

## Commentary

## The NSF "Systemic" Projects—A New Tradition

by Gordon M. Barrow

The NSF initiative Systemic Changes in the Undergraduate Chemistry Curriculum consists of five major, well-funded projects that have a common goal: "significant" and "fundamental" changes affecting mainstream students, primarily those in introductory chemistry courses. Now that the projects in this initiative are about ready for adoption and the initiative seems set to make a major impact, we need to look at what we are getting into.

In a previous commentary (*J. Chem. Educ.* **1997**, *74*, 1154) I pointed out that most students expect the educational system to help them manage the information and procedures of various aspects of the complex world in which they find themselves. In introductory chemistry courses they expect to learn the social and management skills that allow them to be successful as beginning members of the chemical community. But some students have a different, contrary attitude. They want their education to show them that they can, with the help of teachers and textbooks, build their own understanding. Distinguishing the two attitudes, which can be labeled *information management* and *individual understanding*, opens up these two great avenues into chemistry. The NSF initiative is already vigorously exploring one of them.

The nature of the NSF initiative is shown by the summary statements available on the Internet. The following selective comments include quotations from this material.

Most of the five major projects of the initiative are student-centered. For example, "the workshop leader is a student who has successfully completed the course, and is trained in group dynamics and in pedagogical issues. By working together with the faculty, students become a part of the community of the department." The modules around which most of the courses are built can be "about chemistry and the environment, chemistry and technology in society, and the molecular basis of life" and about specific technologies such as the chemistry of air bags. The goals of the learning experience are described in various ways: students "are able to appreciate the significance and possible consequences of new information"; or they "will command the knowledge skills necessary to permit continued learning, lead productive lives and make informed decisions"; or the course will "promote scientific literacy for all students and demonstrate the importance of science to society". In these new ways of getting students into chemistry we can see a response to social and cultural changes—a "new tradition"—rather than an adherence to the traditions of science.

The projects of the NSF initiative are in tune with the attitudes that the majority of beginning chemistry students bring with them from the modern lives they lead. Furthermore, these projects can accommodate students with a great variety of attitudes toward learning and a diversity of educational goals. The unimpeded success of the initiative, and of the whole of the introductory chemistry enterprise, depends, however, on understanding that information-management is the essence of the initiative and that building-of-understand-

ing is a separate matter.

(Traditional academic instincts lead us to deride that which is mainstream and popular. But accessing and managing the information and procedures developed by others is many-dimensional, broadened by the growth of science, the capabilities of modern technology, and social connections. It is no trivial matter, and therefore academically acceptable, to learn to deal with the information and procedures, and the technology and the people, of modern chemistry.)

Only if the nature of the NSF initiative is clearly recognized will it produce the lasting mainstream changes that it promises. The information-management direction will then not be dragged back into the mishmash of conflicting attitudes that has plagued introductory chemistry courses for decades. We must, for example, recognize that using real-world examples and setting practical puzzles for students to solve can add interest and motivation. But students in mainstream courses are not building their own understanding and can not make these anecdotes into building blocks. The courses spawned by the NSF initiative will thrive only if they are consistent with their information-management mission.

While the NSF initiative tackles, and seems likely to solve, the problems that trouble mainstream introductory chemistry courses, it can serve equally to solve the problems that the initiative does not address. The distinguishing character of the NSF-sponsored projects can invite, or at least allow, the development of a separate route for those students who, for various reasons, prefer to "know the subject as their own".

Success in bringing about "significant" and "fundamental" change for mainstream students and allowing the emergence of a minority traditional track can be the great accomplishment of the NSF initiative. But some practical questions are raised. Will university-level chemical education be strengthened by an emphasis on managing or will students be more successful in, but less satisfied with, university education? Will we create the right mix of masters and artisans for the scientific enterprise of the future? What will be the added advantages and perhaps the limitations for students who think of science as managing the results of others? How will the science of chemistry prosper with these new practitioners? Is it proper for our educational system, and the NSF, to push this socialization-of-chemistry into our colleges and universities?

With the likely mainstream success of this major initiative, will there be space for those who want to have their own experiences and build their own understanding? Where would courses that serve this minority, perhaps a minority crucial to the well-being of science, find a home? Perhaps in alternative paths, perhaps in certain select colleges and universities? Is it the responsibility of the National Science Foundation to help sustain or revive this trodden remnant of the Age of Enlightenment?

If this diagnosis of the NSF initiative is accepted, the projects that it supports might be just what the doctor ordered—for both the patient and its relatives! Mainstream introductory chemistry courses will be taken away from their old tangled lifestyle and set on a new path to recovery. And courses based on the old traditions of reason and the individual will have the breathing room they need to regain their vitality.

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