Teaching Biology Means Teaching Evolution

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Evolution is a complex topic for any science teacher, given the misconceptions that some students bring to the classroom and the gaps that can occur in teacher preparation. In *Investigating Evolutionary Biology in the Laboratory*, William F. McComas writes that evolution is "the most important, most misunderstood, and most maligned concept in the syllabus – if it even appears in the syllabus."

McComas wrote the book's introductory sections, which engagingly explain the science of evolution and the challenges of teaching this core principle of biology.

These chapters are also a valuable resource for parents and others concerned about science education. In a succinct account of the development of understanding of evolution by Darwin and other scientists, McComas suggests that studying the actual history of the theory would teach students more about science in general and evolution in particular than the myths employed by most textbooks.

McComas, professor of science and technology education at the University of Arkansas, edited *Investigating Evolutionary Biology* and wrote several chapters. He assembled a host of scholars with rich research and classroom experience to write chapters that examine legal issues, review teaching strategies and present laboratory activities. He begins by establishing the centrality of evolution to modern biology.

"Without evolution, biology would simply be little more than a kind of 'natural history stamp collecting' in which individual species are

discarded, examined and identified as individual entities with no apparent link between them and anything else in the living world," he writes.

McComas makes an important distinction between the fact of evolution and the theory of natural selection – the theory that explains how evolution works. He discusses briefly the overwhelming scientific support for evolution as fact. The evidence for the natural principle of change through time, he writes, "is awesome and no one who has studied even a fraction of the data can seriously doubt that evolution has occurred."

While McComas calls the theory of natural selection "one of the most useful and encompassing in all of biology," he notes that scientists have continued to evaluate and enhance the theory. Any controversies among scientists about evolution, he emphasizes, "involve fine points of the explanation, not its ultimate validity or utility."

His chapter on "Cognitive Challenges of Evolution Education" discusses the deep-seated misconceptions that students bring to the classroom, including misunderstandings about the sources of variation, the mechanisms of inheritance of characteristics and adaptation.

"It is interesting to note that many misconceptions about evolution held by students mirror the views offered by 18th and 19th century naturalists who proposed explanations for the diversity of life on Earth," McComas writes.

Such misconceptions include the notions that organisms choose to change to meet a specific goal, that all organisms progress from less complex to more complex forms or that characteristics acquired by individuals can be inherited or passed down to their children. Even at the college level, student misunderstandings of evolution are not related to

whether they believe the theory to be true or untrue.

Many high school science teachers “are not well prepared in either the theory or the evidence for evolution and therefore have difficulty conveying these complex ideas to students,” McComas writes. When surveyed about their preparation for teaching science, “many teachers do not recall ever having taken college-level science coursework that incorporated evolution,” and most “do not even recall hearing the word evolution in their college biology courses.”

“Unfortunately, it is not enough to teach about evolution as if it were just another topic in biology,” McComas writes. “The range of misconceptions is simply too great even if one discounts the complication of creationist and other non-scientific counterarguments.”

McComas identifies instructional methods that engage students in testing both natural selection and competing models and that have been shown to produce a marked improvement in student understanding of fundamentals of science and evolution. Experience with these models shows that “when students’ misconceptions are addressed proactively, students are likely to accept the scientific explanation.”

“The recommendation is clear,” McComas writes. “School laboratory practice should be directed away from confirmation and toward authentic investigations so that students have an opportunity to explore rather than just reiterate vital ideas in science. This approach will require that educators give evolution education the prominence it deserves both as a foundation principle in biology and because evolution and natural selection are pedagogically complex topics.”

Investigating Evolutionary Biology in the Laboratory is published by Kendall/Hunt Publishing Co., Dubuque, Iowa.

McComas holds the Parks Family Endowed Professorship in Science and Technology Education in the College of Education and Health Professions at the University of Arkansas. He serves on the board of directors of the Association for Science Teacher Education and is president of the International History, Philosophy and Science Teaching Association. His research interests include the intersection of the history and philosophy of science and science teaching; science in non-school environments, such as museums and nature centers; and effective use of the laboratory as a teaching venue.

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