A Case for Ethics

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Two short notes (*1*, *2*) have appeared in *this Journal* that foreshadow an active area of curriculum development in the next decade: the formal treatment of ethical decision-making when confronting a moral dilemma. Like social, philosophical, and historical issues, the threads of ethical behavior are woven tightly into the fabric of science. Although such liberal topics can be neatly isolated in professional training as textbook sidebars or completely ignored (*3*), lessons of ethical training are imbedded in every value judgment a scientist makes. Thus, the "moral" dimension is much broader than an ecclesiastical or humanitarian definition. Moral aspects of science that require ethical decision-making cover a broad range of responsibilities, including experimental design, the interpretation and reporting of data, the interactions between collaborators, and the evaluation of colleagues.

Smith (*4*) pointed out that, in the last 25 years, scientific training for faculty has been largely isolated from reflection on moral matters; training the technical intelligence was deemed sufficient. Ironically, in retrospect, we have many cases of scientific misconduct (*5*). These cases are symptoms of a greater ill: the widespread separation of the sciences from the rest of academia.

By the mid-1970's, for example, history of science had nearly disappeared as a field of inquiry. Although many of the scientists from the Manhattan Project era, including Conant (*6*), Oppenheimer (*7*), and Heisenberg (*8*), exhorted the virtues of science for making good citizens in an educated democracy, the post-Sputnik, NSF-supported era of science and science education has focused a great deal of attention on producing more scientists. The intellectual children of the first generation of these scientists, who are today's young faculty, were raised in a climate of competitive funding, research agendas driven by predicting the "hot" area of investigation, and the accumulation of students, papers, and citations as a measure of scholarly value. There has been little time to acknowledge moral values in intellectual pursuit.

Education is Not Neutral

Education is not a neutral activity. A sustained program of education inevitably affects the way a student looks at the world, so it must have some effect on the student's character. Even if we educate poorly or the effect is small, the aggregate outcome on students is still significant, as are our responsibilities. We provide instruction in ethics with every decision we make and every action we take in the collaborative enterprise of education. This means there is no need to create a new compartment within the University based on the false assumption that teaching ethics will make unethical behavior go away. Whatever requirements for studying ethics may be instituted, we must relate our concern with professional ethics to the norms and values that are central to our profession. There may be some overall moral principles of general relevance, but as chemists our focus should be on the particular situations that arise in chemistry. The individual decisions made by chemists differ from the decisions made by physicians because chemistry differs from medicine.

Meaningful instruction, the kind that changes world views, is situated within the detailed workings of a discipline. We teach behavior by example and habit, not just by inviting students to attend classes to talk about it. Like it or not, lessons in ethics inevitably accompany the other lessons we provide, whether it is a discussion of how to approach learning in an undergraduate classroom or the selection of human subjects for biomedical experiments. Like it or not, we are all moral philosophers.

Instructional Objectives

What should be the goals for a science education to keep the moral dimension in balance with the intellectual training?

1. The Development of Character. We offer character as the virtue of educated people. This includes the ability

- to identify and articulate the moral dimension of events
- to understand the ideals and rules that govern them
- to have an awareness of moral complexity in a world drawn in gray tones

The development of moral character allows people to acknowledge the conflict in controversial matters while being an active and self-reflective participant in the debate. In the educational recommendations he proposes in his recent book, Emotional intelligence, Goleman also arrrives at the word "character" to describe the basic psychological effects of intellectual development (*9*), as we have here for moral development.

2. The Development of Cognitive Skills. As character mediates identification, cognitive skills mediate action. Matters of discernment and logic require higher-order abilities to appreciate complexity, see subtlety, and balance judgments against uncertain outcomes.

3. The Development of Disciplinary Skills. In science education, we propose the following categories for goals of classroom and laboratory practice.

- *Expectations.* The expectations of science education are to inspire students with wonder and inquiry about the workings of the natural world; to require of them, in Feynman's language, "utter honesty" in all aspects of data collection and management; to educate them about the factual content; and to model the habits of a life-long learner
- *Knowledge of the Process of Science.* Education in the process of science gives students the procedures for acquiring knowledge, the ability to articulate discovery and engage in criticism, and the normal standards of ethical behavior.
- *Civic Accountability.* There are many risks and responsibilities in a life in science. Decisions are rarely clear-cut at the leading edges of any discipline, and we must all learn to negotiate the uncertainties of living on the edge: Today's beauti-

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ful theory, Huxley reminds us, falls victim to tomorrow's ugly fact. The academy is self-regulated and self-governed, so professional citizenship and accountability are crucial responsibilities. We are also simultaneously responsible for our own professional development as well as that of our students. Much of science operates in service to society, and we must account for the return on society's investment. We must also educate ourselves and others on the consequences of failed trust and misconduct, both for private or local conflict resolution and for situations that arise in the public arena.

The Ethical Perspective

Bringing an explicit ethical perspective to science education is important because, like it or not, ethics are part of the decisions we make and because the consequences of neglect increase daily. Scientists should have ethical reasoning skills for many reasons.

- They are essential to the collective enterprise of science.
- Scientists need personal and professional integrity as the players on the stage.
- Learning by trial and error is too slow, involves unacceptable risk, rarely provides a second chance, and is irrational.
- It is becoming required: Individuals who hold NIH Training Grants must now provide explicit training in research ethics, and this requirement may be adopted widely in the future.

Interestingly, the Editors of the Publications Division of the American Chemical Society began publishing, starting in the late July 1994 issues of ACS journals, a set of "Ethical Guidelines to Publication of Chemical Research" (see, for example, *J. Am. Chem. Soc.* **1994**, *116*(13), 8A–10A). Finally, developing the tools for ethical reasoning neither represents nor advocates a prescribed moral position, nor does it commit someone to dogmatic solutions to all moral problems in advance.

Many of the issues that are formally associated with discussions of research ethics can be extended to classroom and other interpersonal situations for students. Although relatively easy to analyze on the surface, incidents of academic dishonesty or conflicts in the management of residential-life situations are good opportunities for students to engage their ethical reasoning skills. For all members of the science-education community, the general topics with which to address ethical reasoning have already been fairly well laid out over time, although every new technological advance spawns a new set of questions.

Some major rubrics under which consideration of cases of unethical behavior occur are

- falsification, fabrication, and plagiarism
- other serious deviations from normal practice
- conflict of interest
- authorship and attribution
- peer review
- financial management
- rules for chemicals and for human and animal subjects
- the security of whistle blowers
- confidentiality
- record keeping and data management

A variety of suggestions have been made for how programs might incorporate ethical issues into existing curricula (*10–17*); some of them, such as those from professional degree programs, have been around for a long time, while others are more recent responses to changes in federal requirements. We propose the following guidelines for making ethical reasoning a more explicit part of the science-education curriculum.

- A consensus on the normative minima for instruction in ethical behavior should be established for different educational environments. The needs in undergraduate chemistry instruction will vary for first-year students compared with seniors, and will not be the same as those for graduate students.
- Instruction is best imbedded in the usual context in which situations arise.
- Sensitivity to program and course-time demands should be maintained.
- Social, historical, and philosophical perspectives can provide rich environments in which to explore ethical reasoning.
- Writing and analyzing case studies has emerged as an effective formal strategy for ethics instruction (*18*), although more objective survey-based tools can be effective for large-scale work (*19*).
- Informal instruction by being outwardly reflective about habit and example in authentic research situations creates the most powerful model for students.

When we educate people we change their world view. In science education, this responsibility carries the need to explore how scientists deal with the subjective, value-laden aspects of inquiry. Inevitably, a science education that explicitly includes the moral dimension will produce scientists who are more capable of handling complex ethical questions and nonscientists who can see more of the humanity within the ordinary workings of science.

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