

# Rejecting Darwin: The Occurrence & Impact of Creationism in High School Biology Classrooms

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During the past 40-plus years, creationists have lost every legal challenge regarding the teaching of Darwinian evolution (specifically, a change in the allelic frequency in a population over time due to differential reproductive success as a result of inherited variation) and creationism (a supernatural version, often based on the Bible, of life's origins and development). Biologists and others have cheered these court decisions, with many declaring that the integrity of biology classrooms had been protected from the religion of creationism. As legal scholar Juliana Moore noted after *Edwards v. Aguillard* (the U.S. Supreme Court decision that declared the teaching of "creation science" to be unconstitutional), "When Susie's dad asks her what she learned in school today, she most certainly won't reply that she learned about creationism in science class. The Supreme Court's recent ruling has insured that the separation between church and state in our public schools will remain" (Moore, 1987). In light of these decisions, most biology teachers – like Moore – assume that creationism is not part of biology courses. *But is it?*

In this study, we examined the extent and impact of the teaching of creationism in high school biology courses. We wanted to answer these questions:

- How often is creationism included in biology courses? That is, how often do biology teachers reject Darwinian evolution for other ideas about life's diversity?
- Are biology majors more likely than non-majors to have encountered evolution and/or creationism in their high school biology courses? That is, does having evolution in a high school biology course increase the probability of students becoming biology majors?
- How does the inclusion of evolution and/or creationism in high school biology courses affect students' views of evolution and creationism when they enter college?

## ○ Methods

### Study Population

During 2007 and 2008, we surveyed students enrolled in 1) introductory biology for majors, 2) introductory biology for non-majors, and 3) an upper-division genetics course at the Twin Cities campus of the University of Minnesota. Sample sizes of each sub-population ranged from 74 to 406 students. The survey was conducted during or before the first day of classes, and all of the students in this study had taken a biology course in a public high school. Biology majors have an average high school graduation-percentile of  $94 \pm 5\%$  and an average ACT composite score of  $27 \pm 3$ . Non-majors have an average high school graduation-percentile of  $84 \pm 12\%$  and an average ACT composite score of  $25 \pm 4$ .

### The Survey Instrument

We designed our survey to assess student background in, and perspectives of, the theory of evolution. First, we asked students to tell us whether their high school biology course included evolution but not creationism, creationism but not evolution, both evolution and creationism, or neither evolution nor creationism (Table 1). We then asked students to respond to several statements from the Measure of the Acceptance of the Theory of Evolution (MATE) instrument developed and validated by Rutledge and Sadler (2007). Students could answer "strongly agree," "agree,"

**Table 1. Responses of biology majors and non-majors to the MATE instrument. Numbers in the table are percentages of students who agreed with each statement.**

	MAJORS	NON-MAJORS
My high school biology course included ...		
evolution but not creationism.	68	65
creationism but not evolution.	3	2
evolution and creationism.	16	21
neither evolution nor creationism.	13	12
Modern organisms are the product of evolutionary processes that have occurred over millions of years.	87	78
Humans are the product of evolutionary processes that have occurred over millions of years.	72	73
The theory of evolution cannot be correct since it disagrees with the Biblical account of creation.	14	11
With few exceptions, organisms on Earth came into existence at about the same time.	17	21
The age of the Earth is at least four billion years.	59	64
Evolution is a scientifically valid idea.	68	70

“unsure,” “disagree,” “strongly disagree,” or not answer at all. The study was voluntary, anonymous, and approved by the university’s Institutional Review Board. Students’ responses were tabulated electronically and had no impact on students’ grades.

## ○ Results

### Study Population

Students’ descriptions of their high school biology courses are shown in Table 1. Regardless of whether they were biology majors or non-majors, approximately two-thirds (i.e., 65-68%) of the students in this study had taken high school biology courses that included evolution and not creationism. Although only 3-5% of students reported having been taught only creationism (i.e., no evolution), 16-20% of students were taught evolution and creationism in their high school biology class, and another 8-13% were taught neither evolution nor creationism.

### Comparing Majors & Non-Majors

The mean responses of biology majors and non-majors to statements from the MATE instrument are shown in Table 1. Although biology majors were more likely than non-majors to agree with the statement that modern organisms are the product of millions of years of evolution (87 vs. 78%, respectively), majors and non-majors had near-identical responses to a similar statement about human evolution (72 vs. 73%, respectively), and similar responses to all other statements (i.e., about special creation, the age of Earth, rejection of evolution because of Biblical literalism, and the scientific validity of evolution).

## ○ Discussion

This study had several possible limitations. For example, all of the students in this study attended the same university, and therefore are probably not a truly random sampling of all incoming college students. Similarly, students’ recollections of their high school biology courses may not have been perfect, and some students may have been exposed to evolution or creationism in non-biology courses. In light of these limitations, we do not assign a completely causative link between students’ high school biology experiences and students’ subsequent acceptance of evolutionary theory. Nevertheless, much evidence suggests that the data reported here are reliable and representative. Our sample was large and diverse, and students’ responses about the prevalence of evolution and/or creationism in their high school biology courses are consistent with those reported by biology teachers (Kraemer, 1995; Moore, 2004, 2008; Moore & Kraemer, 2005) and other researchers (Tatina, 1989; Aguillard, 1999; Weld & McNew, 1999; Randak, 2001; Rutledge & Mitchell, 2002; Trani, 2004) over several decades in various parts of the United States.

Regardless of whether they are biology majors or non-majors, approximately two-thirds of students entering college took biology courses in high school that included evolution but not creationism, 12-13% of students’ courses included neither evolution nor creationism, 16-21% of courses included both evolution and creationism, and tiny percentages (2-3%) of courses included creationism but not evolution (Table 1). These results indicate that students’ differing exposures to either evolution or creationism (or both, or neither) in their high school biology courses is not associated with whether students choose biology as their major in college.

Although biology courses that include creationism and not evolution are rare in public schools, almost one-fourth of college students claim that their high school biology classes included

creationism. There is direct support for these claims, for 20% of high school biology teachers in public schools acknowledge that they include creationism in their courses (Kraemer, 1995; Moore & Kraemer, 2005). Taken together, these results indicate that creationism remains alive and well in high school biology courses, despite decades of science education reform, state educational standards, and numerous professional organizations advocating the teaching of evolution and the rejection of creationism in science classes, and numerous court decisions affirming the teaching of evolution and the rejection of creationism (e.g., creation science, intelligent design) because it is religion and not science. Clearly, many biology teachers have abandoned scientific reasoning for the non-scientific beliefs associated with their religion.

## ○ Are the Views of Biology Majors About Evolution Different from Those of Non-Majors?

Although biology majors are more likely than non-majors to accept that modern organisms are the product of evolution over millions of years, they are not more likely to accept that humans are products of the same process. Indeed, almost 30% of majors and non-majors alike reject, to some degree, current scientific understanding of human evolution. Similarly, one of seven biology majors rejects evolution because they believe it disagrees with the Bible, and almost 20% of biology majors believe that organisms appeared on Earth at the same time; only 59% of biology majors accept an old Earth, and one-third do not believe that evolution is a scientifically valid idea. Biology majors have many beliefs that are inconsistent with the basic tenets of evolution.

The beliefs of some of these students are presumably altered during their introductory courses and undergraduate careers. However, for other students, these beliefs remain unchanged throughout their time in college, and even persist into their careers as biology teachers. Indeed, one-sixth of biology teachers are young-Earth creationists (Bandoli, 2008), and even larger percentages of biology teachers believe that creationism has a valid scientific foundation and include some form of creationism in their biology courses (Kraemer, 1995; Moore & Kraemer, 2005). As Lawson and Worsnop (1992) have noted, “Highly religious students are more likely to express a belief in special creation and are less likely to give it up during instruction.” The systematic nature of the problem may be in part due to a disconnect between college-level biology teachers and their students; ongoing work surveying biology teachers in Minnesota and Wisconsin suggests that over one-third of college instructors “have no idea” about their students’ backgrounds in evolution. Of those teachers who volunteer an estimate, very few think their students were exposed to creationism in their high-school biology classes (Lydia Habte, 2009, personal communication).

## ○ Why Would Teachers Not Teach Evolution?

Some biology teachers may accept evolution, but not teach it because of pressure from parents, administrators, and others to ignore evolution. This pressure, which has been documented in several studies (Kraemer, 1995; National Sciences Teachers Association, 2005, and references therein), often causes teachers to ignore, downplay, or de-emphasize evolution in their courses (Berkman, Pacheco & Plutzer, 2008).

Other biology teachers apparently do not believe that evolution is an overly important topic in biology. For example, only about one-fourth of high school teachers use evolution as a unifying

theme in their biology courses (Berkman, Pacheco & Plutzer, 2008). Similarly, a group of 54 teachers was recently asked to identify, from a list of 39 subjects in biology, the 28 subjects that are most important for inclusion in an introductory biology course. More than one-fifth of the teachers did not include evolution as one of the top 28 subjects (Eileen Gregory, 2007, personal communication).

## ○ Why Would Biology Teachers Teach Creationism?

There have been several studies of why biology teachers teach creationism. Several factors seem to be irrelevant:

**State standards:** Evolution instruction is not significantly different in states having weak versus strong standards for evolution education (Bandoli, 2008). Relatively large percentages of teachers either include creationism or ignore evolution in both types of states.

**Legal decisions:** A variety of legal decisions have declared that creation science is religion, that creation science has no educational value as science, that intelligent design is religion, and that it is unconstitutional to teach creationism (Moore & Moore, 2006). Although various ways of teaching creationism have been repeatedly declared to be unconstitutional, the practice continues unabated.

**Policy statements of professional organizations:** Numerous scientific and religious organizations have advocated the teaching of evolution and condemned the teaching of creationism (National Center for Science Education, 2008).

**Knowledge of evolution:** Despite being certified to teach biology, many teachers claim that they do not have the knowledge base to teach evolution (Kraemer, 1995; Rutledge & Mitchell, 2002). Although such teachers would presumably be motivated to learn about evolution, much evidence indicates that understanding evolution does not necessarily mean that teachers will teach evolution effectively. For example, Johnson & Peeples (1987) have concluded that students' misconceptions about evolution often remain "well ingrained even after a thorough coverage of the evidences supporting evolution" in college. Similarly, when teachers were provided with a 14-week evolution course designed to address documented misconceptions identified by a pre-course survey, the teachers learned more about evolution, but their preferences for teaching remained unchanged; most of the teachers "still preferred that antievolutionary ideas be taught in school" (Nehm & Schonfeld, 2007).

So, what *does* cause a biology teacher to teach creationism instead of biology? Studies have consistently concluded that a primary factor is teachers' religious beliefs. Teachers' personal views of a subject influence how they teach that subject (Carlesen, 1991), and teachers having the strongest religious beliefs are most likely to reject evolution (Lawson & Worsnop, 1992). Not surprising, then, is the fact that most teachers who include creationism in their courses do so because of their religious beliefs (Trani, 2004). Although most biology teachers who teach creationism claim that there are valid scientific alternatives to evolution (Berkman, Pacheco & Plutzer, 2008), in fact they teach only the Christian version of creationism; the numerous other stories of other faiths are ignored and, by implication, presented as inconsequential or wrong (Moore, 2008). Similarly, one-sixth of biology teachers are young-Earth creationists (Bandoli, 2008), a longstanding belief of

religious fundamentalists that rejects biology, geology, paleontology, and other aspects of modern science in favor of a story that fits their interpretation of religious documents. For creationists, there is urgency to their message, for they defy professional standards, legal decisions, and state educational guidelines to tell students about their religious beliefs.

In 1972, the American Institute of Biological Sciences (AIBS) deplored efforts by creationists to inject their religion into biology courses. In 1999, AIBS updated its stance, noting "It is very troubling that more than 20 years [after our 1972 statement], there is an urgent need to reaffirm AIBS's earlier position. ... Attempts by creationists continue in a variety of guises" (American Institute of Biological Sciences, 1994). More than a decade after AIBS's reaffirmation, and 150 years after Charles Darwin articulated the logic for, and evidence in favor of, evolution through naturalistic processes, the teaching of creationism continues. •

## References

- Aguillard, D. (1999). Evolution education in Louisiana public schools: A decade following *Edwards v. Aguillard*. *The American Biology Teacher*, 61(3), 182-188.
- American Institute of Biological Sciences. (1994). AIBS Board Resolution, as amended and reconfirmed by the Executive Committee. Washington, DC: American Institute of Biological Sciences.
- Bandoli, J.H. (2008). Do state science standards matter? *The American Biology Teacher*, 70(4), 212-216.
- Berkman, M.B., Pacheco, J.S. & Plutzer, E. (2008). Evolution and creationism in America's classrooms: A national portrait. *PLoS Biology* 6(5): e124 doi:10.1371/journal.pbio.0060124.
- Carlesen, S. (1991). Effects of new biology teachers' subject-matter knowledge on curricular planning. *Science Education*, 757, 631-647.
- Gregory, E. (2007). Personal communication.
- Habte, L. (2009). Personal communication.
- Johnson, R.L. & Peeples, E.E. (1987). The role of scientific understanding in college student acceptance of evolution. *American Biology Teacher*, 49(2), 93-98.
- Kraemer, K.A. (1995). A comparative study of Minnesota teachers' attitudes toward the teaching of evolution and creationism. Unpublished Master's thesis, Bemidji State University, Bemidji, MN.
- Lawson, A. & Worsnop, W. (1992). Learning about evolution and rejecting a belief in special creation: Effects of reflective reasoning skill, prior knowledge, prior belief and religious commitment. *Journal of Research in Science Teaching*, 29, 143-166.
- Moore, J.S. (1987). The *Edwards* decision: The end of creationism in our public schools? *Akron Law Review*, 21, 255-266.
- Moore, R. (2004). State standards and evolution: Are standards relevant to the teaching of evolution in public school biology classrooms? *The Science Teacher*, 71(6), 41-44.
- Moore, R. (2008). Creationism in the biology classroom: What do teachers teach and how do they teach it? *The American Biology Teacher*, 70(2), 79-84.
- Moore, R. & Kraemer, K. (2005). The teaching of evolution and creationism in Minnesota. *The American Biology Teacher*, 67(8), 457-466.
- Moore, R. & Moore, J. (2006). *Evolution 101*. Westport, CT: Greenwood Press.
- National Center for Science Education. (2008). *Voices for Evolution*. Berkeley, CA: National Center for Science Education.
- National Science Teachers Association. (2005). Survey indicates science teachers feel pressure to teach nonscientific alternatives to evolution. Retrieved February 16, 2008. Available online at: <http://www.nsta.org/publications/surveys/survey20050324.aspx>.
- Nehm, R.H. & Schonfeld, I.S. (2007). Does increasing biology teacher knowledge of evolution and the nature of science lead to greater preference for the teaching of evolution in schools? *Journal of Science Teacher Education*, 18(5), 699-723.

- Randak, S. (2001). The children's crusade for creationism. *The American Biology Teacher*, 63(4), 226, 228, 230.
- Rutledge, M.L. & Mitchell, M.A. (2002). High school biology teachers' knowledge structure, acceptance, and teaching of evolution. *The American Biology Teacher*, 64(1), 21-28.
- Rutledge, M.L. & Sadler, K.C. (2007). Reliability of the Measure of Acceptance of the Theory of Evolution (MATE) instrument with university students. *The American Biology Teacher*, 69(6), 332-335.
- Tatina, R. (1989). South Dakota high school biology teachers and the teaching of evolution. *The American Biology Teacher*, 51, 275-280.
- Trani, R. (2004). I won't teach evolution, it's against my religion; And now for the rest of the story. *The American Biology Teacher*, 66(6), 419-427.
- Weld, J. & McNew, J.C. (1999). Attitudes toward evolution. *The Science Teacher* 66(9), 27-31.

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