Biology in the Liberal Arts

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Science belongs with the arts, humanities, and social sciences in proper, nondoctrinaire general education not for the facts it can impart, but because the work of scientists is a path into the large questions that define our culture. Science springs from the same human impulse as do music and philosophy: the impulse to create order from chaos, to capture a piece of the universe's truth by sheer will and creativity. Precisely because scientists can change the world for the rest of us as they ask their unanswerable questions, science in general education can and should deal with the same deep, unanswered questions found at the center of the other portions of a proper general education curriculum.

The major obstacle to science in general education is neither political nor cultural. It is the purely academic resistance to general education as such in many science departments. The current structure of university science departments makes good courses hard to get and harder to maintain. Interdepartmental courses in particular will never be easy to organize, or to sustain, as long as salaries, promotions, and office, lab space, and teaching assignments all flow to faculty from the chairs of separate departments.

The nation-states of Religion, Classics, English, Comparative Literature, and Languages have been able to agree on a common market of the Humanities. The kingdoms of Economics, History, Political Science, and the like have the political maturity to band together for their common good. The departments of physics, chemistry, biology, psychology, astronomy, mathematics and computer sciences are each a separate and sufficient world to their faculties. Few science departments anywhere are quite ready to acknowledge their membership in even a loose academic Federation of Science. As a chemist once said to me, "I don't teach science, I teach chemistry." And he did, brilliantly, but irrelevantly to the hundreds of college students who, fearing and loathing the way chemistry has to be taught to chemists, never had the chance to meet him.

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The moat around each science department cannot be easily crossed by student, professor, or dean. It is a permanent fiscal high tide, held in place by the full moon of government funding. Research supported by outside funds permits scientists to live better than their colleagues in the departments of the humanities and social sciences. Federal procedures allocate money for scientific research by field, usually through peer review. These funds pay for the research itself, of course, and for the visibility it may bring to the institution.

In many universities a professor may claim as well one or two extra months of salary from a grant, usually for the summer. Through the much-maligned and misunderstood mechanism of indirect cost recovery, outside grants pay for a variety of legitimate, research-related expenses—departmental computers, secretaries, faxes, copying machines, and the like—that make a science professor's life incrementally easier than it would otherwise be.

Given these facts of life, no one should be surprised to find that scientists have organized life on their departmental islands so as to keep up the tidal flow of outside research grants. Steeped in the ethos of peer-reviewed granting, researching, promoting and hiring, many regard themselves first and foremost as citizens of their departments and, only when convenient, as citizens of their college or university. As a direct result of this enlightened self-interest, interdepartmental, general curricular concerns rarely get proper attention.

Some of the most creative and potentially most interesting scientists look puzzled when a well-meaning colleague or dean asks them to put some extra time and effort into general education. It brings them no grants, adds not a bit to their research capability, and requires them to teach outside of their expertise to students who by definition will never become their intellectual offspring. They enter such discussions open-minded but puzzled, then become amused, and then bring the conversation to a close by getting back to their real work.

Leadership will be required to change this situation: scientists active in their laboratories cannot be asked to create and maintain their enterprises out of good will alone. We need the leaders of our colleges and universities to articulate a vision of the university that includes at its center a commitment to general education and to back that vision with reasonable resources. Without such a jump-start, the other interests that lie at the heart of a science department are simply too strong and too utilitarian to be budged. The problem is, all too often we are managed rather than led. Here is how a great academic leader, the late A. Bartlett Giamatti of Yale, distinguished between the two:

> Management is the capacity to handle multiple problems, neutralize various constituencies, motivate personnel . . . . Leadership on the other hand is an essentially moral act, not—as in most management—an essentially protective act. It is the assertion of a vision, not simply the exercise of a style: the moral courage to assert a vision of the institution in the future and the intellectual energy to persuade the community or the culture of the wisdom and validity of the vision. It is to make the vision practicable, and compelling. (National Research Council, *Fulfilling the Promise: Biology Education in the Nation's Schools,* National Academy Press, 1990.)

The in-house leadership we deserve will have to be backed in turn by leadership from our colleagues in the federal research establishment. For the sake of better science education, and to assure that tomorrow's science teachers will be prepared to teach tomorrow's science, the paradigm of government funding of academic research will need to be redefined.

The most direct way for outside granting agencies to show leadership here, to shake up the science departments, and to capture talented scientists for teaching in interdepartmental general education programs, would be to pay them extra to do it. A precedent for such a subsidy exists. The National Science Foundation (NSF) and the Hughes Foundation help to cover the costs of faculty who are willing to take undergraduates into their laboratories for summer or term-time research. NSF gives a grantee this money more or less for the asking, as a supplement to a regular research grant.

Practicing, funded lab scientists who were willing to put in the effort to teach nonscience students ought to get some support for their research in exchange. Here are some suggestions for how to do this:

- Funded scientists could be invited to apply to NSF or the National Institutes of Health (NIH) for a month of summer salary for course preparation. Those already taking this money from their grants should be able to apply this curricular stipend to their research.
- A similar arrangement should be worked out to provide summer salary for funded research science faculty to produce short, inexpensive textbooks and sets of readings for use in general education science courses.
- Training grants for Ph.D. programs and for postdoctoral fellowships in the sciences should include a supplementary stipend for teaching nonscientists.
- Research scientists who teach in general education courses should be able to apply to their funding agencies for additional graduate student support.
- Secondary school science teachers ought to be given the opportunity to spend a summer working in a research laboratory.

Have I just merely jerked my liberal, tax-and-spend knee? I don't think so. In the private sector it is common to find a few percent of profits plowed back into research and development. I am talking about plowing a small fraction of the basic research budget back into research on, and development of, ways to ensure a next generation of scientists who will have the support of a scientifically well-educated citizenry. The budget for basic research from NIH and NSF alone is in the tens of billions of dollars. Summer support for a senior professor comes to about $10,000, including fringes and indirect costs. About 10,000 new research grants are issued each year. If 1 in 10 professors getting new grants also could also receive a summer supplement for general education purposes, the additional cost would be about $10 million a year.

This is about 1/10 of 1% of the grant budget, or one volley's worth of Patriot missiles, each year. Either way, it is no giveaway. It is a prudent way to bring the next generation of science teachers and students out of the 19th century before the 21st century begins.