BIG IDEAS

Life is a result of interactions at the molecular and cellular levels.	**Evolution** occurs at the population level.	**Organisms** are grouped based on common characteristics.

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 **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	*Students are expected to know the following:* • **levels of organization** • **cell structure and function** • sexual and asexual **reproduction** • **energy transformations** in cells • **viruses** • First Peoples understandings of **interrelationships between organisms** • **microevolution:** – adaptation to changing environments – **changes in DNA** – **natural selection** • **macroevolution:** – **speciation** – **processes of macroevolution** – **evidence for macroevolution** • artificial selection and **genetic modifications** • **single-celled and multi-celled organisms** • **trends in complexity** among various life forms • **evidence for phylogenetic relationships** • **taxonomic principles** for classifying organisms • binomial nomenclature • **First Peoples knowledge on classification** • similarities and differences between **domains and kingdoms**

Learning Standards (continued)

Curricular Competencies	Content
• 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 their 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	

Learning Standards (continued)

Curricular Competencies	Content
Applying and innovating • Contribute to care for self, others, community, and world through individual or collaborative approaches • Cooperatively 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 and 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**	

Big Ideas – Elaborations

- **Life:**
  Sample questions to support inquiry with students:
  - What debates are ongoing with the terms “living” and “non-living”?
  - What cellular processes allow organisms to live on land?
- **Evolution:**
  Sample questions to support inquiry with students:
  - What is the role of DNA in evolution and biodiversity?
  - What factors might influence speciation in your local environment?
- **Organisms:**
  Sample questions to support inquiry with students:
  - How is DNA analysis used to demonstrate the relatedness of species?
  - How can morphology provide evidence for relatedness?
  - Why do two organisms compete to coexist in the same niche?

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Curricular Competencies – Elaborations

- **Questioning and predicting:**
  Sample opportunities to support student inquiry:
  - What conditions are needed for life by different organisms?
  - How do changing climates, such as desertification of biomes, affect the organisms that live there?
  - Why are viruses considered to be living and non-living? Provide evidence to support or refute why they are considered living and non-living.
  - Consider evidence for the theories of evolution to develop a series of questions. Predict the answers.
  - Hypothesize why local organisms (e.g., snow geese) exhibit behavioural or migratory changes. What evidence can you gather to support your hypothesis?
- **Planning and conducting:**
  Sample opportunities to support student inquiry:
  - Use embryology examples to develop a method for demonstrating evolution. What kinds of resources would you need? What are the known and unknown variables?
  - Design an experiment to determine the effects of temperature on the rate of bacterial growth, coral growth, plant growth, etc.
  - Using a compound microscope, observe prepared slides of animal and plant cells. How can you increase the reliability of your observations?
  - Complete magnification calculations for biological diagrams of a protist.

- **Processing and analyzing data and information:**
  Sample opportunities to support student inquiry:
  - How do First Peoples traditional clam gardens increase biodiversity of species and population density of clams in the garden area?
  - Create a dichotomous key for local plant life.
  - Construct a graph to show the rate of bacterial growth at different temperatures.
  - Make a cladogram showing the patterns of body plans in plants and animals in different phyla.
  - Using a set of data about the development of agriculture in human history, determine the effects of artificial selection on the human species.
- **Evaluating:**
  Sample opportunities to support student inquiry:
  - What are the pros and cons of fish farms? Consider environmental effects and impacts on First Peoples fisheries.
  - Identify the limitations of the theories of evolution.
  - Consider how microscopy, over time, has informed our understanding of cells.
  - Debate the merits of mandatory labelling of genetically modified organisms.
  - Explore the social, ethical, and environmental implications of humans on evolution through artificial selection and genetic modifications.
- **Applying and innovating:**
  Sample opportunities to support student inquiry:
  - How can drug companies, health agencies, and governments work together to implement strategies to prevent pandemics (e.g., avian flu, Zika virus, H1N1)?
  - Using your knowledge of life cycles and ecosystem interactions, how can you help to preserve fish habitats in local rivers?
  - How has DNA research helped scientists better understand evolution?
  - Through the study of viruses and bacteria, how might scientists find new and innovative ways to prevent the spread of future diseases?
- **Communicating:**
  Sample opportunities to support student inquiry:
  - Using your knowledge of living things, develop a public relations message to educate about the need to preserve local habitats.
  - Invite a local First Peoples Elder to share their knowledge about the historical and contemporary use of traditional indigenous resources, including plants and animals.
- **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

- **levels of organization:** molecular, cellular, tissue, organ, organ system, organism, population, community, ecosystem
- **cell structure and function:**
  - prokaryotic and eukaryotic
  - unicellular and multicellular
  - cell specialization
- **reproduction:** mitosis, meiosis, budding, conjugation, binary fission
- **energy transformations:**
  - cellular respiration: glucose broken down in the presence of water yields energy (ATP) and carbon dioxide
  - photosynthesis: consumes carbon dioxide and water, produces oxygen and sugars
- **viruses:**
  - at the boundary of living and non-living
  - lytic and lysogenic cycles
  - viral disease: immunity, vaccines, herd immunity, reducing the spread of viral diseases (e.g., H1N1, avian flu, HIV, Ebola, STIs)
- **interrelationships between organisms:** plants as indicators of timing for corresponding events, decaying animals as plant nutrients
- **microevolution:** change within a species that occurs over time in a population
- **changes in DNA:** mutations, population genetics
- **natural selection:** mechanisms of gradual change
- **macroevolution:**
  - major evolutionary changes over long periods of time
  - origin of new species
- **speciation:**
  - neo-Darwinism (gradualism)
  - punctuated equilibrium
  - genetic drift
  - sexual selection
  - adaptive radiation
- **processes of macroevolution:**
  - divergent
  - convergent
  - co-evolution

Content – Elaborations

- **evidence for macroevolution:**
  - embryology
  - mitochondrial DNA
  - molecular evolution
  - fossil record
- **genetic modifications:** gene therapy, GMOs, ethical considerations
- **single-celled and multi-celled organisms:**
  - prokaryotic and eukaryotic
  - aerobic and anaerobic
  - sexual and asexual reproduction
- **trends in complexity:** symmetry, coelom, tissue development, transport, gas exchange, cephalization, reproduction, vascularization, alternation of generations, seed production
- **evidence for phylogenetic relationships:** DNA, biochemistry, anatomy, embryology, fossil evidence, biogeography
- **taxonomic principles:**
  - taxa: kingdom, phylum, class, order, family, genus, species
  - phylogenetic tree (cladogram)
  - dichotomous key
- **First Peoples knowledge on classification:**
  - classification of animals based on use (e.g., traditional clothing, food, hunting seasons)
  - classification of BC plants based on use (e.g., food, medicine)
- **domains and kingdoms:**
  - unifying criteria for classification
  - hierarchical nature of diversity
  - changing models based on emerging knowledge

