CHEMISTRY 11

Big Ideas	Elaborations
Atoms and Molecules • Atoms and molecules are the fundamental building blocks of matter. • Chemical bonds are the result of electrostatic forces. • Periodicity can be explained by atomic structure.	*Sample opportunities to support student inquiry:* • How does the number of protons, electrons, and neutrons in an atom influence its properties? • How does the arrangement of electrons around the nucleus of an atom influence the chemical properties of an element? • How do the properties of the elements support their position on the periodic table?
The Mole • The mole is a convenient way to express quantities of particles.	*Sample opportunities to support student inquiry:* • How could you demonstrate Avogadro's hypothesis?
Chemical Reactions • The rearrangement of atoms in chemical reactions is predictable. • Matter and energy are conserved in chemical reactions. • Chemical reactions and their applications have significant implications for human health, society, and the environment	*Sample opportunities to support student inquiry:* • How could you measure negative and/or positive impacts of chemical reactions on human health, society, and/or the environment in your local community?
Solution Chemistry • Solubility within a solution is determined by the nature of the solute and the solvent. • Solution chemistry and its applications have significant implications for human health, society, and the environment.	*Sample opportunities to support student inquiry:* • How does the bent shape of the water molecule cause polarity? • Why do some materials dissolve in water or other liquids, but other materials do not?
MODULE YOU MAY CHOOSE TO INCLUDE:	
Organic Chemistry • Carbon's ability to form four bonds, with itself and other elements, results in a wide variety of organic compounds. • Organic chemistry and its applications have significant implications for human health, society, and the environment.	*Sample opportunities to support student inquiry:* • How do organic compounds differ in structure and properties? • How is carbon the basis for all living things? • How do the structure and geometry of organic compounds contribute to their usefulness in medicine?

Curricular Competencies	Elaborations	Content	Elaborations
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	*Sample opportunities to support student inquiry:* Questioning and predicting **problem of personal, local, or global interest:** Chemical Reactions • What are the applications of chemical reactions within your local community (e.g., smelting, pulp and paper industry, food chemistry, petrochemical smog)? Solution Chemistry • How do carbon dioxide solutions contribute to	THIS COURSE COMPRISES FOUR MODULES AND ONE MODULE (ORGANIC CHEMISTRY), WHICH TEACHERS MAY CHOOSE TO INCLUDE. *Students are expected to know the following:* Atoms and Molecules • **classification of matter** • **model of the atom** • the subatomic structures of atoms, ions, and **isotopes** • quantum mechanical model • **electron configuration** • Lewis structures	Atoms and Molecules • **classification of matter:** o the observable properties and characteristics of elements, compounds, and mixtures as they are related to the concept of atoms and molecules o solution versus pure substance • **model of the atom:** development of the model of the atom • **isotopes:** distinguish between atomic mass and mass number • **electron configuration:** o molecular geometry

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
- 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

climate change?

Organic Chemistry

- What aspects of organic chemistry apply to your life (e.g., medicine, nutrition, cosmetics, transportation)?

Planning and conducting

plan, select, and use appropriate investigation methods:

Atoms and Molecules

- Observe physical characteristics and chemical reactivity of families of elements.
- Relate spectral lines to the quantum mechanical model.

The Mole

- Demonstrate Avogadro's hypothesis (e.g., Zn and HCl to produce a mole of H_2 gas).

Chemical Reactions

- How would you measure negative and/or positive impacts of chemical reactions on human health, society, and/or the environment in your local community?
- safe preparation and collection of a gas (e.g., collection of hydrogen from the reaction of Zn and HCl by displacing water from a tube [single displacement reaction])
- safe test of a gas (e.g., testing hydrogen gas by igniting it with a glowing splint [synthesis reaction])

Solution Chemistry

- Perform trial-and-error precipitation reactions to determine basic solubility rules.
- Use a solubility chart to predict whether ions can be separated from solution through precipitation, and outline an experimental procedure that includes compound added, precipitate formed, and method of separation.

- **periodic table:**
    - chemical and physical properties of the elements
    - periodicity
    - the similarities and trends in the properties of elements
- **chemical bonding**

The Mole

- the significance and use of the mole
- Avogadro's hypothesis
- stoichiometric calculations (using significant figures) involving:
    - atomic mass, molecular mass, molar mass
    - molar quantities of **gases** at STP, SATP
    - molecular and empirical formulae to identify a substance

Chemical Reactions

- physical and chemical change
- the rearrangement of the atoms as bonds are broken and new bonds are formed
- **formula equations**:
    - **balancing**
    - predicting products and reactants
    - energy changes: ΔH
- stoichiometric calculations (using significant figures) involving:
    - mass
    - number of molecules
    - gas volumes
    - molar quantities
    - excess and limiting reactants
- **practical applications**, including local chemical processes

Solution Chemistry

- solubility of molecular and ionic compounds
- **dissociation of ions**
- polarity of water and other solvents
- **properties** of solutions
- solubility tables and predicting precipitates
- stoichiometric calculations (using significant

    - valence shell electron pair repulsion (VSEPR) theory
- **periodic table:** development of the periodic table
- **chemical bonding:** various types of chemical bonding:
    - based on electronegativity
    - names, formulas, and Lewis structures
    - polarity

The Mole

- **gases:** gas laws:
    - Boyle (PV)
    - Charles (VT)
    - Gay-Lussac (PT)
    - ideal gas

Chemical Reactions

- **formula equations:**
    - synthesis
    - decomposition
    - single replacement
    - double replacement
    - combustion
    - acid-base neutralization
- **balancing:**
    - coefficients
    - representation of solid, liquid, gas, or aqueous species
- **practical applications:**
    - smelting
    - pulp and paper industry
    - food chemistry
    - petrochemical smog
    - traditional First Peoples medicine preparation techniques

Solution Chemistry

- **dissociation of ions:**
    - equations
    - Lewis acids and bases
- **properties:**
    - physical
    - electrical conductivity

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

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

- Use solution chemistry analysis techniques to investigate local water, soil, and/or air samples.

Organic Chemistry
- Design and carry out a single-step synthesis of an ester (e.g., banana, orange, pineapple, wintergreen).

uncertainty:
The Mole
- Estimate the uncertainty in a measurement.
- Use significant figures to communicate the uncertainty in a measurement.

Chemical Reactions
- How would you estimate the uncertainty in a measurement?
- How would you use significant figures to communicate the uncertainty in a measurement?

Solution Chemistry
- How would you estimate the uncertainty in a measurement?
- How would you use significant figures to communicate the uncertainty in a measurement?

Processing and analyzing data and information
patterns:
Atoms and Molecules
- How does VSEPR theory allow you to predict the number and location of electrons in orbitals?

trends:
Solution Chemistry
- How is the solubility of ions related to their position on the periodic table?
- Using shared First Peoples knowledge, determine which traditional medicine might be used for a particular condition.

relationships between variables:
figures) involving:
  - molarity
  - **concentration of ions** in solution
- **analysis techniques**
- environmental impacts of **non-metal oxide solutions**

MODULE YOU MAY CHOOSE TO INCLUDE:
Organic Chemistry
- features and common applications of organic chemistry
- **bonds/forces** in organic compounds
- names, structures, and geometry of **simple organic compounds**
- common **functional groups**
- an **organic synthesis**

  - colligative
- **concentration of ions:**
  - dilution effect
  - when two solutions are mixed (assuming no reaction occurs)
- **analysis techniques:**
  - dissolved oxygen
  - pH
  - nitrates
  - phosphorus
- **non-metal oxide solutions:**
  - CO_2 (e.g., acid rain, ocean carbon uptake, greenhouse effect, contribution to climate change)
  - nitrogen oxides (e.g., pollution, petrochemical smog)

Organic Chemistry
- **bonds/forces:**
  - covalent, hydrogen
  - intra- and intermolecular forces
  - impact on properties
- **simple organic compounds:**
  - alkanes, alkenes, alkynes
  - structural isomers
- **functional groups:** common functional groups, including:
  - halogens
  - alcohols
  - carboxylic acids
  - ketones
  - amines
  - aldehydes
  - ethers
  - phenols
- **organic synthesis:**
  - single-step
  - multi-step

• 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	The Mole • What variables affect the behaviour of gases? Solution Chemistry • What variables affect: o solubility o concentration (molarity) o conductivity **analyze, and interpret graphs:** Atoms and Molecules • electronegativity • atomic radii • ionic radii Evaluating **uncertainty:** The Mole • Calculate uncertainty in derived values. Chemical Reactions • How would you calculate uncertainty in derived values? Solution Chemistry • How would you calculate uncertainty in derived values? **changes in knowledge over time:** Atoms and Molecules • the role technology plays in the evolution of the model of the atom Applying and Innovating **Contribute to finding solutions:** Solution Chemistry • What changes or solutions would you propose to address the concerns around carbon dioxide in the environment? Organic Chemistry		

- What changes or solutions would you propose to address or prevent an identified negative impact of an organic chemistry–related activity in your local community (e.g., disposal of pharmaceuticals, pesticide use and disposal, causes of ozone depletion, food industry, pollution)?

Implement multiple strategies to solve problems in real-life:

Chemical Reactions

- You have been hired by the local government in your community to consult on the chemistry of fireworks. Provide suggestions for a spectacular yet safe show.

Communicating

suggested course of action:

Chemical Reactions

- How would you best present your proposal for a fireworks show at a community information meeting?

Solution Chemistry

- How would you best present your solutions to the problem of waterway acidification to an audience of various stakeholders?

Organic Chemistry

- How would you best present your solutions to a local organic chemistry–related problem to an audience of various stakeholders?