Book Review

Chemistry Structure & Dynamics by George M. Bodner, Lyman H. Rickard, & James N. Spencer

Reviewed by
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I classroom-tested the preliminary edition of the Bodner, Rickard, and Spencer core text, Chemistry Structure & Dynamics, in Integrated General Chemistry I, (26 students) and Integrated General Chemistry II, (18 students) in the fall of 1995. Eight students were enrolled in both courses. I assigned the first 14 chapters in the textbook, and three sections from Chapter 15 (Interaction of Electromagnetic Radiation with Matter—Spectroscopy, The Fox River Mystery, and Dead Cats) in conjunction with laboratory experiments in the two courses.

For each chapter, I recommended a subset of the end-of-chapter problems. I have mixed feelings about having answers to problems provided. Students like them because they provide the feedback of the "correct" answer, telling students that they are on the right track. However, it relieves them of the responsibility of judging whether their answer is reasonable (something they will have to do, or should be doing, on exams). Learning to make such judgments is an important skill to develop. Furthermore, having the answers available gives the strong impression that there is one right answer and that any other answer must be wrong. Sometimes the answers in the back of the book are wrong, at least from my perspective. All this places too much emphasis on the answer and not enough emphasis on how one gets to it. In addition, I like having some problems that have a range of possibilities for answers. Having the Instructor's Manual, but not having the answers to problems presented in Appendix C, would give the instructor the flexibility of deciding how answers would be made available to the students. This increases the instructor's responsibility for giving students feedback, but that is a responsibility the instructor should take seriously. Both the students and I would appreciate having brief solutions to the checkpoints in the back of the text. Ideally they are pausing to think about the checkpoints when studying the text and, here, it would be helpful to be able to check and see whether they are thinking along appropriate lines.

Before my comments on the core text, I will relate two general comments from students. An unprecedented number of students purchased their own periodic table; and there were repeated complaints about the core text not having a periodic table that included atomic masses. Other comments, more laments than complaints, concerned the absence of color illustrations and pictures. There is something inviting about a text with color
illustrations and pictures, and students missed them. I didn't mind at all, nor did I see students objecting to a softbound chemistry text. If they were asked to choose between a lower cost text without color illustrations and pictures, and a text with them that costs significantly more, I think the lower cost might be the preferred choice. In this multimedia age with the World Wide Web, instructors can provide attractive and colorful visuals to supplement the core text. I did this only minimally using the preliminary edition of the core text, as I was kept busy mastering the new approaches to teaching general chemistry in the core text. Having gone through the course with the text once, I certainly would be better able to provide the students with colorful supplementary visuals in the second go-around.

Chapter 1 (Elements and Compounds) and Appendix A
I supplemented Appendix A with a seven-page presentation of simple statistics that the Colorado College chemistry department has prepared and includes with its laboratory manual for the course. I believe that statistical analysis of numerical and experimental data is an important skill for students in general chemistry. I was glad to see a discussion of scanning tunneling microscopy included in Chapter 1. As I noted above, the presentation of the periodic table with only atomic numbers, was considered inadequate by almost all students.

Chapter 2 (The Mole)
The figures in this chapter are helpful. The presentation of a sequence of steps for solving limiting reagent problems is an effective method of presentation, particularly because it is good modeling of how to solve chemical problems. Perhaps by the authors stating explicitly (a) that they are modeling a way of solving chemical problems, (b) that they are going to continue this modeling practice throughout the text, and (c) by encouraging the student to develop their own sequence of steps for solving different types of chemical problems, the text could get students practicing this important discipline more extensively.

Chapter 3 (The Structure of the Atom)
Incorporating photoelectron spectroscopy and the energy structure of atoms is a big plus, but more emphasis should be placed on the fact that it is the energy structure that is being revealed. I am less enamored of the use of the shell model and would prefer that the authors talked about orbitals as representing energy levels and spatial distributions of electrons, instead. A statement such as "one electron occupies the outer shell" combines energy level and spatial distribution in a way that is conducive to student misconceptions in the visualization of electrons in atoms. I would be happier if the authors presented orbitals and orbitals diagrams rather than shells and shell diagrams.

At first I did not see the necessity of introducing the new (to me) concept of average valence electron energy (AVEE). However, it has value in distinguishing between metals, nonmetals and semimetals. I tried using first ionization potentials for this purpose, and it did not work. So, if you want to give some meaning to that stair-step line on the periodic table (which I do), AVEE is apparently the way to do it. Using this concept also provides a reason for paying attention to electronic energy levels in atoms.

Chapter 4 (The Covalent Bond)
One of the very positive aspects of the core text is the introduction and relating of equations for calculating formal charge, partial charge, and oxidation number for atoms in molecular species from the electronic structure of the molecular species. It very effectively ties together these three ways of counting electrons.

I also like the use of the modified version of the VSEPR theory, the electron-domain (ED) theory. I have been using a similarly modified form of the VSEPR theory myself, but lacked a good term for electron bonding and nonbonding regions; electron-domain theory does the job very nicely. Most of the students in the first course reported that they had mastered ED theory to predict the geometry of molecular species, and their performance on examinations indicated that they had. Section 4.15 (The Role of Nonbonding Electrons in the ED Theory) is very important. I think it really helped my students distinguish between electron domain geometry and molecular geometry, which heretofore has typically been a problem for them.