Chemistry: Human Activity, Chemical Reactivity

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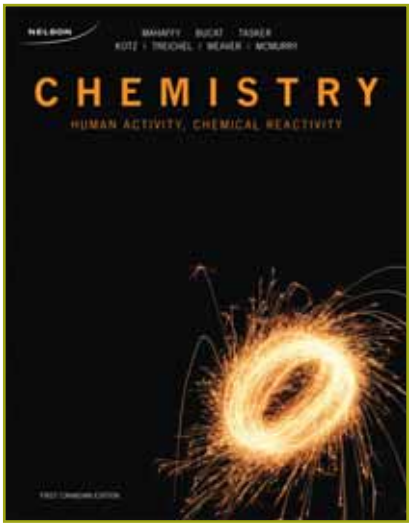
reviewed by Tina L. Overton

There are many general chemistry textbooks on the market and they all almost inevitably cover similar content. Academic staff choose these books for their undergraduate students based on many criteria; level, detailed content, layout, design, chapter order, habit, etc. *Chemistry: Human Activity, Chemical Reactivity* may give academics additional criteria to consider. The book is authored by a well-known team of chemical educators who have a particular passion for representing chemistry visually, using electronic resources to enhance conceptual understanding, and for making explicit the importance of chemistry in the world today. Thus, when choosing your general chemistry text for next semester, ask yourself whether it is important to you that your students leave your course with an understanding of the centrality of chemistry, with an appreciation of its impact on all aspects of life on Earth. Ask yourself whether you want your students to have access to a varied range of high quality e-resources to supplement your own interaction with them. If either of these criteria is important to you then I recommend that you spend some time studying what *Chemistry: Human Activity, Chemical Reactivity* has to offer.



It is the "human activity" in the title that is central to the philosophy of this book. Many textbooks describe the applications of chemistry in everyday life, and this book does that too. But the contexts are not add-ons or afterthoughts; rather, they act as the driver for the text. Each chapter commences with a substantial case study. These case studies draw from the natural world issues of green chemistry and sustainability in most chapters. For example, the chapter on carbon compounds starts with a case study of methane clathrates, and that on chemical reactions and energy, with a case study of hydrogen as a fuel. The more obviously organic chapters use contexts from pharmaceuticals or biological chemistry, with case studies on curing and death and dying in the aromatics compounds chapter, and a case study on the discovery of penicillin in the carbonyl compound chapter. These case studies are fascinating and a useful resource in themselves, and I looked forward to each one. It is perhaps a little unfortunate that the first two are about drug abuse, and that some potential adopters may be prudish enough to be put off by that. But in each case the topics are discussed in their scientific context, and in a way that helps us to appreciate (in these cases) the power of analytical techniques.

The case studies are not the only place that the essential importance of chemistry is discussed. Real-life context is embedded within the text, often in a way that encourages students to think about how we know what we know, and that demonstrates the scientific method effectively. Context in this book is not assigned to "boxes" or sections but is an integrated part of the whole. Big issues are tackled here: climate change, alternative energy sources, feeding the world. It is right and proper that chemistry be presented in these important contexts—especially, I suspect, for many general chemistry students for whom this will be their last encounter with formal education in the subject.

The authors have been very careful about explaining to students the multiple ways in which chemical information can be presented at the symbolic, observational, and molecular levels. All too often tutors move between these levels without properly explaining to students what the ground rules are, why there are different conventions, and why they matter. This problem has been faced head-on in this book and should result in students having increased confidence in using the book and tackling chemistry.

A major failing of many general chemistry books is a dire lack of organic chemistry. Organic chemistry is introduced here in chapter 4, and is then comprehen-

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sively dealt with in seven further chapters. Organic compounds are treated in the same way as inorganic compounds throughout the text, so that students will be just as familiar with carbon chemistry as they are with the rest of the periodic table. So, for example, discussion of Lewis acidity or shapes of molecules is just as likely to use organic species as inorganic ones. The integrated approach extends to the other major branches of chemistry too, so that it is difficult to identify chapters as predominantly inorganic or physical, and the power of analytical chemistry as a tool in answering "How do we know?" is also demonstrated throughout.

Compared with the comprehensive treatment of carbon compounds, the rest of the periodic table is dealt with in just two dedicated chapters, one on main group chemistry and one on transition metal chemistry. This might seem a little stingy but probably reflects the current importance of organic chemistry. And inorganic chemistry looms large in the chapters on, for example, structure and bonding, equilibrium, solubility, and energy. The chapter on main group chemistry focuses on charge density and polarization as underlying concepts that are used to describe trends in the properties. The chemistry is described in terms of underlying trends before presenting essential and distinguishing features of each group. The chapter on transition metal chemistry takes a structure-and-bonding approach rather than a descriptive one and deals very effectively with complexes, crystal field theory, and magnetism as well as metallic chemistry. The final chapters in the book take this text where other general texts don't currently go and that is to the frontiers of contemporary research topics. So the book is very nicely rounded off with chapters on materials, biomolecules, and nuclear chemistry.

There are worked examples and in-chapter questions throughout the book, and extensive end-of-chapter exercises. I particularly liked the end-of-chapter summary and conceptual questions. These move away from closed questioning to more open-ended questions that test synoptic and conceptual understanding.

As might be expected from these authors, the book is beautifully illustrated with photographs, molecular structures, and stills from animated molecular simulations. I am sure that these will do much to aid students' understanding.

This is a book for which the e-resources are marketed as strongly as the text itself, and it will be interesting to see how this new approach to publishing might progress. The online resources are available when you have registered and received a password. The textbook suggests that students pay for four semesters' access to these resources.

The e-book is searchable, which will be a great advantage for users. It is also possible to highlight the text and bookmark pages, which makes it easy to return to for key sections. Embedded additional resources include "think about it" tutorials that link to an in-depth tutorial on a specific topic—for example, use of isotopic ratio mass spectrometry in identifying the origins of methane linking to four case studies. These tutorials use animations, video, and questioning to explore students' understanding. These are a useful additional resource, but unfortunately not all of the simulations ran on my PC. The chapters also have links to interactive exercises that give students practice in calculations and answering questions. Some of these use videos of chemical reactions, animations, and multiple-choice questions. The "taking it further" links take the reader to what look like additional textbook pages that extend the material covered in the main text. These additional resources also have links to "think about it," interactive exercises and molecular modeling activities.

There are also links to molecular simulations that utilize the Odyssey software. The book also provides access to the Odyssey software itself, which presents tutorials and demonstrations for each chapter. In addition, the "applied chemistry" resources give interactive molecular models for many molecules organized by application—for example, sanitation, pharmaceuticals, materials, and polymers. There is also an extensive "molecular stockroom" resource that gives interactive molecular models for hundreds of molecules, organized by molecule type, group, or functional group. The molecular modeling kit enables students to build their own interactive models. The Odyssey resources are potentially the biggest draw of all the e-resources, and I imagine that students will find them enlightening, entertaining, and useful.

The embedding of these additional online resources in an e-book certainly greatly enhances the textbook. They add an additional dimension that should support students who need extra help and stretch those who want to take their studies further.

The website also offers a range of additional instructor's downloads. These include a solutions manual for all of the exercises and problems in the book. There is a test bank of objective questions covering each chapter. This is a rich resource, as each chapter is served by about 35 questions, all categorized by intellectual level—for example, memorization or higher order. Some chapters also contain some

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essay-style questions that instructors may find useful in setting assignments. Also available is an instructor's guide. This resource summarizes each chapter and gives suggested "lesson plans" with ideas for in-class activities and discussions. These could be used alongside the PowerPoint files for each chapter, which provide a lecture related to the chapter. I am not a fan of PowerPoint in teaching, but these are as good as it gets—not too many and full of visual images. These two resources taken together could be very useful for new instructors or anyone who wants to tie their teaching very closely to each chapter. The third in-class resource is a set of Turningpoint files that provide PowerPoint slides of multiple-choice questions designed to be used directly with in-class voting systems or clickers. Taken together, these resources provide a comprehensive pack of material to support instructors.

An image bank of all the images from the book is also available. There are also links to additional resources for students, but these were all unavailable at the time I tried to access them.

Overall, this is a great general chemistry text. The student experience is enriched significantly by the embedded activities in the e-book. The additional downloads for instructors will make their job easier and enable them to enhance their students' learning. The book succeeds in conveying the importance of chemistry in the natural and human environments and should make the subject accessible and captivating to students.

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www.chemistry.nelson.com/mahaffycommunity/default.html

Stamps International

See also www.iupac.org/publications/ci/indexes/stamps.html

Vitamin C and the Age of Discovery

Among the stamps celebrating the International Year of Chemistry, the one issued in Switzerland on 3 March 2011 features the molecular structure of L ascorbic acid (vitamin C). This simple molecule has played a fascinating role in history, particularly since the relationship between the consumption of citrus fruits and fresh vegetables rich in vitamin C and the prevention of scurvy was realized around the mid 18th century. In this regard, Jay Burreson and Penny Le Couteur argue in their provocative book *Napoleon's Buttons* that vitamin C may well be responsible for extending the trade routes to the Americas and the Far East during the 17th and 18th centuries. The exploration of the world, fueled by the Europeans' relentless appetite for spices and precious metals, certainly accelerated when more balanced diets and healthier ship crews enabled longer maritime voyages. Nowadays, vitamin C is a common dietary supplement even though its ability to prevent or cure diseases, ranging from the common cold to cancer, has not been unequivocally demonstrated.

The stamp illustrated in this note also pays tribute to Tadeus Reichstein (1897-1996), the Polish-Swiss chemist who developed in 1933 a practical semisynthetic method for the industrial production of vitamin C while working at the Federal Institute of technology in Zurich. The Reichstein process, still widely used today, involves the hydrogenation of naturally occurring D glucose and the bacterial fermentation of the resulting D sorbitol intermediate to L sorbose in its initial steps. Interestingly, it was not Reichstein but the British chemist Sir Norman Haworth (1883-1950) who received the 1937 Nobel Prize in Chemistry for his independent (and virtually simultaneous) synthesis and structural elucidation of vitamin C and his extensive work on carbohydrates. However, it is also worth noting that Reichstein's methodical discovery and isolation of several hormones of the adrenal cortex, including cortisone and aldosterone, were eventually rewarded with the Nobel Prize in Physiology or Medicine in 1950.

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