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The ACS Inorganic Exam and Its Influence (?) on the Inorganic Curriculum

There is an enormous amount of personpower invested by the ACS Division of Chemical Education in developing standardized tests for the various areas of chemistry. Is it worth it? Several years ago when I was Chairman of the Inorganic Subcommittee, the first thing we did was to find out whether multiple-choice questions were a valid way to test knowledge of inorganic chemistry. As a professional research chemist, I shared my colleagues' distrust of an appraisal that could be machine graded. Our subcommittee made up a test that was part multiple-choice and part essay. This was given to about 400 students spread out over 21 schools throughout the country. All the papers came back to Cornell where Bill Hatfield, Ed Mercer, Bodie Douglas, John Howatson, Ralph Birdwhistell, and I spent a memorable three days in August 1967, grading and regrading the essay part of the test. Ted Ashford then analyzed the results for us, particularly the correlations between the essay grade, the objective grade, and the student's own grade as supplied by his/her professor. To our surprise, we found that our essay grades and the objective grades did not correlate very well, but they separately correlated extremely well with the student's own grade. In other words, our tests gave us the correct information—but we were not sure just exactly what that information was. As Ted Ashford said, "the essay examination measured some other outcome than what the objective test measured." We had two good tests, but not of the same thing. Given the enormous amount of time that we had put into the essay grading, it was hard to justify going to the trouble of giving both kinds of test questions on every exam. However, we did salve our conscience. Thereafter, we always included with the standard multiple-choice questions an essay part that the instructor could use optionally . . . providing he or she did the grading themselves.

What about the feedback? Does the very existence of an ACS standardized exam have an influence on what is taught in the inorganic course. To find out, I recently sent out a questionnaire to 178 of my colleagues who were teaching inorganic chemistry at various colleges and universities. The questions I asked were

1) Does your department use the ACS tests in inorganic chemistry?
2) If so, would you say that they have an influence on what topics are included in the course and at what level?
3) Do you believe that external exams have much, moderate, or little influence on curricula?
4) What do you think are chief controlling factors on what goes into a course?
5) Do you have any specific suggestions on what might be done to enhance the amount of inorganic chemistry in the undergraduate curriculum?

We got answers from 137 people. I thank all these people for their kind cooperation. Ninety-seven of them used ACS tests either at the graduate or undergraduate level. Their responses to question 2 were revealing: 33 responded *yes,* 59 responded *no.* Even more revealing was question 3. *Ten* people believed external exams have *much* influence on course curricula, 33 said *moderate,* 94 said *little* or *none.* One could do an extended psychological study on the tone of some of the letters which clearly resented the implication that the writer was influenced by *anything* in setting the curriculum, let alone an external exam! More thoughtful respondents tried to distinguish between conscious and unconscious effects. Still, the overriding impression was that other factors dominate.

According to my sample (and I must emphasize that this was strictly an amateur survey, with all the pitfalls inherent in polling plus some new ones of my own devising) the chief controlling factors on what goes into a course are (1) instructor's preference, and (2) textbook content. Many respondents carefully differentiated among instructor's expertise, training, knowledge, interest, and perception of what is needed by the student; very few mentioned anything about student interest. Yet, it must be admitted that the departure of descriptive chemistry from inorganic courses is largely reflective of student disinterest, at least in the way descriptive chemistry is taught at the present time.

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Most interesting to me were the specific suggestions on what might be done to enhance the amount of inorganic chemistry in the undergraduate curriculum. None of the projected solutions is easy, because there has to be a radical change in attitude of organic and physical chemists. Our colleagues have to be made to realize that *freshman chemistry can no longer be equated to inorganic chemistry.* Inorganic chemistry should have equal time, and there is a strong feeling that the ACS MUST insist on a full-year course in inorganic chemistry either at the 2nd or 3rd or possibly even 4th year level, as is done in other countries.

As a practicing realist, I appreciate that convincing our teaching colleagues to require 1 year of inorganic chemistry at the nonfreshman level will not be easy. Every group pushes its own requirement (more computer science, more bio, more spectroscopy, more quantum chemistry, more math, more physics, more lasers, more etc.). Something has to be thrown out! None of our colleagues will suggest what has to go first, so we will need to do it as a cooperative effort. We should sit down with our physical, organic, and analytical counterparts and make a deal. Give us a year inorganic course in the curriculum (nonfreshman), and we will give up our attempts to teach watered-down physical chemistry (the single most serious affliction of inorganic courses). Also, we will do a proper job of including the organic and analytical aspects you assign to us. We have a golden chance to attract students with group theory, bio-inorganic, organometallic chemistry, and solid state chemistry already handed to us on a platter. Surely with this as a base we can set up inorganic courses that would be a vital, exciting part of the curriculum.

First and foremost, we need to select carefully the proper person to teach the course. That means an inorganic chemist, not a physical chemist. Indeed, we would do better getting organic chemists involved than the mathematicians and abstractionists who are taking us in the wrong direction. Second, we need to encourage the creation of proper textbooks. Modern texts tend to be somewhat overwhelming, with encyclopedic coverage of all the bright new findings in all the possible subtopics that now comprise inorganic chemistry. To attract students, we need to sharpen our focus, to zero in on inorganic chemistry in the real world. We need to be more critical of what has been done in the past, and we need to project some tough guidelines for future work. Catalysis, materials, and energy conversion are important new challenges that come to mind. They will be with us for a long time. Our future will indeed be grim if we do not properly prepare our students to work on these problems.