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LETTER

The Theory of Evolution is Not an Explanation for the Origin of Life

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Abstract The propagation of misconceptions about the theory of biological evolution must be addressed whenever and wherever they are encountered. The recent article by Paz-y-Mino and Espinoza in this journal contained several such misconceptions, including: that biological evolution explains the origin of life, confusion between biological and cosmological evolution, and the use of the term "Darwinism," all of which we address here. We argue that science educators, and biology educators particularly, must be aware of these (and other) misconceptions and work to remove them from their classrooms.

Keywords Science education · Darwinism · Misconceptions · Biological evolution · Origin of life · Creationism · Intelligent design · Abiogenesis

As university-level biology and science education instructors, we were very pleased to see the interesting and important paper (Paz-y-Mino and Espinoza 2009) focusing on the acceptance of the theory of evolution among college students. We whole-heartedly agree with the authors' conclusion that "evolution literacy" should be fortified at all educational levels. Unfortunately, Paz-y-Mino and Espinoza promote three significant misconceptions about the theory of biological evolution that routinely plague those of us helping students understand, and potentially come to accept, this central theme of biology.

First, the authors state on several occasions (e.g., initial sentence of the Introduction, p. 655; in questions 1 and 3 of their survey, p. 656; and at the end of their penultimate sentence in the Relevance of this Study section, p. 674) that the theory of evolution provides an explanation for the origin of life. The theory of evolution, both currently and as first conceived by Darwin and Wallace, neither provides, nor requires, an explanation for the origin of life. As Gould (1987) noted over two decades ago, "Evolution, in fact, is not the study of origins at all.…Evolution studies the pathways and mechanisms of organic change following the origin of life." The theory of evolution is a naturalistic, and well-supported, explanation for how life diversified after it originated by any (currently unknown) means, as is clearly described in modern biology texts (Campbell et al. 2008; Sadava et al. 2008; Futuyama 1998).

This concern may seem to be a trivial "semantic issue," but it is not. A large percentage of United States citizens are either skeptical of biological evolution, or outright reject the theory (Miller et al. 2006). This resistance to evolutionary theory arises, at least in part, from the mistaken notion that biological evolution claims to explain the origin of life. This misconception is held by creationists, the general public, and students (Scott 2004; Pigliucci 2002), and it even appeared repeatedly in Justice Scalia's opinion in the Louisiana evolution/creation Supreme Court case (Gould 1987). Wrongly confusing the initial origin of life with biological evolution interferes with students' acceptance of biological evolution in at least two ways: (a) students often hold more tightly to a supernatural account for the origin of life than they do to a supernatural account for how the diversity of life arose, and (b) because no compelling natural explanation

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exists for how life originated, students also reject biological evolution. Importantly, scientists are working on fascinating and important questions regarding the origin of life (abiogenesis), but the field is currently distinct from evolutionary biology and falls more into the realm of the physical sciences (chemistry or physics).

Second, although the term "evolution" is used in other scientific fields (e.g., stellar or galactic evolution, computer science, etc.), the context of the paper and the research presented by Paz-y-Mino and Espinoza are referring primarily to biology. Biological evolution should not be confused with evolutionary processes outside the realm of biology as it does not provide explanations concerning the "universe" or the "cosmos" (e.g., last sentence of their paper, p. 674 and elsewhere).

Third, Paz-y-Mino and Espinoza refer to the theory of evolution as "Darwinism" (second sentence of the Introduction, p. 655). In our experience, the term "Darwinism" is most commonly used by the opponents of evolution to trivialize the theory as being merely the idea of one person or to attempt to place the theory on par with other "isms," e.g., Protestantism. This reinforces the view held by some members of the public that evolution (and science in general) is merely a cult or type of religion. In addition, even if "Darwinism" was an appropriate description in 1859, it certainly is not now. The scientific community currently has access to far more data to support Darwin's (and Wallace's) seminal idea than when he first published on how new species arise from a common ancestor. We encourage all individuals involved in the challenging task of educating students about the theory of evolution to expunge "Darwinism" from their vocabulary.

We implore educators, researchers, and anyone else who deals with biological evolution to be precise and accurate in stating the claims of the theory of evolution. Although the non-scientific idea of "intelligent design" and the biblically based idea of "creationism" argue to be explanations for both the origin and the diversity of life on Earth, the theory of biological evolution explains only the diversity of life. Stating that biological evolution explains the origin of life and its place in the universe will not increase our students' or the general public's acceptance of the theory. In fact, these falsehoods may have the opposite effect.

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