BIG IDEAS

Global Water Systems	**Global Warming and Climate Change**	**Land Use and Sustainability**	**Global Environmental Changes**
Human actions affect the quality of water and its ability to sustain life.	Human activities have caused changes in the global climate system.	Sustainable land use and food production will meet the needs of a growing population.	Living sustainably supports the well-being of self, community, and Earth.

Learning Standards

Curricular Competencies	**Content**
Students are expected to be able to do the following:	*Students are expected to know the following:*
Questioning and predicting	**Global Water Systems**

• Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest
 • Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world
 • Formulate multiple hypotheses and predict multiple outcomes
	• water quality:
	   − chemical and physical **parameters**
	   − **bio-indicators and indices**
	 • **availability** and **water use**
	 • **conservation** and **personal choices**

Planning and conducting	**Global Warming and Climate Change**

• 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
 • Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data
 • Apply the concepts of accuracy and precision to experimental procedures and data:
   − significant figures
   − uncertainty
   − scientific notation
	• global changes to Earth's climate **system**:
	   − greenhouse gases and Earth's **energy balance**
	   − **sinks and sources**
	 • **impacts** on society
	 • **mitigation** and **personal choices**
	 Land Use and Sustainability
	 • soil **quality**
	 • **land use** practices
	 • global **food security** and **technologies**
	 • **land management** and **personal choices**

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Learning Standards (continued)

Curricular Competencies	Content
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 - Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies - Construct, analyze, and interpret graphs, 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 - Describe specific ways to improve their investigation methods and the quality of the data - 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 bias in their own work and in primary 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 to evaluate claims in primary and secondary sources - Consider social, ethical, and environmental implications of the findings from their own and others' investigations - Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems - Assess risks in the context of personal safety and social responsibility	**Global Environmental Changes** - human **health and environmental impacts** of population growth **environmental ethics** - First Peoples **perspectives**, **philosophies**, and responsibilities

Learning Standards (continued)

Curricular Competencies	Content
Applying and innovating • Contribute to care for self, others, community, and world through individual or collaborative approaches • Co-operatively design projects with local and/or global connections and applications • Contribute to finding solutions to problems at a local and/or global level through inquiry • Implement multiple strategies to solve problems in real-life, applied, and conceptual situations • Consider the role of scientists in innovation **Communicating** • Formulate physical or mental theoretical models to describe a phenomenon • Communicate scientific ideas, 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	

	SCIENCE – Environmental Science
Big Ideas – Elaborations	**Grade 12**

Global Water Systems

Sample opportunities to support student inquiry:

- How does the amount and quality of water in our environment affect living things?
- How do humans affect global water systems?

Global Warming and Climate Change

Sample opportunities to support student inquiry:

- How do changes in the composition of the atmosphere lead to changes in the global climate?

Land Use and Sustainability

Sample opportunities to support student inquiry:

- How are your decisions around personal food consumption linked to global food security?

Global Environmental Changes

Sample opportunities to support student inquiry:

- How can we live responsibly in the local, national, and global community?
- How does society and governance contribute to sustainability?

Questioning and predicting:

Sample opportunities to support student inquiry:

- How can you decrease your personal contributions to greenhouse gas emissions?
- How much of your diet is produced within 100 km of your home?
- How much waste does your lifestyle generate?

Planning and conducting:

Sample opportunities to support student inquiry:

- How can the amount of particulate matter produced by an automobile's exhaust be measured?
- How can you measure the ecological footprint of your food choices?
- How can you measure the amount of landfill trash that you generate in one year?

Processing and analyzing data and information:

Sample opportunities to support student inquiry:

- What type of graph best illustrates the relationship between LEED building designs and energy use?
- How can the relationship between population growth and reduction of agricultural land be shown?
- How has the amount of trash generated per person changed over the past 200 years?
- How have rising mercury levels from industrial pollution affected the diet and health of Canada's northern First Peoples populations?
- How does the impact of rising global temperatures on populations in the Arctic compare with that in other parts of Canada?

Evaluating:

Sample opportunities to support student inquiry:

- How can we differentiate between anthropogenic and natural sources of atmospheric carbon dioxide?
- How can community gardens reduce the ecological footprint of our diet?
- How can we make more sustainable choices to reduce the amount of waste that we generate?

Applying and innovating:

Sample opportunities to support student inquiry:

- Which bylaws would you recommend for your community to reduce greenhouse gas production?
- How can we establish a school or community garden?
- How can the design of packaging be improved to reduce the amount of waste generated?

Communicating:

Sample opportunities to support student inquiry:

- How would you advocate for additional bike lanes in your community as a mechanism to reduce greenhouse gas emissions?
- How would you increase awareness of the availability of locally grown produce?

Global Water Systems

- **parameters:** measuring alkalinity, pH, dissolved oxygen, phosphate, temperature, turbidity, total dissolved solids, nitrate, hardness, conductivity, bacteria
- **bio-indicators and indices:**
  - species range of tolerance
  - Calculate species diversity indices (e.g., Shannon-Weiner diversity index).
- **availability:** water cycle, scarcity, global water crisis, trends
- **water use:** personal, industrial, commercial, recreational, agriculture, industry, municipal
- **conservation:** laws and regulations, habitat restoration, stream and shore cleanup, nutrient loading, protecting species at risk, controlling invasive species, local stewardship projects
- **personal choices:** rain harvesting, waste water recycling, mitigation, xeriscaping

Global Warming and Climate Change

- **system:** weather, climate, greenhouse effect, albedo effect, change over time, positive and negative feedback loops, global temperatures
- **energy balance:** conduction, radiation, convection, albedo, longwave and short wave radiation, atmospheric circulation and weather
- **sinks and sources:**
  - carbon dioxide (fossil fuels, deforestation, ocean)
  - nitrous oxide (soil cultivation, fertilizers, burning fossil fuels)
  - methane (livestock, rice cultivation, waste management)
- **impacts:** rising sea level, desertification, ocean acidification, polar regions, human health (e.g., changes in vectors)
- **mitigation:**
  - emission reductions, bike lanes, alternative energy
  - stabilizing the levels of heat-trapping greenhouse gases in the atmosphere
  - building and construction (e.g., LEED)
  - urban green spaces
  - laws and regulations
- **personal choices:** home energy use, sustainable transportation, vegetarian diet alternatives, recycle/upcycle

Land Use and Sustainability

- **quality:** types, texture, structure, moisture, pH, percolation, nutrient levels, microbes
- **land use:** landfills, waste, deforestation, erosion, desertification, habitat loss, urbanization, food production, harvesting, mining, golf courses
- **food security:** availability, food access, food use, distribution
- **technologies:** pollination, monocultures, crop rotations, fertilization, traditional ecological knowledge
- **land management:** local plantings, xeriscaping, green spaces, reforestation, harvesting regulations, ecotourism, parks and protected areas, agriculture land reserves, biogeoclimatic zones, laws and regulations
- **personal choices:** 100-mile diet, gardens, composting, organic, reduce, reuse, recycle

Global Environmental Changes

- **health and environmental impacts:** pollutants and toxins, ozone depletion (skin, eye, immune system), acute and chronic effects, air pollutants, atmospheric composition changes, hunger, disease, economic effects, resource use, habitat loss, IPAT model for understanding human impact

- **environmental ethics:** political, social, economic, environmental, cultural, and health considerations

- **perspectives, philosophies:** stewardship, role of traditional ecological knowledge, First Peoples laws of nature