# Board/Authority Authorized Course Framework Template

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| **School District/Independent School Authority Name:**<br>School District No. 8 (Kootenay Lake) | **School District/Independent School Authority Number (e.g. SD43, Authority #432):**<br>SD8 |
| **Developed by:**<br>Ms. Sherry Lynn McGregor | **Date Developed:**<br>March 9, 2018 |
| **School Name:**<br>L.V. Rogers | **Principal's Name:**<br>Tamara Malloff |
| **Superintendent Approval Date (for School Districts only):** | **Superintendent Signature (for School Districts only):** |
| **Board/Authority Approval Date:**<br>March 12, 2019 | **Board/Authority Chair Signature:** |
| **Course Name:**<br>Environmental Chemistry 12 | **Grade Level of Course:**<br>12 |
| **Number of Course Credits:**<br>4 | **Number of Hours of Instruction:**<br>120 |

**Prerequisites:** Chemistry 11 & Pre-calculus 11

**Special Training, Facilities or Equipment Required:**
Ability to swim, adequate physical fitness for outdoor pursuits, basic outdoor wear, hiking boots, and rubber boots or hip-waders.

**Course Synopsis:**
This course is designed to help students gain an appreciation of the real-world applications of science and in particular, chemistry. In addition, it is hoped that students will gain an appreciation for their surrounding ecosystem and humans' impact on it.

To begin the course, students will review their knowledge of chemistry, ecosystems, and nutrient cycles. Students will then explore possible sources, impacts, and signs of pollution within an ecosystem. The focus will primarily be on our local ecosystems, but more global situations will be discussed.

It is hoped that the opportunity will exist for students to meet and learn from local scientists and community members. Local historical events will invariably have to be covered due to their impact on ecosystems. Local traditional ecological knowledge will be a large portion of the course and will be integrated wherever applicable.

Once the background science is covered, students will learn about environmental field assessment techniques. This will include scientific journaling, cleaning and calibration of equipment, sampling collection, safety in the field, and transportation of collected samples back to the lab.

Laboratory testing will be a large component of the course. Students will learn to measure pH, dissolved oxygen, phosphates, nitrates, turbidity, and fecal coliform, among other test.

Finally, students will prepare a scientific report on their findings from all field studies accomplished. Statistics and scientific writing will be covered at this point. In addition, students will be required to use technology to aid in the communication of their findings. Their final assessment will be the presentation of their findings to other students, community and/or family members, or school personnel.

This is designed to be primarily a hands-on course. To keep costs down, local ecosystems will assessed. Travel will mostly be by foot, but small half-day trips may be necessary. All testing will follow industry protocols as much as possible. This will allow for yearly data to be compared and trends over time to be studied.

The course would support students looking toward a future in Science or Applied Science areas. In addition, students will benefit from increased environmental literacy.

**Rationale:**
Chemistry and General Science courses have become increasingly theory based. Hands-on and experiential education has given way to paper test-based, data-generating outcomes. Science is a verb and it is all around us. This course was created in response to the current direction of the ministry away from the true nature of science. Also students, with all the technology at their fingertips are becoming increasingly disconnected from the natural world.

Many students at L.V. Rogers Secondary are expressing a keen interest in the environment. This has been demonstrated by the popularity of our environmental, global perspective, and social justice programs. In addition, many school clubs have been created around the issues of social justice and the environment. It is expected that students will have an interest in this course.

**Goals:**
- Develop an understanding of the impact humans and their activities affect the local and global environment
- Develop an understanding of the practical applications of environmental chemistry
- Develop skills necessary to analytically study the chemistry of the environment
- Effectively communicate the results and findings of a large scientific study
- Develop a more intimate knowledge of the local biotic and abiotic environment and ecosystem

**Aboriginal Worldviews and Perspectives:**

Declaration of the First Peoples' Principals of Learning:

- Environmental responsibility ultimately supports the well-being of the community, the land, the spirits, and the ancestors.
- Learning Is holistic, reflexive, reflective, experiential, and relational (focus on connectedness, on reciprocal relationships, and a sense of place.
- The study of the environment involves recognizing the consequences of human actions.
- Chemistry involves professional roles and responsibilities.
- Holistic science recognizes the role of indigenous knowledge.
- Learning is embedded in memory, history, and story.
- Scientific study involves patience and time.
- Scientific knowledge involves recognizing that some knowledge is only shared with permission and/or in certain situations.

Declaration of Aboriginal Worldviews and Perspectives:

Many of the First Peoples' Principals of Learning are inherent in the aspects included in Environmental Chemistry 12. Environmental Chemistry is inseparable from connectedness and relationships, specifically:

- Reciprocal relationship with the local environment
- Local focus
- Experiential (hands-on) learning
- The power of story
- Community involvement
- Processes and protocols
- Leadership
- Focus on the well-being of the local environment for future generations

**Recommended Instructional Components:**

- Explicit instruction
- Experiential learning
- Independent instruction
- Modeling
- Group work
- Independent Study
- Indirect Instruction
- Peer Assessment
- Self Assessment

**Recommended Assessment Components:**

Tests and Quizzes: (10%) For the theory-based portions of the course, tests and quizzes will be necessary. It will assess whether or not the students is aware of the protocols and standards associated with testing water, soil and air samples and, therefore, ready to go out into the field.

Lab Reports: (20%) Students will be required to provide periodic scientific reports on the testing done prior to that point. They will be assessed on completeness, neatness, data collection, data presentation, and conclusions drawn.

Assignments: (10%)

Scientific Processes and Behaviours: (20%) Rubrics will be created to assess a student's scientific skills. These will include (but are not limited to) cooperation, safety, focus, sampling techniques, inquiry, and lab work.

Journal: (10%) Students will keep a lab journal in which they will record all data and observations during field work and subsequent lab test. It will be assessed on neatness and completeness and thoroughness.

Year-end Presentation: (30%) Students will be responsible for a portion of the final presentation. The student will create and present this portion to an audience. Many things will be assessed here such as: presentation skills, quality of output, and continuity with other students' portions. This is their final project and will be in lieu of a final exam.

**Learning Resources:**

- Elders (Siniixt and Ktunaxa where possible)
- Community members
- Toni Appleby – Aboriginal Support Worker
- Local Scientists
- *Kootenay Lake: Compilation and Synopsis of Physical, Chemical and Biological Data From 1968 to 1984*. Richard J. Crozier and William F. A. Duncan
- *Environment 203: Aquatic Monitoring and Sampling, Standard Operating Procedures Manual, Camosun College: Environmental Technology Program,* R. Warren Drennan
- *Rivers Curriculum Guide: Chemistry*, Dr. Robert Williams, et al.
- *Chemistry: An Environmental Perspective*, Phyllis Buell and James Girard.
- *Project Soils Activity Guide, 2nd edition*, Saskatchewan Soil Conservation Association, Inc, 1995
- *Project Wet*, Council for Environmental Education, 1996
- Environmental Chemistry, 4th edition, Stanley E. Manahan, 1984

**Additional Information:**

none

**Area of Learning: SCIENCE – Environmental Chemistry**

Course Name: Environmental Chemistry 12 Grade: 12

**BIG IDEAS**

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| Chemistry (and all science) is a unique way to study the world around us | Water, soil and air have unique chemical properties | Human activities have far-reaching and varied impacts on the local environment | Scientific study of the environment requires safe, standard, and strict protocols to be recognized as credible | The culmination of scientific studies requires communication and presentations of findings |

**Learning Standards**

| Curricular Competencies | Content |
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| *Students are expected to do the following:*<br><br>**Questioning and Predicting**<br><br>• Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest<br>• Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world<br>• Formulate multiple hypotheses and predict multiple outcomes<br><br>**Planning and Conducting**<br><br>• Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)<br>• Demonstrate safe practices when in the field<br>• Demonstrate use of protocols when taking samples from the environment<br>• Demonstrate the ability to work cooperatively as a member of a group<br>• Demonstrate safe lab procedures<br>• Assess risks and address ethical, cultural and/or environmental issues associated with their proposed methods | *Students are expected to know the following:*<br><br>• Chemistry is the study of matter and its properties<br>• Identify chemical reactions associated with natural water, atmosphere and soil chemistry<br>• The components of a healthy ecosystem<br>• The identity of possible impacts of pollution on ecosystems<br>• Describe the characteristics of local bodies of water<br>• Describe the characteristics of local soil<br>• Describe the characteristics of local air/atmosphere<br>• Analyze local industries, past and present, for their possible impacts on local ecosystems<br>• Outline the processes for testing and controlling air pollution<br>• Outline the processes for testing and controlling water pollution<br>• Outline the processes for testing and controlling soil pollution<br>• Assess the scope and impact of pollution on soil, water, and air |

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| • Ensure that safety and ethical guidelines are followed in their investigations<br>• Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data<br>• Apply the concepts of accuracy and precision to experimental procedures and data:<br>— significant figures<br>— uncertainty<br>— scientific notation<br><br>**Processing and Analyzing Data and Information**<br><br>• Experience and interpret the local environment<br>• Apply First Peoples perspectives and knowledge, other **ways of knowing**, and local knowledge as sources of information<br>• Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies<br>• Construct, analyze and interpret graphs, models and/or diagrams<br>• Use knowledge of scientific concepts to draw conclusions that are consistent with evidence<br>• Analyze cause-and-effect relationships<br><br>**Evaluating**<br><br>• Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions<br>• Describe specific ways to improve their investigation methods and the quality of the data<br>• Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modeled<br>• Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and secondary sources<br>• Consider the changes in knowledge over time as tools and technologies have developed<br>• Connect scientific explorations to careers in science<br>• Exercise a healthy, informed skepticism, and use scientific knowledge and findings to form their own investigations and to evaluate claims in secondary sources<br>• Consider social, ethical, and environmental implications of the findings from | • Analyze and outline techniques used by government and industry to monitor water, soil and air samples<br>• Outline the characteristics of technical writing and scientific reports. |

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| their own and others' investigations<br>• Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems<br><br>**Applying and innovating**<br><br>• Contribute to care for self, others, community, and world through individual or collaborative approaches<br>• Transfer and apply learning to new situations<br>• Generate and introduce new or refined ideas when problem solving<br>• Contribute to finding solutions to problems at a local and/or global level through inquiry<br>• Consider the role of scientists in innovation<br>• Formulate physical or mental theoretical models to describe a phenomenon<br>• Assess risks in the context of personal safety and social responsibility<br><br>**Communicating**<br><br>• Formulate physical or mental theoretical models to describe a phenomenon<br>• 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<br>• Express and reflect on a variety of experiences, perspectives, and worldviews through **place** | |

| **Big Ideas - Elaborations** |
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| **Chemistry (and all science) is a unique way to study the world around us:**<br>• Use elements of the scientific method in the study of a local ecosystem<br><br>**Water, soil and air have unique chemical properties:**<br>• Describe the analyze characteristics of local bodies of water<br>• Describe and analyze characteristics of local samples of soil<br>• Describe and analyze characteristics of local samples of air<br><br>**Human activities have far-reaching and varied impacts on the local environment:**<br>• Test local samples for types of water pollution including disease-causing agents, oxygen consuming wastes, plant nutrients, suspended solids, dissolved solids, toxic substances, thermal pollution, radioactive substances, acids, and acids<br>• Analyze local industries, past and present, for their possible impacts on local ecosystems |

- Compare different types and processes of water treatment including local methods
- Outline the processes for testing and controlling air pollution
- Outline the processes for testing and controlling water pollution
- Outline the processes for testing and controlling soil pollution
- Assess the scope and impact of pollution on soil, water, and air

**Scientific study of the environment requires safe, standard, and strict protocols to be recognized as credible:**

- Test local samples for types of water pollution including disease-causing agents, oxygen consuming wastes, plant nutrients, suspended solids, dissolved solids, toxic substances, thermal pollution, radioactive substances, acids, and acids
- Analyze and outline techniques used by government and industry to monitor water samples
- Analyze and outline techniques used by government and industry to monitor air samples
- Analyze and outline techniques used by government and industry to monitor soil samples

**The culmination of scientific studies requires communication and presentations of findings:**

- Analyze data obtained from local water, soil and air samples to determine the level of pollution on an ecosystem
- Create a presentation with Power Point or similar software to report findings to others
- Present report finding to a group of peers, community or family members, or school personnel.
- Maintain a scientific journal including dates, locations, observations, measurements taken, sampling techniques used, tests performed and results of those tests.

**Curricular Competencies - Elaborations**

**Questioning and Predicting:**

- Analyze and outline techniques used by government and industry to monitor water samples
- Analyze and outline techniques used by government and industry to monitor air samples
- Analyze and outline techniques used by government and industry to monitor soil samples

**Planning and Conducting:**

- Demonstrate safe lab procedures
- Demonstrate proficiency in using testing kits and lab procedures used to analyze air, water, and soil samples
- Assess risks and address ethical, cultural and/or environmental issues associated with their proposed methods
- Ensure that safety and ethical guidelines are followed in their investigations
- 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:**

- Demonstrate proper cleaning, labeling, and care of sample bottles used for environmental assessments
- Demonstrate safe practices when in the field
- Demonstrate use of protocols when taking samples from the environment
- Demonstrate the ability to work cooperatively as a member of a group
- Demonstrate safe lab procedures
- Demonstrate proficiency in using testing kits and lab procedures used to analyze air, water, and soil samples
- Utilize statistics to validate and present final results
- Analyze and outline techniques used by government and industry to monitor water samples
- Analyze and outline techniques used by government and industry to monitor air samples
- Analyze and outline techniques used by government and industry to monitor soil samples

**Evaluating** :

- Demonstrate safe lab procedures
- Demonstrate proficiency in using testing kits and lab procedures used to analyze air, water, and soil samples
- Assess risks and address ethical, cultural and/or environmental issues associated with their proposed methods
- Ensure that safety and ethical guidelines are followed in their investigations
- 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

**Communicating:**

- Create a presentation with Power Point or similar software to report findings to others
- Present report finding to a group of peers, community or family members, or school personnel.
- Maintain a scientific journal including dates, locations, observations, measurements taken, sampling techniques used, tests performed and results of those tests

**Content - Elaborations**

**Chemistry (and all science) is a unique way to study the world around us:**

- Differences, similarities and relationships between science and technology
- Describe chemistry as the study of matter and its properties
- Describe biotic and abiotic components of ecosystems

**Water, soil and air have unique chemical properties:**

- Explain the sources and impacts of CO, $CO_2$, $SO_2$, $NO_2$, NO, $SO_3$, particulates, and organic compounds in the atmosphere
- Describe air pollutants as primary or secondary
- Explain the source and impact of photochemical smog
- Identify chemical reactions associated with natural water, atmosphere and soil chemistry
- Describe the water cycle and predict the potential impact of disruptions or contamination on the system
- Describe the characteristics of local bodies of water
- Define and describe the major layers of the atmosphere and their properties
- Describe the chemical and photochemical reactions in the atmosphere
- Describe the characteristics and chemical composition of natural soil, rivers, lakes, and air
- Demonstrate an understanding of pH, acidity, and alkalinity, biological oxygen demand, and other indications of air, water, and soil health

**Human activities have far-reaching and varied impacts on the local environment:**

- identify types of water pollution including disease-causing agents, oxygen consuming wastes, plant nutrients, suspended solids, dissolved solids, toxic substances, thermal pollution, radioactive substances, acids, and acids
- Describe pollution as point source or non-point source.
- Analyze local industries, past and present, for their possible impacts on local ecosystems
- Compare different types and processes of water treatment including local methods
- Describe the impact of temperature inversions with respect to pollution and air quality
- Outline the processes for testing and controlling air pollution
- Assess the scope and impact of pollution on soil

**Scientific study of the environment requires safe, standard, and strict protocols to be recognized as credible:**

- Analyze and outline techniques used by government and industry to monitor water samples
- Analyze and outline techniques used by government and industry to monitor air samples
- Analyze and outline techniques used by government and industry to monitor soil samples

**The culmination of scientific studies requires communication and presentations of findings:**

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