

Enhanced Introductory College Chemistry

ENHANCED INTRODUCTORY COLLEGE CHEMISTRY

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CONTENTS

Accessing and Using Enhanced Introductory College Chemistry	xiii
Acknowledgements	xvii
Land Acknowledgements	xx
Commitment to Equity, Diversity, Inclusion and Indigenization in Chemistry	xxi
Accessibility Statement	xxviii

Chapter 1. Welcome to Chemistry!

1.1 Chemistry in Context	4
1.2 Phases and Classification of Matter	12
Chapter 1 - Summary	28
Chapter 1 - Review	29

Chapter 2. Understanding Measurement

2.1 Measurements	37
2.2 Measurement Uncertainty, Accuracy, and Precision	47
2.3 Mathematical Treatment of Measurement Results	60
Chapter 2 - Summary	72
Chapter 2 - Review	74

Chapter 3. Building Blocks of Matter

3.1 Elements	88
--------------	----

3.2 The Periodic Table	93
3.3 Compounds and Formulas	104
Chapter 3 Summary	112
Chapter 3 Review	114

Chapter 4. Matter and its Properties

4.1 Physical and Chemical Properties	121
4.2 Energy Basics	128
4.3 Calorimetry	143
4.4 Enthalpy	159
Chapter 4 - Summary	182
Chapter 4 - Review	184

Chapter 5. Introductory Atomic Theory and Structure

5.1 Early Atomic Theory: Dalton's Model of the Atom	199
5.2 Electric Charge	209
5.3 Subatomic Particles of the Atom	214
5.4 Defining the Nuclear Atom	223
5.5 Isotopes of the Elements	232
5.6 Atomic Mass	243
Chapter 5 - Summary	251
Chapter 5 - Review	254

Chapter 6. Inorganic Compound Nomenclature

6.1 Elements and Their Ions	269
-----------------------------	-----

6.2 Writing Formulas of Ionic Compounds	273
6.3 Naming Binary Compounds	281
6.4 Naming Compounds Containing Polyatomic Ions	294
6.5 Naming Acids	302
Chapter 6 - Summary	307
Chapter 6 - Review	309

Chapter 7: A Mole of Compounds

7.1 The Mole Concept and Avogadro's Number	318
7.2 Molecular Mass, Avogadro's Number and The Mole	323
7.3 Percent Composition	338
7.4 Determining Empirical and Molecular Formulas	343
Chapter 7 Summary	354
Chapter 7 - Review	356

Chapter 8: Chemical Equations

8.1 Writing and Balancing Chemical Equations	367
8.2 Classifying Composition, Decomposition, and Combustion Reactions	377
8.3 Classifying and Completing Single- and Double-Displacement Reactions	381
Chapter 8 - Summary	390
Chapter 8 - Review	392

Chapter 9: Stoichiometry using Chemical Equations

9.1 Stoichiometry Basics	401
9.2 Mole-Mass and Mass-Mass Calculations	405

9.3 Limiting Reactants	415
9.4 Reaction Yields	420
Chapter 9 - Summary	424
Chapter 9 - Review	426

Chapter 10: Modern Atomic Theory

10.1 Electromagnetic Radiation	435
10.2 The Bohr Atom	452
10.3 Wave Nature of Matter	463
10.4 Quantum Mechanical Model of the Atom	470
10.5 Atomic Structures of the First 20 Elements	485
10.6 Atomic Properties and Periodic Table Trends	503
Chapter 10 - Summary	516
Chapter 10 - Review	520

Chapter 11: Chemical Bonding

11.1 Ionic Bonding	536
11.2 Covalent Bonding	543
11.3 Lewis Symbols and Structures	553
11.4 Formal Charges and Resonance	570
11.5 Strengths of Ionic and Covalent Bonds	578
11.6 Molecular Structure and Polarity	589
Chapter 11 - Summary	612
Chapter 11 - Review	615

Chapter 12: Gases

12.1 Gas Pressure	646
12.2 Relating Pressure, Volume, Amount, and Temperature: The Ideal Gas Law	661
12.3 Effusion and Diffusion of Gases	680
12.4 Stoichiometry of Gaseous Substances, Mixtures, and Reactions	688
12.5 The Kinetic-Molecular Theory	707
12.6 Non-Ideal Gas Behaviour	715
Chapter 12 - Summary	721
Chapter 12 - Review	723

Chapter 13: Properties of Liquids and Water

13.1 Intermolecular Forces	742
13.2 Properties of Liquids	758
13.3 Phase Transitions	766
13.4 Phase Diagrams	783
13.5 Water: A Special Liquid	793
Chapter 13 - Summary	797
Chapter 13 - Review	799

Chapter 14: Solutions

14.1 Solutions: An introduction	813
14.2 Solubility	820
14.3 Molarity	832
14.4 Other Units for Solution Concentrations	850
14.5 Colligative Properties and Osmosis	859
14.6 Colloids	884

Chapter 14 - Summary	893
Chapter 14 - Review	896

Chapter 15: Reactions in Aqueous Solutions

15.1 Salts	913
15.2 Electrolytes	917
15.3 Precipitation Reactions	921
15.4 Describing Reactions in Solutions by Writing Molecular, Complete Ionic, and Net Ionic Equations	929
Chapter 15 - Summary	940
Chapter 15 - Review	942

Chapter 16: Acids and Bases

16.1 Acids and Bases	951
16.2 Reactions of Acids and Bases	969
16.3 Ionization of Water	975
16.4 Introduction to pH and pOH	981
16.5 Neutralization	995
16.6 Titrations and Neutralization Calculations	1002
16.7 Buffers	1012
Chapter 16 - Summary	1019
Chapter 16 - Review	1023

Chapter 17: Equilibrium and Equilibrium Constants

17.1 Chemical Reaction Rates	1035
17.2 Chemical Equilibria	1043

17.3 Equilibrium Constants	1050
17.4 Shifting Equilibria: Le Châtelier's Principle	1063
17.5 Equilibrium Calculations	1073
17.6 Precipitation and Dissolution	1090
17.7 Relative Strengths of Acids and Bases	1108
17.8 Real World Examples of Equilibria	1129
Chapter 17 - Summary	1138
Chapter 17 - Review	1141

Chapter 18: Oxidation-Reduction

18.1 Redox Reactions and Oxidation Numbers	1184
18.2 Balancing Redox Reactions	1192
18.3 Galvanic Cells	1198
18.4 Electrode and Cell Potentials	1205
18.5 Batteries and Fuel Cells	1211
18.6 Corrosion	1217
18.7 Electrolysis	1221
Chapter 18 - Summary	1229
Chapter 18 - Review	1233
Appendix A: The Periodic Table	1242
Appendix B: Essential Mathematics	1248
Appendix C: Units and Conversion Factors	1257
Appendix D: Fundamental Physical Constants	1261
Appendix E: Polyatomic Ions	1263
Appendix F: Water Properties	1267
Appendix G: Composition of Commercial Acids and Bases	1273
Appendix H: Standard Thermodynamic Properties for Selected Substances	1275
Appendix I: Ionization Constants of Weak Acids	1291

Appendix J: Ionization Constants of Weak Bases	1297
Appendix K: Solubility Products	1301
Appendix L: Formation Constants for Complex Ions	1307
Appendix M: Standard Electrode (Half-Cell) Potentials	1311
Glossary	1319
Ancillary Resources for Faculty	1372

ACCESSING AND USING ENHANCED INTRODUCTORY COLLEGE CHEMISTRY

Welcome to Enhanced Introductory College Chemistry

This textbook is designed to be accessible using standard web browsers, mobile devices, screen readers and other assistive technology. You can access the book in a number of formats. Requirements, tools, and suggestions for navigating and using the book are listed on this page. If you encounter any issues in accessing the book, please connect with your professor.

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- Check out our Student Guide to Using OER Textbooks (<https://ecampusontario.pressbooks.pub/georgianoer/>)

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|----------------|-------------|--------------|
| • Front matter | • Chapter 5 | • Chapter 10 |
| • Chapter 1 | • Chapter 6 | • Chapter 11 |
| • Chapter 2 | • Chapter 7 | • Chapter 12 |
| • Chapter 3 | • Chapter 8 | • Chapter 13 |
| • Chapter 4 | • Chapter 9 | • Chapter 14 |

- Chapter 15
- Chapter 16
- Chapter 17
- Chapter 18
- Appendices
- Glossary

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- Check for printing costs at your on-campus print shop (such as Grenville at Georgian College) or a local print shop (Staples, etc)
- Consider printing this textbook in black & white (not full colour), and refer to the web-book or PDF where you need to examine the colour diagrams
- Printing a large document is often significantly less expensive at a print shop than it is to print on your home printer or at the Library
- Ask about binding or 3 hole punching when you order, as this is usually low cost and will make your textbook easier to use

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Please consult with your Adaptive technologist or Accessibility advisor for assistance if necessary.

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Original OER Sources

This OER, *Enhanced Introductory College Chemistry*, is a collection of resources adapted to meet the needs of students in introductory chemistry courses. In most sections of this OER, updates have been made to the existing content to improve usability and accessibility, incorporate interactive elements and improve the overall student experience. Except where otherwise noted, images and diagrams are derived from the source attributed at end of each page. This OER adaptation reuses content from the following key resources:

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Please submit feedback to [OER\[at\]georgiancollege.ca](mailto:OER[at]georgiancollege.ca)

Disclaimer

We have done our best to acknowledge all participants involved in this project. In the event, we have made an error please reach out to the project manager to have this corrected.

LAND ACKNOWLEDGEMENTS

Georgian College

Georgian College acknowledges that all campuses are situated on the traditional land of the Anishnaabeg people. The Anishnaabeg include the Odawa, Ojibwe and Pottawatomi nations, collectively known as the Three Fires Confederacy. Georgian College is dedicated to honouring Indigenous history and culture and committed to moving forward in the spirit of reconciliation and respect with all First Nations, Métis and Inuit people.

Loyalist College

Loyalist College is located on the territory of the Huron-Wendat, the Anishnaabeg, and the Haudenosaunee people. We acknowledge our shared obligation to respect, honour, and sustain these lands and the natural resources contained within.

Conestoga College

At Conestoga College, we would like to acknowledge that in Kitchener, Waterloo, Cambridge and Brantford we are located on the Haldimand Tract, land promised to the Haudenosaunee people of Six Nations, which includes six miles on either side of the Grand River. This is the traditional territory of the Anishnawbe, Haudenosaunee, and Neutral peoples. To recognize the land is an expression of gratitude and appreciation to those whose territory we reside on, and a way of honouring the Indigenous people who have been living and working on the land for thousands of years.

COMMITMENT TO EQUITY, DIVERSITY, INCLUSION AND INDIGENIZATION IN CHEMISTRY

Equity, Diversity, and Inclusion in Chemistry

Our colleges (Equity, diversity, inclusion & belonging – Georgian College [New Tab] (<https://www.georgiancollege.ca/about-georgian/corporate-information/equity-diversity-inclusion-and-belonging/>)) recognize the need to support and encourage equity, diversity, inclusion and belonging (EDIB) in our teaching practices. When discussing equity, diversity and inclusion in the context of a chemistry classroom, the nature of the traditional science classroom and way of learning need to be questioned. In compiling this resource, the contributors have made conscious efforts to include examples of diversity of representation with chemistry scholars.

But examples of diversity of scholars are only the start of incorporating EDIB chemistry teaching. So much more comes from how the conversations about the development and progression of chemistry are led and respected in the classroom environment. It starts with the building of an inclusive community through respect and understanding of everyone's contribution to the classroom. It continues through the development of a metanarrative to the science content. And it continues further through the acknowledgement that objectivity is not singular but multifaceted. Below are suggestions of discussion topics that faculty and students can use to encourage the inclusion of EDIB.

- What questions were asked and who was allowed to ask those questions as the science of chemistry developed?
- Whose agenda and research received funding and support to “discover” these scientific concepts?
- Who was hired to teach the next generation and lead the conversations about chemistry?
- Whose interests and pursuits are followed?
- In pharmaceutical industry (for example), who were the subjects that were used for testing?
- In industrial chemical industry (for example), who had to become ill or die to know that a chemical was toxic?
- What experiences did individuals have in their chemistry careers (personalize this whenever possible)?
- Who is working in the background of the famous discoveries?
- How is the history of erasure and the value of representation included in chemistry?
- What might this area of study or concept have looked like if a female/visible minority/LGBTQ2+

person have discovered it?

To further support EDIB within chemistry and science faculties, consider:

- Setting up a committee of peers to review curriculum, hiring and other components of program areas
- Creating a culture of support for future scholars and researchers
- Offering opportunities to complete critical inquiry and equity analysis of curriculum
- Joining existing organizations working to promote EDI initiatives in science and chemistry

Several chemistry departments at Ontario and Canadian institutions are publicly stating their commitment to EDIB. Read statements from University of Toronto [New Tab] (<https://www.chemistry.utoronto.ca/our-department/diversity-and-inclusion>), University of Waterloo [New Tab] (<https://uwaterloo.ca/chemistry/about-chemistry/equity-diversity-decolonization-and-inclusion>) and University of British Columbia [New Tab] (<https://www.chem.ubc.ca/equity-diversity-inclusion>). The Chemical Institute of Canada (CIC) [New Tab] (<https://www.cheminst.ca/about/equity-diversity-and-inclusion/>) promotes EDI initiatives and there are local groups across the country representing the Canadians Working for Inclusivity in Chemical Sciences, Engineering and Technology (CWIC) Network [New Tab] (<https://www.cheminst.ca/communities/mrgs/cwic/>). Georgian College is a facilitating participant with the Inclusive STEM Teaching Project [New Tab] (<https://www.inclusivestemteaching.org/>) working to support educators in their EDIB development.

In addition to the scientists highlighted in this resource, all scientists represent diverse cultures and experiences. Here are some suggested resources to expand the EDIB conversation:

- American Chemistry Society Reactions (Twitter: @ACSReactions) has a commemoration tweet of Juneteenth2022 highlighting Black chemists and their impact on our lives. Reactions on Twitter: “To commemorate #juneteenth2022 we’re looking at handful of Black chemists and the impact they’ve made on our lives. Meet Alice Ball. She developed the “Ball Method,” which was the most effective treatment for leprosy during the early 20th century. <https://t.co/d7dnkmJ4ui>” / Twitter [New Tab] (<https://twitter.com/ACSReactions/status/1538573574914686976>)
- Compound Interest (curated by Andy Brunning) has a Women in Chemistry category of infographics that highlights 100s of women throughout history and today who excel in the field of chemistry. Women in Chemistry – Compound Interest (compoundchem.com) [New Tab] (<https://www.compoundchem.com/category/women-in-chemistry/>)
- “My STEM Stories” presented by CWIC is a YouTube channel with video highlights of some amazing current STEM researchers and scientists. “My STEM Stories” presented by CWIC – YouTube [New Tab] (<https://www.youtube.com/playlist?list=PLCXXs71St1WPJ1ZDYnKa8BFDSqauZbDWv>)
- Journal of Chemical Education published an entire special issue dedicated to Diversity, Equity, Inclusion and Respect in Chemistry Education Research and Practice. Journal of Chemical Education | Vol 99,

No 1 (acs.org) [New Tab] (<https://pubs.acs.org/toc/jceda8/99/1>)

- C&EN (Chemical and Engineering News) published Out and Proud Celebrating LGBTQ+ chemists (Out and proud (acs.org) [New Tab] (<https://cen.acs.org/careers/diversity/LGBTQ-diversity-Trailblazers-2022/100/i12>)) and a Movers and Shakers article highlighting LGBTQ+ chemists past and present. LGBTQ+ chemists you should know about (acs.org) [New Tab] (<https://cen.acs.org/people/lgbtq-scientist-chemist-history/99/web/2021/06>)
- Royal Society of Chemistry offers an LGBT+ toolkit to support inclusivity. LGBT+ toolkit (rsc.org) [New Tab] (<https://www.rsc.org/new-perspectives/talent/inclusion-and-diversity/resources/lgbt-toolkit/>)

Indigenization in Chemistry

In 2015, the Truth and Reconciliation Commission of Canada (TRC), led by Honourable Justice Murray Sinclair, released Honouring the Truth, Reconciling for the Future: Summary of the Final Report of the Truth and Reconciliation Commission of Canada [New Tab] [PDF] (https://ehprnh2mwo3.exactdn.com/wp-content/uploads/2021/01/Executive_Summary_English_Web.pdf). Their extensive consultative research process resulted in 94 Calls to Action (CTA) in order to begin dismantling the systemic racism devastating Indigenous Peoples in Canada. The CTA are outlined in What Are the Truth & Reconciliation Commission's 94 Calls to Action & How Are We Working Toward Achieving Them Today? (reconciliationeducation.ca) [New Tab] (<https://www.reconciliationeducation.ca/what-are-truth-and-reconciliation-commission-94-calls-to-action>) When considering how to incorporate actions towards reconciliation in the chemistry classroom, we need to start by educating ourselves on the true history of Canada and our personal acknowledgement to the land on which we live.

“Education got us into this mess and education will get us out of it.” (Renkas, 2021)

“Education is the key to walking on this journey of reconciliation. Teachers in particular have a sacred responsibility to ensure that all their children, regardless of their heritage, are able to think about four key questions throughout their education:

“Where do I come from?”, “Where am I going?”, “Why am I here?”, and most importantly, “Who am I?”” (Ore, 2021) (Waters et al., 2022)

~ Honourable Justice Murray Sinclair (chair of the Truth and Reconciliation Commission)



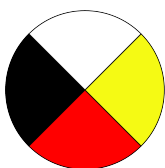
The journey from decolonization to reconcili-ACTION through transformation of coming to know with voice and hope and education. (credit: work by Giulia Forsythe, CC BY 2.0)

Our colleges (Indigenization – Georgian College [New Tab] (<https://www.georgiancollege.ca/about-georgian/corporate-information/indigenization/>)) continue to strive to meet the education related CTAs. One step in that journey is the 2022 release of the Indigenization Strategy [New Tab] (<http://georgiancollege.uberflip.com/i/1483918-indigenization-strategy-booklet/0?>). When discussing Indigenous ways of knowing (IWK) in the context of a chemistry classroom, the nature of the traditional science classroom and way of learning need to be questioned. In compiling this resource, the contributors have made conscious efforts to include examples of Indigenous uses of chemistry.

But examples of Indigenous uses of chemistry are only the start of incorporating Indigenous chemistry teaching. So much more comes from how the classroom environment and processes of learning Indigenous ways are represented and respected. It starts with the building of an inclusive community through respect and understanding of everyone’s contribution to the classroom. It continues through the development of a metanarrative to the science content.

Indigenous ways of knowing (IWK) are based on principles of Respect, Relevance, Reciprocity, Responsibility, Relationality, and Care. These are reflected in the Anishnaabe’s Seven Grandfather Teachings of (Manitowabi):

- Love: Love is finding peace and joy in our connection to all of Creation
- Respect: Respect is to understand that all life is sacred and part of Creation
- Bravery: Bravery is to listen to your heart and courage to do what is right
- Honesty: Honesty is to be straightforward in a kind and caring way
- Humility: Humility is being thankful and grateful knowing we belong and each has something to give
- Wisdom: Wisdom is to embrace knowledge and share our life teachings
- Truth: Truth is knowing who we are and living the Grandfather Teachings



The Indigenous Medicine Wheel. (credit: work by Littlejohn657, CC BY 4.0)

The Medicine Wheel (circle of knowledge or circle of awareness) encourages us to consider the whole person in all our actions. The circle represents the integrated connections of all aspects of oneself including the connection with the Earth and natural world. (Joseph, 2023) The yellow quadrant represents the East and the Spiritual connection to the natural world. The red quadrant represents the South and the Emotional connection to the natural world. The black quadrant represents the West and the Physical connection to the natural world. And the white quadrant represents the North and the Mental connection to the natural world. (Bell, 2022) (Zimak, 2020)

The guiding principle of Two-Eyed Seeing or Etuaptmumk (Mi'kmaw) combines the learning seen from one eye with the strengths of Indigenous knowledges and ways of knowing, and from the other eye with the strengths of Western knowledges and ways of knowing. The strengths of both eyes combine together for the benefit of all. (Institute for Integrative Science & Health, n.d.)

We have attempted to start the process of reconciliation by including Indigenous examples in this textbook. We acknowledge that significantly more work is needed to truly decolonize science education. To further support Indigenization within chemistry, science faculties and classrooms, faculty should consider:

- Inviting Indigenous elders or representatives to share their knowledge of the land and its offerings
- Having class/lab activities outside linking learning to the natural environment
- Reading UBC Science Skylight (The Science Centre for Learning and Teaching) How do I get started? Creating safer learning environments for Indigenous students in STEM at UBC [New Tab][PDF] (<https://skylight.science.ubc.ca/sites/skylight.science.ubc.ca/files/How%20do%20I%20get%20started%20-%20FAQ%20for%20non-Indigenous%20STEM%20faculty.pdf>)
- Exploring How do you talk about Indigenous issues in the classroom? [New Tab] (<https://inthearts.arts.ubc.ca/>) from UBC
- Reading the 94 Calls to Action and commit to making steps forward in the process of reconciliation
- Reading the Final Report from the National Inquiry into the Missing and Murdered Indigenous Women and Girls (MMIWG) [New Tab] (<http://www.mmiwg-ffada.ca/>) and their Calls to Justice
- Learning more about Indigenous history and current actions in Canada. A good starting place is Skoden – Teaching, Talking and Sharing About and for Reconciliation OER book: Skoden – Simple Book Publishing (pressbooks.pub) [New Tab] (<https://ecampusontario.pressbooks.pub/skoden/>)
- Learning more about Indigenous chemists and chemistry in Indigenous communities:
 - University of Waterloo CHEM 13 News Magazine (Fall 2022 Special Edition entitled Chemistry and Inuit Life and Culture [New Tab] (<https://uwaterloo.ca/chem13-news-magazine/>))
 - Dawn Pratt [New Tab] (<https://www.cbc.ca/news/canada/saskatchewan/chemist-bringing-indigenous-perspectives-to-science-1.6064560>) and askenootow STEM Enterprise Inc. [New Tab]

- (<https://www.askenootowstem.com/>)
- Vincent Ziffle at First Nations University of Canada [New Tab] (<https://www.nccie.ca/story/department-of-indigenous-science-the-environment-and-economic-development/>)
- Cecelia Brooks [New Tab] (<https://www.thestar.com/life/travel/2022/08/19/relearning-reconnection-reconciliation-mikmaq-tourism-operators-are-offering-authentic-experiences-to-visitors-and-to-their-own-communities.html>) and Wabanaki Tree Spirit Tours & Events [New Tab] (<https://wabanakitreespirit.com/>)
- Listening to young Indigenous representatives discuss their careers in Fireside Chats from Future Pathways [New Tab] (<https://www.firesidechats.ca/>)

Here are some suggested resources to further explore Indigenous history, knowledge and reconciliation and connections to chemistry:

- Indigenization at Georgian [New Tab] (<https://library.georgiancollege.ca/indigenization>) library collection of Indigenous resources
- Indigenous Education Chemistry resources [New Tab] (<https://indigenous-education.com/chemistry>)
- Knowing Home: Braiding Indigenous Science with Western Science, Book 1 [New Tab] (<https://pressbooks.bccampus.ca/knowinghome/>)
- National Centre for Truth and Reconciliation [New Tab] (<https://nctr.ca/>)
- Crown-Indigenous Relations and Northern Affairs Canada [New Tab] (<https://www.canada.ca/en/crown-indigenous-relations-northern-affairs.html>)

Attribution & References

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ACCESSIBILITY STATEMENT

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This statement was last updated on February 28, 2023.

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