Chemistry Texts for Nonscience Students: Is This *Chemistry?*

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I know this has happened to you, too: I have just met someone and am entering the "sharing-backgrounds-to-find-common-ground" stage of our first conversation. Before my new friend has even asked what I do, I know *exactly* where the conversation will go three sentences down the road: "I teach chemistry at Colorado College." (Have you anticipated the rest of this paragraph already?) "Oh, my God! Chemistry was the *worst* class I ever took. How can you *stand* it?"

By this time I am feeling tremendous empathy with lepers. How could any decent, sensitive, aesthetic person possibly tolerate *taking* more than one chemistry class, let alone *inflict* it on innocents? Dentists and morticians receive the same sort of generic disgust from the public, simply for having chosen such a rotten way to make a living.

I don't want to apologize for liking chemistry, but I find myself defending the idea that it can be a stimulating and pleasurable way to pass the time of day: "I get a lot of satisfaction from helping to reduce the fear of people taking chemistry courses." (In fact, I expend most of my teaching time convincing students that they *can* do chemistry—without pain—and about 15 minutes per day conveying subject matter.) Am I weird because I like this stuff, or vice versa?

This public fear of chemistry is just so pervasive that I now expect this reaction, and am pleasantly surprised by the 3% (God love 'em!) who enjoyed their chemistry classes. They are such a distinct minority, though, that we now see textbooks that are written specifically for that alienated majority: These texts spend 80% of their time jollying the readers out of their chemistry trauma and 20% on subject matter. Indeed, there is an entire spectrum of texts, ranging from the spare-the-rod school ("By God, I learned it without a lot of four-color diagrams!") to the who-me-teach-chemistry? school, which is often aimed at nonscientists ("Maybe they won't notice the formulas if we pack them in between enough relevant examples.")

It seems to me that we chemists also suffer from a certain amount of guilt by association with some of the less pleasant aspects of our modern society. Of course, neither you nor I manufactured herbicides with traces of dioxin in them (for use in Vietnam), and *we* didn't send dangerously toxic wastes off to be dumped in someone's backyard. But *maybe* I educated one of those chemists who *did.* At least it is true that some people with the same general training as mine have used poor judgement in some environmental matters. We technocrats—as a group—must share some blame for the undesirable products of modern technology.

My response to this professional guilt is to try to make it all better by using chemistry for the enlightenment of the populace and the reduction of environmental degradation. I teach environmental classes, I study atmospheric pollution, and I give public lectures about acid rain. I want *so* much for people to see that chemists can also be people of conscience and that we really do care about preserving our planet. When I read of a particularly flagrant abuse, I wish I had spent more time talking to my classes about personal responsibility and professional ethics.

Some chemists respond to both of the above concerns by writing chemistry texts in which the scary stuff (the formulas and word problems) is hidden between pictures of waste dumps and smoke stacks. The student is motivated because the material is *relevant*, the awful parts are disguised so that you never even *know* you just learned about Avogadro's number, and the instructor feels good because his students are learning how *not* to abuse their chemical knowledge. Although personal values and ethics are seldom discussed, such texts respond to the perception that nonscience students need a bit more motivation than the masochists who chose this field on purpose, and that they therefore need still more relevance, cleverness, and apology in their texts than the hard-core chemistry majors do.

One such relevant-chemistry-for-nonscientists text was written in part, at least, "to give nonscience students a basic

understanding and awareness of chemistry." I really doubt that most such texts achieve the goals that their authors or their users set for them.

First of all, chemistry is a quantitative science. We chemists try to make models that we can test with quantitative experiments. We use numbers and equations a lot. For a student to get a "basic awareness" of chemistry, I think he or she should experience the quantitative aspect of our science. Many modern texts seem to take the approach that word problems and equations are scary and thus should be deemphasized. The exercises at the end of one chapter start with, "Why do we say that gas makes up the 'loosest' form of matter?" Mildly arithmetic problems usually do follow, but are often deemphasized relative to descriptive ones. (If chemists sit around all day discussing the looseness of matter, I believe I'll major in econ, thanks.) Is it *impossible* for introductory students to do some of the exciting things we do?

It also seems to me that part of what makes chemistry stimulating is the use of chemical knowledge to make *judgements* about things. An awareness of real chemistry should include such exercises. Can a student who has read four paragraphs about acid rain in a chemistry text make better judgements about political candidates, platforms, and legislation than one who has only read about acid rain in the newspaper? I doubt it very seriously. Perhaps it is heretical of me, but I question the value of using two pages for this subject (which is near and dear to my heart!) if you can't give students enough of a critical mass of information that they can think about some real pros and cons of the issue!

I would rather that textbooks discuss fewer environmental problems, if necessary, so that the remaining ones could be presented in enough detail that students could engage in the exciting process of weighing information and evaluating alternatives.

Today our education system is sadly lacking both teachers and texts that encourage students to learn to *think*. It saddens me each month to see yet another text pumping students up with yet another set of facts to learn, while the kids' reasoning powers lie fallow for yet another semester.

It really is difficult for an author to give an introductory student, already afraid of science, enough of a background to be able to make useful judgements about thorny environmental problems. It is also difficult to write a text so that students have to learn to reason and think as they work through it. I know I find myself assigning exercises that don't encourage real thinking; why should it be any easier for authors to avoid them?

I am certain that our authors have done much better at writing nonscience students' textbooks than I ever could. But if these texts don't teach either reasoning or the excitement of the scientific search for difficult answers, why bother to use them?