Teaching Chemistry in the United States, Post-9/11

by Mark A. Benvenuto and Matthew J. Mio

Since the birth of chemistry as a discipline in the 19th century, chemists have always been the “bomb-makers.” Traditionally, this has been part of the allure for students for the “central science.” Even students who will never be scientists consider chemistry for their science elective in part because chemists are the ones who “blow things up.” Whether simple drain-cleaner bombs, military explosives, or nuclear weapons are being discussed, chemists are the ones who know the details of how to make things go “boom!”

Given the events of September 11, 2001, and terrorist activities worldwide, several questions arise: Has student attraction to chemistry dimmed in the U.S., post-9/11? Have chemistry instructors been forced by governmental or administrative authority to tone down the explosive side of chemical concepts? Or have instructors themselves independently decided to mute the detonations of the past?

What We Used to Do

For a large number of undergraduates, completing one or two science courses is all that is required to earn their bachelor’s degree. Given the choice of a smorgasbord of 100-level courses and a few friends more senior to guide them, most students will gravitate either to the easiest course or the course that is the most

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fun. Chemistry is seldom considered the easiest offering; biology usually gets that title. Thus, to win students and keep non-science students interested, the chemists have to work to be considered the most fun teachers. One way to do this in a general-level class is to detonate something or light something on fire, often at the start of the first class period. There are a number of relatively tame demonstrations a faculty member can do, the preparations of which can easily be found on countless Web sites: igniting methane soap bubbles, making a soda pop fountain, or detonating a hydrogen-filled balloon. The important thing, as all experi-

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enced chemistry faculty know, is to have tried the demonstration beforehand, and not to alter anything during the execution of it in front of students. While the students may not immediately notice, safety is always the main concern during a chemical demonstration.

The occasional explosion, ignition, or loud demonstration throughout the semester often wakes up a class by shaking them out of a dull routine. Students like these events and often make comment to that effect on end-of-term course evaluations. Of course, the good instructor knows that he or she should combine some kind of vibrant explosion or combustion with a concept that is being covered in class. For example, hydrocarbon combustion—burning gasoline or natural gas on a stove—can be combined with the methane soap bubbles demonstration, as they are the same phenomenon. More exotically, redox chemistry—the loss and gain of electrons in a reaction—can be combined with burning or exploding sodium metal in water, again because this mirrors a textbook concept. Strung together, several of these lively explosions and burnings have for years kept enrollment numbers and student interest up.

Another aspect of chemistry classes is the out-of-class report. These assignments help students gain experience at the university library and learn more about a specific topic in the field. Some of the topics students think are enjoyable include: manufacturing TNT, producing fireworks, the history and combustion of gunpowder, and how an atomic bomb functions. No teacher in his or her right mind ever expects a student to synthesize explosive materials or build an incendi-
ary device. In fact, the students routinely discover in the course of writing these reports how difficult such operations can be, the amount of work that goes into them, and the scarcity of key materials.

**DID 9/11 CHANGE WHAT WE DO?**

Our experience suggests that, in the immediate aftermath of 9/11, local and federal government law enforcement agencies did little to limit the free speech of chemistry faculty in the classroom. But what happened in the classroom did change and the change was far more subtle. Faculty members seem to be censoring themselves. Immediately following 9/11, making any connection between the events of that day and the chemistry we study in the classroom was considered insensitive at best and offensive at worst. For example, the reason the two towers of the World Trade Center collapsed is in part due to the metal support beams melting within the superstructure of the buildings. Metal has only minuscule intermolecular forces holding its atoms together. Thus, it melts (or burns) throughout a whole sample much more rapidly than wood, which has significant intermolecular forces. In 2002, probably no one mentioned this as a class example, although it may have been given as an answer when a teacher was queried on it specifically. This self-censorship has lessened over the last few years, but most of us still don’t evoke the chemistry of 9/11 as an example in lecture.

Another example of self-censorship comes directly from the students. They don’t ask the glib questions about bombs and explosives they once did. It’s doubtful that anyone has done a proper study of this attitude change from the pre-9/11 era until now, but examples can be found everyday in the classroom. There appear to be very few spontaneous student questions on how to make bombs. This was certainly not the case in the pre-9/11 world. Questions about drain cleaner and aluminum foil bombs don’t get asked nearly as much. *The Anarchist Cookbook* seems to have disappeared.

Several years prior to 9/11, a student asked in a general chemistry class a very
detailed question about how to make mercury fulminate, a touch-powder like explosive that detonates upon contact. The grasp of technical information in the student’s question indicated knowledge of the *The Anarchist’s Handbook*. When asked about this, the student held the book up in class and grinned. What ensued was a diversion in the lecture that covered mercury fulminate, the mining industry, plus lab safety, as the directions in the *Cookbook* are poor when it comes to safe preparation of such shock-sensitive materials.

This example provides two points about how we are lessened by our collective self-censorship. First, students apparently do not feel as free to explore such literature as they once did. They, like the faculty, have probably heard about new laws in which librarians are supposed to report certain book *withdrawals*. Second, it takes away the opportunity to discuss explosives and the consequences of not using them safely. One author, when confronted with a student and *The Anarchist Cookbook*, realized that the student may try some home synthesis anyway and seized the chance to lecture a bit about first running any reaction on a very small scale. Chapter 4 of *The Anarchist Cookbook* is lax when it comes to pointing out that smaller is safer and that every reaction needs to be run on a trial basis first. This entire topic may seem frightening to non-scientists today. Yet, chemists and other scientists who are faculty members have always had as a part of their charge the education of their students in proper lab technique. Safety must be emphasized at every step. After all, we know what can happen when a reaction goes awry. Indeed, we are morally and ethically obligated to teach proper precautions to our students.
The most obvious case of self-censorship may be found in faculty performing fewer explosive classroom demonstrations. Perhaps we fear that showing our students a controlled explosion will give them detailed enough instructions that they can replicate it. Perhaps we are fearful of some form of university reprisal, or we fear word of this will get to law enforcement and be taken the wrong way. Perhaps we think it has become too easy for students to connect such phenomena with terrorist bombings and 9/11, a reminder that few wish for. Whatever the reasons, it is likely we are constraining ourselves in some way. One author recalls a lecture on explosives taught in a forensic chemistry course post-9/11. Simple demonstrations of fuses, hydrogen balloon detonations, and flame colors brought wonder and understanding to the students. A student asked if such displays were appropriate. Seeing an opportunity, the author decided to open the floor for discussion. Most thought the chemical demonstrations were acceptable, but still speculated that classmates might be taking notes for illicit purposes! This led to a discussion of the positive aspects of explosives—terraforming, mining, demolition, and, in the case of fireworks, pleasure—expanding the students’ knowledge of explosives to include positive uses.

In addition, shortly after 9/11 librarians were told they would be monitoring the circulation of key materials. For many, this meant that who checked what kinds of books out might become information to pass on to law enforcement authorities. In such cases librarians were not allowed to inform the person in question that their name was being turned in. This has put a constraint on academic freedom in that out-of-class projects could now cause a problem if, for instance, the general theme were the mining industry or rocket propellants. Both would require that students withdraw a number of references on various known explosives, and could trigger whatever clandestine red flags have been put in place.

**WHO CARES?**

“Who cares?” is the quick, sarcastic answer from academics who don’t understand why such information should be available in the first place. After all, the stu-
udents are 18- to 22-year-olds in general chemistry classes. Do we really want to provide them with the information they need to make bombs, explosives or atomic weaponry? The answer is quite simple: all this information is already available on the Internet and in the library. Students can use it whether they are supervised or not. On the other hand, if there is open dialogue between students and faculty about such subjects, older and wiser heads—the faculty—are involved. Safety and responsibility can be introduced into the conversation at every juncture. When topics like these are driven out of the classroom, even by well-meaning self-censorship, students learn less and we are all less free.

The government is not breathing down our necks when it comes to science education in the post-9/11 world. We don't need to fear the police, whether at the local, state, or federal level. We need to fear, or at least monitor, our own self-imposed limits. Those limits ultimately harm our students and take away from the inherent pedagogical freedom we enjoy in our country.

ENDNOTES
1 This is not meant to denigrate or enrage any biologists. The statement is made based on over a decade of anecdotal information from students at the authors' home institution.
2 Holley and Seastrunk.
3 Powell.
4 National Coalition Against Censorship

WORKS CITED