BIG IDEAS

Diversity in Local Ecosystems	Processes and Changes in Local Ecosystems	Sustainability in Local Ecosystems	Conservation and Restoration of Ecosystems
Local environments contain diverse ecosystems with many roles and relationships.	• Interconnected systems sustain healthy ecosystems. • Ecosystem stability is an important result of sustainability	Human practices affect the sustainability of ecosystems.	Humans can play a role in conservation and restoration of ecosystems.

Learning Standards

Curricular Competencies	Content
Students are expected to be able to do the following: **Questioning and predicting** • 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 **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 • 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	*Students are expected to know the following:* **Diversity in Local Ecosystems** • **abiotic** and **edaphic** factors • biodiversity: – species and their **ecological roles** – **relationships and interactions** in ecosystems **Processes and Changes in Local Ecosystems** • **energy flow** • **matter cycles** • **population dynamics** and landscape **structure** • **change and stability** in ecosystems **Sustainability in Local Ecosystems** • **benefits** of healthy ecosystems • humans as agents of change: – First Peoples and other **traditional ecological knowledge** – **unsustainable and sustainable** ecosystem practices

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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	**Conservation and Restoration of Ecosystems** • **environmental stressors** challenge ecosystem integrity, health, and sustainability • ecological **restoration principles** and **practices** • First Peoples concept of interconnectedness as related to conservation and restoration • **engagement** in ongoing and potential stewardship projects

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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	

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Big Ideas – Elaborations

Diversity in Local Ecosystems

Sample opportunities to support student inquiry:

- What are the roles and relationships in an ecosystem in your local area?
- How do some of the roles and relationships in ecosystems contribute to biodiversity?
- Why is biodiversity an important feature of sustainable ecosystems?

Processes and Changes in Local Ecosystems

Sample opportunities to support student inquiry:

- How does energy drive ecological processes?
- How has an ecosystem in your local area changed over time?

Sustainability in Local Ecosystems

Sample opportunities to support student inquiry:

- How do human actions affect the sustainability of an ecosystem?
- How do healthy ecosystems influence the well-being of humans?

Conservation and Restoration of Ecosystems

Sample opportunities to support student inquiry:

- How can I become involved in a local stewardship project?
- How have First Peoples communities lived sustainably and conserved ecosystems?

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Curricular Competencies – Elaborations

Questioning and predicting:

Sample opportunities to support student inquiry:

- What is the biodiversity level within a local stream?
- What type of human activities has an ecosystem in your local area sustained over the years?
- How have your decisions affected an ecosystem in your local area?

Planning and conducting:

Sample opportunities to support student inquiry:

- How can we measure the biodiversity within a local stream?
- What stories describe the human activities that have shaped local ecosystems over the years?
- What tools and technology can you use to determine your local ecological footprint?

Processing and analyzing data and information:

Sample opportunities to support student inquiry:

- What is the relationship between water quality and biodiversity within a local stream?
- Who can you collaborate with to provide additional perspectives that will deepen your understanding of your findings?
- How can gross and net productivity within an ecosystem be calculated?

Evaluating:

Sample opportunities to support student inquiry:

- What other factors can be considered to determine the overall health of a local stream?
- How does traditional ecological knowledge compare and align with your findings?
- How has your ecological footprint affected productivity within an ecosystem in your local area?

Applying and innovating:

Sample opportunities to support student inquiry:

- What kind of changes can be made to improve the biodiversity of a local stream?
- How can traditional ecological practices inform possible future sustainable practices within an ecosystem in your local area?
- How can you engage in a local ecosystem restoration project?

Communicating:

Sample opportunities to support student inquiry:

- How can your findings be used to advocate for the importance of a local stream?
- How can you share the findings with local community groups?
- How can you share with others what you have learned from your experience with a local ecosystem restoration project?

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Content – Elaborations

Diversity in Local Ecosystems

- **abiotic:** sunlight, wind, temperature, water (pH, flow, dissolved oxygen, turbidity, salinity), soil (nutrients, minerals)
- **edaphic:** soils – pH, water content, temperature, acidity, aeration, nutrients
- **ecological roles:** niche, autotrophs, heterotrophs, producers, consumers, decomposers, scavengers, keystone species, indicator species
- **relationships and interactions:**
  - among species — predator-prey, competition, pollination, symbiosis, mutualism, parasitism, commensalism, mimicry
  - between biotic and abiotic-limiting factors
  - tolerances
  - biodiversity index

Processes and Changes in Local Ecosystems

- **energy flow:**
  - energy transfers, food webs, laws of thermodynamics
  - photosynthesis
  - chemosynthesis
  - trophic levels, biomass, energy pyramid, law of 10 (i.e., only 10% of energy is transferred from one trophic level to next higher level)
- **matter cycles:** water, nitrogen, carbon, phosphorus
- **population dynamics:**
  - exponential growth, logistic size, limiting factors, mortality, natality, growth rate, carrying capacity
  - species richness, species abundance (species diversity indices)
  - immigration, extinction, theory of island biogeography
- **structure:**
  - community — food chains, food web, cycles, trophic levels, populations
  - landscape structure (e.g., habitat fragmentation, scale and pattern, patches, connectivity, corridors, ecotones, edge effect)
- **change and stability:** natural disturbances, succession, equilibrium, resistance

Sustainability in Local Ecosystems

- **benefits:**
  - ecosystem goods and services (food, water, air, waste, habitat)
  - health and medicine
  - cultural, economic, social, and other values
  - natural capital, sustainable yield
- **traditional ecological knowledge:** local historical practices and ways of knowing (e.g., agriculture, ethnobotany, forestry, fisheries, mining, energy)

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- **unsustainable and sustainable:**
  - harvesting, resource extraction, population growth, urbanization, consumption, land use, habitat loss/fragmentation, climate change, pollution, disease
  - species at risk, extinctions, invasive species
  - traditional ecological knowledge practices (e.g., controlled burning, harvesting cycles)

Conservation and Restoration of Ecosystems

- **environmental stressors:** biological, physical, chemical, climatic, fire, radiation, thermal, pollution, harvesting of species, urbanization
- **restoration principles:**
  - recovery of an ecosystem's health, integrity, and sustainability
  - use of ecological, cultural, and historical sources
  - dynamic (processes or functions) attributes of ecosystems (e.g., predator-prey cycles, fire, nutrient cycling, hydrologic cycle, pollination, erosion control)
  - resistance
  - resiliency
  - stability
- **practices:** reclamation, rehabilitation, mitigation, ecological engineering, resource management (e.g., wildlife, fisheries, forestry), traditional ecological knowledge–based sustainable practices (e.g., prescribed fire, selective harvesting, plant propagation and pruning, clam gardens)
- **engagement:**
  - connecting with local leaders, including First Peoples leaders
  - advocate for and/or partner with conservation groups
  - increase awareness of local projects
  - citizen science projects (e.g., monitoring of local populations)
  - local stewardship projects (e.g., school gardens)
  - projects (e.g., habitat restoration, stream and shore clean-up, protecting species at risk, controlling invasive species)

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