BIG IDEAS

Earth materials are changed as they cycle through the geosphere and are used as resources, with economic and environmental implications.	**Plate tectonic theory** explains the consequences of tectonic plate interactions.	The transfer of energy through the **atmosphere** creates weather, and this transfer is affected by climate change.	The distribution of **water** has a major influence on weather and climate.	Astronomy seeks to explain the origin and interactions of **Earth and its solar system**.

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:* • properties of earth materials: – **minerals** – **igneous rocks** – **sedimentary rocks** – **metamorphic rocks** – **geologic resources** • surface and internal **processes** of the rock cycle • **economic and environmental implications** of geologic resources within B.C. and globally • evidence that supports plate tectonic theory • factors that affect **plate motion** • First Peoples knowledge of local plate tectonic settings and geologic terrains • the **hydrologic cycle** • changes in the composition of the atmosphere due to natural and human causes • **weather** as the interaction of water, air, and energy transfer • solar radiation **interactions** and **impacts on the energy budget**

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 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	• **evidence of climate change** • First Peoples knowledge of climate change and interconnectedness as related to environmental systems • **water as a unique resource** • First Peoples knowledge and perspectives of water resources and processes • **properties of the ocean and the ocean floor** • local and global **ocean currents** • influences of large bodies of water on **local and global climates** • **effects of climate change** on water sources • the nebular hypothesis (explanation of the formation and properties of our solar system) • **Earth as a unique planet** within its solar system • **stars** as the centre of a solar system • impacts of the **Earth-moon-sun system** • application of space technologies to the study of changes in Earth and its systems

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 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

- **Earth materials:**
  Sample questions to support inquiry with students:
  - What role does the rock cycle play in the diversity of earth materials?
  - What criteria must be met for an earth material to be considered a “resource”?
- **Plate tectonic theory:**
  Sample questions to support inquiry with students:
  - What determines the type and distribution of volcanoes and earthquakes?
  - How does the local plate tectonic setting affect the people and geography of a region?
- **atmosphere:**
  Sample questions to support inquiry with students:
  - What are the relationships between heat transfer in the atmosphere and weather?
  - Why are extreme weather events predicted to become more frequent in the future?
- **water:**
  Sample questions to support inquiry with students:
  - How is the hydrosphere connected with the geosphere and the atmosphere?
  - Why might water be considered Earth’s most important resource?
- **Earth and its solar system:**
  Sample questions to support inquiry with students:
  - How was the solar system formed?
  - Why is Earth the only planet in our solar system that supports life?

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Curricular Competencies – Elaborations

- **Questioning and predicting:**
  Sample opportunities to support student inquiry:
  - Which geologic resources are found and extracted in B.C.?
  - How is the earthquake potential of an area, locally and globally, influenced by plate boundaries?
  - How do El Niño and La Niña events affect weather patterns locally and globally?
  - Predict positive and negative effects of an increased greenhouse effect.
  - How would Earth be different if we had more or less surface water?
  - Explore a First Peoples narrative based on celestial observations.

- **Planning and conducting:**
  Sample opportunities to support student inquiry:
  - Record qualitative and quantitative observations of a variety of earth materials based on their chemical and physical differences (e.g., fizz in acid, hardness, colour, crystal size, density).
  - Assess the safety risks and environmental issues of collecting rock samples from your local environment.
  - Determine which equipment is appropriate for accurately and precisely collecting and recording local weather-related data.
  - Record and visually present nightly qualitative observations of the moon for one month.
- **Processing and analyzing data and information:**
  Sample opportunities to support student inquiry:
  - Use multiple sources of evidence to explain how continents have shifted over time (e.g., fossil data, mountain ranges, coastline puzzle fit, paleo-glacial data, rock types).
  - Identify trends and patterns in the global distribution of earthquakes and volcanoes.
  - Identify cause-and-effect relationships that have contributed to the changing composition of our atmosphere over time.
  - What effect do acidic and alkaline solutions have on minerals and on living things?
  - Construct an accurate map of the ocean floor hidden inside a 3D “black box” simulation (e.g., teacher-created terrain inside a shoebox).
  - Identify and interpret patterns within our solar system (e.g., density, composition, structure, moons, temperature, orbit/spin, volcanism).
  - Classify stars in terms of their characteristics (e.g., luminosity, size) and identify trends on the Hertzsprung-Russell diagram.
  - Graph lunar and tidal data to determine the significance of the moon to Earth’s tides.
  - How do a lunar year and a solar year compare?
- **Evaluating:**
  Sample opportunities to support student inquiry:
  - How has industry in B.C. changed as resource technologies (e.g., exploration, extraction, refinement) have developed over time?
  - Evaluate the advantages and disadvantages of various extraction methods, such as open-pit versus underground mining, and fracking of geological oil and gas reservoirs.
  - Evaluate the validity and limitations of models of Earth’s interior.
  - How have First Peoples knowledge and oral traditions contributed to our understanding of geologic events in B.C.?
  - What does it mean for a company to be “carbon neutral”?
  - Identify the assumptions, bias, and questions that should be asked in order to assess whether all electric vehicles are better for the planet than other types of vehicles.
  - Consider the social, ethical, and environmental implications of rising global ocean temperatures.
- **Applying and innovating:**
  Sample opportunities to support student inquiry:
  - What are some possible innovations for the remediation of resource sites?

Curricular Competencies – Elaborations

- Consider the role of science in the development of new technologies used in the process of refining ores (e.g., bacteria).
- Investigate building techniques that are resistant to earthquake damage.
- How do First Peoples principles and knowledge guide our understanding and strategies for maintaining environmental systems?
- Identify the problems caused by an extreme weather event and propose possible solutions.
- How have science and technology worked together to further our understanding of the universe?

- **Communicating:**
  Sample opportunities to support student inquiry:
  - Create a visual representation to illustrate the importance of a mining or other earth material extraction operation to the local economy.
  - Create topographical maps and cross-sections of tectonic settings that represent mountain ranges, subduction zones, faults, and past earthquake data.
  - How does the tectonic setting of an area contribute to different people's perspectives, experiences, and sense of place?
  - How can the relative distances from the sun and the sizes of various planets, moons, and asteroids be modelled?
  - Develop a timeline that documents the major events in the formation of our solar system.
- **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.

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Content – Elaborations

- **minerals:**
  - common minerals found in igneous, metamorphic, and sedimentary environments
  - valuable, ore-forming minerals found in B.C.
- **igneous rocks:**
  - common types of igneous rocks (e.g., basalt, granite, pumice)
  - relationships between texture, crystal size, and rate of cooling
  - intrusive versus extrusive
- **sedimentary rocks:**
  - common types of sedimentary rocks (e.g., conglomerate, shale, coal, limestone)
  - chemical/biochemical versus clastic
- **metamorphic rocks:**
  - common types of metamorphic rocks (e.g., slate, schist, gneiss)
  - foliated versus non-foliated rocks

- **geologic resources:** for example, minerals, ores, fossil fuels, metals, aggregates
- **processes:** for example, weathering, erosion, melting, crystallization, metamorphism
- **economic and environmental implications:**
  - economic feasibility (e.g., price, concentration, accessibility, environmental concerns)
  - exploration methods (e.g., use of geochemical and geophysical data, field work, remote sensing, mapping, drilling)
  - extraction methods (e.g., open-pit versus underground mining, fracking of oil and gas reservoirs, methods of concentrating and refining ore minerals and fossil fuels)
  - site remediation (e.g., government regulations, failed tailings ponds, acid rock drainage, land reclamation)
- **plate motion:** Heat both from within the core and from excess radioactivity within the mantle contribute to ridge push and slab pull, as well as convection currents within the mantle.
- **hydrologic cycle:** driven by the transfer of energy within the atmosphere and hydrosphere
- **weather:**
  - air masses
  - air pressure
  - humidity and dew point
  - fronts and frontal systems
  - extreme weather events
  - local (e.g., on-shore breeze, tornadoes) and global (e.g., jet stream) air currents
  - El Niño and La Niña
- **interactions:** atmosphere, hydrosphere, geosphere
- **impacts on the energy budget:** both natural and man-made impacts, including:
  - greenhouse effect
  - albedo
  - changes to carbon sinks/sources
- **evidence of climate change:** both historical and recent (i.e., the last 100 years) climate change (e.g., ice core data, deep sea sediments, First Peoples knowledge)
- **water as a unique resource:**
  - fresh water (e.g., rivers, glaciers, groundwater)
  - salt water (e.g., oceans, salt lakes)
  - resource concerns (e.g., aquifer depletion, sea water intrusion, contamination from landfills and industry)
- **properties of the ocean and the ocean floor:** determined by remote sensing and direct observation
- **ocean currents:** dependent on salinity, temperature, and density

Content – Elaborations

- **local and global climates:**
  - local: on-shore breeze, temperature moderation
  - global: oceans as carbon sink, albedo effect
- **effects of climate change:** for example, ocean acidification, changes to ocean currents, loss of glaciers, rising sea levels
- **Earth as a unique planet:** for example, presence of water, life, protective magnetic field, temperature, atmosphere
- **stars:** stellar classification, life cycle, magnitude, brightness
- **Earth-moon-sun system:** for example, tides, eclipses, seasonal variation, albedo, precession, moon phases, solar winds

