



Science

Science Grade 11

Curriculum Map

Topic A: Chemical Changes

Resources Included: *Canada in Context*, *Global Issues in Context*, *Science in Context*

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On Behalf of THE ALBERTA LIBRARY

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User Guide

Curricular Topic

I. Themes.....	5
II. Overview.....	5
III. Focusing Questions.....	5
IV. General Outcome 1.....	5
V. General Outcome 2.....	6
VI. General Outcome 3.....	7

(taken from Alberta Education's Program of Studies)

Section 1: General References.....8

Title ([hyperlinked](#)): ORC Database: Brief Description of what is included.

Section 2: Definitions.....9

"Title." ([hyperlinked](#)) *Publication*: Author, Publication Date/Info. ORC Database. Date located.

Section 3: Websites.....12

"Title." ([hyperlinked](#)) *Publication*: Author, Publication Date/Info. pg. ORC Database. Date located.

Section 4: Articles.....13

"Title." ([hyperlinked](#)) *Publication*: Publication Date/Info. ORC Database. Date located.

Section 5: Resource Links 2learn.ca.....13

"Title." (hyperlinked) *Publication:* Publication Date/Info. ORC Database. Date located.

Section 6: Global Issues in Context.....14

"Title." (hyperlinked) *Publication:* Publication Date/Info. ORC Database. Date located.

If you have any questions regarding this guide or if you would like a guide for additional grades please contact Bethany Arsenault, ORC Coordinator at barsenault@thealbertalibrary.ab.ca

Topic A: Chemical Changes

Themes

Matter, Change and Energy

Overview

Chemical changes involve a change in energy. In order for students to understand how numerous useful materials are produced, they need to develop an understanding of concentrations of aqueous solutions, oxidation-reduction (redox) processes and the characteristics of hydrocarbons. Economically important industries in Alberta and other parts of Canada are based upon the application of chemical principles.

Focusing Questions

What is concentration? How has knowledge about oxidation-reduction in aqueous solutions been applied to solve practical problems? What characteristics of hydrocarbons are important to industry in Alberta?

Students will:

- investigate aqueous solutions to determine conductivity and to calculate concentration
- explain oxidation, reduction and spontaneity and apply this knowledge to voltaic and electrolytic cells and to industrial processes
- describe the properties of simple hydrocarbons and describe hydrocarbon-based industrial processes that are important in Alberta.

General Outcome 1

Students will investigate aqueous solutions to determine conductivity and to calculate concentration.

Specific Outcomes for Knowledge

Students will:

- explain how dissolving substances in water is often a prerequisite for chemical reactions and chemical changes; *e.g., batteries, baking, medications*
- differentiate, on the basis of properties, between electrolytes and nonelectrolytes compare and explain how concentrations of

solutions are expressed in moles per litre, percent by volume and parts per million

- determine the concentration of solutions in moles per litre, percent by volume and parts per million
- determine the concentration of diluted solutions and the quantities of a concentrated solution and of water to use when diluting.

General Outcome 2

Students will explain oxidation, reduction and spontaneity and apply this knowledge to voltaic and electrolytic cells and to industrial processes.

Specific Outcomes for Knowledge

Students will:

- balance provided single-replacement reaction equations, building on knowledge from Science 10, Unit A
- determine the reactivity of metals by comparing their reaction in various aqueous solutions relate single-replacement reactions to oxidation-reduction and apply mole ratios from given equations to predict moles of metals consumed or produced
- define, operationally, oxidation and reduction and spontaneous and nonspontaneous reactions; i.e., loss of electrons is oxidation, gain of electrons is reduction, a spontaneous oxidation-reduction reaction produces electrical energy from chemical change, and a nonspontaneous oxidation-reduction reaction requires electrical energy to produce chemical change
- apply the principles of oxidation-reduction and half-reactions to describe, in general terms, the operation of voltaic and electrolytic cells; *e.g., batteries, metal extraction, cathodic protection, galvanizing, electroplating*
- compare modern and traditional methods for the extraction of metals and for protection from corrosion, *e.g., development of glazes in traditional Aboriginal pottery manufacturing*

General Outcome 3

Students will describe the properties of simple hydrocarbons and describe hydrocarbon-based industrial processes that are important in Alberta.

Specific Outcomes for Knowledge

Students will:

- identify materials used in daily life that are based upon Alberta's petrochemical industry and that involve changes in energy; *e.g., plastics, cosmetics, gasoline*
- identify the physical characteristics of hydrocarbons, including trends with respect to melting and boiling points and solubility of alkanes, alkenes and alkynes
- provide International Union of Pure and Applied Chemistry (IUPAC) names and structural formulas for simple and noncyclic hydrocarbons in the homologous series of alkanes, alkenes and alkynes that contain up to eight carbon atoms in the parent chain
- identify hydrocarbons as a source of fossil fuels and explain the processes of fractional distillation to refine petroleum and catalytic cracking to produce ethene (ethylene) classify, balance and apply mole ratios to important hydrocarbon reactions:
 - combustion of hydrocarbons to produce carbon dioxide, water vapour and energy
 - production of ethene (ethylene) from catalytic cracking
 - hydrogenation of alkenes (unsaturated) to produce alkanes (saturated)
 - polymerization of ethene (ethylene) to polyethene (polyethylene).

Section 1: General Reference

[Alberta Oil Sands](#): Topic Page/Definition, with links to reference articles, news, magazines, academic journals, images, videos, audio and websites.

[Batteries](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

[Fossil Fuels](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

[Fracking](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

[Hydrocarbons](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

[Oil Refining](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

[Oil \(Petroleum\)](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

[Oxidation](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

[Solutions and Mixtures](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

Section 2: Definitions

"[Alkenes](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 12 Aug. 2015.

"[Anode](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 5 Aug. 2015.

"[Battery](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 5 Aug. 2015.

Video: "[The Invention of the Battery](#)." *Khan Academy* 1 June 2012. *Science in Context*. Web. 7 Aug. 2015.

"[Cathode](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 5 Aug. 2015.

Cathodic Protection: "[Where do you place the anodes?](#)" *Machine Design* 12 Jan. 2006: 131. *Science in Context*. Web. 12 Aug. 2015.

"[Cell, Electrochemical](#)." *UXL Encyclopedia of Science*. Ed. Amy Hackney Blackwell and Elizabeth Manar. 3rd ed. Farmington Hills, MI: UXL, 2015. *Science in Context*. Web. 5 Aug. 2015.

"[Electrolyte](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 5 Aug. 2015.

"[Electrical conductivity](#)." *World of Physics*. Gale, 2001. *Science in Context*. Web. 5 Aug. 2015.

"[Electrolysis](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 5 Aug. 2015.

"[Electrolyte supplements](#)." *The Gale Encyclopedia of Medicine*. Ed. Jacqueline L. Longe. 5th ed. Farmington Hills, MI: Gale, 2015. *Science in Context*. Web. 5 Aug. 2015.

"[Ethylene](#)." *World of Scientific Discovery*. Gale, 2007. *Science in Context*. Web. 12 Aug. 2015.

"[Ethene](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 12 Aug. 2015.

"[Concentration](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 5 Aug. 2015.

"[Hydrocarbon](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 12 Aug. 2015.

"[Ion](#)." *UXL Encyclopedia of Science*. Ed. Amy Hackney Blackwell and Elizabeth Manar. 3rd ed. Farmington Hills, MI: UXL, 2015. *Science in Context*. Web. 5 Aug. 2015.

[Oxidation](#): Topic Page/Definition with links to featured content articles, reference, experiments, images, news items, videos, academic journals, magazines and related topics

"[Oxidation-reduction reaction](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 5 Aug. 2015.

"[Oxidation reduction reactions](#)." *Environmental Encyclopedia*. Gale, 2011. *Science in Context*. Web. 5 Aug. 2015.

"[Oxidation-reduction reaction](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 5 Aug. 2015.

Experiment: "[Oxidation-Reduction](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 5 Aug. 2015.

Video: "[The Invention of the Battery](#)." *Khan Academy* 1 June 2012. *Science in Context*. Web. 5 Aug. 2015.

Image: "[Cell, Electrochemical](#)." *UXL Encyclopedia of Science*. Ed. Amy Hackney Blackwell and Elizabeth Manar. 3rd ed. Farmington Hills, MI: UXL, 2015. *Science in Context*. Web. 5 Aug. 2015.

"[Titration](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 5 Aug.

Alberta Oil & Gas:

"[Alberta](#)." *Worldmark Encyclopedia of U.S. and Canadian Environmental Issues*. Ed. Susan Gall and Margaret Antone. Detroit: Gale, 2012. 533-541. *Global Issues In Context*. Web. 10 Aug. 2015.

[ALBERTA OIL SANDS](#): See subsections: Energy: A Hub of Coal and Oil Production, Mining Oil Sands: A Precious and Controversial Resources

"[Fossil Fuel Exploration](#)." *Global Issues in Context Online Collection*. Detroit: Gale, 2015. *Global Issues In Context*. Web. 10 Aug. 2015.

"[Petroleum Exploration and Recovery](#)." *U*X*L Encyclopedia of Water Science*. Ed. K. Lerner, Brenda Lerner, and Lawrence Baker. Vol. 2. Detroit: U*X*L, 2005. 300-306. *Global Issues In Context*. Web. 10 Aug. 2015.

Oil Sands:

Video: "[Heat: Fossil Fuels, the Engine of Our Lives](#)." *Frontline* 2008. *Science in Context*. Web. 7 Aug. 2015.

Since the Industrial Revolution, economic growth has largely been tied to the refining and use of petroleum products. Scientists are now articulating questions and issues related to the environmental consequences of a global dependence on the products of oil refining.

Video: "[Tar Sands](#)." *AFP News Footage* 23 Nov. 2009. *Science in Context*. Web. 5 Aug. 2015.

"[Tar sands](#)." *Environmental Encyclopedia*. Gale, 2011. *Science in Context*. Web. 5 Aug. 2015.
2015.

Section 3: Websites

[Alberta Energy](#). Government of Alberta. Web. 5. Aug. 2015

[Alberta Environment](#). Government of Alberta. Web. 4 Aug. 2015.

[Alberta Oil Sands](#). Government of Alberta. Web. 10 Aug. 2015.

[Alberta Oil Sands Information Portal](#). Government of Alberta. Web 10 Aug. 2015.

[Oils Sands Watch](#). Pembina Institute. Web. 10. Aug. 2015

[How Coal Works](#). *Union of Concerned Scientists: Science for a Healthy Planet and Safer World*. Web. 10 Aug. 2015.

[Hydrofracking](#). ECOCentric Blog. *GRACE Communications Foundation*. Web. 31 Aug. 2015. Read about the environmental and economic issues associated with the controversial natural gas extraction method hydraulic fracturing, commonly called "fracking."

[In Fracking's Wake](#). NRDC document. *Natural Resources Defense Council*. 2012. Web. 31 Aug. 2015. This report combines an evaluation of federal and state laws regulating fracking wastewater with a thorough review, compiled for NRDC by an independent scientist, of the health and environmental risks posed by this high-volume waste stream and the currently available treatment and disposal methods.

[Is Fracking Safe? The 10 Most Controversial Claims About Natural Gas Drilling](#). *Popular Science*. Jan 5, 2015. Web. 31 Aug. 2015.

[Natural Gas Extraction: Hydraulic Fracturing](#). *United States Environmental Protection Agency*. Web. 31 Aug. 2015.

[The Pennsylvania Guide to Hydraulic Fracturing, or "Fracking"](#). *StateImpact Pennsylvania*. Web. 31 Aug. 2015.

Section 4: Articles

"[Argonne flows into utility-scale battery research.](#)" *ENP Newswire* 29 June 2012. *Science in Context*. Web. 5 Aug. 2015.

Scientists at the U.S. Department of Energy's (DOE) Argonne National Laboratory have developed an all-organic non-aqueous lithium-ion redox flow battery that would help expand use of large-scale solar and wind energy on the nation's electrical grid.

"[Fort McMurray: future city of the far north](#)*." *The Geographical Review* 93.2 (2003): 258+. *Science in Context*. Web. 5 Aug. 2015.

"[Oil-Sands Boom Town Is Bursting at the Seams.](#)" *Washington Post* 1 July 2012. *Science in Context*. Web. 5 Aug. 2015.

"[Oil sands pollutants in traditional foods.](#)" *CMAJ: Canadian Medical Association Journal* 2 Sept. 2014: E444. *Science in Context*. Web. 5 Aug. 2015.

"[Simulation of zinc extraction from aqueous solutions using polymeric hollow-fibers.](#)" *Polymer Engineering and Science* 54.10 (2014): 2222+. *Science in Context*. Web. 5 Aug. 2015.

Section 5: Resource Links from 2learn.ca

[SEEDS Energy Literacy Series – Petroleum Interactive Module](#)

Take a virtual tour of places and geology where petroleum is found, learn about petroleum production and what types of equipment is used. There is also a section dedicated to issues and impacts of the petroleum industry.

[Electrolytes and Conduction 1](#): An interactive animation showing an experiment to investigate the conductivity of electrolytes. Two electrodes connected to a battery, a lamp and a switch are placed in solid sodium chloride. Click the switch to test the conductivity. Use in conjunction with [Electrolytes and Conduction 2](#) and [3](#).

[Electrolytes and Conduction 2](#): An interactive animation showing an experiment to investigate the conductivity of electrolytes. Two electrodes connected to a battery, a lamp and a switch are placed in solid sodium

chloride. Click the switch to test the conductivity. Use in conjunction with Electrolytes and Conduction 1 and 3.

[Electrolytes and Conduction 3](#): An interactive animation showing an experiment to investigate the conductivity of electrolytes. Two electrodes connected to a battery, a lamp and a switch are placed in solid sodium chloride. Click the switch to test the conductivity. Use in conjunction with Electrolytes and Conduction 1 and 2.

*[Voltaic Cell with Molarity](#): Select the metal and solution for each beaker attached to the connectors from the voltaic cell, along with setting the molarity. Check the "on" button to complete the demonstration.

*Link doesn't work. Check with 2learn.ca

Section 6: Global Issues in Context

"[Fracking](#)." *Global Issues in Context Online Collection*. Detroit: Gale, 2015. *Global Issues In Context*. Web. 10 Aug. 2015.

"[The Other Pipeline You Should Worry About](#)." *New York Times* 17 Jan. 2015: A17(L). *Global Issues In Context*. Web. 10 Aug. 2015.

Videos:

"[Nuns Versus Pipeline](#)." *R&E (Religion and Ethics) Newsweekly* 31 Jan. 2014. *Global Issues In Context*. Web. 10 Aug. 2015.

Report on a 200-year-old order of Catholic nuns, the Sisters of Loretto, as they battle the construction of a pipeline that would transport toxic gases through their Kentucky homeland.

"[The Price of Gas: A Need to Know investigation](#)." *Need to Know* 21 Oct. 2011. *Global Issues In Context*. Web. 10 Aug. 2015.

Examines the practice of fracking in Wyoming, where some residents believe fracking is contaminating their water and risking their health.

"[Fracking wastewater proposal studied by Amherst and Dieppe](#)." *CBC* 4 Nov. 2014. *Global Issues In Context*. Web. 10 Aug. 2015.

A second Maritime community is now in talks with a Nova Scotia company to take in 30 million litres of treated wastewater from hydraulic fracturing operations. Video provided by CBC

"[Fracking Proposal Divides Residents Near Gros Morne](#)." *CBC* 31 July 2013. *Global Issues In Context*. Web. 10 Aug. 2015.

The search for oil off Newfoundland's west coast has divided people who live near the World Heritage Site that is a major draw to the region.

"[Long-Awaited EPA Study Finds Fracking Has Not Led to Widespread Water Contamination](#)." *Energy in Depth*. Web. 10 Aug. 2015.

[In Fracking's Wake: New Rules are Needed to Protect Our Health and Environment from Contaminated Wastewater](#). NRDC. May 2012.