The topic of the 2007 Essay

"Anthropology professors and teaching assistants are often encountering students who state that they can not accept evolution because it collides with their religion. If you were in this situation, how would you encourage the student to learn, while remaining respectful of his/her personal beliefs? "

The Winners

This year, we received 48 submissions which were evaluated by the individuals listed above plus Craig Hadley and Erin Kimberly (in 2006, we received 6 submissions). The winners of the 2007 Pollitzer travel award are:

Elizabeth DiGangi, University of Tennessee
Amy Farnbach, Arizona State University.
Rebecca Gray, University of Florida.
Robert Omalley, University of Southern California.
Susan Landers Roberts, University of Colorado
Kristin Young, University of Kansas

The winning essays

Kristin Young
University of Kansas

As an instructor of the introductory physical anthropology course at a Kansas university, the perceived controversy between evolution and religion is an issue that I confront every semester, and with more urgency after the recent actions by the Kansas Board of Education. My strategy is to defray the argument by providing students with a firm foundation in the basic tenets of science, as well as first-hand experience of the public perception of science. On the first day of class, students complete a survey which I adapted from the teaching materials provided as a companion to the PBS *Evolution* series asking, among other questions, (1) What is science? (2) Do you like science? Why or why not? (3) What are the steps in the scientific process? (4) What is a scientific theory? (4) What is evolution? and (5) Why is evolution called a theory? Students also do a little fieldwork of their own and interview two members of the general public using the same survey. As a class, we compare responses from the class with those from the public, and discuss how science is misunderstood in society. It is not unusual to receive responses stating that science is a subject in high school, a theory is a guess, and that evolution is a theory because there is no evidence to support it. I do my best to dispel these fallacies, while at the same time pointing out that this reflects the lack of sound science education in our country.

We discuss the historical development of evolutionary theory, including how the traditions of western science grew out of the Judeo-Christian concept of logical positivism, the notion that studying the order of the universe revealed the nature of God, and how Darwin himself studied theology, and delayed publishing his most infamous

work (*On the Origin of Species)* because he feared embarrassing his family, especially his devoutly Christian wife, Emma. I also make the point that all of the concepts necessary for the development of evolutionary theory, including the great age of the earth (Lyell), the struggle for existence (Malthus), and adaptation of species to their environment (Lamarck and Buffon), were in place, so that if Darwin had not devised natural selection, someone else would have, and that Alfred Russel Wallace, in fact, did.

We also discuss in detail why creationism is not science, emphasizing the fact that it is not falsifiable, and therefore is emphatically not science, and pay particular attention to intelligent design, in part because it is the latest repackaging of creationism, and in part because of the Kansas BOE. After the board revised the state standards in 2005, science was redefined, from "Science is the human activity of seeking natural explanations for what we observe in the world around us" in 2002, to "Science is a systematic method of continuing investigation that uses observations, hypothesis testing, measurement, experimentation, logical argument and theory building to lead to more adequate explanations of natural phenomena."[1] Students are quick to notice that the new definition omits the word natural, leaving the door open for supernatural (i.e., non-scientific) explanations.

We discuss the history of teaching evolution in the United States, starting with the Scopes Monkey Trial, through Epperson v. Arkansas, and up to Kitzmiller v. Dover. Students learn that religious evangelicals have singled out evolution as a theory with gaps (in Cobb County, GA, and Dover, Pennsylvania), and that students should be open to other theories, In each case, the judicial branch of our government has ruled that these policies are in violation of the Establishment Clause of the First Amendment to the Constitution, which most students also are sadly unfamiliar with, but which guarantees that the government can make no laws regarding an establishment of religion. In essence, I want my students to understand the fundamentals of science, how it differs from religion, and why it is inappropriate in this country to discuss religious beliefs in science classrooms. That does not mean, however, that the class I teach is anti-religious. I point out to my students that science looks for natural explanations for observed phenomena, and so can say nothing about morals or values, and that their own morals and values are not at risk in my class. They can understand evolution and still be spiritual individuals.

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[1] Kansas Board of Education Science Standards : http://www3.ksde.org/outcomes/sciencestd.html. Accessed January 15th, 2007.

Elizabeth DiGangi
University of Tennessee

In the proverbial "Bible Belt," certain topics are considered socially impolite to outright sacrilegious when discussed in public. Having grown up in relatively liberal New York State and relocated to the South, I have experienced shock and disbelief at the reaction of many of my fellow Tennesseans to subjects from same sex marriage to evolution. Ah, the dreaded "e-word." That species are subjected to natural selection is something I take as scientific fact, the gospel truth. As a scientist, I find it difficult to accept that others may not and do not see it the same way. However, as an anthropologist, I am culturally relative and acknowledge that the vast majority of my students now and in the future may either (a) have no accurate knowledge of what evolution is and/or (b) choose not to accept it based on their own personal beliefs.

As a graduate student, I am fortunate to have had the opportunity to teach undergraduates, in the capacity as both teaching assistant and lecturer. Evolution is covered extensively in two of the courses I teach. The first day when evolution is discussed in detail, certain aspects of student body language reflect classic resistance and emotional detachment: arms are crossed in front of bodies and eyes are reflected downward. When one is faced with such nonverbal indications of disagreement, it can be disheartening to continue a discussion of the subject matter. The question remains: what is an anthropology instructor to do?

In order to alleviate the above, first a disclaimer is necessary explaining that while the student is expected to learn the presented material, it is not the purpose of the course to supplant the student's personal beliefs. It is useful to include a brief discussion of what education is meant to be – referring to a quote from Aristotle, "it is the mark of an educated mind to entertain a thought without accepting it." I emphasize it is more important that they *think* about the presented material, rather than whether or not they actually choose to accept it.

In addition, I believe a discussion of what science is, and perhaps more importantly, what it is not, should precede the topic of evolution. Science and religion are distinct entities, and it is important to clearly explain that science, by its very definition, cannot entertain a discussion of the supernatural. Science is relegated to the natural world. I explain to students that whatever their faith may be, there is no way for science to ever prove or disprove the existence of any supernatural entities. As a result, religion and science are forever separate, each answering questions of life on Earth in its own distinctive way. This helps students realize that science and religion are equally valid yet distinct lines of inquiry.

Furthermore, many students are unaware to what exactly scientific theory refers. It is important that students understand the scientific definition, as misunderstanding it is the cornerstone for uninformed statements such as, "evolution is *just* a theory." After a full explanation of the difference between the way the term "theory" is used in science and the way it is used in the everyday vernacular, I play a game with my students dubbed "Theory or Hypothesis" where I present various statements and they have to determine the accurate category. I use examples of guesses based on circumstantial evidence –

hypotheses – and examples that are grounded in scientific fact and not yet disproved – theories.

This game opens the door for a discussion of the theory of natural selection and the theory of evolution. Once students understand that theories are hypotheses that have been subjected to rigorous scientific testing and have not been disproved, it begins to resolve some misconceptions they may have without shattering or being disrespectful of their religious beliefs.

In conclusion, the preparation for a discussion of the processes of evolution, natural selection, and the human fossil record is perhaps more important than the presentation of the actual evidence itself when it comes to encouraging students to learn despite what their personal religious beliefs may be. An emphasis on discussing the goals of education, explaining the distinct domains of science and religion, and clarifying the definition of scientific theory meets the objective of breaking through a student's defenses so that they can learn about evolution while remaining respectful of their personal beliefs.

Amy W. Farnbach
Arizona State University

Throwing Matches at the World: Challenge and Complacency in Evolution Education

I am in a science classroom in an inner-city high school. Warned ahead of time to wear nothing that might be interpreted as gang-related (no sports team insignia, no caps, no colored kerchiefs, the list reads in part), I am dressed in drab neutrals begged from friends with jobs in conservative offices; I have passed through the metal detector and been escorted through the halls by a security guard who seems to warn rather than wish me to have a good day. I am in a science classroom, and a young man in the front row is glaring at me with open hostility. At seventeen or eighteen, he is bigger, stronger than me, his body arranged to command maximum space—torso slouched and legs splayed into the space of surrounding students, who deferentially curve their bodies away from his imposition. His arms crossed across his chest, he sighs disruptively and pushes back from his desk when I mention I will be discussing human evolution. As I continue my introduction, he jerks his chin aggressively upward to catch my attention and grits, "My grandmother says we didn't come from monkeys—we came from God." I explain that evolution by natural selection is one theory put forward to explain the temporal and geographic occurrence of the primates we would examine in class. I explain that there is room for other explanations, and talk about what people have thought in the past. I tell him that he doesn't have to like my explanation, that he can look at the fossil skulls and find his own answer.

"Every day, Tim Sullivan burned down the world," writes Chris Fuhrman of an iconoclastic Catholic schoolboy in his novel *The Dangerous Lives of Altar Boys*. "Tim Sullivan burned down the world, and then you lived in the places that withstood it, the ones that were strong to begin with." (1994: 42) As scientists, we are trained to seek out robust findings, to throw matches at our own work and that of others to see what will burn; as educators, we can train all of our students to examine findings skeptically, to seek out interpretations other than their own in order to carve out a space strong enough to withstand opposing views. A worldview that is never challenged can be neither clearly defined nor fully understood; it is through opposition and reaffirmation that we come to clarify and strengthen what we accept, whether divine creation, the theory of evolution, or an amalgam of both. "Every day, Tim Sullivan burned down the world," writes Fuhrman. "You loved this. You discovered that you could think too." (1994: 42)

I am in a science classroom in an inner-city high school, watching a deeply suspicious young man drive his group to take measurements more efficiently so they can see the next fossil skull. When I ask for comments and questions at the end of the hour, he calls my attention with another terse half-nod. He tells me he is glad to have seen "the reasons people say evolution [happened]." He tells me he thinks maybe "evolutionists and creationists" are both right in different ways. He tells me this, and I think about my own acceptance of the theory of evolution. Like Camus' stranger, I find comfort in "the gentle indifference of the world" (1988: 122), for me present not in the currents of the night air, but in the random machinations of nucleotide, gene, organism, and environment; the blind watchmaker (Dawkins, 1996) slipped into my worldview without

challenge. I encourage my students who do not accept evolution to burn down their world, to find the strong places where their faith can explain or coexist with the evidence for evolution I present in class. But in hearing their arguments, in talking with them about the ways in which they reconcile Darwin and God, I also strike a match against the complacency of paradigmatic science. I think and talk with them about inconsistencies in evolutionary explanations, about the hypotheses we can and cannot test with available evidence, and I find whether my world is still strong enough to withstand it.

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Susan Landers Roberts
University of Colorado Denver and Health Sciences Center

"I don't believe in evolution: I study it."

Students often ask if I believe in evolution. I use a response I first heard from Richard Stucky (2006) as my mantra: "I don't believe in evolution: I study it." When faced with opposition to the theory of evolution in the classroom, or in any public arena, answering like a true scientist breaks down ideological barriers. By taking no absolute position and remaining open to new evidence, conversation is released from potential polarization.

Habermas, a philosopher and social theorist, stated that good communication requires the absence of arrogant attitudes, *ad hominem* attacks or derogation, and must insist upon honest and rational discourse (Roderick 1986). Science, in its truest form, follows the same practice of intellectual honesty and reason. By maintaining objectivity and a healthy skepticism, an instructor can bring the classroom skeptics into the conversation instead of alienating them. It is the instructor's responsibility to encourage deliberation, not profess absolutes.

Students whose defenses are poised to block any acceptance of the theory of evolution, have everything to lose by entertaining concepts that destroy their worldview. The *Bible'*s literal readers believe that humans were created in the image of their god. Evolution attacks this belief at its core. To sidestep this and other potential battles with fundamentalists, science's empirical methodology encourages discourse and help students gain objectivity. One way the instructor can bring distance, thus objectivity, to the discussion, is by approaching evolution historically.

Through history students can discover that ideas, like intelligent design, are not new. In the 18th century, Carolus Linnaeus outlined a classification system that seemed to exalt nature's design. However, as he classified plants and animals, humans melded into the animal kingdom. Human "godliness" was leveled through observation. Linnaeus' descriptions brought about a paradigm shift in science (Ember, Ember, and Peregrine 2006).

In the 19th century, Cuvier documented and classified extinct fossils. He concluded that extinctions occurred several times during the earth's history. Cuvier attributed the findings to non-biblical catastrophism, since the idea of a series of catastrophes did not fit the biblical flood story. Lyell disagreed with Cuvier in that he did not think that the geologic evidence fit with multiple and sudden catastrophes. He observed that the forces of nature, such as, erosion and flooding explained how geologic strata were built up and worn down; that most change seemed to occur slowly; and that nature's processes appeared to function uniformly through time (uniformitarianism). The vast amount of time, the climatic shifts and formation of new landscape paved the way for explaining gradual evolution (O'Neill 2006; Ember, Ember, and Peregrine 2006).

Students primed with these historical roots of evolution can study Darwin's ideas with less animosity, if the ideas are unfolded logically. They will see, as Lyell did, that gradualism fits with the geologic observations, with some exceptions. By walking in the

footsteps of these scientific giants, the students will encounter discoveries in the same sequence that drew 18th and 19th century thinkers to evolution as the viable explanation for the changes in nature. These thinkers wrestled with contradictions with their old worldviews in face of new evidence. They reconciled the inconsistencies by modifying the old paradigms. The "Evolution of Evolution," as Ember, Ember, and Peregrine (2006) called it, offers insight into the scientific process and demystifies evolution.

After establishing a basic knowledge of evolution, discussions can move to current issues in science that affect humans. Issues such as global warming, cloning, the bird flu, and antibiotic-resistant bacteria call for an understanding of human evolution. Students would need to learn about genetics, evolution of human anatomy and physiology, and migration patterns, for example. To understand the present, they must delve into the past. Whether looking at diverse ecological patterns that reflect climate change, e.g., global warming during the late Eocene (Gunnell 1997); looking at migrations patterns through mitochondrial DNA analysis (Kolman, Nambuughin, and Bermingham 1995); or looking at structure and mass of human long bones at different latitudes (Stock 2006), evolution drives the analysis.

The historical approach encourages students to mull over the concept of evolution from its scientific infancy, but at a safe distance from their personal convictions. After establishing a dialogue based on science, the discussions can move to present research on human evolution and the relevance of evolution in their daily lives. Students should leave class knowing that science is a process; that absolutes counter the spirit of science. Above all, they will understand that I don't believe in evolution, I study it and hope they do the same.

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Robert Omalley
University of Southern California

Anthropology professors and teaching assistants are often encountering students who state that they can not accept evolution because it collides with their religion. If you were in this situation, how would you encourage the student to learn, while remaining respectful of his/her personal beliefs?

The conflict between evolution and religion is often presented as an "either/or" scenario in school board hearings, academia, and the popular media. A person can accept either religious or evolutionary ideas: not both. But while scientific and religious perspectives do represent fundamentally different paradigms, cherished religious ideas need not be a barrier to understanding evolution. As a way to sidestep some contentious aspects of the debate, I think it is appropriate to present evolutionary and religious tenets to students not as a dichotomy, but as perspectives that can fall along a broad continuum.

At one extreme, a person might hold that an objective, physical universe is all that exists, and all processes within that universe are (in theory, at least) predictable and understandable on a purely mechanical basis[1]. Under this view there is no need to invoke supernatural explanations for any event, and the burden of proof falls to those who advocate the possibility of supernatural explanations to prove why such ideas should be taken seriously. Evolutionary theory is sufficient to explain the common descent of all organisms from a common ancestor in the distant past. Even belief in supernatural forces can be viewed from an evolutionary perspective, either as something that has been subject to natural selection, or as a byproduct of human neurological complexity.[2]

A person at the other end of the scale might be completely comfortable with supernatural explanations for almost anything in the world around them. For example, all organisms could easily have been created, fully-formed, by God in the recent past. The fossil record is a misinterpretation of the aftermath of the Great Deluge described in Scripture, or represents efforts by Satan to deceive the faithful. Evolutionary theory is self-deception (on the part of scientists) at best.

Polls suggest that most people in the United States fall somewhere between these two extremes (though the proportion of people who reject evolutionary ideas remains high.[3]) Even many proponents of the so-called 'Intelligent Design' (ID) movement, who argue that many aspects of the natural world are too complex to have evolved without a designer (i.e. God), accept aspects of evolutionary theory--such as natural selection--to explain certain phenomena of the natural world.[4] Furthermore, a substantial segment of the 'elite' scientific community remains agnostic about the existence of God and the afterlife, even if the majority reject such ideas entirely.[5] I believe teaching a 'continuum' perspective encourages students to learn about evolution by emphasizing that there is not necessarily a conflict between scientific and religious ideas on a personal level. Scientific and religious ideas may represent fundamentally different paradigms, yet students may feel more comfortable if they recognize that they don't have to adhere to an extreme view either way.

In a world where ecological degradation, outbreaks of disease, and bioterrorism are almost daily news, it is vitally important that students have some grasp of what

evolutionary theory is all about, even if they might not agree with or accept it entirely. To that end, an educator should explain that the ultimate goal of science is to better understand how the natural world works-- typically by developing and testing hypothesis through experimentation or direct observation. Few concepts in the natural sciences have as much empirical support as evolutionary theory. But while it is extremely unlikely that the theory of evolution as a whole will ever be discarded, it is worth emphasizing to students that many disagreements and debates persist in evolutionary biology, and new debates arise all the time. A healthy degree of skepticism about 'the Truth,' and a willingness to re-examine what everyone 'knows' to be true is always appropriate.

Personal religious beliefs need not come in conflict with the scientific method, since supernatural forces or entities (such as God) are by definition not subject to natural laws or explanations. But whether or not supernatural forces exist, it is impossible to incorporate such ideas into a scientific paradigm because human beings have no objective means to detect or measure such influences. Religious ideas can be powerful and compelling, and provide important insights into human experience and existence on a personal level. However, they cannot help us understand (for example) the biology of cancer, or the importance of preserving ecological diversity.

An understanding of evolutionary theory is essential to the study of biology, and educators must work to make evolutionary concepts accessible to students of all faiths and backgrounds. But ultimately how a student chooses to incorporate evolution into their understanding of the world will remain their choice.

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Rebecca Gray

Ms. Student:

First off, I want to assure you that your questioning of scientific principles is welcome in this classroom. The scientific process is built upon examining data and evaluating hypothesis, and never upon blind acceptance of dogma. It is important, however, that whether or nor you accept the theory of evolution, you can be assured that you comprehend how evolution is understood to operate from a scientific perspective and why scientists accept the validity of Darwinian evolution.

Evolution, simply, is change. It is change in gene frequency within a species over generations. Random variation is always present with in a species, caused by mutations within genes, which may result in phenotypic alterations perceptible to other members of the species. Natural selection confers greater reproductive success to those phenotypes that are better able to survive and reproduce within an environment. In the next generation, a higher proportion of individuals will carry the favorable genes, adapting to their environment.

One of the most salient examples of evolution and adaptation operating in our lives is viral resistance. The reason we needed a new flu shot this winter is that the influenza virus accumulates mutations over the course of a season which enable it to adapt to our immune system response. President Bush has voiced his concern about the H5N1 avian influenza virus developing the capacity to be transmitted from human to human[1]. This crucial advantage of having 6 billion additional hosts would likely cause a pandemic similar in scope to the 1918 influenza outbreak.

However, because evolution is non-directed, there is no guarantee that the H5N1 will ever mutate in the exact manner necessary for spread in humans. In fact the fossil record is overwhelmingly full of extinct species, suggesting that usually that the critical mutation for most individuals never occurs. However, just because evolution is non-directed does not imply that any path of evolution is available to all organisms. Developmental constraints that are already in place preclude some – if not most – adaptations from occurring. This is why we so often see convergent evolution, or similar structures that evolved independently, such as flying[2].

The notion of evolution with regards to humans in particular is rejected by some as it supposedly renders human existence meaningless and the product of a chance occurrence. Yet evolution does not imply that organisms are unable to change their environment or control their destiny. This is especially true for humans: our culture is itself evolving and reproducible in subsequent generations. In fact, cultural evolution is probably just as great of a force as biological evolution. Consider that, while the genes carried by ancient Egyptians are probably very similar to modern Egyptians, and the Vikings with modern Norwegians, all that we have accomplished since then is directly a result of our self-consciousness, intellect, and culture[2,3]. Furthermore, humans are actually able to influence Darwinian evolution. We use “artificial selection,” which just entails crossing the best strains with each other, to produce healthier crop harvests and larger cattle. We can invent new medications that can overcome resistant strains of bacterial infections. We can induce mutations in viruses so that we might figure out

which genetic change is going to create a killer strain, and try to prevent that from occurring.

Evolution is simply a mechanism for genetic change. While the process itself is stochastic, this does not imply that the universe is without meaning. Evolution certainly does not deny or contradict the existence of God, and many people are able to reconcile their religious beliefs with this concept. The creation of the Earth, the first spark of life on Earth, inter-stellar calamities that led to mass extinctions, and the root of human consciousness are all physical, temporal events that are not within the realm of evolution. Non-physical concepts such as morality, faith, and divinity exist in a completely separate realm from evolution, and cannot be threatened by a biological concept of genetic change.

I invite you to further explore the evidence for evolution and its theoretical basis, so that you are fully informed of what the concept can and cannot answer about our world. I also ask that you consider the ways in which many religious people – scientists and non-scientists – have harmonized their faith with scientific principles. Lastly, I encourage you to be receptive to altering your position, as I will endeavor to be amenable towards your position as well, so that our dialogue is at the very least tolerant, and perhaps, enlightening for both of us.

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