Teach Evolution Early

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I share Ross Nehm's concerns (in "Faith-based Evolution Education?" *BioScience* 56: 638–639) about the deplorable state of public education with respect to the teaching of evolution and the urgency of addressing the problem. However, I believe timing is everything. One of the problems with the public schools' teaching of evolution is that it is late. Theodosius Dobzhansky, in his well-known dictum "Nothing in biology makes sense except in the light of evolution," has made the clear-cut case for attending to the teaching of evolution as early on as possible. By the time evolution is typically brought into biology curricula, students have already learned bits and pieces of biology with no firm underpinning—much less understanding—of how the pieces got here, how they work together, and what keeps them running. Evolution becomes a soundbite sidebar rather than the basis of biology.

My sabbatical fellowship here at NESCent [National Evolutionary Synthesis Center] is based on a proposal to craft a curriculum to teach "no-holds-barred evolution" to elementary students and, along the way, to their teachers. This effort is based on experiences I have had teaching ecology to elementary students in a like manner. One of the premises of this curricular philosophy is that elementary students are "undertaught" and are quite capable of understanding the basic ideas and tenets that underlie ecology.

So too in the teaching of evolution. If evolution is to become an understood (rather than misrepresented) part of the vocabulary of public discussion of the world and environment that citizens live in, then its teaching must begin in the elementary grades, where it can become a logical foundation for the rest of scientific teaching and learning.

This point is recognized in the National Research Council's 1996 guide—the *National Science Education Standards*—for the knowledge base that K–12 students should have as educated citizens. The standards note that an understanding of evolution is necessary in describing all aspects of "changes in the universe." Hence, this knowledge base should certainly begin as soon as possible; and I would argue, based on experience, that that would be the third and fourth grade level.

Putting effort into elementary evolution education—including that of teachers—would be a smart and academically profitable way to place the teaching of evolution where it should be—at the forefront of biological education.

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Acknowledging the Social and Ethical Dimensions of Science

I appreciate the attention that *BioScience* grants to science communication issues. Thus I read with pleasure the *BioScience* editorial "Framing Biology" (56: 555), where Timothy Beardsley describes the importance of framing the communication activities of scientists in a context. We cannot disagree with Beardsley when he says that "researchers may have to shoulder more of the burden of communication themselves" in order to avoid "marginalization in an unsympathetic political climate."

I would add that there is a further reason to carry the burden of public communication: avoiding the political exploitation of science. If scientists, as a community, choose "to lament ignorant attitudes [of the public] and return to their terminals," denying the effects of their research on society and avoiding any debate at the socioethical level, then they leave the door open for using science as a political instrument. The denial of the political role of science is itself an implicit political action.

So we should not be ashamed to openly discuss the "surrounding picture" of our laboratory experiments, including their social implications. Maybe it is time to redefine our practice.

How to do that? We could start from our communication structure. Beardsley suggests that we have to learn to "acknowledge that [we] too are human beings with passions and cares." It can be the starting point for initiating a self-reflexive approach that can build foundations for a more transparent, socially robust scientific activity. So why not try to include in our papers also the social and ethical dimensions of our work? Implementing this idea, we would exercise the use of ethical and social argument, making it natural to speak outside the technicalities of the language of our community. Moreover, some reflections on the social consequences of our research in everyday practice will probably raise fruitful debate within the scientific community. As framing theory suggests, "the way the story is told—its choice of a narrative and framing—determine how we understand the problem and solution" (*www.frameworksinstitute.org*). So innovative scientific approaches could arise from changing the way we describe our scientific issues.

This could be the first step for truly *framing* biology (and science in general), that is, considering our work in its societal context.

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