Letters

The Core Curriculum

I am sympathetic to F. H. Westheimer's plea for more emphasis on science in the undergraduate curriculum ("Are our universities rotten at the 'core'?" Policy Forum, 5 June, p. 1165), but the issue of depth versus breadth afflicts many other curricular areas as well. I would submit that learning is no less cumulative and no less hierarchical when it comes to such "soft" fields as foreign languages, communication (writing, speaking, listening), and artistic technique (musical performance, dance, painting, and so on).

But a more fundamental consideration in trying to adjudicate competing claims on curricular time should be social and national need: What are the critical problems of our time, and which disciplines are in the best position to shed light on these problems? The natural sciences do not provide us with the means to cope with issues such as world peace, disarmament, international relations, human rights, poverty, debt, racism, and bigotry. These problems are much more relevant to the fields of psychology, history, economics, political science, anthropology, education, sociology, and area studies.

To a certain extent we have all been mesmerized by the spectacular successes of the natural sciences during the past half-century. Our understanding of the physical universe has increased exponentially, while our understanding of the behavior of human beings and of societies has lagged far behind. This imbalance is being exacerbated by national funding priorities, whereby the natural sciences and engineering enjoy lavish support while research in education and the social sciences gets virtually nothing, by comparison. As long as we continue to delude ourselves into thinking that the human dilemma is subject to a scientific or technological "fix" (the arms race—"Star Wars," in particular—is perhaps the most obvious example of this mind-set), this distortion of national priorities and values is bound to continue.

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A scientist writing to an audience of scientists in a scientific journal to say that science education is crucial to society is assured of a sympathetic audience. But that is, perhaps, not the ideal arena for testing hypotheses. As a professional humanist who reads *Science* regularly, I cannot let Westheimer's Policy Forum go unanswered. His complaints about our curricula are themselves a symptom of what is wrong with so much of our pedagogy.

Fallacy 1. Science is vertical whereas other fields are horizontal. To be sure, elementary science courses are sequential, but Westheimer misrepresents the structure of humanities disciplines. Ask humanities graduate students or advanced undergraduates whether their courses have not grown markedly more sophisticated and rigorous as they have proceeded up the ladder. Humanities courses are not sequential, but they are cumulative.

Study of the humanities is an exercise in making and using such conceptual distinctions. It is training, in other words, in thinking clearly. To be sure, humanists too have their *gradus ad Parnassum*. Westheimer concedes that elementary language courses, at least, are vertical. (I do not know how one could test whether they are "not generally as vertical as those in most of science.") The vertical and the elementary are naturally allied, for the same reason that one has to practice scales before one plays Bach, Beethoven, and Brahms or that one has to learn the multiplication tables step by step before one can do calculations freely. Westheimer's plea to teach science to all students at the highest level possible—with which I wholeheartedly concur—surely is based on an urge to get beyond the merely vertical and merely instrumental levels of education in all subjects.

Fallacy 2. One can "learn" Shakespeare more easily than molecular biology "without instruction in later life." One can indeed easily read Shakespeare (many scientists do), as one can read *Science* or *Scientific American* (many nonscientists do). Merely reading, however is neither studying nor learning. There is a reason why one cannot say, "I didn't learn Shakespeare in college, but that's all right; I learned him last year."

Fallacy 3. Students should learn science, not how scientists think. Westheimer wants us to learn "the advances in science that have occurred in the last half-century." Well and good. But (i) the exposure to salient developments in numerous fields that Westheimer urges is inconsistent with his main goal of exposing students to one or two fields at an advanced level. (ii) Those salient facts are precisely what the sequential, or rather the progressive, nature of science will gradually render obsolete. (iii) We can continue in later life to learn something about the new advances outside our own fields from the public media. We will learn those as we want to, provided that our education has enabled us to understand scientific discourse and scientific reasoning. Various levels of algebra and topology have helped me follow elementary presentations in *Science* of fractals and of other advances in mathematics. But far more important is that they trained a faculty of controlled, abstract reasoning. The contents were the means, not the end. In all other areas outside the field that we will continue practicing in later life, learning how to think should be the only goal, although it is necessary to climb the ladder of information in order to point toward that goal.

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. . . One is awash every day in science and technology; one cannot escape it. Better our future elite (and I dislike that word) should have 4 years of peace to delve into the pure world of thought to see what has happened in the past and to try to develop the moral and ethical insight to govern the staggering changes that science has thrust upon us. . . .

A core curriculum based on humanities is a totally reasonable course in our modern times. I think Westheimer should rethink his opposition to it. He also might consider what could be done to inculcate a sense of ethics into Ph.D. research scientists so that they do not feel that what is right is whatever they are doing.

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Westheimer cuts right to the core. Humanists learn too little science (two semesters at most colleges); and the sciences focus on vertical learning ("depth"), while the humanities focus on horizontal learning ("breadth"). We have recently addressed these issues at Loyola University of Chicago, and as of September 1988 have increased the core requirements for all students to three semesters of science (plus one semester of math) with the proviso that students must choose a sequence of courses providing both breadth and depth. We hope that other schools will follow suit; we can only underscore Westheimer's observation that two courses in science do not prepare our students for life in this and the next century.

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Response: The essential thesis of my Policy Forum ("Are our universities rotten at the 'core'?") is that learning in science is very