USE HUMAN EXAMPLES TO TEACH EVOLUTION

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Evolution, and particularly human evolution, is a subject that generates intense interest among the American public. New findings often make the front pages of popular science magazines and the science pages of print and online news outlets. (A science journalist once told me that unless you’re working in human evolution or dinosaurs, it’s going to be tough to convince people in his field to pay attention to your work.) Despite the prevalence of media coverage of evolutionary discoveries, a near doubing of the number of U.S. citizens with at least some college education between 1995 and 2005 (Verhey, 2005),¹ and strong public trust in what scientists say about evolution,² virtually all national polls indicate that ~40% of Americans strongly reject evolution as a fact-based, well-tested, and robust understanding of the history of life (e.g., Miller et al., 2006). Questions about who we are as a species, our origins, and how we evolved also clearly evoke uncertainty, apprehension, and fundamental misconceptions that betray a lack of knowledge despite this intense interest.

How does this translate to science teaching? Since at least 1925 (with the Scopes trial), many science educators have considered evolution a controversial subject to teach (e.g., Hermann, 2008). Instead of schools in this country serving as key platforms for engaging interest in and addressing misconceptions about evolution, they have become battlegrounds on which the public acceptance of evolution—and of human evolution in particular—is being fought (Christensen, 1998; Branch & Scott, 2008). Sadly, the treatment of human evolution in state science standards has recently been deemed “abysmal,” with only seven states and the District of Columbia providing comprehensive treatment of human evolution (Mead & Mates, 2009). Both science educators and scientists should find these data and attitudes alarming. Why is this so, and how can we change it?

One main reason is that evolution is a conceptually difficult topic for students to fully understand. There is a diverse assortment of affective, cognitive, epistemological, pedagogical, and religious factors that contribute to an anti-evolutionary worldview (e.g., Nehm & Schonfeld, 2007, Smith, 2010a, b). Conceptual resistance can be based in essentialism (a belief in immutable categories or kinds), teleology (need-based explanations), and intentionality (assuming that events are purposeful and may be caused by an intentional agent): three consistencies of “everyday rules of thumb” that are inconsistent with evolutionary explanations (Smith, 2010b). Age is also a factor: adolescents often have a Lamarckian view that things change intentionally, over the lifetime of individual animals, and that those changes can be inherited by future generations (Evans, 2000, 2005). These barriers may be particularly relevant for students’ understanding of human evolution. A 10-year study of college students in a Principles of Biology and Organismal Biology course showed that they were most likely to accept evolution as a historical process for change in physical features of nonhuman organisms, but were less likely to accept evolution as an ongoing process that shapes nonphysical traits (including biochemical, physiological, and behavioral) in humans (Wernh, 2009).

What can we do as science educators? Although it may seem counterintuitive, I agree with a small but growing body of literature that posits that using human examples and examples that have direct relevance to humans may help overcome conceptual barriers to understanding evolution (e.g., Hillis, 2007, Werth, 2009, Nettles, 2010). This strategy can provide an effective, engaging, and easy way to teach core evolutionary concepts because it helps students see this subject as personally meaningful and relevant—and takes advantage of adolescent students’ enormous interest in themselves. In his report on teaching a class entitled “Evolution for Everyone,” Wilson (2005: page 2065) noted that “including humans along with the rest of life vastly increases students’ interest in evolution and acceptance to the degree that it seems to lead to understanding and improvement of the human condition.” In a survey of 476 students at Roger Williams University, 78% of both biology and non-biology majors preferred science courses in which human examples were included in a comprehensive discussion of evolution (Paz-y-Miño & Espinosa, 2009). There is evidence that people can see variation from one person to another more easily than variation among animals (Nettle, 2010), and students who appreciate the extent of individual-level variability are more likely to have a correct mechanistic grasp of natural selection (Shulman & Schulz, 2008). In a study of university students, framing evolutionary scenarios in terms of humans produced fewer conceptual errors than framing logically identical scenarios in terms of other animals (Nettle, 2010).

Help students make connections between the subject matter they are learning and personal experiences or “real-world” examples, and you may achieve deeper learning of many subject domains (e.g., National Research Council, 2000, 2003, 2005, 2007, 2009). Incorporating compelling examples of practical applications of evolution that are relevant to students’ lives and basic social issues may increase their motivation to learn and retain evolutionary concepts (Scharmann, 1990; Hills, 2007, Thanukos, 2010). Use examples of how modern human activities have facilitated the ability of pathogens to cross species barriers and become established in humans (Stein, 2010), or use examples from the evolution of the human immune system, like human pathogens developing resistance to formerly effective antibiotics.³ Our biggest evolutionary threats are no longer large predators like extinct saber-toothed cats, but tiny microbes. Use examples of evolution that focus on current topics and everyday experience, such as health, disease, and medicine (e.g., the common cold,⁴ avian flu,⁵ cancer,⁶ Huntington’s chorea,⁷ HIV). Teach about the evolution of lactose tolerance⁸ or high-altitude adaptations,⁹ great examples of recent human evolution. Teaching in a rural area? Use examples from agricultural practices.¹¹ Teaching a class of athletes? Talk about the evolution of running.¹² Teach genetics by beginning with common, complex human traits¹³ to underscore the fact that phenotypic variation occurs at the level of populations, a critical concept for students to grasp as they learn evolution by natural selection (Dougherty, 2010).

Highlight the relevance and applicability of evolutionary theory by capitalizing on fascination with TV shows like “CSI” and “Bones,” discuss the use of evolutionary analyses in forensic science to detect crimes or catch or exonerate criminals with

¹http://www.pbs.org/wgbh/evolution/educators/lessons/lesson6/ac11notes.html
²http://evolution.berkeley.edu/evolibrary/news/071201_adenovirus
³http://evolution.berkeley.edu/evolibrary/news/051115_birdflu
⁴http://evolution.berkeley.edu/evolibrary/news/071000_cancer
⁵http://evolution.berkeley.edu/evolibrary/article/0_0_0_medicine_05
⁶http://sciencecases.lib.buffalo.edu/cs/collection/detail.asp?case_id=290&id=290
⁷http://evolution.berkeley.edu/evolibrary/news/070901_lactose
⁸http://evolution.berkeley.edu/evolibrary/news/101001_altitude
⁹http://evolution.berkeley.edu/evolibrary/article/0_0_0_agriculture_01
¹⁰http://evolution.berkeley.edu/evolibrary/news/100301_jogging
DNA fingerprinting or HIV evolutionary trees (McKeachie et al., 2002; Evans, 2008; Sinatra et al., 2008). Forensic techniques can even be applied to the fossil record. Speaking of fossils, don’t forget their inherent “cool” factor; use our website’s “mystery skull interactive” to teach students how to be scientists and decide what earlier human species different mystery skulls belong to using our online rotatable skull comparisons. Encourage students to join us on an Indiana Jones-style adventure in the Rift Valley, searching for early human fossils and artifacts. Use our human family tree to underscore the branching nature of evolution, versus the linear “march of man” so often depicted. Wonderfully surprising observations can occur, such as the fact that even in our own family tree, several species lived at the same time in the past (see cover image). Use example analyses of DNA from extinct species like Neandertals and “Demisovans” to stay current and reinforce these messages.

Rather than leaving human evolution until the end of a biology class—or not discussing it at all—sprinkle human examples throughout your evolution teaching. These examples can be relevant, personal, exciting, timely, and motivating. I bet they will encourage students to want to learn more about their origins.

An Announcement

The Smithsonian’s Human Origins Program is launching the “Human Origins Program Education Network” (HopEdNet: http://humanorigins.si.edu/education/network), a collaboration between scientists and science educators to provide a set of tools to promote and support the teaching and learning of human evolution nationwide. If you’re interested in participating, please e-mail us at humanorigins@si.edu.

References


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