

A thick dark blue vertical bar runs down the left side of the page. A blue arrow-shaped graphic points to the right, overlapping the bar, with the word "Science" written inside it in white.

Science

Science Grade 10

Curriculum Map

Topic A: Energy and Matter in Chemical Change

Resources Included: *The Canadian Encyclopedia*,
Science in Context, *Historica Canada*, *World History in
Context*, *Global Issues in Context*

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On Behalf of THE ALBERTA LIBRARY

Published December 2015

Last Edited August 2017

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(taken from Alberta Education's Program of Studies)

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Topic A: Energy and Matter in Chemical Change

Overview

Chemical changes involve energy and transformations of matter. A knowledge of the underlying structure of matter and the basic chemical species is important in understanding chemical changes. As students explore the properties of molecular and ionic compounds, including acids and bases, they begin to appreciate the need for a classification scheme and a system of nomenclature. Students classify, name compounds and write balanced chemical equations to represent chemical changes. As well, students are introduced to the law of conservation of mass and the mole concept.

Outcomes for Science, Technology & Society (STS) & Knowledge

Students will:

1. Describe the basic particles that make up the underlying structure of matter, and investigate related technologies

- Identify historic examples of how humans worked with chemical substances to meet their basic needs
- Outline the role of evidence in the development of the atomic model consisting of protons and neutrons (nucleons) and electrons; i.e. Dalton, Thomson, Rutherford, Bohr
- Identify examples of chemistry-based careers in the community (e.g. chemical engineering, cosmetology, food processing)

2. Explain, using the periodic table, how elements combine to form compounds, and follow IUPAC guidelines for naming ionic compounds and simple molecular compounds

- Illustrate an awareness of WHMIS guidelines, and demonstrate safe practices in the handling, storage and disposal of chemicals in the laboratory and at home
- Explain the importance of and need for the IUPAC system of naming compounds, in terms of the work that scientists do and the need to communicate clearly and precisely
- Explain, using the periodic table, how and why elements combine to form compounds in specific ratios
- Predict formulas and write names for ionic and molecular compounds and common acids (e.g., sulfuric, hydrochloric,

nitric, ethanoic), using a periodic table, a table of ions and IUPAC rules

- Classify ionic and molecular compounds, acids and bases on the basis of their properties; i.e., conductivity, pH, solubility, state
- Predict whether an ionic compound is relatively soluble in water, using a solubility chart
- Relate the molecular structure of simple substances to their properties (e.g., describe how the properties of water are due to the polar nature of water molecules, and relate this property to the transfer of energy in physical and living systems)
- Outline the issues related to personal and societal use of potentially toxic or hazardous compounds (e.g., health hazards due to excessive consumption of alcohol and nicotine; exposure to toxic substances; environmental concerns related to the handling, storage and disposal of heavy metals, strong acids, flammable gases, volatile liquids)

3. Identify and classify chemical changes, and write word and balanced chemical equations for significant chemical reactions, as applications of Lavoisier's law of conservation of mass

- Provide examples of household, commercial and industrial processes that use chemical reactions to produce useful substances and energy (e.g., *baking powder in baking, combustion of fuels, electrolysis of water into $H_{2(g)}$ and $O_{2(g)}$*)
- Identify chemical reactions that are significant in societies (e.g., reactions that maintain living systems, such as photosynthesis and respiration; reactions that have an impact on the

- environment, such as combustion reactions and decomposition of waste materials)
- Describe the evidence for chemical changes; i.e., energy change, formation of a gas or precipitate, colour or odour change, change in temperature
 - Differentiate between endothermic and exothermic chemical reactions (e.g., combustion of gasoline and other natural and synthetic fuels, photosynthesis)
 - Classify and identify categories of chemical reactions; i.e., formation (synthesis), decomposition, hydrocarbon combustion, single replacement, double replacement
 - Translate word equations to balanced chemical equations and vice versa for chemical reactions that occur in living and nonliving systems
 - Predict the products of formation (synthesis) and decomposition, single and double replacement, and hydrocarbon combustion chemical reactions, when given the reactants
 - Define the mole as the amount of an element containing 6.02×10^{23} atoms (Avogadro's number) and apply the concept to calculate quantities of substances made of other chemical species (e.g., *determine the quantity of water that contains 6.02×10^{23} molecules of H_2O*)
 - Interpret balanced chemical equations in terms of moles of chemical species, and relate the mole concept to the law of conservation of mass

Skill Outcomes

Students will:

Ask questions about observed relationships, and plan investigations of questions, ideas, problems and issues

- Define and delimit problems to facilitate investigation
- Design an experiment, identifying and controlling major variables (e.g., design an experiment to differentiate between categories of matter, such as acids, bases and neutral solutions, and identify manipulated and responding variables)
- State a prediction and a hypothesis based on available evidence and background information (e.g., *state a hypothesis about what happens to baking soda during baking*)
- Evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring and decision making (e.g., *list appropriate technology*)

for classifying compounds, such as litmus paper or conductivity tester)

Performing and Recording

Students will:

Conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information

- Carry out procedures, controlling the major variables and adapting or extending procedures (e.g., when performing an experiment to illustrate conservation of mass, demonstrate an understanding of closed and open systems and control for loss or gain of matter during a chemical change)
- Use library and electronic research tools to collect information on a given topic (e.g., information on compounds we use and their toxicity, using standard references, such as the Merck Index, as well as Internet searches)
- Select and integrate information from various print and electronic sources or from several parts of the same source (e.g., collect information on research into subatomic matter, research how pre-contact First Nations communities used available materials such as brain tissue for tanning hides)
- Demonstrate a knowledge of WHMIS standards by selecting and applying proper techniques for the handling and disposal of laboratory materials (e.g., *recognize and use Material Safety Data Sheets [MSDS] information*)
- Select and use apparatus, technology and materials safely (e.g., use equipment, such as Bunsen burners, electronic balances, laboratory glassware, electronic probes and calculators correctly and safely)

Analyzing and Interpreting

Students will:

Analyze data and apply mathematical and conceptual models to develop and assess possible solutions

- Describe and apply classification systems and nomenclature used in the sciences (e.g., *investigate periodicity in the periodic table, classify matter, and name elements and compounds based on IUPAC guidelines*)
- Apply and assess alternative theoretical models for interpreting

knowledge in a given field (*e.g., compare models for the structure of the atom*)

- Compare theoretical and empirical values and account for discrepancies (*e.g., measure the mass of a chemical reaction system before and after a change, and account for any discrepancies*)
- Identify and explain sources of error and uncertainty in measurement, and express results in a form that acknowledges the degree of uncertainty (*e.g., measure and record the mass of a material, use significant digits appropriately*)
- Identify new questions or problems that arise from what was learned (*e.g., how did ancient peoples discover how to separate metals from their ores?; evaluate the traditional Aboriginal method for determining alkaline properties of substances*)

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Communication and Teamwork**Students will:****Work as members of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results**

- Communicate questions, ideas and intentions; and receive, interpret, understand, support and respond to the ideas of others (*e.g., use appropriate communication technology to elicit feedback from others*)
- Represent large and small numbers using appropriate scientific notation
- Select and use appropriate numeric, symbolic, graphical and linguistic modes of representation to communicate ideas, plans and results (*e.g., use appropriate Système international (SI) units, and IUPAC nomenclature*)

Attitude Outcomes

Interest in Science

Students will be encouraged to:

Show interest in science-related questions and issues, and confidently pursue personal interests and career possibilities within science-related fields (*e.g., apply concepts learned in the classroom to the everyday use of chemicals; show interest in a broad scope of chemistry-related careers*)

Mutual Respect

Students will be encouraged to:

Appreciate that scientific understanding evolves from the interaction of ideas involving people with different views and backgrounds (*e.g., recognize the contributions of Canadians to contemporary knowledge of the structure of matter; show awareness of and respect for traditional Aboriginal knowledge about the use of biotic and abiotic materials*)

Scientific Inquiry

Students will be encouraged to:

Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues (*e.g., evaluate inferences and conclusions based on particles of matter that cannot be observed directly*)

Collaboration

Students will be encouraged to:

Work collaboratively in planning and carrying out investigations, as well as in generating and evaluating ideas (*e.g., contribute to group work willingly, assume a variety of roles and accept responsibility for any problems that arise*)

Stewardship

Students will be encouraged to:

Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment (*e.g., recognize that environmental consequences may arise from the development, use and disposal of chemical materials*)

Safety

Students will be encouraged to:

Show concern for safety in planning, carrying out and reviewing activities (e.g., *acknowledge the need for regulations to govern the storage, handling and disposal of potentially hazardous materials in the school laboratory and at home or in the workplace*)

Section 1: General Reference

[Acids and Bases](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Alcoholism](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Atoms and Atomic Theory](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Atomic Nucleus](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Chemical Bonds](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Chemical Compounds](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Chemical Elements](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

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[Combustion](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Ernest Rutherford](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[J.J. Thomson](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[John Dalton](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Moles](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

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[Niels Bohr](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Oxidation](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Periodic Table of Elements](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

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[Solubility](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Solutions and Mixtures](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

[Toxic and Hazardous Waste](#): *Science In Context*: Topic/definition page contains links to featured content, reference, biographies, images, news, videos, academic journals, magazine articles, and websites.

Section 2: Specific References

"[Aboriginal Medicines](#)". The Canadian Encyclopedia. Toronto: Historica Canada, 2006. Web. 8 Feb 2006.

"[Acid and base](#)." *World of Scientific Discovery*. Gale, 2007. *Science in Context*. Web. 3 Nov. 2015.

"[Acids and bases](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Alcohol](#)." *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 Nov. 2015.

"[Alcoholism](#)." *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 Nov. 2015.

Image: "[Ammonia. Blue atom is nitrogen and white atoms are hydrogen](#)." *Chemical Compounds*. Ed. Neil Schlager, Jayne Weisblatt, and David E. Newton. Vol. 1. Detroit: UXL, 2006. *Science in Context*. Web. 3 Nov. 2015.

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

"[Atomic models](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Atomic Nucleus](#)." *World of Physics*. Gale, 2001. *Science in Context*. Web. 3 Nov. 2015.

Image: "[Atomic Structure of Carbon and Hydrogen](#)." *World of Physics*. Gale, 2001. *Science in Context*. Web. 3 Nov. 2015.

"[Atomic theory](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Atoms](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Avogadro's Number](#)." *UXL Encyclopedia of Science*. Ed. Amy Hackney Blackwell and Elizabeth Manar. 3rd ed. Farmington Hills, MI: UXL, 2015. *Science in Context*. Web. 4 Nov. 2015.

"[Avogadro's number](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 4 Nov. 2015.

"[Baking soda](#)." *World of Invention*. Gale, 2006. *Science in Context*. Web. 3 Nov. 2015.

"[Buffalo Hunt](#)". The Canadian Encyclopedia. Toronto: Historica Canada, 2006. Web. 8 Mar 2006.

"[Buffer](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Chemical bond](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Chemical Compounds](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Chemical Compounds](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Chemical reactions](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Combustion](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Composting, microbiological aspects](#)." *World of Microbiology and Immunology*. Ed. Brenda Wilmoth Lerner and K. Lee Lerner. Detroit: Gale, 2007. *Science in Context*. Web. 3 Nov. 2015.

"[Compound, chemical](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Decomposition](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

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

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

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

"[Element, chemical](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 4 Nov. 2015.

"[Endothermic](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 4 Nov. 2015.

"[Endothermic reactions](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 4 Nov. 2015.

"[Endothermic reaction](#)." *World of Forensic Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. Detroit: Gale, 2006. *Science in Context*. Web. 4 Nov. 2015.

"[Equation, chemical](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Equation, Chemical](#)." *UXL Encyclopedia of Science*. Ed. Amy Hackney Blackwell and Elizabeth Manar. 3rd ed. Farmington Hills, MI: UXL, 2015. *Science in Context*. Web. 4 Nov. 2015.

Image: "[The evolution of atomic theory](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Exothermic Reactions](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 4 Nov. 2015.

"[Exothermic reactions](#)." *World of Forensic Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. Detroit: Gale, 2006. *Science in Context*. Web. 4 Nov. 2015.

"[Heat of Combustion](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 4 Nov. 2015.

"[Indicator, acid-base](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Internal combustion engine](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 4 Nov. 2015.

"[International Union of Pure and Applied Chemistry \(IUPAC\)](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 4 Nov. 2015.

"[J. J. Thomson, the Discovery of the Electron, and the Study of Atomic Structure](#)." *Science and Its Times*. Ed. Neil Schlager and Josh Lauer. Vol. 5. Detroit: Gale, 2001. *Science in Context*. Web. 3 Nov. 2015.

"[John Dalton Proposes His Atomic Theory and Lays the Foundation of Modern Chemistry](#)." *Science and Its Times*. Ed. Neil Schlager and Josh Lauer. Vol. 5. Detroit: Gale, 2001. *Science in Context*. Web. 3 Nov. 2015.

"[Metallurgy through the Ages](#)." *Science and Its Times*. Ed. Neil Schlager and Josh Lauer. Vol. 1. Detroit: Gale, 2001. *World History in Context*. Web. 5 Nov. 2015.

"[Mining and Metalwork in Ancient Western Asia](#)." *Civilizations of the Ancient Near East*. Ed. Jack M. Sasson. New York: Charles Scribner's Sons, 1995. *World History in Context*. Web. 5 Nov. 2015.

"[Models of the Atom](#)." *Science and Its Times*. Ed. Neil Schlager and Josh Lauer. Vol. 6. Detroit: Gale, 2001. *Science in Context*. Web. 3 Nov. 2015.

"[Molality](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Molarity](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Moles \(Chemistry\)](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 4 Nov. 2015.

"[Neutralization](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

Image: "[One Mole of Aluminum Metal](#)." *Gale Science in Context*. Detroit: Gale, 2010. *Science in Context*. Web. 4 Nov. 2015.

Image: "[1 M Sodium Hydroxide Solution](#)." *Gale Science in Context*. Detroit: Gale, 2010. *Science in Context*. Web. 4 Nov. 2015.

"[Oxidation](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Oxidation-reduction reaction](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Periodic table](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[pH](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Photosynthesis](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Reactions, types of](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Respiration](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 4 Nov. 2015.

"[Salt](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Sodium bicarbonate](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Solubility](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

Image: "[Solubility curve for various solutes in water](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 3 Nov. 2015.

"[Solutions and Mixtures](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Stoichiometric laws](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Symbol, chemical](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 4 Nov. 2015.

"[Valence](#)." *UXL Science*. Detroit: UXL, 2008. *Science in Context*. Web. 3 Nov. 2015.

"[Volatility](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

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

Image: "[Water. Red atom is oxygen and white atoms are hydrogen](#)." *Chemical Compounds*. Ed. Neil Schlager, Jayne Weisblatt, and David E. Newton. Vol. 3. Detroit: UXL, 2006. *Science in Context*. Web. 3 Nov. 2015.

Section 3: Experiments

"[Acid Rain](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 3 Nov. 2015.

"[Chemical Energy](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 4 Nov. 2015.

"[Chemical Properties](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 3 Nov. 2015.

"Chemiluminescence." *Gale Science in Context*. Detroit: Gale, 2011. *Science in Context*. Web. 4 Nov. 2015.

"[Fizzing and Foaming](#)." *Gale Science in Context*. Detroit: Gale, 2011. *Science in Context*. Web. 4 Nov. 2015.

"[Food Science](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 3 Nov. 2015.

"[Mixtures and Solutions](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 3 Nov. 2015.

"[Oxidation-Reduction](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 3 Nov. 2015.

"[Periodic Table](#)." *Experiment Central: Understanding Scientific Principles Through Projects*. M. Rae Nelson. Ed. Kristine Krapp. 2nd ed. Detroit: UXL, 2010. *Science in Context*. Web. 3 Nov. 2015.

"[Put a Shine on it](#)." *Gale Science in Context*. Detroit: Gale, 2011. *Science in Context*. Web. 4 Nov. 2015.

Section 4: Articles

["Advanced control saves energy: adapting new techniques can optimize plant operation and benefit the environment."](#) *Control Engineering* Jan. 2003: 41+. *Science in Context*. Web. 4 Nov. 2015.

["Alternate way to make oxygen found: process may alter view of how Earth's atmosphere formed."](#) *Science News* 15 Nov. 2014: 12. *Science in Context*. Web. 4 Nov. 2015.

["E-cigarette use by teens triples; officials warn of nicotine addiction."](#) *Alcoholism & Drug Abuse Weekly* 27 Apr. 2015: 1+. *Science in Context*. Web. 5 Nov. 2015.

["The Element Known As."](#) *New York Times* 12 Apr. 2010: A24(L). *Science in Context*. Web. 4 Nov. 2015.

["An exact value for Avogadro's number: untangling this constant from Le Gran K could provide a new definition of the gram."](#) *American Scientist* 95.2 (2007): 104+. *Science in Context*. Web. 4 Nov. 2015.

["Johns Hopkins - Study with 'Never-Smokers' Sheds Light on the Earliest Stages of Nicotine Dependence; Research examines vulnerability to nicotine addiction among nonusers."](#) *ENP Newswire* 10 Sept. 2015. *Science in Context*. Web. 5 Nov. 2015.

["Life's ingredients forged all at once: key cellular parts could be made by same set of reactions."](#) *Science News* 18 Apr. 2015: 10+. *Science in Context*. Web. 4 Nov. 2015.

["Love Canal."](#) *The Gale Encyclopedia of Environmental Health*. Ed. Jacqueline Longe. Vol. 1. Detroit: Gale, 2013. 488-493. *Global Issues In Context*. Web. 5 Nov. 2015.

["New Elements, Once Numbers, Gain Names."](#) *New York Times* 2 Dec. 2011: A15(L). *Science in Context*. Web. 4 Nov. 2015.

"[Nylon goes green](#)." *Science News* 24 Jan. 2015: 13. *Science in Context*. Web. 4 Nov. 2015.

"[Protein found in milk may be a nontoxic flame retardant](#)." *Science News* 19 Apr. 2014: 15. *Science in Context*. Web. 4 Nov. 2015.

"[Sanitation](#)." *The Gale Encyclopedia of Environmental Health*. Ed. Jacqueline Longe. Vol. 2. Detroit: Gale, 2013. 669-674. *Global Issues In Context*. Web. 5 Nov. 2015.

"[Scientists report a surprising link between indoor carbon dioxide levels and cognitive function](#)." *Washington Post* 28 Oct. 2015. *Science in Context*. Web. 4 Nov. 2015.

"[Spikes explain alkali explosions: before a blast in water, metals bristle and electrons escape](#)." *Science News* 21 Feb. 2015: 10+. *Science in Context*. Web. 4 Nov. 2015.

"[Split hydrogen bond allows water to flow](#)." *Science News* 30 Nov. 1991: 359. *Science in Context*. Web. 4 Nov. 2015.

"[A standard mass you can count on: refining Avogadro constant to boost kilogram's precision](#)." *Science News* 20 Nov. 2010: 12. *Science in Context*. Web. 4 Nov. 2015.

"[Waste Disposal](#)." *Global Issues in Context Online Collection*. Detroit: Gale, 2015. *Global Issues In Context*. Web. 5 Nov. 2015.

Section 5: Biographies

"[Antoine-Laurent Lavoisier](#)." *World of Chemistry*. Gale, 2006. *Science in Context*. Web. 3 Nov. 2015.

"[Ernest Rutherford](#)." *Scientists: Their Lives and Works*. Detroit: UXL, 2006. *Science in Context*. Web. 3 Nov. 2015.

"[J. J. Thomson](#)." *Scientists: Their Lives and Works*. Detroit: UXL, 2006. *Science in Context*. Web. 3 Nov. 2015.

"[Joseph John Thomson](#)." *World of Physics*. Gale, 2006. *Science in Context*. Web. 3 Nov. 2015.

"[John Dalton](#)." *Science and Its Times*. Ed. Neil Schlager and Josh Lauer. Vol. 5. Detroit: Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[John Dalton](#)." *Scientists: Their Lives and Works*. Detroit: UXL, 2006. *Science in Context*. Web. 3 Nov. 2015.

"[Niels Bohr](#)." *Scientists: Their Lives and Works*. Detroit: UXL, 2006. *Science in Context*. Web. 3 Nov. 2015.

Section 6: Videos

"[Balancing Chemical Equations](#)." *Khan Academy* 1 June 2012. *Science in Context*. Web. 4 Nov. 2015.

"[Element, chemical](#)." *The Gale Encyclopedia of Science*. Ed. K. Lee Lerner and Brenda Wilmoth Lerner. 5th ed. Farmington Hills, MI: Gale, 2014. *Science in Context*. Web. 31 July 2015.

"[Elements and Atoms](#)." *Khan Academy* 1 June 2012. *Science in Context*. Web. 3 Nov. 2015.

"[Introduction to the Atom](#)." *Khan Academy* 1 Nov. 2011. *Science in Context*. Web. 3 Nov. 2015.

"[The Mole and Avogadro's Number](#)." *Khan Academy* 1 Nov. 2011. *Science in Context*. Web. 4 Nov. 2015.

"[Niels Bohr receiving Atoms for Peace Award](#)." *Landov* 5 Oct. 2011. *Science in Context*. Web. 3 Nov. 2015.

"[Periodic law](#)." *World of Scientific Discovery*. Gale, 2007. *Science in Context*. Web. 31 July 2015.

"[The Periodic Table of Elements](#)." *The Periodic Table of Videos* 1 Nov. 2011. *Science in Context*. Web. 31 July 2015.

"[ScienceTake / New View of Flame](#)." *NYTimes.com Video Collection* 2014. *Science in Context*. Web. 4 Nov. 2015. Imaging technique captures the turbulence of hot gases when a match is lit.

"[What is Fire?](#)" *YouTube.com* 11 Sept. 2011. *Science in Context*. Web. 4 Nov. 2015.

Section 7: Careers in Chemistry

"[Chemical engineering](#)." *World of Chemistry*. Gale, 2000. *Science in Context*. Web. 3 Nov. 2015.

"[Exploring unique careers in STEM](#)." *Children's Technology and Engineering: A Journal for Elementary School Technology and Engineering Education* Mar. 2014: 24+. *Science in Context*. Web. 4 Nov. 2015.

"[Chemistry careers](#)." *American Chemical Society*. *Science in Context*. Web. 4 Nov. 2015.

"[Cool jobs](#)." *StemWorks*. Southern Methodist University, Dallas Texas. *Science in Context*. Web. 4 Nov. 2015.

"[iON Future: The Stem Career Exploration Game](#)." iON Future. *Science in Context*. Web. 4 Nov. 2015.

"[Ready to explore careers?](#)" *Iseekcareers*. Minnesota State Colleges & Universities. 2015. *Science in Context*. Web. 4 Nov. 2015.

Section 8: Websites

"[Alcohol](#)." World Health Organization (WHO).). *Science in Context*. Web. 5 Nov. 2015.

"[Alcohol and Youth](#)." National Institutes of Health (NIH). *Science in Context*. Web. 5 Nov. 2015.

"[The ChemCollective: Virtual Lab](#)." *Gale Science in Context*. Detroit: Gale, 2010. *Science in Context*. Web. 31 July 2015.

"[Chemicool](#)." *Gale Science in Context*. Detroit: Gale, 2015. *Science in Context*. Web. 31 July 2015. An interactive periodic table that provides detailed information about each of the elements.

"[Dynamic Periodic Table of the Elements](#)." *Gale Science in Context*. Detroit: Gale, 2015. *Science in Context*. Web. 31 July 2015.

"[Los Alamos National Laboratory. 'Periodic Table of Elements.'](#)" *Gale Science in Context*. Detroit: Gale, 2011. *Science in Context*. Web. 31 July 2015.

"[Periodic Table: Date of Discovery](#)." Chemical Elements.com (An interactive periodic table, with ..." *Gale Science in Context*. Detroit: Gale, 2015. *Science in Context*. Web. 31 July 2015

"[PeriodicTable.com \(Information about the periodic table suited to different audiences.\)](#)." *Gale Science in Context*. Detroit: Gale, 2015. *Science in Context*. Web. 31 July 2015.