BIG IDEAS

Genes are the foundation for the diversity of living things.	Chemical processes require energy change as atoms are rearranged.	Energy is conserved and its transformation can affect living things and the environment.	The formation of the universe can be explained by the big bang theory.

Learning Standards

Curricular Competencies

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 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

- 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 (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

Content

Students are expected to know the following:

- DNA structure and function
- genes and chromosomes
- **simple patterns of inheritance**
- mechanisms for the diversity of life:
  - **mutation** and its impact on evolution
  - **natural** and **artificial selection**
- **applications of genetics** and **ethical considerations**
- rearrangement of atoms in chemical **reactions**
- acid-base chemistry
- law of conservation of mass
- **energy change** during chemical reactions
- **practical applications and implications** of chemical processes, including First Peoples perspectives
- law of conservation of energy
- **transformation** of **potential** and **kinetic** energy
- local and global **impacts of energy transformations** from technologies

Learning Standards (continued)

Curricular Competencies	Content
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 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 • Consider social, ethical, and environmental implications of the findings from their own and others' investigations • Critically analyze the validity of information in secondary sources and evaluate the approaches used to solve problems **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** • Formulate physical or mental theoretical models to describe a phenomenon • 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**	• **First Peoples perspectives on energy** • nuclear energy and **radiation**: – fission versus fusion – **technologies and applications**, and **implications** • formation of the universe: – big bang theory – **components of the universe over time** – **astronomical data and collection methods**

Big Ideas – Elaborations

SCIENCE
Grade 10

Genes are the foundation for the diversity of living things.

Sample questions to support inquiry with students:

- How does DNA result in biodiversity?
- How is the structure of DNA related to the function of DNA?

Chemical processes require energy change as atoms are rearranged.

Sample questions to support inquiry with students:

- In what ways do atoms rearrange during reactions?
- How is energy involved in chemical processes?
- What chemical processes — personal, local, or global — affect your life?
- What safety considerations need to be taken into account when dealing with chemicals?

Energy is conserved and its transformation can affect living things and the environment.

Sample questions to support inquiry with students:

- 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?

The formation of the universe can be explained by the big bang theory.

Sample questions to support inquiry with students:

- What evidence supports the big bang theory?
- How could you model the formation of the universe?
- How has the advancement of technology deepened our understanding of the universe?

Curricular Competencies – Elaborations

SCIENCE
Grade 10

Questioning and predicting:

Sample questions to support inquiry with students:

- How would you determine if characteristics are genetically inherited?
- Why do materials need different amounts of energy to start reacting?
- How are plants used by First Peoples in your local area?
- Why do some roller coasters go faster than others?
- How would you investigate the age of the universe?

Curricular Competencies – Elaborations

Planning and conducting:

Sample questions to support inquiry with students:

- How would you gather genetic data to study certain traits?
- What tools are needed to measure the energy absorbed or released in a reaction?
- How are traditional medicines prepared in your local area? What local protocols need to be considered?
- How would you design a roller coaster to test a variable?
- What criteria could be used to select the appropriate instruments for different astronomical investigations?

Processing and analyzing data and information:

Sample questions to support inquiry with students:

- How would you apply the laws of genetics to offspring?
- What are the implications of chemical processes in your personal, local, and global context?
- How would you safely determine the effects of a traditional medicine?
- What variables would affect your roller coaster's speed?
- How can you use multiple sources of data to support theories or conclusions about the universe?
- **ways of knowing:** Ways of knowing refers to the various beliefs about the nature of knowledge that people have. They can include, but are not limited to, First Peoples, gender-related, subject/discipline-specific, cultural, embodied, and intuitive beliefs about knowledge.

Evaluating:

Sample questions to support inquiry with students:

- What is the probability of offspring having specific genetic traits?
- What are possible sources of error when measuring energy change in a reaction?
- How are traditional medicines prepared for different uses?
- What factors would you change to increase the roller coaster's speed? Would it be appropriate to go faster? How would you improve your experiment?
- How can you support your work and the work of others as valid, free of bias, and acknowledging limitations?

Applying and innovating:

Sample questions to support inquiry with students:

- How can you use what you know about genetics to make a game or activity to help other students learn about heredity?
- How would you design an emergency response plan for a chemical spill in your area?
- How would you design a garden for your school that features local plants and considers appropriate plant choices?
- How would you build a cart for your roller coaster that has as little friction as possible?
- How are new technologies being used to extend the reach of human investigations into space?

Curricular Competencies – Elaborations

SCIENCE
Grade 10

Communicating:

Sample questions to support inquiry with students:

- How would you prepare for a debate on the pros and cons of genetically modified organisms?
- How would you best present the effects of adding industrial waste water to an aquatic ecosystem to different stakeholders?
- How does your garden filled with local plants contribute to your sense of place?
- How would you promote your roller coaster design based on scientific evidence?
- How can you create models to clearly communicate ways of knowing about the universe?
- **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

SCIENCE
Grade 10

The following elaborations are possible illustrations of the Content:

- **simple patterns of inheritance:** Mendelian genetics, Punnett squares, complete dominance, co-dominance, incomplete dominance, sex-linked inheritance
- **mutation:**
  - positive, negative, and neutral impacts
  - mutagens and carcinogens
- **natural selection:**
  - adaptive radiation
  - selection pressure (e.g., adaptation and extinction, invasive species)
  - adaptations
  - extinctions
- **artificial selection:**
  - agricultural examples (e.g., monoculture, polyculture, food sustainability)
  - breeding (plant and animal)
- **applications of genetics:** genomics, GMOs, gene therapy, cloning, stem cells, reproductive technology, species, population and ecosystems, forensics, genetic engineering
- **ethical considerations:** the health, environmental, social, and political implications of modern genetics
- **reactions:** types include synthesis, decomposition, single-double replacement, combustion/oxidation, neutralization
- **energy change:**
  - exothermic and endothermic
  - activation energy

Content – Elaborations

- **practical applications and implications:** household chemical safety (e.g., ammonia and bleach), combustion (e.g., kindling temperature, ignition point, oxygen concentration), polymer chemistry, semiconductors, resource extraction (e.g., ore, fracking), pulp and paper chemistry, food chemistry, corrosion/prevention, tanning, traditional medicines, phytochemistry, pharmaceuticals, environmental remediation, water quality, oil spill cleanup
- **transformation:**
  - transfer of energy in closed and open systems
  - heat ($Q = mc\Delta T$)
  - roller coasters, pendulums
- **potential:** stored energy (e.g., gravitational PE = mgh)
- **kinetic:** energy of motion ($KE = 1/2\ mv^2$)
- **impacts of energy transformations:** pollution, habitat destruction, carbon dioxide output
- **First Peoples perspectives on energy:** energy use and conservation include generational roles and responsibilities
- **radiation:** ionizing versus non-ionizing
- **technologies and applications:** stars, nuclear power, medical isotopes, tanning beds, dental X-rays, food irradiation, radioactive dating
- **implications:** positive and negative impacts, including environmental, health, economic
- **components of the universe over time:** changes to energy, matter, fundamental forces
- **astronomical data and collection methods:** different types of data are collected and analyzed as evidence to support theories about the universe (e.g., radio telescopes, background microwave radiation, red/blue shift (Doppler), Mars rover, SNOLAB, ISS, Canadarm/Dextre)