **Reflect:**
  - Share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions

Curricular Competencies—Elaborations

- **Estimate reasonably:**
  - be able to defend the reasonableness of an estimated value or a solution to a problem or equation (e.g., measurement calculations, angle-size reasonableness, primary trigonometric ratio calculations)
- **situational contexts:**
  - including real-life scenarios and open-ended challenges that connect mathematics with everyday life
- **flexible and strategic approaches:**
  - deciding which mathematical tools to use to solve a problem
- **Explain and justify:**
  - use mathematical arguments to convince
- **Connect mathematical concepts: reasoning:**
  - to develop a sense of how mathematics helps us understand ourselves and the world around us (e.g., daily activities, local and traditional practices, popular media and news events, social justice, cross-curricular integration)

Big Ideas—Elaborations • **Energy** – *Where does energy come from and what happens to it?* – *How does energy in the form of radiation affect living things?* – *How do energy transformations affect the environment?* ***Curricular Competencies—Elaborations*** • **place:** Place is any environment, locality, or context with which people interact to learn, create memory, reflect on history, connect with culture, and establish identity. The connection between people and place is foundational to First Peoples perspectives. ***Content—Elaborations*** • **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output		
Activity 5: How Much Carbon Is in That Tree?		
Curricular Competencies **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest • Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting**	***Curricular Competencies*** **Reasoning and modelling** • **Model** with mathematics in **situational contexts** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom	***Curricular Competencies*** **Reasoning and modelling** • **Model** with mathematics in **situation contexts** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom

- Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)
- Select and use appropriate equipment, including digital technologies, to systematically and accurately collect and record data
- Ensure that safety and ethical guidelines are followed in their investigations

Processing and analyzing data and information

- Experience and interpret the local environment
- Use knowledge of scientific concepts to draw conclusions that are consistent with evidence
- Analyze cause-and-effect relationships

Evaluating

- Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions
- Connect scientific explorations to careers in science

Applying and innovating

- Contribute to care for self, others, community, and world through individual or collaborative approaches
- Transfer and apply learning to new situations
- Contribute to finding solutions to problems at a local and/or global level through inquiry

Content

- primary **trigonometric** ratios

Big Ideas—Elaborations

- **connections:**
  - how can visualization support algebraic thinking?
- **Indirect measurement:**
  - Using measurable values to calculate immeasurable values (e.g., calculating the height of a tree using distance from the tree and the angle to the top of the tree)
  - When might we need to measure a length or angle indirectly?

Curricular Competencies—Elaborations

- **Estimate reasonably:**
  - be able to defend the reasonableness of an estimated value or a solution to a problem or equation (e.g., estimating the solution for a system of equations from a graph)
- **Model:**
  - take a complex, essentially non-mathematical scenario and figure out what mathematical concepts and tools are needed to make sense of it
- **situational contexts:**
  - including real-life scenarios and open-ended challenges that connect mathematics with everyday life
- **flexible and strategic approaches:**
  - deciding which mathematical tools to use to solve a problem

Content

- **Primary trigonometric ratios**
- **Surface area and volume**

Big Ideas—Elaborations

- **measuring:**
  - What measurement is the most important for examining 3D objects?
  - Why is it important to understand the components of a formula?

Curricular Competencies—Elaborations

- **analyze**
  - examine the structure of and connections between mathematical ideas (e.g., angle relations, primary trigonometric ratios, measurement calculations)
- **situational contexts:**
  - including real-life scenarios and open-ended challenges that connect mathematics with everyday life
- **Think creatively:**
  - by being open to trying different strategies
- **flexible and strategic approaches:**
  - deciding which mathematical tools to use to solve a problem

Content—Elaborations

- **primary trigonometric ratios:**
  - single right-angle triangles; sine, cosine, and tangent
- **conversions:**
  - using tools and appropriate units to measure with accuracy

• Consider the role of scientists in innovation **Communicating** • Communicate scientific ideas, claims, information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations ****Note:** This activity has strong MATH links.	• **discussions:** – partner talks, small-group discussions, teacher-student conferences • **Reflect:** – share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions ***Content—Elaborations*** • **trigonometric:** – right-triangle problems: determining missing sides and/or angles using trigonometric ratios and the Pythagorean theorem – contexts involving direct and indirect measurement	• **surface area and volume:** – contextualize problems involving 3D shapes
Activity 6: When Does It Make Sense to Switch?		
Curricular Competencies **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest • Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting** • Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)	***Curricular Competencies*** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Content*** • **functions and relations**: connection data, graphs, and situations • **linear functions:** slope and equations of lines • **systems** of linear equations	***Curricular Competencies*** **Reasoning and modelling** • **Model** with mathematics in **situation contexts** **Communicating and representing** • **Explain and justify** mathematical ideas and **decisions** in **many ways** • **Represent** mathematical ideas in concrete, pictorial, and symbolic forms • Use mathematical vocabulary and language to contribute to **discussions** in the classroom ***Content*** • create, interpret, and critique **graphs**

Processing and analyzing data and information

- Seek and analyze patterns, trends, and connections in data, including describing relationships between variables (dependent and independent) and identifying inconsistencies
- Use knowledge of scientific concepts to draw conclusions that are consistent with evidence

Evaluating

- Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and secondary sources
- Consider the changes in knowledge over time as tools and technologies have developed
- Connect scientific explorations to careers in science
- Consider social, ethical, and environmental implications of the finding from their own and others' investigations

Applying and innovating

- Transfer and apply learning to new situations
- Generate and introduce new or refined ideas when problem solving
- Contribute to finding solutions to problems at a local and/or global level through inquiry
- Consider the role of scientists in innovation

Communicating

- Communicate scientific ideas, claims, information, and perhaps a suggested course of action, for a specific purpose and audience,

Big Ideas—Elaborations

- **relations:**
  - How can we tell if a relation in linear?
  - How can we use rate of change to make predictions?
- **situations:**
  - Why are trends important?

Curricular Competencies—Elaborations

- **Estimate reasonably:**
  - Be able to defend the reasonableness of an estimated value or a solution to a problem or equation (e.g., estimating the solution for a system of equations from a graph)
- **situational contexts:**
  - including real-life scenarios and open-ended challenges that connect mathematics with everyday life
- **flexible and strategic approaches:**
  - deciding which mathematical tools to use to solve a problem
- **solve problems:**
  - interpret a situation to identify a problem
  - apply mathematics to solve the problem
  - analyze and evaluate the solution in terms of the initial context
- **decisions:**
  - Have students explore which of two scenarios they would choose and then defend their choice
- **discussions:**

Big Ideas—Elaborations

- **measuring:**
  - What measurement is the most important for examining 3D objects?
  - Why is it important to understand the components of a formula?
- **Representing and analyzing data:**
  - How can investigating trends help us make predictions?

Curricular Competencies—Elaborations

- **situational contexts:**
  - including real-life scenarios and open-ended challenges that connect mathematics with everyday life
- **flexible and strategic approaches:**
  - deciding which mathematical tools to use to solve a problem
- **Explain and justify:**
  - use mathematical arguments to convince
- **decisions:**
  - Have students explore which of two scenarios they would choose and then defend their choice
- **Connect mathematical concepts: reasoning:**
  - to develop a sense of how mathematics helps us understand ourselves and the world around us (e.g., daily activities, local and traditional practices, popular media and news events, social justice, cross-curricular integration)

constructing evidence-based arguments and using appropriate scientific language, conventions, and representations ***Content*** • **transformation of energy** • local and global **impacts of energy transformations** from technologies ***Big Ideas—Elaborations*** • **Energy** – *Where does energy come from and what happens to it?* – *How does energy in the form of radiation affect living things?* – *How do energy transformations affect the environment?* ***Content—Elaborations*** • **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output	– partner talks, small-group discussions, teacher-student conferences • **Reflect:** – Share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions ***Content—Elaborations*** • **functions and relations:** – connecting graphs and context – understanding the meaning of a relation • **systems:** – solving graphically	
Design Challenge: Climate in a Container		
Curricular Competencies **Questioning and predicting** • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest • Make observations aimed at identifying their own questions, including increasingly complex ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes **Planning and conducting** • Select and use appropriate equipment, including digital	***Curricular Competencies*** **Understanding and solving** • Develop, demonstrate, and apply mathematical understanding through play, story, inquiry, and problem solving ***Big Ideas—Elaborations*** • **situations:** – Why are trends important?	***Curricular Competencies*** **Understanding and solving** • Develop, demonstrate, and apply conceptual understanding of mathematical ideas through play, story, **inquiry**, and problem solving

technologies, to systematically and accurately collect and record data • Ensure that safety and ethical guidelines are followed in their investigations **Processing and analyzing data and information** • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence **Evaluating** • Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions • Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled • Connect scientific explorations to careers in science **Applying and innovating** • Transfer and apply learning to new situations • Contribute to finding solutions to problems at a local and/or global level through inquiry • Consider the role of scientists in innovation **Communicating** • Formulate physical or mental theoretical models to describe a phenomenon ***Content*** • **transformation of energy** • local and global **impacts of energy transformations** from technologies	***Curricular Competencies—Elaborations*** • **discussions:** – partner talks, small-group discussions, teacher-student conferences	

Big Ideas—Elaborations • **Energy** – *Where does energy come from and what happens to it?* – *How does energy in the form of radiation affect living things?* – *How do energy transformations affect the environment?* ***Content—Elaborations*** • **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output		

Evidence for Climate Change

Curriculum Connections

MANITOBA—Senior 2 Science

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

ELA = English Language Arts, MATH = Mathematics, TFS = Technology as a Foundation Skill Area, GLO = General Learning Outcome

Senior 2 Science Curriculum Connections (April 2001)	**Grade 10 Mathematics Curriculum Connections** (2014)
Activity 1: Carbon Dioxide	

Skills and Attitude Outcomes
 	
S2-0-1c Identify STSE issues which could be addressed. GLO: C4
 	
S2-0-2a Select and integrate information obtained from a variety of sources.
Include: print, electronic, specialists, other resource people. GLO: C2, C4, C6, TFS: 1.3.2, 4.3.4 (ELA: S2: 3.1.4, 3.2.4; Math: S1-B-1, 2)
 	
S2-0-3a State a testable hypothesis or prediction based on background data or on observed events. GLO: C2
 	
S2-0-4b Demonstrate work habits that ensure personal safety, the safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, WHMIS regulations, and emergency equipment. GLO: B3, B5, C1, C2
 	
S2-0-6a Interpret patterns and trends in data, and infer and explain relationships. GLO: C2, C5, TFS: 1.3.1, 3.3.1, (ELA: S2: 3.3.1: MATH: S2: AMA J-2, CMA D-5, F-2, H-4)
 	
Senior 2, Cluster 2: Chemistry
 	
S2-2-08 Experiment to classify acids and bases using their characteristic properties.
Include: pH, indicators, reactivity with metals. GLO: D3, E1
 	
S2-2-09 Discuss the occurrence of acids and bases in biological systems, industrial processes, and domestic applications.
Include: environmental, health, and safety issues. GLO: B2, B3, C1, C8
 	
S2-2-11 Describe the formation and the environmental
GLO: B5, C6, D2, D5
	Grade 10—Introduction to Applied and Pre-Calculus Mathematics
	
	Measurement
	
	10I.M.1. Solve problems that involve linear measurement, using
	
	▪ SI and imperial units of measure
	
	Relations and Functions
	
	10I.R.1. Interpret and explain the relationships among data, graphs, and contexts. [C, CN, R, T, V]
	
	10I.R.5. Determine the characteristics of the graphs of linear relations, including the
	
	▪ intercepts
	▪ slope
	▪ domain
	▪ range [CN, PS, R, T, V]
	  ▪ Determine the slope of the graph of a linear relation.
	  ▪ Determine the domain and range of the graph of a linear relation.

Senior 2, Cluster 4: Weather Dynamics S2-4-02 Outline factors influencing the Earth's radiation budget. Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude. GLO: D4, D5, E2, E3	
Activity 2: Climate Modelling	

Skills and Attitude Outcomes
 	
S2-0-1c Identify STSE issues which could be addressed. GLO: C4
 	
S2-0-3a State a testable hypothesis or prediction based on background data or on observed events. GLO: C2
 	
S2-0-4e Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. GLO: C2, C4, C7 (ELA: S2: 3.1.3, 5.2.1)
 	
S2-0-6a Interpret patterns and trends in data, and infer and explain relationships. GLO: C2, C5, TFS: 1.3.1, 3.3.1 (ELA: S2: 3.3.1: MATH: S2: AMA J-2, CMA D-5, F-2, H-4)
 	
Senior 2, Cluster 4: Weather Dynamics
 	
S2-4-02 Outline factors influencing the Earth's radiation budget. Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude. GLO: D4, D5, E2, E3
 	
S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities. Include: the use of technology in gathering and interpreting current and historical data. GLO: A1, A4, D5, E3
 	
S2-4-08 Discuss potential consequences of climate change. GLO: A1, A2, C5, C8
	Grade 10—Introduction to Applied and Pre-Calculus Mathematics
	
	Relations and Functions
	
	10I.R.1. Interpret and explain the relationships among data, graphs, and contexts. [C, CN, R, T, V]
	
	10I.R.3. Demonstrate an understanding of slope with respect to
	▪ rise and run
	▪ line segments and lines
	▪ rate of change
	▪ parallel lines
	▪ perpendicular lines [PS, R, V]
	  ▪ Explain, using examples, slope as a rate of change.
	  ▪ Determine the slope of a line segment by measuring or calculating the rise and run.

Activity 3: A Warming World	
Skills and Attitude Outcomes S2-0-3c Plan an experiment to answer a specific scientific question. Include: materials, variables, controls, methods, safety considerations. GLO: C1, C2 S2-0-4b Demonstrate work habits that ensure personal safety, the safety of others, as well as consideration for the environment. Include: knowledge and use of relevant safety precautions, WHMIS regulations, and emergency equipment. GLO: B3, B5, C1, C2 S2-0-4e Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. GLO: C2, C4, C7 (ELA: S2: 3.1.3, 5.2.1)	***Grade 10 Essential Mathematics—Half Course I*** ***Measurement*** 10E1.M.1. Demonstrate an understanding of the Système International (SI) by describing relationships of the units for length, area, volume, capacity, and mass. [C, CN, ME, V] It is intended that this learning outcome be limited to the base units and the prefixes milli, centi, deci, deca, hecto, and kilo.

S2-0-5b Estimate and measure accurately using Système International (SI) and other standard units. Include : SI conversions. GLO: C2 (MATH S2-AMA: H-2, CMA: D-1) S2-0-6a Interpret patterns and trends in data, and infer and explain relationships. GLO: C2, C5, TFS: 1.3.1, 3.3.1 (ELA: S2: 3.3.1: MATH: S2: AMA J-2, CMA D-5, F-2, H-4) ***Senior 2, Cluster 4: Weather Dynamics*** S2-4-01 Illustrate the composition and organization of the hydrosphere and the atmosphere. Include: salt water, fresh water, polar ice caps/glaciers, troposphere, stratosphere. GLO: D5, E2 S2-4-02 Outline factors influencing the Earth's radiation budget. Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude. GLO: D4, D5, E2, E3 S2-4-03 Explain effects of heat transfer within the atmosphere and hydrosphere on the development and movement of wind and ocean currents. Include: Coriolis effect/convection, prevailing westerlies, jet streams, El Niño. GLO: A2, D5, E2, E4 S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities. Include: the use of technology in gathering and interpreting current and historical data. GLO: A1, A4, D5, E3 S2-4-08 Discuss potential consequences of climate change. GLO: A1, A2, C5, C8	
Activity 4: The Impact of Transportation	
Skills and Attitude Outcomes S2-0-1c Identify STSE issues which could be addressed. GLO: C4 S2-0-4e Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. GLO: C2, C4, C7 (ELA: S2: 3.1.3, 5.2.1) ***Senior 2, Cluster 2: Chemistry in Action*** S2-2-12 Investigate technologies that are used to reduce emissions of potential air pollutants. GLO: A5, B5, C8, E2 ***Senior 2, Cluster 4: Weather Dynamics*** S2-4-02 Outline factors influencing the Earth's radiation budget. Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude. GLO: D4, D5, E2, E3 S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities.	***Grade 10—Introduction to Applied and Pre-Calculus Mathematics*** ***Measurement*** 10I.M.1. Solve problems that involve linear measurement, using ▪ SI and imperial units of measure

Include: the use of technology in gathering and interpreting current and historical data. GLO: A1, A4, D5, E3	
Activity 5: How Much Carbon Is in That Tree?	

Skills and Attitude Outcomes
 	
S2-0-4b Demonstrate work habits that ensure personal safety, the safety of others, as well as consideration for the environment.
Include: knowledge and use of relevant safety precautions, WHMIS regulations, and emergency equipment. GLO: B3, B5, C1, C2
 	
S2-0-4e Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. GLO: C2, C4, C7 (ELA: S2: 3.1.3, 5.2.1)
 	
S2-0-5b Estimate and measure accurately using Système International (SI) and other standard units.
Include: SI conversions. GLO: C2 (MATH S2-AMA: H-2, CMA: D-1)
 	
Senior 2, Cluster 4: Weather Dynamics
 	
S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities.
Include: the use of technology in gathering and interpreting current and historical data. GLO: A1, A4, D5, E3
	Grade 10—Introduction to Applied and Pre-Calculus Mathematics
	
	Measurement
	
	10I.M.3. Solve problems, using SI and imperial units, that involve the surface area and volume of 3-D objects, including
	▪ right cones
	▪ right cylinders
	▪ right prisms
	▪ right pyramids
	▪ spheres [CN, PS, R, T, V]
	  ▪ Sketch a diagram to represent a problem that involves surface area or volume.
	  ▪ Solve a contextual problem that involves surface area or volume, given a diagram of a composite 3-D object.
	
	Grade 10 Essential Mathematics—Half Course 2
	
	Trigonometry
	
	10E2.TG.2. Demonstrate an understanding of primary trigonometric ratios (sine, cosine, tangent) by
	▪ applying similarity to right triangles
	▪ generalizing patterns from similar right triangles
	▪ solving problems [CN, PS, R, T, V]
	  ▪ Solve a contextual problem that involves right triangles, using the primary trigonometric ratios.
	
	10E2.TG.3. Solve problems that require the manipulation and application of formulas related to
	▪ the Pythagorean theorem

	▪ primary trigonometric ratios [C, CN, ME, PS, R]
	  ▪ Solve a contextual problem that involves the application of a formula that does require manipulation.
	  ▪ Describe, using examples, how a given formula is used in a trade or an occupation.
	
	Grade 10—Introduction to Applied and Pre-Calculus Mathematics
	
	Measurement
	
	10I.M.1. Solve problems that involve linear measurement, using
	▪ SI and imperial units of measure
	▪ estimation strategies
	▪ measurement strategies [ME, PS, V]
	  ▪ Solve a contextual problem that involves linear measure, using instruments such as rulers, tape measures, trundel wheels, micrometers, or calipers.
	
	10I.M.4. Develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles. [C, CN, PS, R, T, V]

Activity 6: When Does It Make Sense to Switch?	
Skills and Attitude Outcomes S2-0-4e Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. GLO: C2, C4, C7 (ELA: S2: 3.1.3, 5.2.1) ***Senior 2, Cluster 2: Chemistry in Action*** S2-2-12 Investigate technologies that are used to reduce emissions of potential air pollutants. GLO: A5, B5, C8, E2 ***Senior 2, Cluster 4: Weather Dynamics*** S2-4-02 Outline factors influencing the Earth's radiation budget. Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude. GLO: D4, D5, E2, E3	***Grade 10 Essential Mathematics—Half Course II*** ***Consumer Decisions*** 10E2.C.1. Solve problems that involve unit pricing and currency exchange, using proportional reasoning. [CN, ME, PS, R] ▪ Determine or compare the unit price of two or more items. ▪ Solve problems that involve determining the best buy, and explain the choice in terms of the cost as well as other factors, such as quality and quantity.

S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities.
Include: the use of technology in gathering and interpreting current and historical data. GLO: A1, A4, D5, E3
	Grade 10—Introduction to Applied and Pre-Calculus Mathematics
	Relations and Functions
	10I.R.1. Interpret and explain the relationships among data, graphs, and contexts. [C, CN, R, T, V]
	10I.R.3. Demonstrate an understanding of slope with respect to
	▪ rise and run
	▪ line segments and lines
	▪ rate of change
	▪ parallel lines
	▪ perpendicular lines [PS, R, V]
	  ▪ Explain, using examples, slope as a rate of change.
	  ▪ Determine the slope of a line segment by measuring or calculating the rise and run.
	10I.R.9. Solve problems that involve systems of linear equations in two variables, graphically and algebraically. [CN, PS, R, T, V]
	▪ Model a situation, using a system of linear equations.
	▪ Solve a contextual problem that involves a system of linear equations, with or without technology.

Design Challenge: Climate in a Container	
Skills and Attitude Outcomes S2-0-1c Identify STSE issues which could be addressed. GLO: C4 S2-0-2a Select and integrate information obtained from a variety of sources. Include: print, electronic, specialists, other resource people. GLO: C2, C4, C6, TFS: 1.3.2, 4.3.4 (ELA: S2: 3.1.4, 3.2.4; Math: S1-B-1, 2) S2-0-3a State a testable hypothesis or prediction based on background data or on observed events. GLO: C2 S2-0-3c Plan an experiment to answer a specific scientific question. Include: materials, variables, controls, methods, safety considerations. GLO: C1, C2	

S2-0-4b Demonstrate work habits that ensure personal safety, the safety of others, as well as consideration for the environment. Include: knowledge and use of relevant safety precautions, WHMIS regulations, and emergency equipment. GLO: B3, B5, C1, C2 S2-0-4e Work cooperatively with group members to carry out a plan, and troubleshoot problems as they arise. GLO: C2, C4, C7 (ELA: S2: 3.1.3, 5.2.1) ***Senior 2, Cluster 4: Weather Dynamics*** S2-4-02 Outline factors influencing the Earth's radiation budget. Include: solar radiation, cloud cover, surface reflectance (albedo), absorption, latitude. GLO: D4, D5, E2, E3 S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities. Include: the use of technology in gathering and interpreting current and historical data. GLO: A1, A4, D5, E3	

Evidence for Climate Change

Curriculum Connections

NEW BRUNSWICK—Science, Grade 10

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

* Further curriculum connections can be made to Introduction to Environmental Science 120, Physical Geography 110, Physics 11, and Chemistry 11, but that is beyond the scope of this particular chart.

Science, Grade 10 Curriculum Connections (Atlantic Canada Science Curriculum, 2002)	**Number, Relations and Functions 10 and Geometry, Measurement and Finance 10 Curriculum Connections** (Department of Education of New Brunswick, 2011)
Activity 1: Carbon Dioxide	
Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 114-6 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies 115-2 illustrate how science attempts to explain natural phenomena ***Skills*** ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues ***Performing and Recording*** 213-2 carry out procedures controlling variables and adapting or extending procedures where required 213-3 use instruments effectively and accurately for collecting data 213-6 use library and electronic research tools to collect information on a given topic 213-7 select and integrate information from various print and electronic sources or from several parts of same source	***Number, Relations and Functions 10*** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. SCO RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V]

Analysing and Interpreting 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots 214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion	
Activity 2: Climate Modelling	
Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 115-6 explain how scientific knowledge evolves as new evidence comes to light ***Relationships between Science and Technology*** 116-1 identify examples where scientific understanding was enhanced or revised as a result of the invention of a technology ***Skills*** ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues ***Analysing and Interpreting*** 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots 214-10 identify and explain sources of error and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty 214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion ***Communication and Teamwork*** 215-5 develop, present, and defend a position or course of action, based on findings ***Knowledge*** 331-2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents	***Number, Relations and Functions 10*** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. SCO RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V]

Activity 3: A Warming World	
Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 115-2 illustrate how science attempts to explain natural phenomena ***Skills*** ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues ***Performing and Recording*** 213-3 use instruments effectively and accurately for collecting data ***Analysing and Interpreting*** 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots 214-10 identify and explain sources of error and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty 214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion ***Knowledge*** 331-1 describe and explain heat transfer within the water cycle 331-2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents 331-3 describe how the hydrosphere and atmosphere act as heat sinks within the water cycle	***Number, Relations and Functions 10*** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. SCO RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V]
Activity 4: The Impact of Transportation	
Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 114-6 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies ***Social and Environmental Contexts of Science and Technology*** 117-6 analyse why scientific and technological activities take place in a variety of individual and group settings	**Number, Relations and Functions 10** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. SCO RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V]

Skills ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues ***Performing and Recording*** 213-6 use library and electronic research tools to collect information on a given topic 213-7 select and integrate information from various print and electronic sources or from several parts of same source ***Analysing and Interpreting*** 214-10 identify and explain sources of error and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty 214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion ***Communication and Teamwork*** 215-5 develop, present, and defend a position or course of action, based on findings	
Activity 5: How Much Carbon Is in That Tree?	
Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 115-2 illustrate how science attempts to explain natural phenomena ***Skills*** ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues ***Performing and Recording*** 213-3 use instruments effectively and accurately for collecting data ***Analysing and Interpreting*** 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots	**Number, Relations and Functions 10** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. SCO RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] **Geometry, Measurement and Finance 10** SCO G3 Demonstrate an understanding of primary trigonometric ratios (sine, cosine, tangent) by: applying similarity to right triangles, generalizing patterns from similar right triangles, applying the primary trigonometric ratios, and solving problems. [CN, PS, R, T, V]

Physical Science: Motion ***Skills*** ***Initiating and Planning*** 212-9 develop appropriate sampling procedures 213-3 use instruments for collecting data effectively and accurately ***Analysing and Interpreting*** 214-10 identify and explain sources of errors and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty	
Activity 6: When Does It Make Sense to Switch?	
Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 114-6 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies 115-2 illustrate how science attempts to explain natural phenomena ***Skills*** ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues ***Analysing and Interpreting*** 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots	**Number, Relations and Functions 10** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. SCO RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V]
Design Challenge: Climate in a Container	
Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 114-6 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies 115-2 illustrate how science attempts to explain natural phenomena ***Skills*** ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues	

Performing and Recording 213-3 use instruments effectively and accurately for collecting data 213-6 use library and electronic research tools to collect information on a given topic 213-7 select and integrate information from various print and electronic sources or from several parts of same source ***Analysing and Interpreting*** 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots 214-10 identify and explain sources of error and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty **Physical Science: Motion** ***STSE*** ***Social and Environmental Contexts of Science and Technology*** 118-3 evaluate the design of a technology and the way it functions on the basis of identified criteria such as safety, cost, availability, and impact on everyday life and the environment	

Evidence for Climate Change

Curriculum Connections

NEWFOUNDLAND AND LABRADOR—Science 1206

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

* This compilation could be used to support outcomes in Environmental Science (ES3205), Unit 5: The Atmosphere and the Environment

Science 1206 Curriculum Connections (September 2018)	Mathematics 1201 Curriculum Connections (2015)
Activity 1: Carbon Dioxide	
Initiating and Planning 1.0 identify questions to investigate that arise from practical problems and issues [GCO 2] 3.0 state a prediction and a hypothesis based on available evidence and background information [GCO 2] 6.0 evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making [GCO 2] ***Performing and Recording*** 11.0 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data [GCO 2] 14.0 select and use apparatus and materials safely [GCO 2] 15.0 demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for handling and disposing of lab materials [GCO 2] ***Analyzing and Interpreting*** 17.0 compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots [GCO 2] 18.0 interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables [GCO 2]	**Relations and Functions** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] RF4 Describe and represent linear relations, using: • words • ordered pairs • table of values • graphs • equations. [C, R, V] RF5 Determine the characteristics of the graphs of linear relations, including the: • intercepts • rate of change • domain • range. [CN, PS, R, V] **Linear Relations** ***Relations and Functions*** RF3 Demonstrate an understanding of slope with respect to:

21.0 identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty [GCO 2] 22.0 provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion [GCO 2] 24.0 identify new questions or problems that arise from what was learned [GCO 2] ***Communication and Teamwork*** 27.0 identify multiple perspectives that influence a science-related decision or issue [GCO 2] 28.0 develop, present, and defend a position or course of action, based on findings [GCO 2] ***Climate Change*** 39.0 explain how scientific knowledge evolves as new evidence comes to light [GCO 1] ***Chemical Reactions*** 46.0 classify substances as acids, bases, or salts, based on their characteristics, name, and formula [GCO 3]	• rise and run • line segments and lines • rate of change • parallel lines • perpendicular lines. [PS, R,V] RF6 Relate linear relations expressed in: • slope-intercept form $y = mx + b$ • general form $Ax + By + C = 0$ • slope-point form $y - y_1 = m(x - x_1)$ to their graphs. [CN, R, T, V]
Activity 2: Climate Modelling	
Initiating and Planning 1.0 identify questions to investigate that arise from practical problems and issues [GCO 2] 3.0 state a prediction and a hypothesis based on available evidence and background information [GCO 2] ***Performing and Recording*** 10.0 estimate quantities [GCO 2] 11.0 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data [GCO 2] 12.0 use library and electronic research tools to collect information on a given topic [GCO 2] ***Analyzing and Interpreting*** 18.0 interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables [GCO 2] 21.0 identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty [GCO 2]	**Relations and Functions** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] RF4 Describe and represent linear relations, using: • words • ordered pairs • table of values • graphs • equations. [C, R, V] RF5 Determine the characteristics of the graphs of linear relations, including the: • intercepts • rate of change • domain • range. [CN, PS, R, V]

22.0 provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion [GCO 2] ***Communication and Teamwork*** 26.0 select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, plans, and results [GCO 2] 27.0 identify multiple perspectives that influence a science-related decision or issue [GCO 2] 28.0 develop, present, and defend a position or course of action, based on findings [GCO 2] ***Climate Change*** 39.0 explain how scientific knowledge evolves as new evidence comes to light [GCO 1] ***Science Disciplines*** 40.0 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies [GCO 1]	**Linear Relations** ***Relations and Functions*** RF3 Demonstrate an understanding of slope with respect to: • rise and run • line segments and lines • rate of change • parallel lines • perpendicular lines. [PS, R,V] RF6 Relate linear relations expressed in: • slope-intercept form $y = mx + b$ • general form $Ax + By + C = 0$ • slope-point form $y - y_1 = m(x - x_1)$ to their graphs. [CN, R, T, V]
Activity 3: A Warming World	
Initiating and Planning 1.0 identify questions to investigate that arise from practical problems and issues [GCO 2] 3.0 state a prediction and a hypothesis based on available evidence and background information [GCO 2] 6.0 evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making [GCO 2] ***Performing and Recording*** 8.0 carry out procedures controlling the major variables and adapting or extending procedures where required [GCO 2] 9.0 use instruments effectively and accurately for collecting data [GCO 2] 11.0 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data [GCO 2] 12.0 use library and electronic research tools to collect information on a given topic [GCO 2] 14.0 select and use apparatus and materials safely [GCO 2]	**Relations and Functions** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] RF4 Describe and represent linear relations, using: • words • ordered pairs • table of values • graphs • equations. [C, R, V] RF5 Determine the characteristics of the graphs of linear relations, including the: • intercepts • rate of change • domain • range. [CN, PS, R, V]

15.0 demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for handling and disposing of lab materials [GCO 2] ***Analyzing and Interpreting*** 18.0 interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables [GCO 2] 20.0 evaluate the relevance, reliability, and adequacy of data and data collection methods [GCO 2] 21.0 identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty [GCO 2] 22.0 provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion [GCO 2] 24.0 identify new questions or problems that arise from what was learned [GCO 2] ***Communication and Teamwork*** 27.0 identify multiple perspectives that influence a science-related decision or issue [GCO 2] 28.0 develop, present, and defend a position or course of action, based on findings [GCO 2] ***Heat Transfer and Earth's Spheres*** 30.0 describe how the hydrosphere and atmosphere act as heat sinks [GCO 3] ***Climate Change*** 39.0 explain how scientific knowledge evolves as new evidence comes to light [GCO 1]	**Linear Relations** ***Relations and Functions*** RF3 Demonstrate an understanding of slope with respect to: • rise and run • line segments and lines • rate of change • parallel lines • perpendicular lines. [PS, R,V]
Activity 4: The Impact of Transportation	
Initiating and Planning 1.0 identify questions to investigate that arise from practical problems and issues [GCO 2] ***Performing and Recording*** 11.0 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data [GCO 2] 12.0 use library and electronic research tools to collect information on a given topic [GCO 2] 13.0 select and integrate information from various print and electronic sources or from several parts of the same source [GCO 2]	**Relations and Functions** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] RF4 Describe and represent linear relations, using: • words • ordered pairs • table of values • graphs • equations. [C, R, V]

Analyzing and Interpreting 17.0 compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots [GCO 2] 21.0 identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty [GCO 2] 22.0 provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion [GCO 2] ***Communication and Teamwork*** 27.0 identify multiple perspectives that influence a science-related decision or issue [GCO 2] 28.0 develop, present, and defend a position or course of action, based on findings [GCO 2] ***Science Disciplines*** 40.0 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies [GCO 1] ***Climate Change*** 39.0 explain how scientific knowledge evolves as new evidence comes to light [GCO 1]	RF5 Determine the characteristics of the graphs of linear relations, including the: • intercepts • rate of change • domain • range. [CN, PS, R, V] **Linear Relations** ***Relations and Functions*** RF3 Demonstrate an understanding of slope with respect to: • rise and run • line segments and lines • rate of change • parallel lines • perpendicular lines. [PS, R,V]
Activity 5: How Much Carbon Is in That Tree?	
Initiating and Planning 1.0 identify questions to investigate that arise from practical problems and issues [GCO 2] 6.0 evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making [GCO 2] ***Performing and Recording*** 9.0 use instruments effectively and accurately for collecting data [GCO 2] 11.0 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data [GCO 2] 14.0 select and use apparatus and materials safely [GCO 2] ***Analyzing and Interpreting*** 17.0 compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots [GCO 2]	**Measurement** ***Measurement*** M1 Solve problems that involve linear measurement, using: • SI and imperial units of measure • estimation strategies • measurement strategies. [ME, PS, V] M3 Solve problems, using SI and imperial units, that involve the surface area and volume of 3-D objects, including: • right cones • right cylinders • right prisms • right pyramids • spheres. [CN, PS, R, V]

18.0 interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables [GCO 2] 21.0 identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty [GCO 2] 22.0 provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion [GCO 2] ***Communication and Teamwork*** 28.0 develop, present, and defend a position or course of action, based on findings [GCO 2] ***Climate Change*** ***Attitude*** Encourage students to have a sense of personal and shared responsibility for maintaining a sustainable environment. [GCO 4]	**Trigonometry** ***Measurement*** M4 Develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles. [C, CN, PS, R, T, V]
Activity 6: When Does It Make Sense to Switch?	
Initiating and Planning 1.0 identify questions to investigate that arise from practical problems and issues [GCO 2] ***Performing and Recording*** 11.0 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data [GCO 2] 12.0 use library and electronic research tools to collect information on a given topic [GCO 2] 13.0 select and integrate information from various print and electronic sources or from several parts of the same source [GCO 2] ***Analyzing and Interpreting*** 17.0 compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots [GCO 2] 18.0 interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables [GCO 2] 21.0 identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty [GCO 2] 22.0 provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion [GCO 2]	**Relations and Functions** ***Relations and Functions*** RF1 Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] RF4 Describe and represent linear relations, using: • words • ordered pairs • table of values • graphs • equations. [C, R, V] RF5 Determine the characteristics of the graphs of linear relations, including the: • intercepts • rate of change • domain • range. [CN, PS, R, V] **Linear Relations** ***Relations and Functions*** RF3 Demonstrate an understanding of slope with respect to: • rise and run

Communication and Teamwork 27.0 identify multiple perspectives that influence a science-related decision or issue [GCO 2] 28.0 develop, present, and defend a position or course of action, based on findings [GCO 2] ***Science Disciplines*** 40.0 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies [GCO 1] ***Climate Change*** 39.0 explain how scientific knowledge evolves as new evidence comes to light [GCO 1] ***Motion*** ***Motion Technologies*** 64.0 evaluate the design of a technology and the way it functions on the basis of identified criteria such as safety, cost, availability, and impact on everyday life and the environment [GCO 1] ***Attitude*** Encourage students to have a sense of personal and shared responsibility for maintaining a sustainable environment. [GCO 4]	• line segments and lines • rate of change • parallel lines • perpendicular lines. [PS, R,V] RF6 Relate linear relations expressed in: • slope-intercept form $y = mx + b$ • general form $Ax + By + C = 0$ • slope-point form $y - y_1 = m(x - x_1)$ to their graphs [CN, R, T, V] ***Systems of Linear Relations*** ***Relations and Functions*** RF9 Solve problems that involve systems of linear equations in two variables, graphically and algebraically. [CN, PS, R, T, V]
Design Challenge: Climate in a Container	
Initiating and Planning 1.0 identify questions to investigate that arise from practical problems and issues [GCO 2] 6.0 evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making [GCO 2] ***Performing and Recording*** 14.0 select and use apparatus and materials safely [GCO 2] 15.0 demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for handling and disposing of lab materials [GCO 2] ***Analyzing and Interpreting*** 17.0 compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots [GCO 2]	

22.0 provide a statement that addresses the problem or answers the question investigated in light of the link between data and the conclusion [GCO 2] 23.0 propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan [GCO 2] 25.0 communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others [GCO 2] ***Communication and Teamwork*** 27.0 identify multiple perspectives that influence a science-related decision or issue [GCO 2] 28.0 develop, present, and defend a position or course of action, based on findings [GCO 2] 29.0 work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise [GCO 2] ***Climate Change*** 39.0 explain how scientific knowledge evolves as new evidence comes to light [GCO 1]	

Evidence for Climate Change

Curriculum Connections

NOVA SCOTIA—Science 10

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

Mathematical Processes: Communication [C], Problem Solving [PS], Connections [CN], Mental Mathematics and Estimation [ME], Technology [T], Visualization [V], Reasoning [R]

Science 10 Curriculum Connections (2012)	**Mathematics at Work 10 Curriculum Connections** (August 2013)
Activity 1: Carbon Dioxide	
Physical Science: Chemical Reactions ***STSE*** 116-3, 117-7, 215-6, 116-5 investigate and collaborate to describe science and technology relationships and their functions 213-9, 117-5 investigate chemical reactions while applying WHMIS standards, using proper techniques for handling and disposing of materials ***Skills*** 212-8, 213-5 perform experiments, using appropriate instruments and procedures, to identify substances as acids, bases, and or salts, based on their characteristic properties **Earth and Space Science: Weather Dynamics** ***STSE*** ***Nature of Science and Technology*** 115-6 explain how scientific knowledge evolves as new evidence comes to light ***Attitudes*** ***Appreciation of Science*** 436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not	***Measurement*** **M03** Students will be expected to solve and verify problems that involve SI and imperial linear measurements, including decimal and fractional measurements. [CN, ME, PS, V]

Scientific Inquiry 443 use factual information and rational explanations when analyzing and evaluating ***Stewardship*** 446 have a sense of personal and shared responsibility for maintaining a sustainable environment 448 want to take action for maintaining a sustainable environment ***Safety*** 449 show concern for safety and accept the need for rules and regulations	
Activity 2: Climate Modelling	
Earth and Space Science: Weather Dynamics ***Knowledge*** 331-2 use weather data to describe and explain heat transfers in the hydrosphere and atmosphere, showing how these affect air and water currents **Life Science: Sustainability of Ecosystems** ***STSE*** 114-1 question and analyze how a paradigm shift in sustainability can change society's views 118-9, 215-4, 118-5 identify, investigate, and defend a course of action on a multiperspective social issue ***Skills*** 213-7, 215-1, 318-4 diagnose and report the ecosystem's response to short-term stress and long-term change 212-4, 214-3, 331-6 predict and analyze the impact of external factors on the sustainability of an ecosystem, using a variety of formats ***Earth and Space Science: Weather Dynamics*** ***STSE*** ***Nature of Science and Technology*** 114-6 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies 115-6 explain how scientific knowledge evolves as new evidence comes to light	***Measurement*** **M03** Students will be expected to solve and verify problems that involve SI and imperial linear measurements, including decimal and fractional measurements. [CN, ME, PS, V]

Attitudes ***Appreciation of Science*** 436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not ***Interest in Science*** 439 show a continuing and more informed curiosity and interest in science and science-related issues ***Scientific Inquiry*** 443 use factual information and rational explanations when analyzing and evaluating ***Collaboration*** 445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas ***Stewardship*** 446 have a sense of personal and shared responsibility for maintaining a sustainable environment 448 want to take action for maintaining a sustainable environment	
Activity 3: A Warming World	
Earth and Space Science: Weather Dynamics ***Knowledge*** 331-3 describe how the atmosphere and hydrosphere act as heat sinks in the water cycle 331-2 use weather data to describe and explain heat transfers in the hydrosphere and atmosphere, showing how these affect air and water currents ***STSE*** ***Nature of Science and Technology*** 115-6 explain how scientific knowledge evolves as new evidence comes to light ***Attitudes*** ***Appreciation of Science*** 436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not	***Measurement*** **M04** Students will be expected to solve problems that involve SI and imperial area measurements of regular, composite, and irregular 2-D shapes and 3-D objects, including decimal and fractional measurements, and verify the solutions. M04.11 Determine if a solution to a problem that involves an area measurement is reasonable.

Scientific Inquiry 443 use factual information and rational explanations when analyzing and evaluating 444 value the processes for drawing conclusions ***Collaboration*** 445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas ***Stewardship*** 446 have a sense of personal and shared responsibility for maintaining a sustainable environment 448 want to take action for maintaining a sustainable environment ***Safety*** 449 show concern for safety and accept the need for rules and regulations	
Activity 4: The Impact of Transportation	
Physical Science: Motion ***STSE*** 114-3, 115-4, 118-3 describe and evaluate the design and functions of motion technology 114-6, 117-8 identify and imagine questions that could be investigated using relevant research in science and technology 117-10 describe examples of Canadian contributions to science and technology in the area of motion **Life Science: Sustainability of Ecosystems** ***STSE*** 114-1 question and analyze how a paradigm shift in sustainability can change society's views 118-9, 215-4, 118-5 identify, investigate, and defend a course of action on a multiperspective social issue **Earth and Space Science: Weather Dynamics** ***STSE*** ***Nature of Science and Technology*** 114-6 relate personal activities and various scientific and technological endeavours to specific science disciplines and interdisciplinary studies 115-6 explain how scientific knowledge evolves as new evidence comes to light	***Measurement*** **M03** Students will be expected to solve and verify problems that involve SI and imperial linear measurements, including decimal and fractional measurements. [CN, ME, PS, V] M03.02 Estimate a linear measurement, using a referent. M03.05 Solve a linear measurement problem including perimeter, circumference, and length + width + height (used in shipping and air travel).

Attitudes ***Appreciation of Science*** 436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not ***Interest in Science*** 439 show a continuing and more informed curiosity and interest in science and science-related issues ***Collaboration*** 445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas ***Stewardship*** 446 have a sense of personal and shared responsibility for maintaining a sustainable environment 448 want to take action for maintaining a sustainable environment	
Activity 5: How Much Carbon Is in That Tree?	
Earth and Space Science: Weather Dynamics ***Knowledge*** 331-1, 214-3 using scientific theory, identify questions about, illustrate, and explain heat energy transfers that occur in the water cycle 331-3 describe how the atmosphere and hydrosphere act as heat sinks in the water cycle 331-2 use weather data to describe and explain heat transfers in the hydrosphere and atmosphere, showing how these affect air and water currents **Life Science: Sustainability of Ecosystems** ***STSE*** 114-1 question and analyze how a paradigm shift in sustainability can change society's views 118-9, 215-4, 118-5 identify, investigate, and defend a course of action on a multiperspective social issue 114-5, 116-1, 117-3, 118-1 identify and describe peer preview, Canadian research, and global projects where science and technology affect sustainable development	***Geometry*** G02.07 Solve a problem using the Pythagorean theorem. G04.05 Solve a contextual problem that involves right triangles, using the primary trigonometric ratios. G06.09 Solve a contextual problem that involves angles. ***Algebra*** A01.01 Solve a contextual problem that involves the application of a formula that does not require manipulation. ***Measurement*** **M01** Students will be expected to demonstrate an understanding of the International System of Units (SI) by • describing the relationships of the units for length, area, volume, capacity, mass, and temperature

Attitudes ***Appreciation of Science*** 436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not ***Interest in Science*** 441 consider further studies and careers in science- and technology-related fields ***Collaboration*** 445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas ***Stewardship*** 446 have a sense of personal and shared responsibility for maintaining a sustainable environment 448 want to take action for maintaining a sustainable environment	**M03** Students will be expected to solve and verify problems that involve SI and imperial linear measurements, including decimal and fractional measurements. [CN, ME, PS, V] M03.05 Solve a linear measurement problem including perimeter, circumference, and length + width + height (used in shipping and air travel). • solve problems that involve linear measure, using instruments such as rulers, calipers, or tape measures.
Activity 6: When Does It Make Sense to Switch?	
Earth and Space Science: Weather Dynamics ***Knowledge*** 331-2 use weather data to describe and explain heat transfers in the hydrosphere and atmosphere, showing how these affect air and water currents **Physical Science: Motion** ***STSE*** 114-3, 115-4, 118-3 describe and evaluate the design and functions of motion technology 114-6, 117-8 identify and imagine questions that could be investigated using relevant research in science and technology 117-10 describe examples of Canadian contributions to science and technology in the area of motion **Life Science: Sustainability of Ecosystems** ***STSE*** 114-1 question and analyze how a paradigm shift in sustainability can change society's views 118-9, 215-4, 118-5 identify, investigate, and defend a course of action on a multiperspective social issue	***Number*** N01.01 Compare the unit price of two or more given items. N01.02 Solve problems that involve determining the best buy, and explain the choice in terms of the cost as well as other factors, such a quality and quantity.

Earth and Space Science: Weather Dynamics ***STSE*** ***Nature of Science and Technology*** 115-6 explain how scientific knowledge evolves as new evidence comes to light ***Attitudes*** ***Appreciation of Science*** 436 value the role and contribution of science and technology in our understanding of phenomena that are directly observable and those that are not ***Scientific Inquiry*** 443 use factual information and rational explanations when analyzing and evaluating 444 value the processes for drawing conclusions ***Collaboration*** 445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas ***Stewardship*** 446 have a sense of personal and shared responsibility for maintaining a sustainable environment 448 want to take action for maintaining a sustainable environment	
Design Challenge: Climate in a Container	
Earth and Space Science: Weather Dynamics ***Skills*** 213-3, 213-6, 213-7 use weather instruments effectively and accurately for collecting local weather data and collect and integrate weather data from regional and national weather observational networks 214-10, 331-5, 212-1 identify questions and analyze meteorological data for a given time span and predict future weather conditions, using appropriate technologies ***Knowledge*** 331-1, 214-3 using scientific theory, identify questions about, illustrate, and explain heat energy transfers that occur in the water cycle 331-3 describe how the atmosphere and hydrosphere act as heat sinks in the water cycle	

331-2 use weather data to describe and explain heat transfers in the hydrosphere and atmosphere, showing how these affect air and water currents **Life Science: Sustainability of Ecosystems** ***STSE*** 118-9, 215-4, 118-5 identify, investigate, and defend a course of action on a multiperspective social issue ***Skills*** 212-4, 214-3, 331-6 predict and analyze the impact of external factors on the sustainability of an ecosystem, using a variety of formats 213-7, 215-1, 318-4 diagnose and report the ecosystem's response to short-term stress and long-term change **Earth and Space Science: Weather Dynamics** ***STSE*** ***Nature of Science and Technology*** 115-6 explain how scientific knowledge evolves as new evidence comes to light ***Attitudes*** ***Interest in Science*** 439 show a continuing and more informed curiosity and interest in science and science-related issues ***Scientific Inquiry*** 444 value the processes for drawing conclusions ***Collaboration*** 445 work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas ***Stewardship*** 446 have a sense of personal and shared responsibility for maintaining a sustainable environment 448 want to take action for maintaining a sustainable environment	

Grade 10: Evidence for Climate Change (Academic–SNC2D/MPM2D)

Curriculum Connections

ONTARIO - Earth and Space Science: Climate Change

IP = Initiating and Planning, PR = Performing and Recording, AI = Analysing and Interpreting, C = Communicating

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 1: Carbon Dioxide	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, pH paper) for particular inquiries [IP] – **A1.3** identify and locate print, electronic, and human sources that are relevant to research questions [IP] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] ***Earth and Space Science: Climate Change*** – **D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo*, *anthropogenic*, *atmosphere*, *cycles*, *heat sinks*, and *hydrosphere* [C] – **D2.3** analyse different sources of scientific data (e.g., lake cores, tree rings, fossils and preserved organisms, ice cores) for evidence of natural climate change and climate change influenced by human activity [PR, AI, C] – **D2.4** investigate a popular hypothesis on a cause-and-effect relationship having to do with climate change (e.g., the combustion of fossil fuels is responsible for rising global temperatures; the concentration of atmospheric CO_2 is responsible for rising global temperatures; global temperatures have been on the increase since the industrial revolution; the severity of cyclones, hurricanes, and tornadoes increases as atmospheric temperatures increase), using simulations and/or time-trend data that model climate profiles (e.g., data from Statistics Canada and Environment Canada) [PR, AI, C] – **D2.6** investigate, through laboratory inquiry or simulations, how water in its various states influences climate patterns (e.g., water bodies moderate climate, water vapour is a greenhouse gas, ice increases the albedo of Earth's surface) [PR, AI] – **D3.4** identify natural phenomena (e.g., plate tectonics, uplift and weathering, solar radiance, cosmic ray cycles) and human activities (e.g., forest fires, deforestation, the burning of fossil fuels, industrial emissions) known to affect climate, and describe the role of both in Canada's contribution to climate change – **D3.5** describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour) – **D3.6** describe how different carbon and nitrogen compounds (e.g., carbon dioxide, methane, nitrous oxide) influence the trapping of heat in the atmosphere and hydrosphere – **D3.7** describe, in general terms, the causes and effects of the anthropogenic greenhouse effect, the depletion of stratospheric and tropospheric ozone, and the formation of ground-level ozone and smog – **D3.8** identify and describe indicators of global climate change (e.g., changes in: glacial and polar ice, sea levels, wind patterns, global carbon budget assessments)	***Analytic Geometry*** *Using Linear Systems to Solve Problems* – solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 2: Climate Modelling	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.9** analyse the information gathered from research sources for reliability and bias [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., meteorologist, medical illustrator, geochemist, optical physicist) and the education and training necessary for these careers ***Earth and Space Science: Climate Change*** – **D1.1** analyse current and/or potential effects, both positive and negative, of climate change on human activity and natural systems (e.g., loss of habitat for Arctic mammals such as polar bears and loss of traditional lifestyles for Inuit as Arctic ice shrinks; famine as arable land is lost to desertification; an increase in water-borne disease and human resettlement as coastal lands are flooded; expansion of the growing season in some regions) [AI, C] – **D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo*, *anthropogenic*, *atmosphere*, *cycles*, *heat sinks*, and *hydrosphere* [C] – **D2.3** analyse different sources of scientific data (e.g., lake cores, tree rings, fossils and preserved organisms, ice cores) for evidence of natural climate change and climate change influenced by human activity [PR, AI, C] – **D2.4** investigate a popular hypothesis on a cause-and-effect relationship having to do with climate change (e.g., the combustion of fossil fuels is responsible for rising global temperatures; the concentration of atmospheric CO_2 is responsible for rising global temperatures; global temperatures have been on the increase since the industrial revolution; the severity of cyclones, hurricanes, and tornadoes increases as atmospheric temperatures increase), using simulations and/or time-trend data that model climate profiles (e.g., data from Statistics Canada and Environment Canada) [PR, AI, C] – **D2.9** compare different perspectives and/or biases evident in discussions of climate change in scientific and non-scientific media (e.g., with reference to knowledge, beliefs, and values) [AI, C] – **D3.4** identify natural phenomena (e.g., plate tectonics, uplift and weathering, solar radiance, cosmic ray cycles) and human activities (e.g., forest fires, deforestation, the burning of fossil fuels, industrial emissions) known to affect climate, and describe the role of both in Canada's contribution to climate change – **D3.5** describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour) – **D3.6** describe how different carbon and nitrogen compounds (e.g., carbon dioxide, methane, nitrous oxide) influence the trapping of heat in the atmosphere and hydrosphere – **D3.7** describe, in general terms, the causes and effects of the anthropogenic greenhouse effect, the depletion of stratospheric and tropospheric ozone, and the formation of ground-level ozone and smog – **D3.8** identify and describe indicators of global climate change (e.g., changes in: glacial and polar ice, sea levels, wind patterns, global carbon budget assessments)	***Analytic Geometry*** *Using Linear Systems to Solve Problems* – solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 3: A Warming World	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, pH paper) for particular inquiries [IP] – **A1.5** conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data [PR] – **A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.9** analyse the information gathered from research sources for reliability and bias [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] ***Earth and Space Science: Climate Change*** – **D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo*, *anthropogenic*, *atmosphere*, *cycles*, *heat sinks*, and *hydrosphere* [C] – **D2.3** analyse different sources of scientific data (e.g., lake cores, tree rings, fossils and preserved organisms, ice cores) for evidence of natural climate change and climate change influenced by human activity [PR, AI, C] – **D2.5** investigate, through laboratory inquiry or simulations, the effects of heat transfer within the hydrosphere and atmosphere [PR, AI] – **D2.6** investigate, through laboratory inquiry or simulations, how water in its various states influences climate patterns (e.g., water bodies moderate climate, water vapour is a greenhouse gas, ice increases the albedo of Earth's surface) [PR, AI] – **D3.2** describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents – **D3.8** identify and describe indicators of global climate change (e.g., changes in: glacial and polar ice, sea levels, wind patterns, global carbon budget assessments)	***Analytic Geometry*** *Using Linear Systems to Solve Problems* – solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 4: The Impact of Transportation	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.7** select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., websites for public health organizations, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A1.11** communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models) [C] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., meteorologist, medical illustrator, geochemist, optical physicist) and the education and training necessary for these careers ***Earth and Space Science: Climate Change*** – **D1.1** analyse current and/or potential effects, both positive and negative, of climate change on human activity and natural systems (e.g., loss of habitat for Arctic mammals such as polar bears and loss of traditional lifestyles for Inuit as Arctic ice shrinks; famine as arable land is lost to desertification; an increase in water-borne disease and human resettlement as coastal lands are flooded; expansion of the growing season in some regions) [AI, C] – **D1.2** assess, on the basis of research, the effectiveness of some current individual, regional, national, or international initiatives that address the issue of climate change (e.g., Drive Clean, ENERGY STAR, federal and provincial government rebates for retrofitting older buildings to be more energy efficient, carbon offset programs, community tree-planting programs, municipal recycling programs, Intergovernmental Panel on Climate Change [IPCC]), and propose a further course of action related to one of these initiatives [PR, AI, C] – **D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo*, *anthropogenic*, *atmosphere*, *cycles*, *heat sinks*, and *hydrosphere* [C] – **D2.9** compare different perspectives and/or biases evident in discussions of climate change in scientific and non-scientific media (e.g., with reference to knowledge, beliefs, and values) [AI, C] – **D3.4** identify natural phenomena (e.g., plate tectonics, uplift and weathering, solar radiance, cosmic ray cycles) and human activities (e.g., forest fires, deforestation, the burning of fossil fuels, industrial emissions) known to affect climate, and describe the role of both in Canada's contribution to climate change – **D3.5** describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour) – **D3.7** describe, in general terms, the causes and effects of the anthropogenic greenhouse effect, the depletion of stratospheric and tropospheric ozone, and the formation of ground-level ozone and smog	***Analytic Geometry*** *Using Linear Systems to Solve Problems* – solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 5: How Much Carbon Is in That Tree?	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, pH paper) for particular inquiries [IP] – **A1.3** identify and locate print, electronic, and human sources that are relevant to research questions [IP] – **A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A1.12** use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units) [C] – **A1.13** express the results of any calculations involving data accurately and precisely [C] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., meteorologist, medical illustrator, geochemist, optical physicist) and the education and training necessary for these careers ***Earth and Space Science: Climate Change*** – **D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo*, *anthropogenic*, *atmosphere*, *cycles*, *heat sinks*, and *hydrosphere* [C] – **D3.5** describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour)	***Analytic Geometry*** *Using Linear Systems to Solve Problems* – solve systems of two linear equations involving two variables, using the algebraic method of substitution or elimination – solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method ***Trigonometry*** *Investigating Similarity and Solving Problems Involving Similar Triangles* – verify, through investigation (e.g., using dynamic geometry software, concrete materials), the properties of similar triangles (e.g., given similar triangles, verify the equality of corresponding angles and the proportionality of corresponding sides) – solve problems involving similar triangles in realistic situations (e.g., shadows, reflections, scale models, surveying) *Solving Problems Involving the Trigonometry of Right Triangles* – determine the measures of the sides and angles in right triangles, using the primary trigonometric ratios and the Pythagorean theorem – solve problems involving the measures of sides and angles in right triangles in real-life applications (e.g., in surveying, in navigating, in determining the height of an inaccessible object around the school), using the primary trigonometric ratios and the Pythagorean theorem

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 6: When Does It Make Sense to Switch?	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.7** select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., websites for public health organizations, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A1.12** use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units) [C] – **A1.13** express the results of any calculations involving data accurately and precisely [C] ***Earth and Space Science: Climate Change*** – **D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo*, *anthropogenic*, *atmosphere*, *cycles*, *heat sinks*, and *hydrosphere* [C] – **D3.4** identify natural phenomena (e.g., plate tectonics, uplift and weathering, solar radiance, cosmic ray cycles) and human activities (e.g., forest fires, deforestation, the burning of fossil fuels, industrial emissions) known to affect climate, and describe the role of both in Canada's contribution to climate change – **D3.5** describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour)	***Analytic Geometry*** *Using Linear Systems to Solve Problems* – solve systems of two linear equations involving two variables, using the algebraic method of substitution or elimination – solve problems that arise from realistic situations described in words or represented by linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method
Design Challenge: Climate in a Container	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, pH paper) for particular inquiries [IP] – **A1.4** apply knowledge and understanding of safe practices and procedures when planning investigations (e.g., appropriate techniques for handling, storing, and disposing of laboratory materials [following the Workplace Hazardous Materials Information System-WHMIS]; safe operation of optical equipment; safe handling and disposal of biological materials), with the aid of appropriate support materials (e.g., the Reference Manual on the WHMIS website; the Live Safe! Work Smart! website) [IP] – **A1.5** conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data [PR] – **A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., meteorologist, medical illustrator, geochemist, optical physicist) and the education and training necessary for these careers	

Science Curriculum Connections	Mathematics Curriculum Connections
Earth and Space Science: Climate Change – **D2.1** use appropriate terminology related to climate change, including, but not limited to: *albedo*, *anthropogenic*, *atmosphere*, *cycles*, *heat sinks*, and *hydrosphere* [C] – **D2.2** design and build a model to illustrate the natural greenhouse effect, and use the model to explain the anthropogenic greenhouse effect [IP, PR, C] – **D2.4** investigate a popular hypothesis on a cause-and-effect relationship having to do with climate change (e.g., the combustion of fossil fuels is responsible for rising global temperatures; the concentration of atmospheric CO_2 is responsible for rising global temperatures; global temperatures have been on the increase since the industrial revolution; the severity of cyclones, hurricanes, and tornadoes increases as atmospheric temperatures increase), using simulations and/or time-trend data that model climate profiles (e.g., data from Statistics Canada and Environment Canada) [PR, AI, C] – **D2.5** investigate, through laboratory inquiry or simulations, the effects of heat transfer within the hydrosphere and atmosphere [PR, AI] – **D2.6** investigate, through laboratory inquiry or simulations, how water in its various states influences climate patterns (e.g., water bodies moderate climate, water vapour is a greenhouse gas, ice increases the albedo of Earth's surface) [PR, AI] – **D2.7** investigate, through research or simulations, the influence of ocean currents on local and global heat transfer and precipitation patterns [PR, AI] – **D3.1** describe the principal components of Earth's climate system (e.g., the sun, oceans, and atmosphere; the topography and configuration of land masses) and how the system works – **D3.2** describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents – **D3.3** describe the natural greenhouse effect, explain its importance for life, and distinguish it from the anthropogenic greenhouse effect – **D3.4** identify natural phenomena (e.g., plate tectonics, uplift and weathering, solar radiance, cosmic ray cycles) and human activities (e.g., forest fires, deforestation, the burning of fossil fuels, industrial emissions) known to affect climate, and describe the role of both in Canada's contribution to climate change – **D3.5** describe the principal sources and sinks, both natural and/or anthropogenic, of greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide, halocarbons, water vapour) – **D3.6** describe how different carbon and nitrogen compounds (e.g., carbon dioxide, methane, nitrous oxide) influence the trapping of heat in the atmosphere and hydrosphere – **D3.7** describe, in general terms, the causes and effects of the anthropogenic greenhouse effect, the depletion of stratospheric and tropospheric ozone, and the formation of ground-level ozone and smog – **D3.8** identify and describe indicators of global climate change (e.g., changes in: glacial and polar ice, sea levels, wind patterns, global carbon budget assessments)	

Grade 10: Evidence for Climate Change (Applied–SNC2P/MFM2P)

Curriculum Connections

Earth and Space Science: Earth's Dynamic Climate

IP = Initiating and Planning, PR = Performing and Recording, AI = Analysing and Interpreting, C = Communicating

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 1: Carbon Dioxide	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, acid-base indicators) for particular inquiries [IP] – **A1.3** identify and locate print, electronic, and human sources that are relevant to research questions [IP] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] ***Earth and Space Science: Earth's Dynamic Climate*** – **D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere,* and *weather* [C] – **D2.2** investigate the principles of the natural greenhouse effect, using simulations, diagrams, and/or models, and compare these principles to those of an actual greenhouse [PR, AI] – **D2.3** use a research process to investigate a source of greenhouse gases (e.g., decaying garbage, animal digestive processes, burning biomass) and its effect on a region of Canada (e.g., melting of the polar ice cap in the Arctic, shrinking of glaciers in the Rockies) [IP, PR, AI] – **D2.4** conduct an inquiry to determine how different factors (e.g., an increase in surface temperature, an increase in water temperature) affect global warming and climate change [PR] – **D3.2** describe the natural greenhouse effect, its importance for life, and the difference between it and the anthropogenic greenhouse effect – **D3.4** identify different greenhouse gases (e.g., carbon dioxide, methane, water vapour, nitrous oxide), and explain how they are produced naturally in the environment – **D3.5** describe methods by which greenhouse gases are produced by humans (e.g., burning of biomass, chemical reactions involving pollutants) – **D3.6** identify the natural and human causes of climate change in the world and, in particular, how Canada contributes to climate change – **D3.7** identify indicators of global climate change (e.g., changes in: the mass of glacial and polar ice, sea levels, wind patterns, global carbon budget assessments, migratory patterns of birds)	***Modelling Linear Relations*** *Graphing and Writing Equations of Lines* – connect the rate of change of a linear relation to the slope of the line, and define the slope as the ratio m = *rise/run* – identify, through investigation, $y = mx + b$ as a common form for the equation of a straight line, and identify the special cases $x = a$, $y = b$ – identify, through investigation with technology, the geometric significance of m and b in the equation $y = mx + b$ – identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism), using graphing technology to facilitate investigations, where appropriate *Solving and Interpreting Systems of Linear Equations* – solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 2: Climate Modelling	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.9** analyse the information gathered from research sources for reliability and bias [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., veterinarian assistant, quality control technician, conservation officer, sound and light technician) and the education and training necessary for these careers ***Earth and Space Science: Earth's Dynamic Climate*** – **D1.2** analyse ways in which human actions (e.g., burning fossil fuels, implementing tree-planting programs) have increased or decreased the production of greenhouse gases [AI, C] – **D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere,* and *weather* [C] – **D2.3** use a research process to investigate a source of greenhouse gases (e.g., decaying garbage, animal digestive processes, burning biomass) and its effect on a region of Canada (e.g., melting of the polar ice cap in the Arctic, shrinking of glaciers in the Rockies) [IP, PR, AI] – **D2.4** conduct an inquiry to determine how different factors (e.g., an increase in surface temperature, an increase in water temperature) affect global warming and climate change [PR] – **D2.7** compare different perspectives and/or biases evident in discussions of climate change in scientific and non-scientific media (e.g., with reference to knowledge, beliefs, and/or values) [PR, AI] – **D3.4** identify different greenhouse gases (e.g., carbon dioxide, methane, water vapour, nitrous oxide), and explain how they are produced naturally in the environment – **D3.5** describe methods by which greenhouse gases are produced by humans (e.g., burning of biomass, chemical reactions involving pollutants) – **D3.6** identify the natural and human causes of climate change in the world and, in particular, how Canada contributes to climate change – **D3.7** identify indicators of global climate change (e.g., changes in: the mass of glacial and polar ice, sea levels, wind patterns, global carbon budget assessments, migratory patterns of birds)	***Modelling Linear Relations*** *Graphing and Writing Equations of Lines* – connect the rate of change of a linear relation to the slope of the line, and define the slope as the ratio m = *rise/run* – identify, through investigation with technology, the geometric significance of m and b in the equation $y = mx + b$ – identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism), using graphing technology to facilitate investigations, where appropriate *Solving and Interpreting Systems of Linear Equations* – solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 3: A Warming World	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, acid-base indicators) for particular inquiries [IP] – **A1.5** conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data [PR] – **A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.9** analyse the information gathered from research sources for reliability and bias [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] ***Earth and Space Science: Earth's Dynamic Climate*** – **D1.1** analyse, on the basis of research, various ways in which living things and natural systems have been affected by climate change (e.g., the effect of loss of permafrost on northern roads and housing; the effect of longer growing seasons in some regions on farmers; the effect of warming oceans on coral reefs), and communicate their findings [IP, PR, AI, C] – **D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere,* and *weather* [C] – **D2.4** conduct an inquiry to determine how different factors (e.g., an increase in surface temperature, an increase in water temperature) affect global warming and climate change [PR] – **D2.6** compare different tools or systems used by scientists to make informed decisions on global climate change (e.g., Ecoregions of Canada, bioclimate profiles) [PR, AI] – **D3.3** describe how heat is transferred and stored in both hydrospheric and atmospheric heat sinks – **D3.7** identify indicators of global climate change (e.g., changes in: the mass of glacial and polar ice, sea levels, wind patterns, global carbon budget assessments, migratory patterns of birds)	***Measurement and Trigonometry*** *Solving Problems Involving Surface Area and Volume, Using the Imperial and Metric Systems of Measurement* – perform everyday conversions between the imperial system and the metric system (e.g., millilitres to cups, centimetres to inches) and within these systems (e.g., cubic metres to cubic centimetres, square feet to square yards), as necessary to solve problems involving measurement ***Modelling Linear Relations*** *Graphing and Writing Equations of Lines* – connect the rate of change of a linear relation to the slope of the line, and define the slope as the ratio m = *rise/run* – identify, through investigation with technology, the geometric significance of m and b in the equation $y = mx + b$ – identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism), using graphing technology to facilitate investigations, where appropriate *Solving and Interpreting Systems of Linear Equations* – solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 4: The Impact of Transportation	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.7** select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., a website for a public health organization, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A1.11** communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats (e.g., data tables, laboratory reports, presentations, debates, simulations, models) [C] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., veterinarian assistant, quality control technician, conservation officer, sound and light technician) and the education and training necessary for these careers ***Earth and Space Science: Earth's Dynamic Climate*** – **D1.2** analyse ways in which human actions (e.g., burning fossil fuels, implementing tree-planting programs) have increased or decreased the production of greenhouse gases [AI, C] – **D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere,* and *weather* [C] – **D2.3** use a research process to investigate a source of greenhouse gases (e.g., decaying garbage, animal digestive processes, burning biomass) and its effect on a region of Canada (e.g., melting of the polar ice cap in the Arctic, shrinking of glaciers in the Rockies) [IP, PR, AI] – **D2.5** investigate their personal carbon footprint, using a computer simulation or numerical data (e.g., determine carbon emissions that result from their travelling to school, work, and recreation venues; from vacation travelling; from buying products imported from distant countries), and plan a course of action to reduce their footprint (e.g., a plan to increase their use of bicycles or public transit; to eat more local foods) [PR, AI, C] – **D2.7** compare different perspectives and/or biases evident in discussions of climate change in scientific and non-scientific media (e.g., with reference to knowledge, beliefs, and/or values) [PR, AI] – **D3.5** describe methods by which greenhouse gases are produced by humans (e.g., burning of biomass, chemical reactions involving pollutants) – **D3.6** identify the natural and human causes of climate change in the world and, in particular, how Canada contributes to climate change	***Modelling Linear Relations*** *Manipulating and Solving Algebraic Equations* – solve first-degree equations involving one variable, including equations with fractional coefficients (e.g., using the balance analogy, computer algebra systems, paper and pencil) – determine the value of a variable in the first degree, using a formula (i.e., by isolating the variable and then substituting known values; by substituting known values and then solving for the variable) (e.g., in analytic geometry, in measurement) *Solving and Interpreting Systems of Linear Equations* – solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 5: How Much Carbon Is in That Tree?	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, acid-base indicators) for particular inquiries [IP] – **A1.3** identify and locate print, electronic, and human sources that are relevant to research questions [IP] – **A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A1.12** use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units) [C] – **A1.13** express the results of any calculations involving data accurately and precisely [C] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., veterinarian assistant, quality control technician, conservation officer, sound and light technician) and the education and training necessary for these careers ***Earth and Space Science: Earth's Dynamic Climate*** – **D1.2** analyse ways in which human actions (e.g., burning fossil fuels, implementing tree-planting programs) have increased or decreased the production of greenhouse gases [AI, C] – **D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere,* and *weather* [C] – **D2.5** investigate their personal carbon footprint, using a computer simulation or numerical data (e.g., determine carbon emissions that result from their travelling to school, work, and recreation venues; from vacation travelling; from buying products imported from distant countries), and plan a course of action to reduce their footprint (e.g., a plan to increase their use of bicycles or public transit; to eat more local foods) [PR, AI, C] – **D3.5** describe methods by which greenhouse gases are produced by humans (e.g., burning of biomass, chemical reactions involving pollutants)	***Measurement and Trigonometry*** *Solving Problems Involving the Trigonometry of Right Triangles* – determine the measures of the sides and angles in right triangles, using the primary trigonometric ratios and the Pythagorean theorem – solve problems involving the measures of sides and angles in right triangles in real-life applications (e.g., in surveying, in navigating, in determining the height of an inaccessible object around the school), using the primary trigonometric ratios and the Pythagorean theorem *Solving Problems Involving Surface Area and Volume, Using the Imperial and Metric Systems of Measurement* – perform everyday conversions between the imperial system and the metric system (e.g., millilitres to cups, centimetres to inches) and within these systems (e.g., cubic metres to cubic centimetres, square feet to square yards), as necessary to solve problems involving measurement – solve problems involving the surface areas of prisms, pyramids, and cylinders, and the volumes of prisms, pyramids, cylinders, cones, and spheres, including problems involving combinations of these figures, using the metric system or the imperial system, as appropriate

Science Curriculum Connections	Mathematics Curriculum Connections
Activity 6: When Does It Make Sense to Switch?	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.7** select, organize, and record relevant information on research topics from various sources, including electronic, print, and/or human sources (e.g., a website for a public health organization, federal and provincial government publications, reference books, personal interviews), using recommended formats and an accepted form of academic documentation [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A1.12** use appropriate numeric, symbolic, and graphic modes of representation, and appropriate units of measurement (e.g., SI and imperial units) [C] – **A1.13** express the results of any calculations involving data accurately and precisely [C] ***Earth and Space Science: Earth's Dynamic Climate*** – **D1.2** analyse ways in which human actions (e.g., burning fossil fuels, implementing tree-planting programs) have increased or decreased the production of greenhouse gases [AI, C] – **D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere,* and *weather* [C] – **D3.5** describe methods by which greenhouse gases are produced by humans (e.g., burning of biomass, chemical reactions involving pollutants) – **D3.6** identify the natural and human causes of climate change in the world and, in particular, how Canada contributes to climate change	***Modelling Linear Relations*** *Manipulating and Solving Algebraic Equations* – solve first-degree equations involving one variable, including equations with fractional coefficients (e.g., using the balance analogy, computer algebra systems, paper and pencil) *Graphing and Writing Equations of Lines* – connect the rate of change of a linear relation to the slope of the line, and define the slope as the ratio $m = rise/run$ – determine the equation of a line, given its graph, the slope and y-intercept, the slope and a point on the line, or two points on the line *Solving and Interpreting Systems of Linear Equations* – determine graphically the point of intersection of two linear relations (e.g., using graph paper, using technology) – solve systems of two linear equations involving two variables with integral coefficients, using the algebraic method of substitution or elimination – solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method *Solving and Interpreting Systems of Linear Equations* – solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Science Curriculum Connections	Mathematics Curriculum Connections
Design Challenge: Climate in a Container	
Scientific Investigation Skills and Career Exploration – **A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research [IP] – **A1.2** select appropriate instruments (e.g., a microscope, laboratory glassware, an optical bench) and materials (e.g., prepared slides, an aquarium, lenses, acid-base indicators) for particular inquiries [IP] – **A1.4** apply knowledge and understanding of safe practices and procedures when planning investigations (e.g., appropriate techniques for handling, storing, and disposing of laboratory materials [following the Workplace Hazardous Materials Information System-WHMIS]; safe operation of optical equipment; safe handling and disposal of biological materials), with the aid of appropriate support materials (e.g., the Reference Manual on the WHMIS website; the Live Safe! Work Smart! website) [IP] – **A1.5** conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data [PR] – **A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams [PR] – **A1.8** analyse and interpret qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis, identifying possible sources of error, bias, or uncertainty [AI] – **A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions [AI] – **A2.1** identify and describe a variety of careers related to the fields of science under study (e.g., veterinarian assistant, quality control technician, conservation officer, sound and light technician) and the education and training necessary for these careers ***Earth and Space Science: Earth's Dynamic Climate*** – **D1.2** analyse ways in which human actions (e.g., burning fossil fuels, implementing tree-planting programs) have increased or decreased the production of greenhouse gases [AI, C] – **D2.1** use appropriate terminology related to Earth's dynamic climate, including, but not limited to: *anthropogenic, atmosphere, carbon footprint, carbon sink, climate, greenhouse gases, hydrosphere,* and *weather* [C] – **D2.2** investigate the principles of the natural greenhouse effect, using simulations, diagrams, and/or models, and compare these principles to those of an actual greenhouse [PR, AI] – **D2.3** use a research process to investigate a source of greenhouse gases (e.g., decaying garbage, animal digestive processes, burning biomass) and its effect on a region of Canada (e.g., melting of the polar ice cap in the Arctic, shrinking of glaciers in the Rockies) [IP, PR, AI] – **D2.4** conduct an inquiry to determine how different factors (e.g., an increase in surface temperature, an increase in water temperature) affect global warming and climate change [PR] – **D3.1** describe the principal components of Earth's climate system (e.g., the sun, oceans, and the atmosphere; the topography and configuration of land masses) – **D3.2** describe the natural greenhouse effect, its importance for life, and the difference between it and the anthropogenic greenhouse effect – **D3.3** describe how heat is transferred and stored in both hydrospheric and atmospheric heat sinks – **D3.4** identify different greenhouse gases (e.g., carbon dioxide, methane, water vapour, nitrous oxide), and explain how they are produced naturally in the environment – **D3.6** identify the natural and human causes of climate change in the world and, in particular, how Canada contributes to climate change	

Evidence for Climate Change

Curriculum Connections

PRINCE EDWARD ISLAND—Grade 10 Science

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

Mathematical Processes: Communication [C], Problem Solving [PS], Connections [CN], Mental Mathematics and Estimation [ME], Technology [T], Visualization [V], Reasoning [R]

Grade 10 Science Curriculum Connections (421 A, 431A, and Environmental Science 621A) **(2005; 1999; 2011)**	**Math 421A Curriculum Connections** **(2011)**
Activity 1: Carbon Dioxide	
SCIENCE 421A: LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS ***STSE*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability **SCIENCE 421A: EARTH AND SPACE SCIENCE: WEATHER DYNAMICS** ***STSE*** ***Nature of Science and Technology*** 115-2 explain how science attempts to explain natural phenomena ***Skills*** ***Performing and Recording*** 213-3 use instruments effectively and accurately for collecting data 213-6 use library and electronic research tools to collect information on a given topic 213-7 select and integrate information from various print and electronic sources or from several parts of same source ***Analysing and Interpreting*** 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots 214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion	***Measurement (M)*** M1 Solve problems that involve linear measurement, using: • SI and imperial units of measure; • estimation strategies; • measurement strategies. [ME, PS, V] ***Relations and Functions (RF)*** SCO: RF1—Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] SCO: RF4—Describe and represent linear relations, using: • words; • ordered pairs; • tables of values; • graphs; • equations. [C, CN, R, V]

SCIENCE 421A: EARTH AND SPACE SCIENCE: CHEMICAL REACTIONS

Knowledge

319-2 (I) classify substances as acids, bases, or salts, based on their characteristics

321-2 describe how neutralization involves tempering the effects of an acid with a base or vice versa

319-1 (I) name and write formulas for some common molecular compounds, including the use of prefixes

SCIENCE 421A: EARTH AND SPACE SCIENCE: WEATHER DYNAMICS

STSE

Nature of Science and Technology

115-2 illustrate how science attempts to explain natural phenomena

115-6 explain how scientific knowledge evolves as new evidence comes to light

Skills

Performing and Recording

213-3 use instruments effectively and accurately for collecting data

213-6 use library and electronic research tools to collect information on a given topic

213-7 select and integrate information from various print and electronic sources or from several parts of same source

Analysing and Interpreting

214-11 provide a statement that addresses or answers the question investigated in light of the link between data and the conclusion

Knowledge

331-2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents

331-3 describe how the hydrosphere and atmosphere act as heat sinks within the water cycle

331-5 analyze meteorological data for a given time span

ENVIRONMENTAL SCIENCE 621A: INTRODUCTION TO ENVIRONMENTAL SCIENCE

2.6 demonstrate critical thinking skills through research and analysis of environmental science issues.

ENVIRONMENTAL SCIENCE 621A: ECOLOGICAL PRINCIPLES

3.7 demonstrate an understanding that humans can have a great impact on systems of living and nonliving things.

ENVIRONMENTAL SCIENCE 621A: ENVIRONMENTAL CHALLENGES AND SUCCESSES 6.2 demonstrate an understanding of how Earth's climate has changed over time. 6.3 demonstrate an understanding of the greenhouse gases found in the troposphere and stratosphere. - natural sources of greenhouse gases - anthropogenic sources of greenhouse gases 6.5 identify that climate change can have a catastrophic effect on Earth.	
Activity 2: Climate Modelling	
SCIENCE 421A: LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS ***STSE*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability ***Knowledge*** 318-1 illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen 318-2 describe the mechanisms of bioaccumulation, and explain its potential impact on the viability and diversity of consumers at all trophic levels 318-3 explain why ecosystems with similar characteristics can exist in different geographical locations 318-4 explain why different ecosystems respond differently to short-term stresses and long-term changes **SCIENCE 421A: EARTH AND SPACE SCIENCE: WEATHER DYNAMICS** ***Knowledge*** 331-2 Describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents. 331-3 Describe how the hydrosphere and atmosphere act as heat sinks within the water cycle. **ENVIRONMENTAL SCIENCE 621A: NATURAL RESOURCES** ***Energy Resources*** 5.19 create a plan to improve energy efficiency in the home. **ENVIRONMENTAL SCIENCE 621A: ECOLOGICAL PRINCIPLES** 3.7 demonstrate an understanding that humans can have a great impact on systems of living and nonliving things	***Relations and Functions (RF)*** SCO: RF1—Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V] SCO: RF3—Demonstrate an understanding of slope with respect to: • rise and run; • line segments and lines; • rate of change; • parallel lines; • perpendicular lines. [PS, R, V]

ENVIRONMENTAL SCIENCE 621A: ENVIRONMENTAL CHALLENGES AND SUCCESSES 6.2 demonstrate an understanding of how Earth's climate has changed over time 6.3 demonstrate an understanding of the greenhouse gases found in the troposphere and stratosphere - natural sources of greenhouse gases - anthropogenic sources of greenhouse gases 6.6 identify the effects that climate change can have on Prince Edward Island - sea level rise - increased erosion - economic effects - social effects - species movement/loss	
Activity 3: A Warming World	
SCIENCE 421A: EARTH AND SPACE SCIENCE: WEATHER DYNAMICS ***STSE*** ***Nature of Science and Technology*** 115-2 illustrate how science attempts to explain natural phenomena ***Skills*** ***Initiating and Planning*** 212-1 identify questions to investigate that arise from practical problems and issues ***Performing and Recording*** 213-3 use instruments effectively and accurately for collecting data 213-7 select and integrate information from various print and electronic sources or from several parts of same source ***Analysing and Interpreting*** 214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion ***Knowledge*** 331-2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents. 331-3 describe how the hydrosphere and atmosphere act as heat sinks within the water cycle. 331-5 analyze meteorological data for a given time span.	***Measurement (M)*** M1 Solve problems that involve linear measurement, using: • SI and imperial units of measure; • estimation strategies; • measurement strategies. [ME, PS, V] ***Relations and Functions (RF)*** SCO: RF1—Interpret and explain the relationships among data, graphs and situations. [C, CN, R, T, V]

SCIENCE 421A: LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS

Skills

Communication and Teamwork

215-5 develop, present and defend a position or course of action based on findings.

Knowledge

318-1 illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen.

318-2 describe the mechanisms of bioaccumulation, and explain its potential impact on the viability and diversity of consumers at all trophic levels.

318-3 explain why ecosystems with similar characteristics can exist in different geographical locations.

ENVIRONMENTAL SCIENCE 621A: INTRODUCTION TO ENVIRONMENTAL SCIENCE

2.1 demonstrate an understanding of environmental science, its history, applications, and common misconceptions

ENVIRONMENTAL SCIENCE 621A: ECOLOGICAL PRINCIPLES

3.7 demonstrate an understanding that humans can have a great impact on systems of living and nonliving things

ENVIRONMENTAL SCIENCE 621A: ENVIRONMENTAL CHALLENGES AND SUCCESSES

6.2 demonstrate an understanding of how Earth's climate has changed over time

6.3 demonstrate an understanding of the greenhouse gases found in the troposphere and stratosphere
- natural sources of greenhouse gases
- anthropogenic sources of greenhouse gases

6.4 distinguish between the green-house effect and global warming

6.6 identify the effects that climate change can have on Prince Edward Island
- sea level rise
- increased erosion
- economic effects
- social effects
- species movement/loss

Activity 4: The Impact of Transportation	
SCIENCE 421A: LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS ***STSE*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability **ENVIRONMENTAL SCIENCE 621A: INTRODUCTION TO ENVIRONMENTAL SCIENCE** 2.1 demonstrate an understanding of environmental science, its history, applications, and common misconceptions **ENVIRONMENTAL SCIENCE 621A: ECOLOGICAL PRINCIPLES** 3.7 demonstrate an understanding that humans can have a great impact on systems of living and nonliving things	***Relations and Functions (RF)*** SCO: RF4—Describe and represent linear relations, using: • words; • ordered pairs; • tables of values; • graphs; • equations. [C, CN, R, V]
Activity 5: How Much Carbon Is in That Tree?	
SCIENCE 421A: LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS ***STSE*** ***Nature of Science and Technology*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability ***Social and Environmental Contexts of Science and Technology.*** 118-9 propose a course of action on social issues related to science and technology, taking into account human and environmental needs ***Skills*** ***Performing and Recording*** 213-8 select and use apparatus and material safely ***Communication and Teamwork*** 215-5 develop, present and defend a position or course of action, based on findings ***Knowledge*** 318-1 illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen **SCIENCE 431A: SUSTAINABILITY OF ECOSYSTEMS** ***STSE*** ***Nature of Science and Technology*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability. Explore and develop a concept of sustainability.	***Measurement (M)*** M1 Solve problems that involve linear measurement, using: • SI and imperial units of measure; • estimation strategies; • measurement strategies. [ME, PS, V] M4—Develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles. [C, CN, PS, R, T, V] A. Explain the relationships between similar right triangles and the definitions of the primary trigonometric ratios. B. Identify the hypotenuse of a right triangle and the opposite and adjacent sides for a given acute triangle in the triangle. C. Solve right triangles, with or without technology. D. Solve a problem that involves one or more right triangles by applying the primary trigonometric ratios or the Pythagorean theorem.

Communication and Teamwork 215-1 communicate questions, ideas, and intentions and receive, interpret, understand, support, and respond to the ideas of others with respect to environmental attitudes. ***Sustainability of Ecosystems*** 318-1 illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen. 118-9 propose a course of action on social issues related to science and technology taking into account human and environmental needs. **ENVIRONMENTAL SCIENCE 621A: INTRODUCTION TO ENVIRONMENTAL SCIENCE** 2.3 define stewardship in relation to sustainability 2.6 demonstrate critical thinking skills through research and analysis of environmental science issues **ENVIRONMENTAL SCIENCE 621A: HUMAN POPULATION AND CARRYING CAPACITY** 4.3 identify individual impacts on the environment using the concept of ecological footprint	E. Solve a problem that involves indirect and direct measurement, using the trigonometric ratios, the Pythagorean theorem and measurement instruments such as a clinometer or a metre stick.
Activity 6: When Does It Make Sense to Switch?	
SCIENCE 421A: LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS ***STSE*** ***Nature of Science and Technology*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability ***Social and Environmental Contexts of Science and Technology.*** 118-9 propose a course of action on social issues related to science and technology, taking into account human and environmental needs ***Communication and Teamwork*** 215-5 develop, present and defend a position or course of action, based on findings **SCIENCE 431A: SUSTAINABILITY OF ECOSYSTEMS** ***STSE*** ***Nature of Science and Technology*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability. Explore and develop a concept of sustainability.	***Measurement (M)*** M1 Solve problems that involve linear measurement, using: • SI and imperial units of measure; • estimation strategies; • measurement strategies. [ME, PS, V] ***Relations and Functions (RF)*** SCO: RF9 Solve problems that involve systems of linear equations in two variables, graphically and algebraically. [CN, PS, R, T, V]

Skills ***Communication and Teamwork*** 215-1 communicate questions, ideas, and intentions and receive, interpret, understand, support, and respond to the ideas of others with respect to environmental attitudes. ***Sustainability of Ecosystems*** 118-9 propose a course of action on social issues related to science and technology taking into account human and environmental needs.	
Design Challenge: Climate in a Container	
SCIENCE 421A: LIFE SCIENCE: SUSTAINABILITY OF ECOSYSTEMS ***STSE*** 114-1 explain how a paradigm shift can change scientific world views in understanding sustainability **SCIENCE 421A: EARTH AND SPACE SCIENCE: WEATHER DYNAMICS** ***STSE*** ***Nature of Science and Technology*** 115-2 explain how science attempts to explain natural phenomena ***Skills*** ***Performing and Recording*** 213-3 use instruments effectively and accurately for collecting data 213-6 use library and electronic research tools to collect information on a given topic 213-7 select and integrate information from various print and electronic sources or from several parts of same source ***Analysing and Interpreting*** 214-3 compile and display evidence and information, by hand or by computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots 214-11 provide a statement that addresses or answers the question investigated in the light of the link between data and the conclusion ***Knowledge*** 318-2 describe the mechanisms of bioaccumulation, and explain its potential impact on the viability and diversity of consumers at all trophic levels 318-3 explain why ecosystems with similar characteristics can exist in different geographical locations	

SCIENCE 431A: WEATHER DYNAMICS

STSE

Nature of Science and Technology

115-2 illustrate how science attempts to explain natural phenomena.

115-6 explain how scientific knowledge evolves as new evidence comes to light.

Skills

Performing and Recording

213-3 use instruments effectively and accurately for collecting data.

213-6 use library and electronic research tools to collect information on a given topic.

213-7 select and integrate information from various print and electronic sources or from several parts of same source.

Analysing and Interpreting

214-11 provide a statement that addresses or answers the question investigated in light of the link between data and the conclusion.

Knowledge

331-2 describe and explain heat transfer in the hydrosphere and atmosphere and its effects on air and water currents.

331-3 describe how the hydrosphere and atmosphere act as heat sinks within the water cycle.

ENVIRONMENTAL SCIENCE 621A: INTRODUCTION TO ENVIRONMENTAL SCIENCE

2.6 demonstrate critical thinking skills through research and analysis of environmental science issues.

ENVIRONMENTAL SCIENCE 621A: ECOLOGICAL PRINCIPLES

3.3 define the components of the Earth's life support system:
- atmosphere
- hydrosphere
- lithosphere
- biosphere

3.7 demonstrate an understanding that humans can have a great impact on systems of living and nonliving things

ENVIRONMENTAL SCIENCE 621A: ENVIRONMENTAL CHALLENGES AND SUCCESSES

6.2 demonstrate an understanding of how Earth's climate has changed over time

6.3 demonstrate an understanding of the greenhouse gases found in the troposphere and stratosphere - natural sources of greenhouse gases - anthropogenic sources of greenhouse gases 6.5 identify that climate change can have a catastrophic effect on Earth	

Evidence for Climate Change

Curriculum Connections

SASKATCHEWAN—Science 10: Climate and Ecosystem Dynamics

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

* Further curriculum connections can be made to Environmental Science 20, Earth Science 30, and Chemistry 30, but that is beyond the scope of this particular chart.

Science 10 Curriculum Connections (December 2015)	**Workplace and Apprenticeship Mathematics 10 and 20; Foundations of Mathematics and Pre-Calculus 10; and Foundations of Mathematics 20 Curriculum Connections** (2010)
Activity 1: Carbon Dioxide	
Climate and Ecosystem Dynamics SCI10-CD1 Assess the implications of human actions on the local and global climate and the sustainability of ecosystems. [CP, DM] a. Pose questions or problems relating to the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal research. (A, S, STSE) b. Reflect upon your personal view of humanity's relationship with the environment. (STSE, A) f. Discuss why it is important to consider economic, social justice and environmental perspectives when examining sustainability. (STSE, A) i. Research how scientists examine changes to the key indicators of climate change (e.g., CO_2 concentration, global surface temperature, Arctic sea ice area, land ice mass and sea level) to support the scientific understanding of climate change. (K, STSE, A) j. Reflect upon individual and societal behavioural and lifestyle choices that can help to minimize anthropogenic sources of global climate change. (K, STSE)	***Workplace and Apprenticeship Mathematics 20*** WA20.11 Extend and apply understanding of representing data using graphs including: • line graphs [C, CN, PS, R, T, V] ***Foundations of Mathematics 10*** FP10.6 Expand and apply understanding of relations and functions including: • relating data, graphs, and situations • analyzing and interpreting • distinguishing between relations and functions. [C, CN, R, T, V]

k. Develop, present and defend a position or course of action based on personal research related to mitigating the effects of global or local climate change or to enhancing the sustainability of an ecosystem, taking into account human and environmental needs. (S, A, STSE)

SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect. [DM, SI]

b. Understand that Earth's climate system results from the exchange of thermal energy and moisture between the sun, ice sheets, oceans, solid earth and the biosphere over a range of timescales. (K, A)

j. Analyze weather and atmospheric data to identify patterns in temperature and atmospheric pressure, and changes in those patterns locally, regionally and globally. (S)

l. Provide examples to show how scientific understanding may be refined in light of new evidence. (STSE)

SCI10-CR1 Explore the properties of chemical reactions, including the role of energy changes, and applications of acids and bases.

Scientific Inquiry [SI]

- posing questions or becoming curious about the questions of others;
- examining books and other sources of information to see what is already known;
- reviewing what is already known in light of experimental evidence and rational arguments;
- using tools to gather, analyze, and interpret data;
- proposing critical answers, explanations, and predictions

STSE Decision Making [DM]

- clarifying an issue;
- evaluating available research and different viewpoints on the issue;
- generating possible courses of action or solutions;
- evaluating the pros and cons for each action or solution;
- making a thoughtful decision;
- examining the impact of the decision

Foundation 4: Attitudes

Appreciation of Science

Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural and ethical events.

Interest in Science

Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school and in the community.

FP10.7 Demonstrate, with and without the use of technology, understanding of slope (concretely, pictorially, and symbolically) with respect to:

- line segments and lines
- rate of change
- ratio of rise to run
- parallel lines
- perpendicular lines.

[PS, R, V]

Foundations of Mathematics 20

FM20.1 Demonstrate understanding of the mathematics involved in an historical event or an area of interest. [C, CN, ME, PS, R, T, V]

d. Interpret data, using statistical methods if applicable.

FM20.8 Demonstrate understanding of systems of linear inequalities in two variables. [CN, PS, T, V]

Inquiry in Science Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge. **Collaboration** Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school. **Stewardship** Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment. **Safety** Students engaged in science and technology activities will be expected to demonstrate a concern for safety and doing no harm to themselves or others, including plants and animals.	
Activity 2: Climate Modelling	
Career Investigation SCI10-CI1 Investigate career paths related to various branches and sub-branches of science. [DM] f. Research the educational qualifications of people engaged in science-related careers. (STSE, S, A) i. Represent the range of career options available related to a specific branch or sub-branch of science. (STSE, S, A) ***Climate and Ecosystem Dynamics*** SCI10-CD1 Assess the implications of human actions on the local and global climate and the sustainability of ecosystems. [CP, DM] a. Pose questions or problems relating to the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal research. (A, S, STSE) b. Reflect upon your personal view of humanity's relationship with the environment. (STSE, A) h. Provide examples of human actions that have contributed to the anthropogenic greenhouse effect. (K, STSE) j. Reflect upon individual and societal behavioural and lifestyle choices that can help to minimize anthropogenic sources of global climate change. (K, STSE) k. Develop, present and defend a position or course of action based on personal research related to mitigating the effects of global or local climate change or to enhancing the sustainability of an ecosystem, taking into account human and environmental needs. (S, A, STSE)	***Workplace and Apprenticeship Mathematics 20*** WA20.11 Extend and apply understanding of representing data using graphs including: • line graphs [C, CN, PS, R, T, V] ***Foundations of Mathematics 10*** FP10.6 Expand and apply understanding of relations and functions including: • relating data, graphs, and situations • analyzing and interpreting • distinguishing between relations and functions. [C, CN, R, T, V] FP10.7 Demonstrate, with and without the use of technology, understanding of slope (concretely, pictorially, and symbolically) with respect to: • line segments and lines • rate of change

SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect. [DM, SI]

c. Investigate how Earth's axial tilt, rotation and revolution around the sun cause uneven heating of Earth's surface, resulting in global convection currents, the Coriolis effect, jet streams, thermohaline circulation of the oceans and climate zones. (S, K)

d. Hypothesize how energy transfer, weather and climate might be different if Earth had a different axial tilt, diameter, period of rotation and/or period of revolution. (S, STSE, A)

e. Explain how greenhouse gases (e.g., water vapour, carbon dioxide, methane, nitrous oxide, sulphur dioxide and ozone), particles, clouds and surface albedo affect the amount of solar energy absorbed and re-radiated at various locations on Earth.(K)

f. Explain the role of natural sources (e.g., volcanoes, fire, evaporation and living organisms) of the primary greenhouse gases in Earth's atmosphere and how they contribute to the natural greenhouse effect. (K, A)

j. Analyze weather and atmospheric data to identify patterns in temperature and atmospheric pressure, and changes in those patterns locally, regionally and globally. (S)

Scientific Inquiry [SI]

- making observations, including watching or listening to knowledgeable sources;
- posing questions or becoming curious about the questions of others;
- proposing critical answers, explanations, and predictions; and,
- communicating the results to various audiences.

STSE Decision Making [DM]

- clarifying an issue;
- evaluating available research and different viewpoints on the issue;
- generating possible courses of action or solutions;
- making a thoughtful decision

Foundation 4: Attitudes

Appreciation of Science

Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural and ethical events.

Interest in Science

Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school and in the community.

- ratio of rise to run
- parallel lines
- perpendicular lines.
  [PS, R, V]

Foundations of Mathematics 20

FM20.8 Demonstrate understanding of systems of linear inequalities in two variables.
[CN, PS, T, V]

Inquiry in Science Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge. **Collaboration** Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school. **Stewardship** Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment.	
Activity 3: A Warming World	
Climate and Ecosystem Dynamics SCI10-CD1 Assess the implications of human actions on the local and global climate and the sustainability of ecosystems. [CP, DM] i. Research how scientists examine changes to the key indicators of climate change (e.g., CO_2 concentration, global surface temperature, Arctic sea ice area, land ice mass and sea level) to support the scientific understanding of climate change. (K, STSE, A) l. Assess the current and potential future effects of ongoing changes to Earth's climate systems on the people and the environment in Saskatchewan and Canada's Arctic region. (K, STSE) SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect. [DM, SI] b. Understand that Earth's climate system results from the exchange of thermal energy and moisture between the sun, ice sheets, oceans, solid earth and the biosphere over a range of timescales. (K, A) c. Investigate how Earth's axial tilt, rotation and revolution around the sun cause uneven heating of Earth's surface, resulting in global convection currents, the Coriolis effect, jet streams, thermohaline circulation of the oceans and climate zones. (S, K) g. Design, construct and evaluate the effectiveness of a model used to illustrate the natural greenhouse effect, the reflectivity of Earth's surface or the relationship between Earth's axial tilt and the seasons. (S, STSE, A) h. Investigate, through laboratory activities or simulations, heat transfer in air and water, including heat involved in phase changes. (S, A)	***Foundations of Mathematics 20*** FM20.8 Demonstrate understanding of systems of linear inequalities in two variables. [CN, PS, T, V]

i. Examine how interactions between heat, pressure and the Coriolis Effect result in global wind patterns, ocean currents, jet streams and severe weather (e.g., hurricanes, tornadoes, blizzards and thunderstorms). (S, STSE)

j. Analyze weather and atmospheric data to identify patterns in temperature and atmospheric pressure, and changes in those patterns locally, regionally and globally. (S)

SCI10-CD4 Investigate the role of feedback mechanisms in biogeochemical cycles and in maintaining stability in ecosystems.

Scientific Inquiry [SI]

- making observations, including watching or listening to knowledgeable sources;
- planning investigations, including field studies and experiments;
- acquiring the resources (financial or material) to carry out investigations;
- using tools to gather, analyze, and interpret data;
- proposing critical answers, explanations, and predictions

STSE Decision Making [DM]

- clarifying an issue;
- evaluating the pros and cons for each action or solution;
- making a thoughtful decision

Foundation 4: Attitudes

Appreciation of Science

Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural and ethical events.

Interest in Science

Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school and in the community.

Inquiry in Science

Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge.

Collaboration

Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school.

Stewardship Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment. **Safety** Students engaged in science and technology activities will be expected to demonstrate a concern for safety and doing no harm to themselves or others, including plants and animals.	
Activity 4: The Impact of Transportation	
Climate and Ecosystem Dynamics SCI10-CD1 Assess the implications of human actions on the local and global climate and the sustainability of ecosystems. [CP, DM] a. Pose questions or problems relating to the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal research. (A, S, STSE) b. Reflect upon your personal view of humanity's relationship with the environment. (STSE, A) c. Research how people from Aboriginal and other cultures view relationships between living organisms and their ecosystems, and the role of humans in those relationships. (STSE) h. Provide examples of human actions that have contributed to the anthropogenic greenhouse effect. (K, STSE) j. Reflect upon individual and societal behavioural and lifestyle choices that can help to minimize anthropogenic sources of global climate change. (K, STSE) SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect. [DM, SI] ***Scientific Inquiry [SI]*** • posing questions or becoming curious about the questions of others; • proposing critical answers, explanations, and predictions ***STSE Decision Making [DM]*** • clarifying an issue; • evaluating available research and different viewpoints on the issue; • generating possible courses of action or solutions; • evaluating the pros and cons for each action or solution; • identifying a fundamental value associated with each action or solution; • making a thoughtful decision; • examining the impact of the decision; and, • reflecting back on the process of decision making.	***Workplace and Apprenticeship Mathematics 20*** WA20.6 Demonstrate understanding of personal budgets and their importance for financial planning. [CN, PS, R, T, V] ***Foundations of Mathematics 10*** FP10.6 Expand and apply understanding of relations and functions including: • relating data, graphs, and situations • analyzing and interpreting • distinguishing between relations and functions. [C, CN, R, T, V] ***Foundations of Mathematics 20*** FM20.3 Expand and demonstrate understanding of proportional reasoning related to: • rates [C, CN, PS, R, V] FM20.8 Demonstrate understanding of systems of linear inequalities in two variables. [CN, PS, T, V]

Foundation 4: Attitudes **Appreciation of Science** Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural and ethical events. **Interest in Science** Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school and in the community. **Inquiry in Science** Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge. **Collaboration** Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school. **Stewardship** Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment.	
Activity 5: How Much Carbon Is in That Tree?	
Career Investigation SCI10-CI1 Investigate career paths related to various branches and sub-branches of science. [DM] ***Climate and Ecosystem Dynamics*** SCI10-CD1 Assess the implications of human actions on the local and global climate and the sustainability of ecosystems. [CP, DM] a. Pose questions or problems relating to the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal research. (A, S, STSE) g. Select, integrate and analyze the validity of information from various human, print and electronic sources (e.g., government publications, community resources and personally collected data), with respect to sustainability, sustainable development and education for sustainable development. (S) h. Provide examples of human actions that have contributed to the anthropogenic greenhouse effect. (K, STSE)	***Workplace and Apprenticeship 10*** WP10.1 Demonstrate understanding of the preservation of equality including solving problems that involve the manipulation and application of formulas related to: • perimeter • area • the Pythagorean Theorem • primary trigonometric ratios • income. [C, CN, ME, PS, R, T] WA10.3 Demonstrate using concrete, and pictorial models, and symbolic representations, understanding of measurement systems including:

i. Research how scientists examine changes to the key indicators of climate change (e.g., CO2 concentration, global surface temperature, Arctic sea ice area, land ice mass and sea level) to support the scientific understanding of climate change. (K, STSE, A)

j. Reflect upon individual and societal behavioural and lifestyle choices that can help to minimize anthropogenic sources of global climate change. (K, STSE)

SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect. [DM, SI]

e. Explain how greenhouse gases (e.g., water vapour, carbon dioxide, methane, nitrous oxide, sulphur dioxide and ozone), particles, clouds and surface albedo affect the amount of solar energy absorbed and re-radiated at various locations on Earth. (K)

f. Explain the role of natural sources (e.g., volcanoes, fire, evaporation and living organisms) of the primary greenhouse gases in Earth's atmosphere and how they contribute to the natural greenhouse effect. (K, A)

Scientific Inquiry [SI]

- planning investigations, including field studies and experiments;
- using tools to gather, analyze, and interpret data;
- proposing critical answers, explanations, and predictions.

Foundation 4: Attitudes

Appreciation of Science

Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural and ethical events.

Interest in Science

Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school and in the community.

Inquiry in Science

Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge.

Collaboration

Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school.

- The Système International (SI)
- The British Imperial system
- The US customary system.

[C, CN, ME, T, V]

WA10.4 Demonstrate, using concrete and pictorial models, and symbolic representations, understanding of linear measurement, including units in the SI and Imperial systems of measurement. [CN, ME, PS, R, T, V]

WA10.8 Demonstrate an understanding of primary trigonometric ratios (sine, cosine, and tangent). [CN, PS, R, T, V]

Workplace and Apprenticeship Mathematics 20

WA20.1 Expand and apply understanding of the preservation of equality including solving problems that involve the manipulation and application of formulae for volume and capacity, surface area, slope and rate of change, simple interest, and finance charges. [C, CN, ME, PS, R, T]

WA20.3 Extend and apply understanding of surface area, volume, and capacity using concrete and pictorial models and symbolic representations (SI or imperial units of measurement). [C, CN, ME, PS, V]

WA20.5 Extend and apply understanding of 3-D objects including:

- top, bottom, and side views
- scale diagrams.

[CN, R, T, V]

Stewardship Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment. **Safety** Students engaged in science and technology activities will be expected to demonstrate a concern for safety and doing no harm to themselves or others, including plants and animals.	WA20.10 Extend and apply proportional thinking to solve problems that involve unit analysis and scale. [C, CN, PS, R, T, V] ***Foundations of Mathematics 10*** FP10.3 Demonstrate understanding of SI and Imperial units of measurement including: • linear measurement • surface area of spheres, and right cones, cylinders, prisms, and pyramids • volume of spheres, and right cones, cylinders, prisms, and pyramids • relationships between and within measurement systems. [C, CN, ME, PS, R, V] FP10.4 Develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles. [C, CN, PS, R, T, V] ***Foundations of Mathematics 20*** FM20.3 Expand and demonstrate understanding of proportional reasoning related to: • scale diagrams • area • surface area [C, CN, PS, R, V] FM20.4 Demonstrate understanding of properties of angles and triangles including: • solving problems. [CN, PS, R, V] FM20.5 Demonstrate understanding of the cosine law and sine law (including the ambiguous case). [CN, PS, R] FM20.8 Demonstrate understanding of systems of linear inequalities in two variables. [CN, PS, T, V]

Activity 6: When Does It Make Sense to Switch?	
Climate and Ecosystem Dynamics SCI10-CD1 Assess the implications of human actions on the local and global climate and the sustainability of ecosystems. [CP, DM] a. Pose questions or problems relating to the effects of human actions on global climate change and the sustainability of ecosystems that arise from personal research. (A, S, STSE) b. Reflect upon your personal view of humanity's relationship with the environment. (STSE, A) f. Discuss why it is important to consider economic, social justice and environmental perspectives when examining sustainability. (STSE, A) j. Reflect upon individual and societal behavioural and lifestyle choices that can help to minimize anthropogenic sources of global climate change. (K, STSE) k. Develop, present and defend a position or course of action based on personal research related to mitigating the effects of global or local climate change or to enhancing the sustainability of an ecosystem, taking into account human and environmental needs. (S, A, STSE) ***Scientific Inquiry [SI]*** • making observations, including watching or listening to knowledgeable sources; • using tools to gather, analyze, and interpret data; • proposing critical answers, explanations, and predictions ***STSE Decision Making [DM]*** • evaluating the pros and cons for each action or solution; • making a thoughtful decision; • examining the impact of the decision; and, • reflecting back on the process of decision making. **Foundation 4: Attitudes** **Appreciation of Science** Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural and ethical events. **Interest in Science** Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school and in the community.	***Workplace and Apprenticeship Mathematics 20*** WA20.6 Demonstrate understanding of personal budgets and their importance for financial planning. [CN, PS, R, T, V] ***Foundations of Mathematics 20*** FM20.3 Expand and demonstrate understanding of proportional reasoning related to: • rates [C, CN, PS, R, V] FM20.8 Demonstrate understanding of systems of linear inequalities in two variables. [CN, PS, T, V]

Inquiry in Science Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge. **Collaboration** Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school. **Stewardship** Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment.	
Design Challenge: Climate in a Container	
Climate and Ecosystem Dynamics SCI10-CD2 Investigate factors that influence Earth's climate system, including the role of the natural greenhouse effect. [DM, SI] g. Design, construct and evaluate the effectiveness of a model used to illustrate the natural greenhouse effect, the reflectivity of Earth's surface or the relationship between Earth's axial tilt and the seasons. (S, STSE, A) h. Investigate, through laboratory activities or simulations, heat transfer in air and water, including heat involved in phase changes. (S, A) ***Scientific Inquiry [SI]*** • planning investigations, including field studies and experiments; • acquiring the resources (financial or material) to carry out investigations; • using tools to gather, analyze, and interpret data; • proposing critical answers, explanations, and predictions; and, • communicating the results to various audiences. ***Technological Problem Solving [TPS]*** • identifying a problem; • identifying alternative possible solutions and selecting one on which to work; • planning and building a prototype or a plan of action to resolve the problem; and, • testing, evaluating and refining the prototype or plan. ***STSE Decision Making [DM]*** • clarifying an issue; • generating possible courses of action or solutions; • making a thoughtful decision; • reflecting back on the process of decision making.	

Foundation 4: Attitudes **Appreciation of Science** Students will be encouraged to critically and contextually appreciate the role and contributions of science and technology in their lives and to their community's culture; and to be aware of the limits of science and technology as well as their impact on economic, political, environmental, cultural and ethical events. **Interest in Science** Students will be encouraged to develop curiosity and continuing interest in the study of science at home, in school and in the community. **Inquiry in Science** Students will be encouraged to develop critical beliefs concerning the need for evidence and reasoned argument in the development of scientific knowledge. **Collaboration** Students will be encouraged to nurture competence in collaborative activity with classmates and others, inside and outside of the school. **Stewardship** Students will be encouraged to develop responsibility in the application of science and technology in relation to society and the natural environment.	

Evidence for Climate Change

Curriculum Connections

Next Generation Science Standards (NGSS): Grades 9–12

Note: These curriculum connections are meant to be a quick reference guide only. If you have any suggestions for additional curriculum connections, or if you are aware of changes in your curriculum, please contact outreach@perimeterinstitute.ca.

* The performance expectations marked with an asterisk integrate traditional science content with engineering through a Practice or Disciplinary Core Idea.

Science Curriculum Connections
(April 2013)

Activity 1: Carbon Dioxide

Earth and Space Science

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. [Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants;

or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.]

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]

Activity 2: Climate Modelling

Earth and Space Science

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [Clarification

Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]

Activity 3: A Warming World

Earth and Space Science

HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.]

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HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for

climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]

Activity 4: The Impact of Transportation

Earth and Space Science

HS-ESS3-3. Create a computational simulation to illustrate the relationships among the management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.]

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future e impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.]

Engineering Design

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Activity 5: How Much Carbon Is in That Tree?

Earth and Space Science

HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.* [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]

Activity 6: When Does It Make Sense to Switch?

Earth and Space Science

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.* [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.]

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]

Design Challenge: Climate in a Container

Earth and Space Science

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

Engineering Design

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.