

Conclusion:

Educating A New Generation about Evolutionary Science and Society

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After a century of conflicts evolution remains a central unifying concept in biology. The scientific community has not refuted the observation that millions of species of animals, plants, and microorganisms exist. In the world there is great diversity. Although species demonstrate diversity, there is significant unity among organisms, an observation that becomes apparent from, for example, an analysis of internal structures, the similarity of chemical processes, and molecular evidence of common ancestry.

In time species evolve. In its essence, evolution results from the interaction of four factors. First, due to reproduction populations (species) have the potential to increase in number. Second, due to mutations and recombinations of genes individuals in a population demonstrate genetic variations. Third, the resources required for life are finite and environments present limiting factors. Fourth, the combination of these three factors result in an advantage of some individuals to survive and reproduce. What we have just described is the scientific explanation for both the diversity of species and unity of species.

What Should Science Teachers Do?

In the United States we continue to witness attempts by some fundamentalist groups to influence science teaching in the school curriculum, and in the course of so doing, assault the integrity of science. Rightfully so, many science teachers ask, “What should we do?” Our response? Begin a vigorous crusade of educating a new generation about evolutionary science and society. As a complement to the societal theme on evolutionary science we also recommend teaching evolutionary science as inquiry and developing students’ understanding of the nature of science.

Numerous individuals have analyzed and written about the logical and evidential flaws in creationist’s arguments, the differences between science and religion, and the Supreme Court decisions that upheld the First Amendment of the U.S. Constitution, especially the Establishment Clause. Stimulated by the media, the history of this conflict is characterized as evolutionists versus creationists and advocates of intelligent design. Although creationists have consistently and relentlessly sought to deny, counter, or eliminate biological evolution from school programs, the method of countering their tactics and pointing out their lack of scientific evidence, has been ineffective. But, it has not resulted in an abatement of their efforts and we suspect it will not do so in the foreseeable future.

In this volume we present a view and the scientific explanations that support and strengthen the scientific position, an appropriate position for all science teachers—and an approach that accommodates students. Without reducing the role and place of evolution in the school curriculum, science teachers should emphasize students’ understanding of the nature of science and their abilities of science inquiry.

Having heard debates, listened to creationists’ positions, and answered reporters’ questions about the controversy, we are convinced of two things. First, it is ultimately futile to try and reason with those individuals who hold creationist beliefs; two, most of the critical issues in the controversy center on an understanding of evolutionary science, inquiry, and the nature of science (or the lack thereof). Concerning the former, our recommendation is not to debate creationists; rather, switch to educating those individuals and groups who can support the

integrity of science in the school curriculum. Although, some individuals and groups (e.g., scientists, National Center for Science Education) are in a position to counter the various tactics and strategies of creationists and advocates of intelligent design, most science teachers are ill prepared for such encounters—nor do they have the time for distractions. Science teachers and science educators would be wise to implement the long-term strategy of developing the public's understanding of science. This could well be the crusade that ultimately makes a difference.

Evolutionary Science Includes Inquiry

When asked about a definition of science most science teachers express the complementary ideas that science is a body of knowledge and a process. In the course of such discussions few disagree with an assertion by John A. More that “science is a way of knowing.” Yet, science textbooks and teaching give significantly more emphasis to science as a body of knowledge and less emphasis to science as a way of knowing. The emergence of modern science in the late sixteenth and early seventeenth centuries was primarily due to the acceptance of new ways of thinking and explaining the natural world.

How does one characterize the basic elements of a scientific way of knowing? Briefly, a scientific explanation of nature must be based on empirical evidence from observations and experiments. Proposed explanations about how the world works must be tested against empirical evidence from nature. The scientific way of knowing stands in contrast to other ways of explaining nature, for example, the acceptance of statements by authority or of religious dogma. After the scientific revolution non-scientific approaches to explaining the natural world were no longer satisfactory. Explanations had to be subject to confirmation by empirical evidence. For example, Galileo's observations of heavenly bodies confirmed Copernicus' heliocentric explanations of planetary motion. Since the emergence of modern science, our understanding of the natural world has progressed through the appeal to current explanations and the interaction of human reasoning and imagination balanced by empirical evidence of nature itself. One could reasonably argue that the scientific way of knowing is among the great intellectual achievements. Remarkable, students leave our schools without an understanding of the nature of scientific knowledge

and the ways by which scientists claim to know about nature. To the degree students are introduced to inquiry and the nature of science, they learn that science proceeds through a prescribed five-step method or through processes that they experience in an unarticulated manner. Such learning does not provide students and citizens with the deeper, more fundamental understanding of sciences—an appreciation that could serve as a major countervailing force against those who propose that authoritative dogmatic, non-scientific explanations be included in the science curriculum.

Evolutionary Science Includes Societal Perspectives

This book introduces science teachers to ideas about evolutionary thinking and then elaborates and summarizes basic concepts about the tree of life and how evolution works. With these basics science teachers are directed to chapters that provide new and contemporary perspectives of evolution. Specifically, evolutionary science helps us understand societal problems including human health, new medicines, forensics, agriculture, and natural resources management.

Educating a new generation means teaching more than the classic Darwinism concepts. It means introducing students to evolution in societal contexts, ones that will have meaning for them. This perspective serves as a counter point to the misunderstanding that science in general and evolutionary science in particular contribute little that has social benefit.

It is time to acknowledge the futility of past methods and to establish different approaches that support the integrity of science in school programs and present an appropriate professional position for science teachers, and enhance students' scientific literacy. This book is one attempt to answer the question, “What should the science education community do about teaching evolutionary science?” Our concluding answer; While teaching evolutionary science, we should increase students' understanding of inquiry and the nature of science and present evolution with a contemporary societal perspective. This book provides science teachers with contemporary essays by leading scientists and appropriate resources by leading educators. All of this should help science teachers educate a new generation.