

Operation Water Biology Curriculum Connections

- ❖ Teaches students about chlorine, chloramine, ammonia, iron, and biological water treatment (a more environmentally friendly method of treating water).
- ❖ This program is made up of 8 lesson plans (7 and 8 are optional, but suggested)
- ❖ Applies to Grades 9 - 12
- ❖ Curriculum Connections Last Updated in the summer of 2015.

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Alberta

Grade Nine

Science

Curriculum Last Updated: 2014

Unit C: Environmental Chemistry (Social and Environmental Emphasis)

- 1: Investigate and describe, in general terms, the role of different substances in the environment in supporting or harming humans and other living things
- 2: Identify processes for measuring the quantity of different substances in the environment and for monitoring air and water quality

- 3: Analyze and evaluate mechanisms affecting the distribution of potentially harmful substances within an environment

Grade Eleven

Science

Curriculum Last Updated: 2014

Unit A: Chemical Changes

- 1: Investigate aqueous solutions to determine conductivity and to calculate concentration
- 2: Explain oxidation, reduction and spontaneity and apply this knowledge to voltaic and electrolytic cells and to industrial processes

Chemistry

Curriculum Last Updated: 2014

Unit C: Matter as Solutions, Acids and Bases

- 1: Investigate solutions, describing their physical and chemical properties

Grade Twelve

Chemistry

Curriculum Last Updated: 2014

Unit B: Electrochemical Changes

- 1: Explain the nature of oxidation-reduction reactions
- 2: Apply the principles of oxidation-reduction to electrochemical cells

British Columbia**Grade Nine****Science****Curriculum Last Updated: 2006**

A1: Perform experiments using the scientific method

A5: Demonstrate ethical, responsible, cooperative behaviour

- Lesson 5 is a great opportunity for students to demonstrate ethical behaviour, open-mindedness, and respect for the contributions of others; through learning about the inadequate drinking water in their surrounding areas

C4: Describe changes in the properties of matter

- Differentiate between chemical changes to water and citing their observations.
- Properties such as Ammonia, Chloramine, Chlorine, and Iron

Grade Ten**Science****Curriculum Last Updated: 2008**

A1: Perform experiments using the scientific method

A5: Demonstrate ethical, responsible, cooperative behaviour

- Lesson 5 is a great opportunity for students to demonstrate ethical behaviour, open-mindedness, and respect for the contributions of others; through learning about the inadequate drinking water in their surrounding areas

B1: Explain the interaction of abiotic and biotic factors within an ecosystem

- Better understand relationships between abiotic (water) and biotic (bacteria) elements within an ecosystem
- Experiment with the effects of altering biotic or abiotic factors (ex. removing iron from water)
- Identify some effects on living things within an ecosystem resulting from changes in abiotic factors (ex. water contamination)

**Grade Eleven
Biology****Curriculum Last Updated: 2006****A2: Design an experiment using the scientific method**

- Formulate and carry out a repeatable, controlled procedure to test the hypothesis
- Observe, measure and record data
- Draw conclusions from results

A3: Interpret data from a variety of text and visual sources

- Using the data found throughout the lessons students will be able to make inferences and generalizations
- Draw and present conclusions

E4: Evaluate the effectiveness of various antibiotics, disinfectants, or antiseptics on bacterial cultures

- Conduct an experiment to test the effects on water of various agents

Chemistry**Curriculum Last Updated: 2006****A1: Demonstrate appropriate safety techniques and proper use of protective equipment**

- Identify the safety and protective equipment available in the laboratory and describe how and when to use each piece of the kit
- Throughout the lessons, students will perform laboratory experiments in a safe manner

A2: Demonstrate skills in measuring and in recording data**A3: Communicate results and data in clear and understandable forms**

- Produce reports in the required format
- Draw appropriate connections between objectives and conclusions

D1: Explain chemical reactions in terms of rearrangement of the atoms as bonds are broken and new bonds are formed

- Observe and record changes that occur during a chemical reaction (ex. the reaction between chlorine and ammonia creating chloramine)

Earth Science

Curriculum Last Updated: 2006

C2: Assess the extraction and use of geological resources

- Identify environmental problems (ex. water contamination) related to development of a natural resource (such as water)
- Suggest strategies to conserve both material and energy resources

Grade Twelve

Biology

Curriculum Last Updated: 2006

A2: Design an experiment using the scientific method

- Formulate and carry out a repeatable, controlled procedure to test the hypothesis
- Observe, measure and record data
- Draw conclusions from results

A3: Interpret data from a variety of text and visual sources

- Using the data found throughout the lessons students will be able to make inferences and generalizations
- Draw and present conclusions

B2: Describe the characteristics of water and its role in biological systems

- Describe the role of water and understand the chemicals it is treated with and for
- Perform calculations involving concentration, volume and dilution factors

Chemistry

Curriculum Last Updated: 2006

A1: Demonstrate awareness that reactions occur at differing rates

- Give examples of reactions proceeding at different rates

G1: Describe oxidation and reduction processes

- Define and identify oxidation, reduction, reducing agent, etc.

H2: Describe how electrochemical concepts can be used in various practical applications

- Give examples of applications of electrochemical cells (ex. Hydrogen-oxygen fuel cells) and explain how each functions.

Manitoba
Grade Ten
Science

Curriculum Last Updated: 2001

Cluster 1: Dynamics of Ecosystems

- S2-1-03 Describe bioaccumulation and explain its potential impact on consumers
- S2-1-10: Investigate how human activities affect an ecosystem and use the decision-making process to propose a course of action to enhance its sustainability

Grade Eleven
Biology

Curriculum Last Updated: 2010

Unit 5: Protection and Control

- B11-5-02: Describe the body's response to allergens, vaccines, and viruses/bacteria

Chemistry

Curriculum Last Updated: 2006

Topic Four: Solutions

- C11-4-13: Differentiate among, and give examples of, the use of various representations of concentration.
- C11-4-14: Solve problems involving calculation for concentration, moles, mass, and volume.
- C11-4-15: Prepare a solution, given the amount of solute (in grams) and the volume of solution (in milliliters), and determine the concentration in moles/litre.
- C11-4-16: Solve problems involving the dilution of solutions.
- C11-4-17: Perform a dilution from a solution of known concentration.
- C11-4-18: Describe examples of situations where solutions of known concentration are important.
- C11-4-19: Describe the process of treating a water supply, identifying the allowable concentrations of metallic and organic species in water suitable for consumption.

New Brunswick

Grade Nine

Science

Curriculum Last Updated: 2002

Unit 2: Physical Science: Atoms and Elements

- 307-12: Investigate materials and describe them in terms of their properties
- 307-13: Describe changes in the properties of materials that result from some common chemical reactions

Grade Ten

Science

Curriculum Last Updated: 2002

Unit 1: Life Science: Sustainability of Ecosystems

- 318-1: Illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen
- 318-6: Explain how biodiversity of an ecosystem contributes to its sustainability
- 331-6: Analyze the impact of external factors on an ecosystem

Grade Eleven

Biology 111/112

Curriculum Last Updated: 2008

Unit 2: Biodiversity

- 331-6: Analyze the impact of external factors on an ecosystem

Unit 3: Maintaining Dynamic Equilibrium

- 314-1: Identify chemical elements that are commonly found in living systems
- 314-2: Identify the role of compounds, such as water, found in living systems
- 314-3: Identify and describe the structure and function of important biochemical compounds, including carbohydrates, proteins and lipids

Environmental Science 120

Curriculum Last Updated: 2012

Unit 1: An Overview of Environmental Science

- Explore and communicate current understanding of local, regional and global environmental issues

- Identify ways to measure environmentally sustainable behaviours, and describe links to economic and social factors
- Become aware of the range of issues arising from overpopulation and human activity
- Explore one or a few local or regional issues with respect to the impact on the environment, and on history, economics and social systems
- Practice research and presentation skills including experimenting to test environmental impact, identifying and accessing various organizations for information and expertise, and considering the legislation which impacts on environmental issues.
- Explore how technology is used to gather and communicate information, and to address the issues

Unit 2: Sustainable Development

- Recognize that humans are just one part of a complex system of living things, with an inordinate impact on the biosphere, often accelerated by the use of technology
- Explore how the development of technologies has affected land and water use
- Find examples of development that is sustainable and is not sustainable - ecologically, economically, socially, and culturally

Unit 3: Optional topics for Study (Fresh Water Use)

- Describe water use, locally, nationally, and globally
- Develop an understanding of the natural fresh water ecology and the impact of people
- Design and carry out an experiment to test the impact of people on fresh water ecology
- Describe ways in which we can use water more sustainably
- Contact relevant local, regional and/or national organizations and government agencies, and identify their mandate and perspective on water issues
- Demonstrate the effective and critical use of a variety of investigation and research methods

Newfoundland and Labrador Secondary Grades Environmental Science 3205

Unit 1: Introduction to Environmental Science

- 1.11: Define environmental Conservation
- 1.16: Recognize that environmental monitoring is an essential component of sustainability
- 1.19: Describe your community's impact on the environment
- 1.20: Describe environmental responsibility
- 1.21: Define eco-citizenship
- 1.40: Identify career opportunities related to the study of environmental issues

Unit 4: Water Use and the Environment

- 4.02: Recognize that water is a finite resource
- 4.12: Identify physical, biological, and chemical impacts on water quality
- 4.13: Evaluate the impacts of human activities on the water resources
- 4.18: List the main sources of drinking water in Newfoundland and Labrador
- 4.19: Outline the risks involved in drinking untreated water
- 4.20: Identify the main components of the multi-barrier approach to ensure safe drinking water
- 4.21: Identify the phases of treating municipal water
- 4.22: Describe alternate methods of water treatment
- 4.23: List sources of wastewater
- 4.24: Indicate the impacts of untreated wastewater on freshwater and marine ecosystems
- 4.25: Describe the disposal and treatment methods for municipal and industrial effluent

Science 1206

Unit 1 Life Science: Sustainability of Ecosystems

- 318-1: Illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen
- 331-6: Analyze the impact of external factors on an ecosystem

Northwest Territories

See Alberta's Curriculum

The Northwest Territories currently makes use of the Alberta curriculum materials.

Nova Scotia
Grade Nine
Science

Curriculum Last Updated: 2012

Atoms and Elements

Physical and Chemical Changes

- Perform experiments, collect evidence, report findings, and demonstrate a knowledge of WHMIS standards in the laboratory (209-7, 111-6, 210-11)
- 307-12: Investigate materials and describe them in terms of their physical properties
- 307-13: Describe changes in the properties of materials that result from some common chemical reactions

Periodic Table

- Use the periodic table as a classification system and compile data about its structure (210-1, 210-2)
- Explain and provide examples of how society's needs for chemistry incorporate science, technology, and environment (112-3, 112-8)

Grade Ten
Science

Curriculum Last Updated: 2012

Life Science: Sustainability of Ecosystems

- 114-1: Question and analyze how a paradigm shift in sustainability can change society's views
- 214-1, 318-6: Describe how the classification involved in the biodiversity of an ecosystem is responsible for its sustainability
- Predict and analyze the impact of external factors on the sustainability of an ecosystem, using a variety of formats (212-4, 214-3, 331-6)
- Diagnose and report the ecosystem's response to short-term stress and long-term change (213-7, 215-1, 318-4)

**Grade Eleven
Chemistry****Curriculum Last Updated: 2012**

Calculations and Chemical Equations

- 214-13: Identify practical problems that involve technology where equations were used
- 213-3: Use instruments effectively and accurately for collecting data
- 215-1: Communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others

Applications of Stoichiometry

- 214-12: Explain how data support or refute the hypotheses or prediction of chemical reactions
- 117-2: Analyze society's influence on science and technology

**Grade Twelve
Chemistry****Curriculum Last Updated: 2012**

Electrochemistry

Oxidation and Reduction

- 115-1: Distinguish between scientific questions and technological problems

Concentration, Properties, and Solubility

- 213-5: Compile and organize solution data, using appropriate formats and data treatments to facilitate interpretation of solubility
- 323-6: Determine the molar solubility of a pure substance in water

Nunavut

See Alberta's Curriculum

Nunavut currently makes use of the Alberta curriculum materials.

Ontario
Grade Nine
Science Academic

Curriculum Last Updated: 2008

B. Biology: Sustainable Ecosystems

- B1: Assess the impact of human activities on the sustainability of terrestrial and/or aquatic ecosystems, and evaluate the effectiveness of courses of action intended to remedy or mitigate negative impacts
- B2: Investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems

C. Chemistry: Atoms, Elements, and Compounds

- C1: Assess social, environmental, and economic impacts of the use of common elements and compounds, with reference to their physical and chemical properties
- C2: Investigate, through inquiry, the physical and chemical properties of common elements and compounds
- C3: Demonstrate an understanding of the properties of common elements and compounds, and of the organization of elements in the periodic table

Grade Ten
Science Academic

Curriculum Last Updated: 2008

C. Chemistry: Chemical Reactions

- C1: Analyze a variety of safety and environmental issues associated with chemical reactions, including the ways in which chemical reactions can be applied to address environmental challenges
- C2: Investigate, through inquiry, the characteristics of chemical reactions

Grade Eleven
Biology

Curriculum Last Updated: 2008

B. Diversity of Living Things

- B1: Analyze the effects of various human activities on the diversity of living things

- B2: Investigate, through laboratory and/or field activities or simulations, the principles of scientific classification, using appropriate sampling and classification techniques

Chemistry

Curriculum Last Updated: 2008

C. Chemical Reactions

- C1: Analyze chemical reactions used in a variety of applications, and assess their impact on society and the environment

E. Solutions and Solubility

- E1: Analyze the origins and effects of water pollution, and a variety of economic, social, and environmental issues related to drinking water
- E2: Investigate qualitative and quantitative properties of solutions, and solve related problems

Grade Twelve

Biology

Curriculum Last Updated: 2008

B. Biochemistry

- B2: Investigate the chemical structures, functions, and chemical properties of biological molecules involved in some common cellular processes and biochemical reactions
- B3: Demonstrate an understanding of the structures and functions of biological molecules, and the biochemical reactions required to maintain normal cellular function

C. Metabolic Processes

- C1: Analyze the role of metabolic processes in the functioning of biotic and abiotic systems, and evaluate the importance of an understanding of these processes and related technologies to personal choices made in everyday life

Prince Edward Island

Grade Nine

Science

Curriculum Last Updated: 2010

Physical Science: Atoms and Elements

- 307-12: Investigate and describe materials in terms of their physical properties
- 307-13: Describe changes in properties that result from chemical reactions

Grade Ten

Science 421A

Curriculum Last Updated: 2005

Life Science: Sustainability of Ecosystems

- 318-1: Illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking carbon, nitrogen, and oxygen
- 331-6: Analyze the impact of external factors on an ecosystem
- 318-6: Explain how biodiversity of an ecosystem contributes to its sustainability

Grade Twelve

Environmental Science 621A

Curriculum Last Updated: 2011

Ecological Principles

- 3.6: Conduct an experiment to measure abiotic factors of an ecosystem

Natural Resources

- 5.8: Demonstrate an understanding of sustainable water use at different levels
- 5.9: Evaluate the significance of water resources for international relations

Environmental Challenges and Successes

- 6.10: Summarize the main types, sources and effects of water pollution
- 6.11: Explain strategies that reduce air and water pollution
- 6.12: Conduct an experiment to determine water pollutants
- 6.13: Identify the types of solid domestic waste
- 6.14: Evaluate pollution management strategies from solid domestic waste on P. E. I.

- 6.15: Propose a course of action on a social issue related to waste management, taking into account human, economic, and environmental needs

Quebec
Secondary Grades
General Biology

Curriculum Last Updated: 1990

Module II: Balance in Nature

- Show that an ecosystem is a group of interacting components
- Show that the interactions among living and non-living things are regulating mechanisms that exist within an ecosystem
- Show that certain regulating mechanisms are necessary to maintain a balanced ecosystem
- Associate quality of life with a well-balanced organism and a stable ecosystem

Ecology

Curriculum Last Updated: 1985

Module 5: Environmental Influences on Living Organisms

- Be aware of the details of environmental phenomena
- Be willing to take an investigative approach
- Be willing to follow a structured approach in consulting reference material
- Be willing to re-examine the ways in which they relate to nature

Physical Science (Physical Environment)

Curriculum Last Updated: 1987

- Gain knowledge of certain physical phenomena in the environment, and consequently, learn about the properties of matter
- Develop certain skills necessary for scientific experiments
- Develop certain attitudes regarding the scientific method, such as a critical sense and a taste for research. This will help the students increase their awareness of the impact of modern technology on the physical environment

Saskatchewan Grade Ten Science

Curriculum Last Updated: 2014

Career Investigation

- SCI10-CI1 Investigate career paths related to various science disciplines and sub-disciplines

Climate and Ecosystem Dynamics

- SCI10-CD1 Assess the consequences of human actions on the local, regional, and global climate and the sustainability of ecosystems

Chemical Reactions

- Explore the characteristics of a variety of chemical reactions, including the role of energy changes

Grade Eleven Environmental Science

Curriculum Last Updated: 2014

Career Exploration

- ES20-CE1 Analyze and explore environmental science related career paths in Saskatchewan, Canada and the world

Human Population

- ES20-HP1 Investigate resource use and waste generation associated with human populations as well as methods and technologies used for mitigation or management

Aquatic Systems

- ES20-AE1 Analyze the relationship between biotic and abiotic factors that provide criteria to determine the condition of aquatic systems

**Grade Twelve
Biology**

Curriculum Last Updated: 2015

Life and Evolution

- BI30-LI3 Assess the implications of applications of biology and biotechnology on self, society, and the environment

Chemistry

Curriculum Last Updated: 2015

Electrochemistry

- CH30-EC1 Investigate the chemistry of oxidation and reduction reactions

Yukon

See British Columbia

The British Columbia program of studies forms the basis of the Yukon curriculum.