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Author: Zeigler, David

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Conveying the Values of Science and Biology

DAVID ZEIGLER

Creationists regularly make the accusation that *secular* science and evolutionary theory take a worldview lacking in values, morals, and ethics in general. Like so many other of their claims—such as the one that evolution violates the second law of thermodynamics—this one is clearly false, but do we teachers take the time to inform our students of the many important values that scientists typically hold and use in guiding their work and worldview? Some teachers may shy away from mentioning values in an attempt to be politically correct. Some in the sciences may even believe that values have little to do with science, but they could not be more mistaken. Science, and biology in particular, holds several foundational values that should be conveyed to students as they pursue careers as scientists or science teachers. As C. P. Snow wrote in *The Two Cultures*, “There is a moral component right in the grain of science itself.”

Science is based on at least four fundamental values:

- Curiosity is good and should be encouraged.
- Knowledge itself is good—it is good to acquire knowledge.
- It is wrong to falsify or fabricate the data on which knowledge is based.
- It is good to keep an open mind (to be willing to examine and consider new evidence and arguments), tempered by a vigilant level of skepticism.

Curiosity is surely the most essential trait a scientist can possess. Curiosity leads to a search for knowledge for its own sake, which is the driving force behind the great majority of scientific discoveries ever made. Acquiring knowledge for curiosity's sake leads naturally

to the second value, that knowledge is good—not because it may be useful in some pragmatic way, but simply because it increases our store of knowledge about the universe in which we live. One goal of teaching is to prepare students for life-long learning, and this is part and parcel of the scientific mindset. Once pure knowledge is accepted as a valued goal, the fabrication or falsification of information (data) automatically becomes an obvious wrong—one that would mislead other scientists and so hinder the progress of science. This value might be more simply stated: be honest when doing science. Staying open-minded and skeptical is certainly a value and goal for all scientists, provided that one's open-mindedness is reserved for objective evidence, as opposed to subjective opinion. This issue often arises in discussions of evolution versus creation, with the creationists and intelligent design proponents claiming that scientists aren't open-minded to their arguments. The scientists rightly and skeptically reply that to gain a hearing, arguments must be backed up with objective evidence—something the creation argument has failed to produce.

Curiosity can be a hard sell because, sadly, many of today's students seem to lack curiosity about the world and universe outside their personal spheres of relevance. Even at the college level, many students appear to have no interest in learning about anything as remote as stellar evolution, photosynthesis, Krebs cycle, the Burgess Shale fossils, hydrothermal vent communities, lateral gene transfer, the bacterial origin of mitochondria, and so on. Yet these topics would not seem remote if they were approached in a creative and spirited manner.

Another value worthy of mention is that of rationality. Science springs from and embraces a rational view of the

world. It could be argued that as a group, scientists are the most rational people on the planet. Yes, one might be rational in one's science but irrational in aspects of one's private life—believing in, say, luck, souls, destiny, unproven medical practices, and a number of other concepts with no objective basis in fact. When we say, “There must be a rational explanation for this,” we mean that some physical causality is present that could explain the phenomenon in question. We are told repeatedly that we should teach our students to use critical thinking, which means much the same as thinking rationally.

Scientists also value the worldwide community of scientists and the work they do to improve our understanding of the natural world. Few scientists (if any) work in isolation. They come to be scientists by learning the foundational content of their subdisciplines, and in the process come to admire and hold in regard the past and present giants of their fields. They often rightly come to revere the work of Bacon, Lyell, Newton, Hubble, Einstein, Pasteur, Morgan, Watson and Crick, Darwin, Wilson, Hamilton, Dawkins, and others, holding them up as heroes to their students.

Many scientists work in the applied sciences, such as biomedical research, renewable energy, and crop sciences. In these areas, the key value is that of helping humanity—a value embraced by most religions as well. Biologists come to hold additional values that are, I believe, worth trying to pass on to our students. Biologists working at almost any level, from the molecular to the ecosystem, usually come to value the beauty of adaptations—the myriad ways in which organisms are morphologically, physiologically, and behaviorally

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adapted to their environments—in other words, the beauty of the fit of organisms to their environment. No demonstration of this is more visually impressive than the amazing examples of camouflage some creatures have evolved to blend into their surroundings, such as the leaflike appendages of sea dragons—those large, fancy sea horses that mimic drifting seaweed—or the plantlike appearance of tropical mantids, which closely resemble the leaves or flowers of their local environment.

Beyond the beauty of individual adaptations, most biologists also value nature in the form of undisturbed natural ecosystems (though sadly, few truly undisturbed ecosystems remain today). Biologists and other scientists often support and speak of the need to preserve as much of the natural world as possible, illustrating the value they place on biodiversity, endangered species, ecosystems, and nature in general. Nature, after all, provides the raw material for the work that biologists do.

Since the environment is our lifeboat in a hostile universe, it makes sense to learn more about it and thereby come to appreciate and value it. We are the only species on the planet with the ability to appreciate and value all of nature, to see the extreme beauty and strangeness

it holds, to feel a sense of awe that we are a part of nature—kin to every other species on the planet and dependent on the health of the biosphere for our survival.

Extinction is forever. Although many people have pointed out that each species may hold genetic and biochemical secrets that may be pragmatically useful to humans, some also speak out for the innate value of biodiversity—the most complex collection of phenomena in the known universe, with an evolutionary history of nearly 4 billion years; all living species are the successful extant tips of these diverse evolutionary lines. Surely these facts should give us pause and concern that so many of these species have recently become, or are about to become, extinct because of human activities on the planet. Biodiversity is without question something we want our students and tomorrow's adults to value and take seriously. To quote E. O. Wilson: "To the extent that we banish the rest of life, we will impoverish our own species for all time" (*Consilience: The Unity of Knowledge*, Knopf, 1998).

Another values issue worth addressing is the false notion that what is natural is good. This erroneous belief has led to the unfounded paranoia of some

European countries over genetically engineered foods, to the mistaken notion that children's vaccinations are associated with high risk, and to the avoidance of some food preservatives that are harmless or whose benefits far exceed their risks. An all-natural food product could still contain botulism toxin, roach feces, or thousands of other harmful—yet natural—substances. Although much has been written on this point, many students nonetheless arrive in our classrooms harboring this false, dangerous notion.

Exposing students to the many important values of science will go a long way toward countering the false arguments of the creationist community, which tries to associate the scientific perspective with a lack of values. Scientists as a group are certainly as moral and law-abiding as people in other walks of life. They hold to ethical principles and practices as uplifting and inspiring as those of most other professions. Letting students in on this culture of knowledge—and values—is surely the right thing to do.

David Zeigler (e-mail: david.zeigler@uncp.edu) is a professor and chair of biology at the University of North Carolina at Pembroke. He is the author of *Understanding Biodiversity* (Praeger, 2007).

