

Not “Just a Theory”

Why Evolution Is True, by Jerry A. Coyne. New York: Viking, 2009. Pp. xx + 282. H/b \$27.95

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Over the last several billion years of our planet's history, evolution has produced millions of species that have colonized the far reaches of the planet and altered Earth's atmosphere. Scientists across disciplines consider the principles of evolutionary biology to be as fundamental to our understanding of natural processes as the principle of gravity. Jerry Coyne's *Why Evolution Is True* underscores how essential evolution is to science and clearly draws the line between scientific and non-scientific realms of thought.

Often, one of the greatest challenges in any debate over evolution centers on the boundaries of the debate itself: is it a discussion about science or about systems of beliefs? Coyne handles this issue deftly by clearly stating that: “Evolution is simply a theory about the process and patterns of life's diversification, not a grand philosophical scheme about the meaning of life (p. 225).” His goal is to simply describe the centrality of evolution to scientific knowledge and understanding. By and large, the author restricts his discussions to science, addressing the scientific evidence that supports evolutionary theory and the failure of creationist “science” to adhere to the core principles of scientific investigation. Throughout the book, he points out that apart from evolution there is no other *scientific* explanation of natural phenomena (such as species diversity, morphological diversity, vestigial traits, and extinction) that is supported by the existing data. This justifies Coyne's claim that “evolution is true.”

In order to provide scientific evidence that supports natural selection, the role of genetic drift in evolutionary

change, development, and paleontology, Coyne delves deeply into complex biological subjects. He equips the reader for forays into the different fields of evolutionary biology by clearly and precisely explaining scientific jargon (tetrapods and pseudogenes) and biological concepts (polyploidy, mosaic evolution, and sexual dimorphism) to his audience and providing a glossary of terms. Readers with a high-school level background in biology should find all they need to explain evolutionary concepts in this book. Remarkably, the examples in the book are so thorough that even an evolutionary biologist will likely learn something new from reading *Why Evolution Is True*.

For example, in the second chapter, “Written in the Rocks,” Coyne uses examples from the fossil record to illuminate how evolution shapes life on a scale longer than that of typical human observation. The author explains how evolution resulted in changes in the body size of a microscopic radiolarian species *Pseudocubus vema* over millions of years, demonstrating how natural selection varies as environmental conditions fluctuate. The example also illustrates a subtlety of evolution: it is rarely a steady process. Evolutionary change in this species was not smooth. But the complex and variable patterns that we see in the fossil record are completely consistent with evolutionary theory and predictions. During the course of this section of the book, Coyne succinctly explains the science behind radiometric dating of fossils. It is in the descriptions of these seemingly accessory scientific methods used by evolutionary biologists that Coyne proves his case: evolution is integral to modern science. One cannot dismiss scientific data supporting evolution without dismissing chemistry, geology, medical sciences, and a host of other disciplines.

An example from medicine may be the most compelling to many readers of this book. Coyne describes antibiotic resistance through a description of rapid evolutionary

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change that has been observed over the course of the last several decades. In 1941, the antibiotic penicillin revolutionized medicine by successfully killing every known strain of *Staphylococcus aureus* (staph). The bacteria evolved resistance to the drug, however, and now over 95% of modern *S. aureus* are unaffected by penicillin. Examples like these remind the reader that the fact of evolution and scientific research into evolution impact daily life.

While Coyne lets the examples of evolutionary fact do much of the legwork, he also includes numerous quotations from leaders in the field who express their ideas in their own words. The in-text quotes span over 150 years and lend a historical perspective to the development of evolutionary thought and the iterative, unending process of science itself. In addition to quotes by Darwin from *On the Origin of Species* and *The Descent of Man*, Coyne includes the words of Wallace, Simpson, early embryology pioneer Karl Ernst Van Baer, and the archeologist Raymond Dart.

The author's passion for the subject is one of the great strengths of the book. He shares his delight and awe about the diversity of forms produced by evolution in vivid language:

“...the *process* of evolution—natural selection, the mechanism that drove the first naked replicating molecule into the diversity of millions of fossil and living forms—is a mechanism of staggering simplicity and beauty (p. xvi).”

Why Evolution Is True is a helpful guide, too, to the particular points of intelligent design creationism and the arguments that scientists and educators might expect to hear in a debate about the merits of alternative views of the origins of biodiversity and humankind. In light of the recent debate in the United States between evolutionary biologists and science educators and the advocates of the pseudo-scientific discipline of Intelligent Design (ID), Coyne provides a concise and clear summary of evolutionary fact and theory. He specifically counters invalid scientific

arguments (the irreducible complexity of the eye) and non-science-based criticism of evolution (i.e., anything not fully understood by modern science must be supernaturally created). He supports his thesis with examples from peer-reviewed scientific literature; an historical overview of how modern evolutionary theory has itself undergone change over time through iterative hypothesis testing, data-gathering, and scientific rigor; and a scientific critique of creationism and intelligent design.

In a very few places, Coyne's passion and sense of urgency that his voice be heard over the din of ID counter-arguments is also a weakness. His tone is occasionally snide and sarcastic, which gives the unfortunate impression of rhetoric over substance. The seemingly offhand commentary directed at groups opposed to evolutionary theory is out of place and counter-productive to Coyne's overall goal of communication and education. For example, in the middle of an outstanding description of the evolutionary arms race between Asian giant hornets and native Japanese honeybees, Coyne remarks that the bees' defense mechanism (a cluster of bees mobs a hornet and heats the hornet's body to 117°F, cooking it alive) is similar to techniques used by Christians in the Spanish Inquisition.

The “Notes” portion of the volume reveals much interesting and useful material, including quotes and citations of works by detractors of evolutionary biology as well as lengthy and specific responses. Because so much of the meat of ID arguments and Coyne's rebuttals are in the “Notes,” this section is essential for a complete reading of the book. More detailed explanation of many scientific examples can be found in this section as well.

Why Evolution Is True clearly demonstrates that evolution is a scientific theory that has been repeatedly tested, supported by data, and underlies our understanding of the natural world. Dismissing evolution as “just a theory” demonstrates a fundamental misunderstanding about the nature of science itself. The fact that evolution shapes our world can be seen in Coyne's examples that span the history of life, running from fossils to microbes to plants to whales.