BIG IDEAS

Characteristics of Living Things	Process of Evolution	Taxonomy
All living things have common characteristics.	Living things evolve over time.	Organisms are grouped on the basis of identifiable similarities.

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 • 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	**Characteristics of Living Things** • cells are the basic unit of life: – **comparing cell structures** – prokaryotic and eukaryotic – unicellular and multicellular – cell specialization – **sexual and asexual reproduction** – **cellular respiration** and **photosynthesis** • viruses: – **basic structure** and function of a virus – lytic and lysogenic cycles – **effects of viruses on organisms**

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	**Process of Evolution** • evolutionary change: – role of DNA in evolution as a hereditary material – five **agents** of evolutionary change • **development** of the theory of evolution • **models of evolution** • speciation: – divergent evolution – convergent evolution – **co-evolution** • **trends in complexity** • artificial selection and **genetic modifications** **Taxonomy** • taxonomy **principles** for classifying organisms: – **taxons** – phylogenetic tree and **cladogram** – dichotomous key – First Peoples understandings of animal body plans – First Peoples uses of local plants • binomial nomenclature • unifying characteristics of the evolutionary continuum across the kingdoms: – **three domains** – **six kingdoms**

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**	

Big Ideas – Elaborations

SCIENCE – Life Sciences
Grade 11

Characteristics of Living Things

Sample opportunities to support student inquiry:

- What characteristics allow organisms to live on land?
- What unique characteristics allow organisms to live in extreme environments?

Process of Evolution

Sample opportunities to support student inquiry:

- What is the role of DNA in evolution and biodiversity?
- What characteristics allow organisms to live in unique environments?
- How might the range of abiotic and biotic characteristics on Earth help us to understand space exploration (e.g., extreme environments — Mars, moon)?

Taxonomy

Sample opportunities to support student inquiry:

- Why do two organisms compete to coexist in the same niche?
- How is DNA analysis used to demonstrate the relatedness of species?
- How can morphology indicate relatedness (e.g., dolphin and human hip structure)?

Curricular Competencies – Elaborations

SCIENCE – Life Sciences
Grade 11

Questioning and predicting:

- **sustained intellectual curiosity:**
  - What conditions are needed for life by different organisms?
  - How do changing climates such as desertification of biomes affect the organisms that live there?
- **Make observations aimed at identifying their own questions:** Consider a collection of pieces that are evidence for the theory of evolution to develop a series of questions and predict/infer the answers.
- **Formulate multiple hypotheses and predict:**
  - Why are viruses considered to be living and non-living?
  - Hypothesize why local organisms (e.g., snow geese) exhibit behavioural and/or migratory changes.

Planning and conducting:

- **plan:** Use predetermined fossil examples to develop a method for demonstrating evolution. What kinds of resources will be needed? What are the known and unknown variables?
- **investigation methods:** Design an experiment to determine the effects of temperature on the rate of diffusion.
- **collect reliable data:** Using a compound microscope, observe prepared slides of animal and plant cells.

- **appropriate SI units and appropriate equipment:** Complete magnification calculations for biological diagrams of a protist.
- **accurately collect and record data:** Conduct dissections (real or virtual) and compare body plans, structures, and functions of different organisms.

Processing and analyzing data and information:

- **Seek and analyze patterns:** Bears have special significance in many BC First Peoples cultures. Compare and contrast structures of humans and bears. What are some similarities and differences in the way humans and bears are adapted to their environments?
- **graphs:** Construct a graph to show the rate of diffusion at different glucose concentrations.
- **models:** Make a cladogram showing the patterns of body plans in plants and animals in different phyla.
- **conclusions that are consistent with evidence:** In First Peoples cultures, there are often concurrent environmental events, such as salmon berries ripening when the sockeye salmon run starts. Can you find similar concurrent events in your local environment?
- **cause-and-effect relationships:**
  - Using a set of data about the change in the amount of agriculture over time, determine the effects of artificial selection on the human species.
  - How do traditional First Nations clam gardens increase biodiversity of species and population density of clams in the garden area?

Evaluating:

- **limitations:**
  - Describe the limitations of microscopes in the investigation of viruses.
  - Identify the limitations of and modern discoveries supporting the theory of evolution.
- **tools and technologies:** Consider how microscopy has informed our understanding of cells.
- **evaluate claims:** Debate the merits of mandatory labelling of genetically modified organisms.
- **social, ethical, and environmental implications:** Explore the social, ethical, and environmental implications of humans on evolution through artificial selection and genetic modifications.
- **Assess risks:** What are the pros and cons of fish farms? Consider environmental effects and impacts on the First Nations fishery.

Applying and innovating:

- **Contribute:** How can drug companies, health agencies, and governments work together to implement strategies to prevent viral pandemics (e.g., avian flu, Zika virus, H1N1)?
- **real-life:** How can you help to preserve fish habitat in the rivers in your local area, using your knowledge of life cycles and survival needs?
- **applied, and conceptual:** How has the use of DNA research helped scientists better understand evolution?
- **role of scientists:** Through the study of viruses and bacteria, how might scientists find new and innovative ways to prevent the spread of future diseases?

Communicating:

- **Information:** Prepare biological diagrams of plant and animal cells.
- **evidence-based arguments:** Using your knowledge of living things, develop a public relations message to educate the public about the steps needed to preserve local habitats.
- **reflect on a variety of experiences, perspectives, and worldviews through place:** Invite an Elder to share oral history on the evolution of local plants and animals.

Content – Elaborations

Characteristics of Living Things

- **comparing cell structures:**
  - membrane-bound organelles or nucleus, lack of organelles
  - presence of a nucleus or not
  - difference in size
  - composition of cell wall
- **sexual and asexual reproduction:** mitosis, meiosis, budding, conjugation
- **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
- **basic structure:** antigens, membranous envelope, protein capsid, nucleic acid core (RNA or DNA)
- **effects of viruses on organisms:** immunity, vaccines, herd immunity, reducing the spread of viral diseases (e.g., H1N1, avian flu, HIV, Ebola, STIs)

Process of Evolution

- **agents:** mutation, genetic drift, gene flow, non-random mating, natural selection
- **development:** Lamarck, Lyell, Malthus, Darwin
- **models of evolution:** gradual change model, punctuated equilibrium model
- **co-evolution:** flowers and pollinators evolving together
- **trends in complexity:** body transport, gas exchange, cephalization, reproduction, symmetry, coelom, tissue development, vascularization
- **genetic modifications:** gene therapy, GMOs, ethical considerations

Taxonomy

- **principles:** DNA similarities, evolutionary relationships, biochemical relationships, homologous structures, embryological relationships
- **taxons:** kingdom, phylum, class, order, family, genus, species
- **cladogram:** a diagram that shows relations among organisms
- **three domains:** Bacteria, *Archaea*, *Eukarya*
- **six kingdoms:** Bacteria, *Arachaea*, *Protista*, *Fungi*, *Plantae* (e.g., algae, vascular and non-vascular plants, angiosperms and gymnosperms; traditional ecological knowledge and First Peoples' uses of plants), *Animalia* (e.g., *Porifera*, *Cnidarian*, *Nematoda*, *Arthropoda*, *Platyhelminthes*, *Annelida*, *Mollusca*, *Echinodermata*, *Chordata*)

