How to Humanize Knowledge, or CSI: Evolution and Climate Change

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One of the great paradoxes of our time is that the more science influences our lives, the less we understand it. We live in a country in which about 45% of our fellow citizens believe the earth is less than 10,000 years old. As biologist Richard Dawkins has pointed out, this temporal confusion is as wrong as believing that the distance between New York and San Francisco is 7.8 yards. More important than lack of basic scientific knowledge is the widespread misunderstanding over the way science works and why: how the quantification, testing, and revision of hypotheses creates new knowledge. Consequently, scientific understanding only minimally impacts our public debate.

Worry about this problem is not new, of course. Speaking to the American Association for the Advancement of Science in June 1922, the historian James Harvey Robinson (1922:94) noted that the discoveries of science have “succeeded in unfolding to our gaze so new a world in its origin, development [and] workings … that practically all of the older poetic and religious ideas have to be fundamentally revised or reinterpreted.” When viewed in the abstract, science, indeed most intellectual work, can appear to the untutored as trivial, an assault on tradition, or simply weird.

Robinson’s primary example of how ignorance about science harms civic debate is also shockingly familiar: he decried the “strong and threatening opposition” to “organic evolution.” Robinson understood that the human “affinity and obvious relationship with the rest of the organic world” was disturbing to many people. Soon after Robinson spoke, these issues exploded onto the national consciousness in the form of the Scopes trial. Things have little improved since. In the early 21st century, a third of Americans fully reject the science of evolution, with many others unsure about evolution or uneasy about how to reconcile evolution with religious belief. Two-thirds of Americans agree that public school biology classes should teach both evolution and “intelligent design”—the new clothing worn by the old creationism—as if there were scientific evidence for creationism.

Evolutionary science in everyday life, or at least on television

Happily, there are also signs that the public may be more open to evolutionary science than is commonly thought. Indeed, debates over evolution may reflect the stigmatization of the term “evolution” but not the fact itself. For example, 78% of adults find perfectly acceptable an evolutionary description of plants and animals if it highlights natural selection but omits the word “evolution”. And how many fans of popular television shows such as CSI: Crime Scene Investigation would be surprised to learn that the very same genetic information used to unravel the weekly crime is also revolutionizing evolutionary science—indeed,
giving modern researchers an unparalleled understanding of evolutionary history? How many American citizens know that the same DNA that solves paternity suits in a court of law deciphers the evolutionary heritage of species in the court of scientific evidence?

Combining the criticism of James Harvey Robinson with the success of science as represented in *CSI* points us, I believe, to a way to spread knowledge about the basics of modern biology that will help the public understand some of the most crucial issues it faces. Civic-minded educators should work to remove evolution from theological debates (while recognizing that fundamentalist readings of biblical texts and science are incommensurable) and insert it into its proper place: as an explanation of how organisms respond to environmental change—particularly climate change—and thus the likely effects on our society of a warming planet.

How would this help educate the public? Television programs such as *CSI* succeed in making science sexy and fun because, in the words of Robinson, they humanize science. “Once it was well to dehumanize science,” argued Robinson; “now it must be rehumanized.” By “dehumanize” he meant that science proceeds by carefully regulating human interest; in Robinson’s words, science advances through its “stubborn refusal to consider natural phenomena in terms of human impulse”. To “rehumanize” science—and especially evolutionary science—is to demonstrate how it applies to the entirety of life—the “essential interweaving and mutual dependence of all things”—rather than boxing it into a category of knowledge removed from the problems of day to day existence. Educators should follow this lead and emphasize to the public how evolution helps us understand—and thus respond intelligently—to one of the greatest challenges facing humanity: global climate change and its attendant problems.

**Making it Personal**

As with evolution, the public is largely misinformed about the science of climate change. Also like evolution, climate change appears isolated from day-to-day life, an abstract concept easily dismissed because of its supposed remoteness. Unlike DNA evidence used to apprehend a murderer, evolution and climate change do not seem urgent—one seems to describe the distant past, the other the distant future. Yet bringing them together can vitalize both concepts. Many of the changes brought about by climate change can only be explained by evolution: the process of organisms adapting—or failing to adapt—to changing environments.

These adaptations can be seen by anyone who looks. Weeds such as the field mustard are thriving in California because they evolved to flower earlier and hence escape drought conditions. Yellow-bellied marmots are weaning their young earlier, because during the past ten years, the average time of spring snowmelt has come earlier. Red squirrels in the Canadian Yukon are reproducing at an earlier time, giving them a head start on gathering spruce cones. Pine beetles, newly able to thrive in Canada due to warmer winter weather, have denuded vast swaths of forest, turning those forests from something that removes atmospheric carbon (a “sink”) into a contributor of carbon dioxide and other greenhouse gases. The pitcher-plant mosquito has shifted toward shorter, more southern climates to initiate its larval dormancy. Nor are these changes merely behavioral; as William Bradshaw and Christina M Holzapfel (2006) argued in *Science*, “recent studies show that over the
recent decades, climate change has led to heritable, genetic changes in populations of animals as diverse as birds, squirrels, and mosquitoes.”

The changing fitness of insects such as mosquitoes provides one of the most vivid and worrisome examples of species evolving in response to climate change. Mosquitoes have long been devastating to human health. They are excellent vectors—that is, disease transmitters—for the protozoan parasites of the genus *Plasmodium* that cause malaria. Prevention of malaria usually centers on killing local mosquito populations, often with DDT, a nerve poison lethal to mosquito larvae. Yet this treatment is only effective for a short time because DDT resistant strains of mosquitoes quickly evolve. As spraying kills the individual mosquitoes most vulnerable to DDT, those that have resistance to the poison are the only ones left to reproduce. Soon, by the process of simple inheritance, mosquito populations can become largely DDT resistant. Indeed, in some areas previously treated with DDT, resistant mosquitoes resurge within months of new spraying. Nor is this a trivial issue: malaria affects between 300 and 500 million people each year, killing over one million annually.

Moreover, the problem of malaria is spreading due to the effects of climate change. The World Health Organization already suspects that climate change is responsible for increased rates of malaria in industrialized countries. Studies have correlated rising temperatures with growing numbers of mosquitoes, and hence increases in the diseases they carry.

Evolution and the effects of climate change are inseparable subjects because disease vectors survive and reproduce within specific climatic conditions. Temperature and precipitation are the most important climatic factors influencing the spread of disease vectors, though others such as elevation, wind, and hours of daylight are also important. The WHO estimates that global temperature increases of 2–3°C would enlarge by hundreds of millions the number of people at risk for malaria infection. Furthermore, the seasonal variation of malaria in its endemic regions would also likely intensify. Mosquitoes, then, are both evolving to produce new strains and are responding to the new opportunities provided by a changing climate.

Disease is not the only way that evolution and climate change affect each other. One of the great worries about a heating planet is the effect of increased temperatures upon agriculture. Like diseases and their vectors, food production depends upon climatic factors such as temperature and rainfall. Global climate change will increase rainfall in some areas, decrease it in others; it is likely to be more variable as a rule.

Temperature may be the most important factor. One published study showed that rice yields decline by 10% for every single degree Celsius increase in nighttime temperature. Nor is this a problem confined to countries dependent upon rice. As Biever (2003) reports, crop yields drop 17% for every 1°C increase in temperature. Moreover, higher temperatures generally mean greater amounts of weeds and insects—and the diseases they spread. Greater temperatures will thus probably increase farmer dependence on pesticides, which will impose a large financial burden and add to groundwater contamination. Many pesticides derive from fossil fuels, exacerbating the ecological and economic vicious cycle. Heartland agriculture, in other words, will decline dramatically if climate change produces new environments for which corn and wheat are not well adapted.
All of this points to the fundamental role of educators in a democratic society: to give the public the information and tools it needs to grapple with the problems of its time. If our society is to meet the great challenges of climate change—and the very existence of our society may depend upon it—the public must have a basic understanding of evolution. Given the history of the reception to evolution in this country, that is no easy task.

**THE MORAL IMPERATIVE**

To wield this tool effectively, then, it is vital that educators humanize evolution by removing it from theological debates in favor of putting it to use understanding and solving environmental problems. To do this we must combat the grossly unfair association of evolution with immorality. It will not be easy to disassociate evolution from such connotations—and fundamentalist religionists will surely continue to use this idea to justify their opposition to basic science—so it is vital that educators continue the struggle to make evolution the center of biological education. Those of us trained in the humanities and social sciences—by definition the humanizers of knowledge—have a special duty to use our training to show the vital role of evolutionary thought in problem solving.

To succeed at this we must insist—and demonstrate—that evolution is not a conspiracy to kill God, or to promote naïve materialism, or to deny moral dialogue. Rather it is a tool of fundamental importance if our society, indeed our world, is to successfully respond to the most profound problems it faces. Indeed, using evolution to solve problems is deeply moral and a social justice issue: poor, nonwhite people are subject to the worst affects of climate change. Conversely, denying this essential tool for understanding our ecological predicament is gravely immoral. Public-spirited educators, then, need to speak out with forceful urgency. Our future depends upon our ability to humanize this knowledge, making it a vital tool of public debate.

**REFERENCES**


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