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Bluebook Citation

Joshua Rosenau, *Leap of Faith: Intelligent Design's Trajectory after Dover*, 4 U. St. Thomas J.L. & Pub. Pol'y 278 (2009).

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LEAP OF FAITH: INTELLIGENT DESIGN'S TRAJECTORY AFTER DOVER

JOSHUA ROSENAU*

*Here on these cliffs of Dover
So high you can't see over
And while your head is spinning
Hold tight, it's just beginning*
—The Decemberists, “We Both Go Down Together”¹

With the failure of Intelligent Design (ID) in *Kitzmiller v. Dover*,² the questions stand: what will be next in the creationism-evolution conflict? Can ID overcome the evidence and legal arguments that sank it in Dover, Pennsylvania? Will a new strategy emerge? And if so, will that successor fare any better than ID, creation science, or biblical creationism before that?

To address these questions, Part I of this article examines the history of creationism and the ID movement. Part II gives specific attention to the *Kitzmiller*³ case and examines whether the ruling was, as critics argue, overbroad and incorrect in its conclusions about whether ID is science or creationism. Part III provides a brief review of current evolutionary biology and its status within the scientific community. Part IV discusses some strategies already being laid out as successors to ID, such as attacks on evolution with little or no overt advocacy for any secular or religious alternative. Finally, Part V critiques the alleged “evidence against evolution.”

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1. THE DECEMBERISTS, WE BOTH GO DOWN TOGETHER (KILL ROCK STARS 2005).
2. *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707 (M.D. Pa. 2005).
3. *Id.*

I. THE HISTORY OF CREATIONISM AND THE DEVELOPMENT OF INTELLIGENT DESIGN

In order to understand ID, it is important to examine the context in which it developed. A full review of creationist history is beyond this article's scope, but a review of key historical analyses shows the clear continuity of ideas, rhetoric, and in some cases personnel from the early fundamentalist movement of the late 19th century to the ID movement and its latest mutations.⁴ In talking about creationism, it is useful to distinguish between doctrines of creation inherent in most religions and the doctrine of special creation developed by American evangelical Christians in the late 19th century. While beliefs that a God or gods created the earth and life on it are ubiquitous (though not universal) in world religion, historical practice was not to interpret those accounts as detailed historical and scientific accounts of the universe, in part because the notion of a detailed historical or scientific account is quite modern.⁵

A. BIBLICAL CREATIONISM

The emergence of the evangelical movement during the eighteenth century's Great Awakening was a reaction to, and an attempt to co-opt, Enlightenment ideals, driven by attempts to model religious practice on the Baconian scientific methods that were proving so effective and to reclaim religious authority in an increasingly secular and technological age.⁶ The Second Great Awakening, beginning in the late nineteenth century, developed as the Industrial Revolution broadened its reach into people's homes and lives, bringing material benefits but also spurring fears of lost control and enforced cosmopolitanism. The rise of scholarship treating the Bible as a book to be analyzed historically and textually like any other edited work, simultaneous with the expansion of science and technology as arbiters of social practice, inspired the fundamentalist movement. This fervent religious movement sought to control the modernization of American society: to co-opt science's growing secular authority and prevent their immediate communities from spinning far from traditional experience,

4. See, e.g., BARBARA FORREST & PAUL R. GROSS, *CREATIONISM'S TROJAN HORSE* (2004); RONALD L. NUMBERS, *THE CREATIONISTS: FROM SCIENTIFIC CREATIONISM TO INTELLIGENT DESIGN* (expanded ed., Harvard Press 2006) (1992); *INTELLIGENT DESIGN CREATIONISM AND ITS CRITICS* (Robert T. Pennock ed., 2001).

5. See generally NUMBERS, *supra* note 4 (documenting the rise of creationism as a component of the late 19th and early 20th century fundamentalist movement); cf. DUANE GISH, *EVOLUTION?: THE FOSSILS SAY NO!* 25 (1973) ("We do not know how God created, what processes He used, *for God used processes which are not now operating anywhere in the natural universe*. This is why we refer to divine creation as special creation.").

6. MARK A. NOLL, *THE SCANDAL OF THE EVANGELICAL MIND* 185–88 (1994).

but not to block the benefits and power of new technologies.

Out of that milieu emerged a group of religious leaders who found evolution's account of life's origins, especially of humanity's hereditary link to other animals, deeply disturbing.⁷ Using an interpretive method modeled loosely on outdated Baconian principles, these writers argued that a proper, literal reading of the inerrant Bible demonstrated that humans could not be related to primates,⁸ a concept widely accepted among contemporary scientists.⁹ Commissioned essays on the subject appeared in a series of volumes known as *The Fundamentals*, which lent fundamentalism its name.¹⁰ Interestingly, while modern fundamentalists are often rigidly committed to belief in an earth far less than the 4.55 billion years estimated by scientific means,¹¹ the authors of the *Fundamentals* often accepted the scientifically determined age of the earth, and focused their critique on human evolution, on natural selection as a mechanism, and on the evidence for evolution and the nature of science more broadly.¹²

The fervid creationist movement received boost when William Jennings Bryan, fresh off his successful campaign for alcohol prohibition, turned his attention to evolution.¹³ Bryan's silver tongue traced certain patterns known as the "Pillars of Creationism" that are still followed today.¹⁴ The first pillar is the claim that evolution is a weak science sure to be abandoned soon. The second is the claim that evolution is incompatible with religious faith and morality, and therefore is incompatible with a stable society. The final pillar is an appeal to the individualistic, classically liberal ideal that parents should be able to choose what their children learn.¹⁵

These arguments persist in barely modified form today. Where first Biblical creationism and then creation science were poised to fulfill the first

7. See Nancy T. Ammerman, *North American Protestant Fundamentalism*, in *FUNDAMENTALISMS OBSERVED* 1, 8 (Martin E. Mary & R. Scott Appleby, eds., 1991) ("Ever since evolutionary ideas came to prominence in the [19th] century, they had been fought by conservatives who saw each biological species (especially humanity) as a unique creation of God"); NUMBERS, *supra* note 4, at 83 (noting an aversion to the existence of pre-Adamic humans).

8. NOLL, *supra* note 6, at 197–200; cf. NUMBERS, *supra* note 4 at 58 (William Jennings Bryan "confided to one friend that he had no objection to 'evolution before man but for the fact that a concession to the truth of evolution up to man furnishes our opponents with an argument which they are quick to use, namely, if evolution accounts for all species up to man, does it not raise a presumption in behalf of evolution to include man?'").

9. PETER J. BOWLER, *EVOLUTION: THE HISTORY OF AN IDEA* 189–99 (Rev. ed. 1989) (evolution was widely accepted by biologists in Europe and America by the 1870s).

10. Ammerman, *supra* note 8, at 2.

11. BRENT DALRYMPLE, *ANCIENT EARTH, ANCIENT SKIES: THE AGE OF EARTH AND ITS COSMIC SURROUNDINGS*, 178–87 (2004).

12. NUMBERS, *supra* note 4, at 53.

13. EDWARD J. LARSON, *SUMMER FOR THE GODS: THE SCOPES TRIAL AND AMERICA'S CONTINUING DEBATE OVER SCIENCE AND RELIGION*, 36–38 (1997).

14. EUGENIE C. SCOTT, *EVOLUTION VS. CREATIONISM* xxiii (2009).

15. *Id.* at xxiii–xxvi.

pillar's promise of a replacement for evolution, now ID is supposedly lapping at the heels of that science. Under the second pillar, where Bryan blamed the German brutality of World War I and the casual violence of Leopold and Loeb on the teaching of evolution,¹⁶ creation scientists pointed to Nazis and the social disruption of the 1960s,¹⁷ and modern creationists point again to the Nazis and to terrorism as evidence of evolution's moral effects.¹⁸ Central to both the first and second pillars, and prevalent throughout creationism's history, is a "contrived dualism"¹⁹ in which only two options are possible for understanding origins (especially of humans): evolution, misrepresented as atheism, and creation, representing all true religion.²⁰ Thus, any evidence for evolution is presented as evidence against religious truth. Moreover, any claimed weakness in evolution is taken as a win for creationism.²¹ Thus, appeals to let students be a jury evaluating the evidence for and against evolution,²² common to both creation scientists and ID promoters,²³ are in effect requests for students to be allowed to choose between science and religion. Given the enduring religiosity of American society, it is clear which way ID promoters hope to force the choice.

B. CREATION SCIENCE

The creation science movement of the 1960s through 1980s grew out of a milieu not so different from that which produced creationism (and fundamentalism more broadly) in the late nineteenth century. Mark Noll, a historian of American evangelicalism, summarizes the creation science movement as, "one of the greatest innovations of recent evangelical history – the establishment of an alternative form of science to the form taught by the intellectual establishments of the culture."²⁴ The creation science movement burst into the public mind rapidly, emerging in the tumultuous 1960s as society reorganized itself politically, racially, and sexually, while also pressed by a persistent need to draw contrast with "godless Communists" and the Cold War fear that technology and unaccountable

16. NUMBERS, *supra* note 4, at 56

17. HENRY M. MORRIS, *THE TWILIGHT OF EVOLUTION* 24 (1963).

18. See HARUN YAHYA, *THE EVOLUTION DECEIT* (Mustapha Ahmad trans., 1st ed. 1999) (Harun Yahya is the pseudonymous author of copious Islamic creationist books. His group has aligned itself with the ID movement).

19. *McLean v. Ark. Bd. Of Educ.*, 529 F. Supp. 1255, 1266 (E.D. Ark. 1982).

20. *Id.*

21. SCOTT, *supra* note 14, at 106.

22. See, e.g., STEPHEN C. MEYER, SCOTT MINNICH, JONATHAN MONEYMAKER, PAUL A. NELSON & RALPH SEELKE, *EXPLORE EVOLUTION* (2007) (an ID textbook presenting the arguments for and against evolution).

23. Compare *id.* at 10 ("We're asking you to be part scientist, part detective, and part juror") with R. L. WYSONG, *THE CREATION-EVOLUTION CONTROVERSY* 48 (1976) (comparing study of evolution and creation to a trial, with students as jurors).

24. NOLL, *supra* note 6, at 192.

bureaucratic systems literally controlled the fate of all humanity.

The popularity of creation science translated readily into political influence.²⁵ Even as the Supreme Court, in 1968, finally overturned Scopes-era evolution bans,²⁶ the Institute for Creation Research, headed by creation science co-originator Henry Morris, crafted a legislative strategy that would require equal time for creation science if evolution were to be taught.²⁷ This strategy was built on the three Pillars, and proponents advocated creation science as a sure replacement for the supposedly waning science of evolution and citing its supposed moral dangers. For example, Morris writes,

Evolution is at the foundation of communism, Fascism, Freudianism, social Darwinism, behaviourism, Kinseyism, materialism, atheism and, in the religious world, modernism and Neo-orthodoxy. . . . Jesus said: "A good tree cannot bring forth corrupt fruit." (Matthew 7:18) In view of the bitter fruit yielded by the evolutionary system over the past hundred years, a closer look at the nature of the tree itself is well warranted today.²⁸

In accordance with the third Pillar, Morris insisted:

Thus, if evolution is to be taught, then creationism should be taught and vice versa. Furthermore, they must be taught equally. One may not be promoted as against another. We suggest that the best and fairest way to do this is simply to define and present the two models, with the scientific evidence evaluated in light of both on a comparative basis.²⁹

C. MCLEAN AND EDWARDS

Creationists across the country advocated for local school board resolutions advocating this "two model" approach, and by the early 1980s, state legislatures in at least twenty-seven states were considering legislation requiring equal time for creationism.³⁰ Only two of these bills passed, one in Arkansas³¹ and the other in Louisiana.³² Both resulted in lawsuits.³³ As

25. SCOTT, *supra* note 14, at 111-13; NUMBERS, *supra* note 4, at 351-52.

26. *Epperson v. Arkansas*, 393 U.S. 97 (1968).

27. HENRY MORRIS, *SCIENTIFIC CREATIONISM* 8-16, 197-98 (1974).

28. MORRIS, *TWILIGHT*, *supra* note 18 at 24.

29. MORRIS, *CREATIONISM*, *supra* note 28, at 197-98.

30. SCOTT, *supra* note 14, at 113.

31. Balanced Treatment for Creation-Science and Evolution-Science Act, ARK. CODE ANN. §17- 80-1663 (1981), *held unconstitutional* by *McLean v. Ark. Bd. Of Educ.*, 529 F. Supp. 1255 (E.D. Ark. 1982)

32. Balanced Treatment for Creation-Science and Evolution-Science Act, LA. REV. STAT. ANN. §17:286.1-.7 (1982) *held unconstitutional* by *Edwards v. Aguillard*, 482 U.S. 578 (1987).

33. *McLean v. Ark. Bd. Of Educ.*, 529 F. Supp. 1255 (E. D. Ark. 1982); *Aguillard v. Treen*,

discussed above, the Arkansas bill was struck down in *McLean v. Arkansas* for unconstitutionally promoting a sectarian religious view.³⁴ Notably, this was despite testimony offered by the state arguing that the complexity of life on Earth implied the need for a non-sectarian “intelligent designer.”³⁵ The case was not appealed, but the substantial trial record proved useful when Louisiana’s bill was challenged in *Edwards v. Aguillard*.³⁶

It is interesting to note that, in *Edwards*, the Louisiana “Balanced Treatment” act was defended by Wendell Bird, general counsel to the Institute for Creation Research acting as special assistant attorney general.³⁷ In addition, Dean Kenyon, a chemist who adopted young earth creationist beliefs in the late 1970s, assisted by filing an affidavit describing his model of creation science, which he believed non-specific enough about religious details as to evade the fate of the Arkansas law.³⁸ Kenyon had previously withdrawn at the last minute from testifying on behalf of creation science in *McLean*, and went on to co-author the first “intelligent design” textbook.³⁹

Edwards spent years moving through the courts, with the Supreme Court’s ultimate ruling that such equal time laws are unconstitutional.⁴⁰ Wendell Bird responded to the decision in an Institute for Creation Research publication entitled “The Supreme Court Decision and its Meaning.”⁴¹ He argued that, until society and judges perceived evolution in a worse light and this ruling was overturned, activists should pursue a fallback strategy whereby,

[S]chool boards and teachers should be strongly encouraged at least to stress the scientific evidences and arguments *against evolution* in their classes (not just arguments against some proposed evolutionary mechanism, but against evolution *per se*), even if they don’t wish to recognize these as evidences and arguments *for creation* (not necessarily as arguments for a particular date of creation, but for creation *per se*).⁴²

440 So.2d 704 (1983), *aff’d sub nom.* *Edwards v. Aguillard*, 482 U.S. 578 (1987).

34. *McLean*, 529 F. Supp. at 1274.

35. NORMAN L. GEISLER, *THE CREATOR IN THE COURTROOM: SCOPES II* 150 (1982).

36. See *Edwards v. Aguillard*, 482 U.S. 578, 600-04 (1987).

37. Nicholas Matzke, *But Isn’t It Creationism? The Beginnings of “Intelligent Design” in the Midst of the Arkansas and Louisiana Litigation*, in *BUT IS IT SCIENCE?* 377, 389 (Robbert Pennock & Michael Ruse eds., updated edition 2009).

38. Kenyon Aff., Sept. 17, 1984, available at <http://www.talkorigins.org/faqs/edwards-v-aguillard/kenyon.html>.

39. Matzke *supra* note 38.

40. *Edwards*, 482 U.S. at 596-97.

41. Wendell R. Bird, *The Supreme Court Decision and its Meaning*. 170 Impact Series (Inst. for Creation Research, El Cajon, Cal.), Aug. 1987, available at <http://www.icr.org/article/supreme-court-decision-its-meaning>.

42. *Id.* at ¶11.

D. THE NOT-SO-SUDDEN APPEARANCE OF ID

Within a few years after *Edwards*,⁴³ the clear successor to creation science was a movement called “Intelligent Design.” ID proponents focused on certain features of creation science, including attacking the definition of science, claiming natural processes alone could not explain certain features of the natural world, and insisting on a form of “special creation”⁴⁴ of life, but remaining strategically vague on questions about the timing of creation, the author of creation, the means of creation, and such details as whether Noah’s flood was global in scope. The ID movement sought to recruit philosophers, scientists, and lawyers into its fold before mounting a full assault on public school science classes.⁴⁵ As the movement grew, legal scholars, historians, scientists, and educators all launched critiques of ID, with legal scholars predicting ID’s rejection long before *Kitzmiller*.⁴⁶

Recognizing that the *McLean* ruling provided a guide to doctrines that might prove too obviously religious, and seeing that *Edwards* offered suggestions about what sorts of arguments might pass constitutional muster, the nascent ID movement dropped overt references to the age of the earth, a global flood, any positive identification of a designer, and focused on factors which could be plausibly presented as science-like.⁴⁷ The goal, Discovery Institute Fellow Paul Nelson explains, was to craft a “big tent” to unite people who:

... affirm the First Article of the Apostles’ Creed: “I believe in God the Father Almighty, maker of heaven and earth.” ... That theological commonality—namely, God is the Author of the Universe, in whatever way He chose to act—has a secular counterpart in the philosophy of science: intelligent design is possible.⁴⁸

William Dembski, a Senior Fellow at the Discovery Institute, describes this mission as “an alternative approach to unifying the Christian world about creation.”⁴⁹ His goal is to “...propose a theory of creation that puts

43. 482 U.S. 578.

44. SCOTT, *supra* note 14, at 19.

45. Cf. INTELLIGENT DESIGN CREATIONISM AND ITS CRITICS, *supra* note 4; FORREST & GROSS, *supra* note 4.

46. See, e.g., Matthew J. Brauer, Barbara Forrest & Steven G. Gey, *Is It Science Yet?: Intelligent Design Creationism and the Constitution*, 83 WASH. U. L.Q. 1 (2005); Jay D. Wexler, *Of Pandas, People, and the First Amendment: The Constitutionality of Teaching Intelligent Design in the Public Schools*, 49 STAN. L. REV. 439 (1997); Jay D. Wexler, *Darwin, Design, and Disestablishment: Teaching the Evolution Controversy in Public Schools*, 56 VAND. L. REV. 749 (2003).

47. SCOTT, *supra* note 14, at 132–33.

48. Paul A. Nelson, *Life in the Big Tent: Traditional Creationism and the Intelligent Design Community*, 24 CHRISTIAN RESEARCH JOURNAL, No. 4 (2002), available at <http://www.equip.org/PDF/DL303.pdf>

49. William Dembski, *Introduction to MERE CREATION: SCIENCE, FAITH AND INTELLIGENT*

Christians in the strongest possible position to defeat the common enemy of creation, to wit [sic], naturalism. . . . [It is] aimed specifically at defeating naturalism and its consequences."⁵⁰

The strategy used to promote ID and its broader fundamentalist Christian agenda was referred to by its promoters as "the Wedge,"⁵¹ because it would begin with a narrow assault on the nature of science and evolution, and then broaden its scope to influence all the sciences and, ultimately, society at large. Phillip Johnson, often referred to as the godfather of ID,⁵² explained the name in an interview, saying,

[T]here are two definitions of 'science' in our culture. One definition says that scientists follow the evidence regardless of the philosophy; the other says that scientists must follow the (materialist) philosophy regardless of the evidence. The "Wedge of Truth" is driven between those two definitions, and enables people to recognize that "In the beginning was the Word" is as true scientifically as it is in every other respect.⁵³

The explicitly religious language concluding Johnson's argument proved to be a good indication of what its promoters believed should drive the Wedge. However, those promoters still insisted that the Intelligent Designer was unspecified, with its identity unknowable scientifically and irrelevant to the debate,⁵⁴ an evasion hard to credit when promoters also claim the designer's identity is a matter for religion.⁵⁵

The ID movement set optimistic goals for recruiting scientists, lawyers, philosophers, politicians, documentarians, and other public intellectuals to make a broad case that science's rules were overly restrictive in excluding

DESIGN 13 (William Dembski ed., 2001) (note that the title of the volume is a reference to C. S. Lewis's "Mere Christianity").

50. *Id.* at 14–15.

51. See, e.g., Ctr. for the Renewal of Sci. & Culture, *The Wedge Strategy* (1998) available at <http://ncseweb.org/creationism/general/wedge-document>; See generally FORREST & GROSS, *supra* note 4 (for an overview of the subject).

52. See, e.g., Eric Young, *Biola to Feature Leading Christian Apologist, 'Godfather' of Intelligent Design* CHRISTIAN POST, Dec. 19 2008, <http://www.christianpost.com/article/20081219/biola-to-feature-leading-christian-apologist-godfather-of-intelligent-design/index.html>; Nicholas Miller, *The Godfather of Intelligent Design* 61 ORIGINS 44–47(2007) (reviewing DARWIN'S NEMESIS: PHILLIP JOHNSON AND THE INTELLIGENT DESIGN MOVEMENT (William A. Dembski ed., 2006)).

53. Barbara Forrest, *The Wedge at Work*, in INTELLIGENT DESIGN CREATIONISM, *supra* note 4, at 33(quoting John 1:1) (the interview is available at <http://www.christianbook.com/Christian/Books/dpep/interview.pl/16559901?sku=22674>).

54. Casey Luskin, *Is Intelligent Design Theory Really an Argument for "God"?*, (Intelligent Design and Evolution Awareness (IDEA) Center), <http://www.ideacenter.org/contentmgr/showdetails.php/id/1341> (last visited January 17, 2010).

55. Jason Rosenhouse, *Who Designed the Designer?*, SKEPTICAL INQUIRER, Nov. 3, 2006, http://www.csicop.org/specialarticles/show/who_designed_the_designer/.

claims about untestable supernatural entities.⁵⁶ Using rhetoric strikingly similar to that of creation scientists in the 1970s and 1980s, they argued that certain biological, astronomical, and cosmological phenomena were too complex for natural processes to explain, and invoked the unnamed designer's unspecified powers of creation to account for those phenomena.⁵⁷ The refusal to offer a detailed account of the mechanism for "design" is a strategic choice intended to legally distance the implied designer from the biblical Creator advocated by creationism.⁵⁸

The use of Intelligent Design as a supposedly secularized alternative to a religious belief can be seen in the textbook at issue in *Kitzmiller v. Dover Area School District*.⁵⁹ *Pandas and People*⁶⁰ (hereinafter *Pandas*) began as creation science textbook, but rapidly switched from using the terms "creation," "creation science," "creationism," "creator," or "creationist" in early drafts to the terms "design," "intelligent design," "design theory," "designer," and "design proponent" after the *Edwards*⁶¹ ruling.⁶² The creationist taxonomy of "kinds"—named after the Genesis passage that describes animals being created "according to their kinds"⁶³—did not survive intact after the 1987 revisions of *Pandas*.⁶⁴ However, the notion of separately created kinds continues to be evident in the discussion of fossils and speciation in *Pandas*, a necessary consequence of the belief that the variation natural processes can produce is necessarily limited—an argument common to creation science and Intelligent Design.⁶⁵

Intelligent Design advocates have struggled without success to achieve academic acceptance as scientists. For example, some attempts have been made to create ID-specific journals comparable to those of creation scientists,⁶⁶ but they have all become moribund,⁶⁷ and an academic society

56. Phillip Johnson, DARWIN ON TRIAL 111–22 (1991).

57. See, e.g., MICHAEL BEHE, DARWIN'S BLACK BOX (The Free Press 1996); GUILLERMO GONZALEZ & JAY WESLEY RICHARDS, THE PRIVILEGED PLANET (2004); WILLIAM DEMBSKI, THE DESIGN INFERENCE (1998). The similarity of this rhetoric to that of earlier creationist movements is described in Matzke, *supra* note 38.

58. Matzke, *supra* note 38, at 378.

59. *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707, 744 (M.D. Pa. 2005).

60. PERCIVAL DAVIS & DEAN H. KENYON, OF PANDAS AND PEOPLE: THE CENTRAL QUESTION OF BIOLOGICAL ORIGINS (Foundation for Thought & Ethics: 2d ed.1993).

61. *Edwards v. Aguillard*, 482 U.S. 578 (1987).

62. Barbara Forrest, *My Role in Kitzmiller v. Dover*, 26 REPORTS OF THE NCSE (Nat'l Ctr. for Sci. Educ., Oakland, Cal.) 47–48 (2006).

63. *Genesis* 1:25.

64. Cf. Davis & Kenyon, *supra* note 64.

65. SCOTT, *supra* note 14, at 63.

66. See, e.g., CREATION RESEARCH SOCIETY QUARTERLY, published continuously since 1964, available at <http://www.creationresearch.org/crsq.html>.

67. Cf., e.g., ORIGINS AND DESIGN, <http://www.arn.org/odesign/odesign.htm> (not published since 2001); PROGRESS IN COMPLEXITY, INFORMATICS AND DESIGN, <http://www.iscid.org/pcid.php> (not published since 2005).

dedicated to ID is similarly defunct.⁶⁸ Major academic ID goals set in a fundraising document in 1998⁶⁹ have gone unachieved, such as the promise of a major monograph by Discovery Institute fellow Paul Nelson, which has been reported as nearly ready to print for over a decade.⁷⁰ The proceedings of a Discovery Institute conference held in the summer of 2007, supposedly highlighting “the very kind of research our critics say we don’t sponsor,”⁷¹ remain unpublished. William Dembski, once heralded on a book jacket as “the Isaac Newton of Information Theory,” has been reduced to rewriting and analyzing toy computer programs originally written for a TV series and popular books in the 1980s by biologist Richard Dawkins as trivial demonstrations of the power of selection.⁷² Dembski explained his poor record of publication in peer-reviewed scientific literature by saying, “I’ve just gotten kind of blasé about submitting things to journals where you often wait two years to get things into print. And I find I can actually get the turnaround faster by writing a book and getting the ideas expressed there. My books sell well.”⁷³ Alas, they don’t convince mathematicians of his mathematical arguments,⁷⁴ prompting Dembski to reply to one critic: “I’m not and never have been in the business of offering a strict mathematical proof for the inability of material mechanisms to generate specified complexity.”⁷⁵ This, despite his claim to have developed a “Law of Conservation of Information” about which he states in one book: “The crucial point of the Law of Conservation of Information is that natural causes can at best preserve CSI. . . , may degrade it, but cannot generate it.”⁷⁶

68. The International Society for Complexity, Informatics, and Design, <http://www.iscid.org/contact.php> (Its website states, “ISCID is no longer being managed as an organization”).

69. Ctr. for the Renewal of Sci. & Culture, *supra* note 53.

70. See *id.* at *Progress Summary, Books*, ¶2.

71. Posting of Bruce L. Gordon to Evolution News & Views, http://www.evolutionnews.org/2008/02/a_few_words_about_a_longwinded.html (Feb. 22, 2008, 9:59 AM).

72. William A. Dembski & Robert J. Marks II, *Conservation of Information in Search: Measuring the Cost of Success*, 39 IEEE TRANSACTIONS ON SYS., MAN AND CYBERNETICS, PART. A: SYS. & HUM., 1051–61.

73. Beth McMurtrie, *Darwinism Under Attack*, 48 THE CHRON. OF HIGHER EDUC. 17 (2001).

74. See, e.g., David H. Wolpert, *William Dembski's treatment of the No Free Lunch theorems is written in jello*, Mathematical Reviews (Feb. 2003) (Note that Wolpert is the codiscoverer of the very “no free lunch” theorems which Dembski claims disprove evolution. Wolpert writes that Dembski’s arguments are “written in jello” because “There simply is not enough that is firm in his text, not sufficient precision of formulation, to allow one to declare unambiguously ‘right’ or ‘wrong’ when reading through the argument. All one can do is squint, furrow one’s brows, and then shrug”).

75. William A. Dembski, *If Only Darwinists Scrutinized Their Own Work as Closely: A Response to “Erik,”* 2002, http://www.designinference.com/documents/2002.08.Erik_Response.htm.

76. WILLIAM A. DEMBSKI, NO FREE LUNCH: WHY SPECIFIED COMPLEXITY CANNOT BE PURCHASED WITHOUT INTELLIGENCE 162 (2001).

In 1998, the Discovery Institute explained to its donors that research was crucial stating, "Phase I [described as 'Research, Writing and Publication'] is the essential component of everything that comes afterward. Without solid scholarship, research and argument, the project would be just another attempt to indoctrinate instead of persuade."⁷⁷ Judges and others seeking to assess the merits of ID going forward need issue no harsher judgment than the Discovery Institute has presented here. By its own standards, ID is intellectually stagnant, and must be regarded as "just another attempt to indoctrinate instead of persuade," in line with previous creationist movements.

The *Kitzmiller* ruling cited as "[a] final indicator of how ID has failed to demonstrate scientific warrant. . . the complete absence of peer-reviewed publications supporting the theory."⁷⁸ The movement, however, did not take this as a call to return to the labs and produce novel results in readiness for future legal challenges.⁷⁹ Instead, the movement has produced a the third edition of *Pandas* (renamed *Design of Life* and no longer aimed at high schools)⁸⁰ and a successor to *Pandas*, called *Explore Evolution*, which contains even less substance and scientific accuracy than its predecessor.⁸¹ The Intelligent Design documentary, *Expelled!: No intelligence allowed*⁸² mangled interviews⁸³ and the history of the Holocaust,⁸⁴ and has been called

77. Ctr. for the Renewal of Sci. & Culture, *supra* note 53, at *Five Year Strategic Plan Summary, Phase I*.

78. *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707, 744 (M.D. Pa. 2005).

79. Discovery Institute did create what amounts to a Potemkin laboratory—the Biologic Institute. Cf. <http://biologicinstitute.org/about/>. Attempts to view the lab spaces or examine their research have been blocked. See Celeste Biever, *Intelligent design: The God Lab*, THE NEW SCIENTIST, Dec. 15 2006, at 8–11. According to one report, the only research finding offered by Biologic actually contradicts a central claim of ID. Posting of Daniel Brooks to Panda'sThumb, <http://pandasthumb.org/archives/2008/02/id-intelligent.html> (Feb. 6, 2008, 6:42 PM) ("We shuffled off for a coffee break with the admission hanging in the air that natural processes could not only produce new information, they could produce *beneficial* new information").

80. WILLIAM A. DEMBSKI & JONATHAN WELLS, *THE DESIGN LIFE: DISCOVERING SIGNS OF INTELLIGENCE IN BIOLOGICAL SYSTEMS* (2007).

81. STEPHEN C. MEYER, SCOTT MINNICH, JONATHAN MONEYMAKER, PAUL A. NELSON & RALPH SEELKE, *EXPLORE EVOLUTION* (2007).

82. *EXPULLED: NO INTELLIGENCE ALLOWED* (Premise Media 2008).

83. Jonathan Rennie & Steve Mirsky, *Six Things in Expelled that Ben Stein Doesn't Want You to Know*, SCI. AM., Apr. 16, 2008, <http://www.scientificamerican.com/article.cfm?id=six-things-ben-stein-doesnt-want-you-to-know> ("Scientists in the film thought they were being interviewed for a different movie"); Nat'l Ctr. For Sci. Educ., *Questionable Interview Tactics*, <http://www.expelledexposed.com/index.php/background/interview-tactics> (last visited Jan. 17, 2010).

84. Press Release, Anti-Defamation League, *Anti-Evolution Film Misappropriates the Holocaust* (Apr. 29, 2008), available at http://www.adl.org/PresRele/HolNa_52/5277_52.htm. (last visited Oct. 4, 2009) Film star Ben Stein replied that the Holocaust was "none of their [the ADL's] f---ing business." Peter McKnight, *No Intelligence Allowed in Stein's Film*, VANCOUVER SUN, June 21, 2008, at C5.

“one of the sleaziest documentaries to arrive in a very long time.”⁸⁵ In addition, Michael Behe published a successor to *Darwin's Black Box*,⁸⁶ *The Edge of Evolution: The Search for the Limits of Darwinism*,⁸⁷ while still failing to address criticism leveled at the earlier work,⁸⁸ even those he himself acknowledged.⁸⁹

II. KITZMILLER V. DOVER

A. THE CASE

In 2004, the Dover Area School District accepted an anonymous donation of 60 copies of *Pandas*.⁹⁰ The district school board mandated that the textbooks be available in classrooms, and that teachers read a statement that evolution is a theory with “gaps . . . for which there are no evidence [sic],” and tell students: “Intelligent Design is an explanation of the origin of life that differs from Darwin's view. The reference book, *Of Pandas and People*, is available for students who might be interested in gaining an understanding of what Intelligent Design actually involves.”⁹¹ As documented in the extensive trial record, the policy sprung from a consultation with the Discovery Institute and other ID proponents during public disputes over a new biology textbook criticized for being “laced with Darwinism,”⁹² as well as calls for “creationism” to be taught.⁹³

Parents brought a lawsuit over the policy, arguing that it violated the establishment clause of the First Amendment of the United States Constitution, as well as the Pennsylvania Constitution.⁹⁴ The trial court evaluated the various ways that one might justify introducing ID into the classroom, exploring each of the theories offered by defense attorneys for the school board.⁹⁵ After forty days of testimony, extensive briefing, and

85. Jeannette Catsoulis, *Resentment Over Darwin Evolves Into a Documentary*, N. Y. TIMES, April 18, 2008, at E13.

86. BEHE, *supra* note 57.

87. MICHAEL J. BEHE, *THE EDGE OF EVOLUTION* (2007).

88. Nicholas Matzke, *The Edge of Creationism*, 22 TRENDS IN ECOLOGY & EVOLUTION 566 (2007).

89. Cf. Michael J. Behe, *Reply to My Critics: A Response to Reviews of Darwin's Black Box: The Biochemical Challenge to Evolution*, 16 BIOLOGY AND PHILOSOPHY 685 (2001) (“There is an asymmetry between my current definition of irreducible complexity and the task facing natural selection. I hope to repair this defect in future work”).

90. *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707, 754 (M.D. Pa. 2005); *see also* Lauri Lebo, *THE DEVIL IN DOVER* (2008) (providing a thorough account of the story behind the case).

91. *Id.* at 708–09.

92. *Id.* at 751.

93. *Id.* at 750–51.

94. *Id.* at 709–10.

95. *Id.* at 716–23 (finding that teaching about the gaps and problems in evolutionary theory are creationist strategies); *id.* at 735–46 (finding that ID is not science).

detailed expert witness reports, the court determined that the Board had acted improperly.⁹⁶ Relying on extensive case law related to creationism, the court ruled that introducing ID into the classroom could not be justified because it possessed essential continuities with creationism⁹⁷ and constitutes religion rather than science.⁹⁸ The court held that there is no secular purpose to justify bringing ID into science classes.⁹⁹

The ID policy and ensuing court case were catastrophic for both the Dover Area School District and ID proponents. The District was left with a divided community¹⁰⁰ and a judgment of over one million dollars in damages and attorney's fees.¹⁰¹ ID promoters not only lost the case decisively, but had so antagonized the town that an election swept in a new school board with no interest in either appealing the decision or attempting any compromise over the teaching of evolution.¹⁰² Observers recognized the ruling as "a model for judicial consideration of the proliferating effort to use Intelligent Design to undermine the teaching of biology,"¹⁰³ and warned:

No one believes that this thoroughgoing repudiation of Intelligent Design will end the incessant warfare over evolution. But any community that is worried about the ability of its students to compete in a global economy would be wise to keep supernatural explanations out of its science classes.¹⁰⁴

The fallout in Dover helped sway policymakers and voters in other areas to re-evaluate flirtations with creationism, whether the issue was an anti-evolution sticker mandated in Georgia,¹⁰⁵ new curriculum guides being debated in Ohio,¹⁰⁶ or science standards being revised in Kansas.¹⁰⁷ Suddenly, deals were being struck, hard-won ID victories were being snatched away, and tentative allies were no longer interested in setting aside

96. *Kitzmiller*, 400 F. Supp. 2d at 766 (holding that the Board's policy violates both the federal and Pennsylvania state constitutions).

97. *Id.* at 716–23.

98. *Id.* at 735–46.

99. *Id.* at 762–63.

100. See Lebo, *supra* note 92 (proving a sensitive portrait of the effect of the *Kitzmiller* trial on the author's community).

101. *Kitzmiller v. Dover Area Sch. Dist.*, No.4:04-CV-2688 (M.D. Pa. Feb. 22, 2006) (unpublished damages award) available at http://ncse.com/webfm_send/72.

102. Michelle Star, *Dover CARES sweeps election: Voters deny request from incumbents to return to the Dover Area school board*, YORK DAILY RECORD, Nov. 8, 2005.

103. Editorial, *Intelligent Decision*, WASHINGTON POST, Dec. 21, 2005, at A28.

104. Editorial, *Intelligent Design Derailed*, NEW YORK TIMES, Dec. 22, 2005, at A32.

105. Press Release, Am. United for Separation of Church and State, Am. United Applauds Settlement of Ga. Lawsuit Over Evolution Disclaimer (Dec. 19, 2006), available at <http://www.au.org/media/press-releases/archives/2006/12/applauds-settlem.html>.

106. Glenn Branch, *Critical Analysis' Defeated in Ohio*, 26 REPORTS OF THE NCSE (Nat'l Ctr. for Sci. Educ., Oakland, Cal.) 7 (2006).

107. *Evolution's foes lose ground in Kansas*, MSNBC, Aug. 2, 2006, http://www.msnbc.msn.com/id/14137751/ns/technology_and_science-science/.

their differences to pursue the ID mission.¹⁰⁸

B. KITZMILLER'S LASTING LEGACY: IS ID SCIENCE?

Significant controversy has arisen over the breadth of *Kitzmiller's* holdings,¹⁰⁹ as well as the breadth of uses to which the case has been put. The court's opinion is undeniably comprehensive, presenting an analysis of whether the District policy violated the federal Establishment Clause under both the *Lemon Test*¹¹⁰ and the endorsement test first outlined in *County of Allegheny v. ACLU*.¹¹¹ The court's analysis of the role religion played in the Board's policy is largely uncontroversial. One board member urged support for the policy by stating in a public meeting: "Two thousand years ago someone died on a cross, won't someone stand up for him?"¹¹² Members referred explicitly to a desire to introduce "creationism" into science classes, and then lied in depositions and on the stand to cover for those unambiguously unconstitutional efforts.¹¹³ Religion was woven through the process to a shameful degree, and few observers expected the judge to ignore that evidence and uphold the policy. While some ID promoters have attempted to relitigate the constitutional issues in law reviews or privately published pamphlets,¹¹⁴ the ruling has withstood such attacks.¹¹⁵ However,

108. Henry Morris, *Intelligent Design and/or Scientific Creationism*, 208 BACK TO GENESIS (Inst. for Creation Research, El Cajon, Cal.), April 2006, at a, a-b (Morris states, "Some of the leaders of the ID movement have been frankly calling it a 'wedge' with which they hope to open up the atheistic science establishment, so that teachers can at least acknowledge intelligent creation of life as a possibility. But, as we creationists have been predicting, they are now finding this outcome highly unlikely at best. . . . [I]t is also now becoming increasingly apparent that ID will never be allowed in the public schools either, regardless of how it is compromised. And what good would it do anyhow? If the ID system has to be so diluted as to be acceptable to any religion or philosophy except raw atheism, then why bother? Would believing in some false god or goddess and following some cultic system of practice be preferable to believing and practicing atheistic secular humanism? Think about it!").

109. *Kitzmiller*, 400 F. Supp. 2d at 734–35 (reaching the issue of whether ID is science).

110. *Id.* at 746–64; *Lemon v. Kurtzman*, 403 U.S. 602, 612–613 (1971) ("First, the statute must have a secular legislative purpose; second, its principle or primary effect must be one that neither advances nor inhibits religion . . . ; finally, the statute must not foster 'an excessive government entanglement with religion'") (internal citations omitted).

111. *Kitzmiller*, 400 F. Supp. 2d at 714–46 (test discussed therein); *County of Allegheny v. ACLU*, 492 U.S. 579 (1989).

112. Lebo, *supra* note 92, at 24.

113. *See id.* at 71–88.

114. *See, e.g.*, DAVID DEWOLF, JOHN WEST, CASEY LUSKIN, & JONATHAN WITT, TRAIPSING INTO EVOLUTION: INTELLIGENT DESIGN AND THE *KITZMILLER V. DOVER* DECISION, (2006); David K. DeWolf, John West, & Casey Luskin, *Intelligent Design Will Survive Kitzmiller v. Dover*, 68 MONT. L. REV. 7 (2007).

115. *See, e.g.*, Peter Irons, *Disaster in Dover: The trials (and Tribulations) of Intelligent Design*, 68 MONT. L. REV. 59 (2007); Richard B. Katskee, *Why It Mattered to Dover that Intelligent Design isn't Science*, 5 FIRST AMEND. L. REV. 112 (2006); Arthur Loewy, *The Wisdom and Constitutionality of Teaching Intelligent Design in Public Schools*, 5 FIRST AMEND. L. REV. 82 (2006); Nicholas A. Schuneman, *One Nation, Under ... The Watchmaker?: Intelligent Design and the Establishment Clause*, 22 BYU J. PUB. L. 179 (2007); Jay D. Wexler, *Intelligent design*

some scholars on both sides of the issue have expressed concern about how the court treated the question of whether ID is science.¹¹⁶

Whether ID is science was a central dispute in *Kitzmiller*.¹¹⁷ Defining science, like all philosophical endeavors, is a difficult task and the approach taken by the court was prudent.¹¹⁸ At trial, extensive testimony was presented by both philosophers and scientists who described their work.¹¹⁹ While philosophers will quibble over the opinion's description of science, Judge Jones showed a solid grasp of how science is practiced.¹²⁰ Science is a process, and only by seeing scientists work through issues on the stand can a court fully appreciate how that process works, and evaluate whether ID fits within that framework. Courts dealing with such issues in the future should be encouraged to follow this empirical approach.

Some have argued that the court erred in choosing to address the question,¹²¹ but it was in fact necessary to evaluating whether the Board had a valid secular purpose in adopting its plan. The defense largely accepted that religious beliefs were discussed, but insisted that whatever the motives of the individual board members, all overt references to religion had been removed from the policy itself so that an objective observer would find that the policy was an not an endorsement of religious belief.¹²² Relying on a

and the Law: A Response, 84 WASH. U. L. REV. 63 (2006); Jay Wexler, *Kitzmiller and the "Is it science?" Question*, 5 FIRST AMEND. L. REV. 90 (2006); David R. Bauer, Note, *Resolving the Controversy Over "Teaching the Controversy": The Constitutionality of Teaching Intelligent Design in Public Schools*, 75 FORDHAM L. REV. 1019 (2006); Todd R. Olin, Note, *Fruit of the Poison Tree: A First Amendment Analysis of the History and Character of Intelligent Design Education*, 90 MINN. L. REV. 1107 (2006); Philip Sparr, Note, *Special Effects: Kitzmiller v. Dover Area School District, and the Fate of Intelligent Design in Our Public Schools*, 86 NEB. L. REV. 708 (2008).

116. Compare Wexler, *Is it Science*, *supra* note 117, at 92 ("The part of *Kitzmiller* that finds ID not to be science is unnecessary, unconvincing, not particularly suited to the judicial role, and even perhaps dangerous both to science and to freedom of religion"), with DeWolf, West, & Luskin, *Intelligent Design Will Survive*, *supra* note 116, at 14 ("[N]ot only was it not 'essential' to [the Judge's] holding that 'an Establishment Clause violation has occurred' to make findings about the whether ID is science, but one federal district court judge cannot, and should not presume to settle a contested scientific issue for all other courts").

117. *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707, 734–35 (M.D. Pa. 2005).

118. See Robert T. Pennock, *Can't Philosophers Tell the Difference Between Science and Religion? in BUT IS IT SCIENCE?*, *supra* note 38, at 312.

119. See *Kitzmiller*, 400 F. Supp. 2d at 735–46.

120. Margaret Talbot, *Darwin In the Dock*, THE NEW YORKER, Dec. 5, 2005, at 66 (describing the testimony as "the biology class you wish you could have taken").

121. See, e.g., Wexler, *Is it Science*, *supra* note 117, at 92 ("The part of *Kitzmiller* that finds ID not to be science is unnecessary, unconvincing, not particularly suited to the judicial role, and even perhaps dangerous both to science and to freedom of religion"); DeWolf, West, & Luskin, *Intelligent Design Will Survive*, *supra* note 105, at 14 ("[N]ot only was it not 'essential' to [the Judge's] holding that 'an Establishment Clause violation has occurred' to make findings about the whether ID is science, but one federal district court judge cannot, and should not presume to settle a contested scientific issue for all other courts").

122. Cf. Def.'s Br. In Supp. Sum. J. 12–17, 2005 WL 3628800..

roadmap laid out by ID promoters long before trial,¹²³ the defense pointed to the Supreme Court's statement in *Edwards v. Aguillard* that "teaching a variety of scientific theories about the origins of humankind to schoolchildren might be validly done with the clear secular intent of enhancing the effectiveness of science instruction."¹²⁴ The defense, in their answer to the original complaint, insisted "Intelligent Design is a scientific theory based on interpretation of scientific data by scientists."¹²⁵ If this were true, the defense argued, teaching ID would be protected by these considerations, and the district policy would "merely provide . . . the students of Dover High School with an honest science education for the valid and clearly secular purpose of enhancing the science curriculum by informing students about . . . the fact that there are alternative scientific theories [to evolution] being advanced by scientists."¹²⁶

In order to make a serious evaluation of the defense's argument that ID is not religious by virtue of being science, it was necessary for the court to examine whether ID is science.¹²⁷ Given the likelihood of appeal (defendants initially planned to take the case to the Supreme Court), and the need for the public to understand the basis for its ruling, the district court had an obligation to lay out the evidence presented at trial and to demonstrate its understanding of that voluminous testimony.¹²⁸

ID proponents object to the court's ruling that ID is equivalent to creationism, despite its similarities to, and historical continuity with, creation science.¹²⁹ They acknowledge that ID has religious implications, but state that the identity of the designer is a question not for science but for theology, and insist that the inference of a supernatural designer does not itself make ID religious belief.¹³⁰ However, key figures in the ID movement, as well as the authors, editors, and reviewers for the book at issue in the case were shown to have extensive ties to the earlier creation science

123. See David DeWolf, Steven Meyer & Mark DeForrest, *Teaching the Origins Controversy: Science, or Religion, or Speech?*, 2000 UTAH L. REV. 39, 106–09 (2000) (arguing that *Edwards* does not bar the teaching of ID).

124. *Edwards v. Aguillard*, 482 U.S. 578, 594 (1987).

125. Def.'s Answer, 5–6, 2004 WL 3646143.

126. *Id.* at 6.

127. *Cf. Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707, 717 (M.D. Pa. 2005) (The court stated, "The court in *McLean* stated that creation science rested on a "contrived dualism" that recognized only two possible explanations for life, the scientific theory of evolution and biblical creationism, treated the two as mutually exclusive such that "one must either accept the literal interpretation of Genesis or else believe in the godless system of evolution," and accordingly viewed any critiques of evolution as evidence that necessarily supported biblical creationism") (citing *McLean v. Ark. Bd. Of Educ.*, 529 F. Supp. 1255, 1266 (E.D. Ark. 1982))).

128. *Cf. Katskee*, *supra* note 117.

129. See, e.g., DeWolf, West, & Luskin, *Intelligent Design Will Survive*, *supra* note 116, at 19–24.

130. DEWOLF, WEST, LUSKIN, & WITT, *TRAIPSING*, *supra* note 116, at 15–16, 30–34.

movement.¹³¹ Furthermore, analysis of ID arguments shows it to be singing from the same hymnal as earlier creationists, with supposedly novel concepts like “irreducible complexity” (the claim that certain structures are too complex to have formed by natural processes alone) showing up in nearly identical form, down to the example of the bacterial flagellum.¹³²

Showing that ID was an endorsement of the religious precept of supernatural creation was key to demonstrating that the Board’s policy lacked a secular purpose. Indeed, much of ID’s argument for scientific merit and independence from earlier manifestations of creationism had been prefigured and rejected in the 1982 *McLean v. Arkansas* case, where the court’s evaluation of creation science was based on significant scientific testimony about the theory’s merits.¹³³ At issue was a statute mandating equal time for evolution and creation science, which the law defined as follows:

[4](a) “Creation-science” means the scientific evidences for creation and inferences from those scientific evidences. Creation-science includes the scientific evidences and related inferences that indicate: (1) Sudden creation of the universe, energy, and life from nothing; (2) The insufficiency of mutation and natural selection in bringing about development of all living kinds from a single organism; (3) Changes only within fixed limits of originally created kinds of plants and animals; (4) Separate ancestry for man and apes; (5) Explanation of the earth’s geology by catastrophism, including the occurrence of a worldwide flood; and (6) A relatively recent inception of the earth and living kinds.¹³⁴

Examining the definition point by point, the court found criteria (1), (4), (5), and (6) to be overtly religious, adding:

If the unifying idea of supernatural creation by God is removed from Section 4, the remaining parts of the section explain nothing and are meaningless assertions.

Section 4(a)(2), relating to the ‘insufficiency of mutation and natural selection in bringing about development of all living kinds from a single organism,’ is an incomplete negative generalization directed at the theory of evolution.

Section 4(a)(3) which describes ‘changes only within fixed limits of originally created kinds of plants and animals’ fails to conform to the essential characteristics of science for several reasons. First, there is no scientific definition of ‘kinds’ and none of the witnesses

131. *Kitzmiller*, 400 F. Supp. 2d at 716–23.

132. See FORREST & GROSS, *supra* note 4; Matzke, *supra* note 14, SCOTT, *supra* note 14.

133. *McLean v. Ark. Bd. Of Educ.*, 529 F. Supp. 1255, 1266–72 (E.D. Ark. 1982).

134. *Id.* at 1264.

was able to point to any scientific authority which recognized the term or knew how many 'kinds' existed. One defense witness suggested there may be 100 to 10,000 different 'kinds.' Another believes there were 'about 10,000, give or take a few thousand.' Second, the assertion appears to be an effort to establish outer limits of changes within species. There is no scientific explanation for these limits which is guided by natural law and the limitations, whatever they are, cannot be explained by natural law.¹³⁵

ID's concerns with definitions of science, origins of biological information and the limits on natural processes in producing such information, fine-tuning of universal constants, and the improbability of living things, are all common features of the creation science movement, and many predate creation science in some form.¹³⁶ As ID mirrors the framework of creation science—albeit without the specificity regarding the details of special creation, the age of the earth, and the identity of the designer—the *McLean* court's analysis of creation science indicates why the ID policy fails as a matter of law.

ID promoters insist that their theory is distinct from creationism, and that earlier court decisions about creationism are not applicable to ID. In particular, they dispute the *Kitzmiller* court's discussion of that history, calling it "partisan" and decrying any link between ID and "Christian 'Fundamentalism' with a capital 'F.'"¹³⁷ ID promoters "distinguish their theory from fundamentalism by pointing out that it does *not* involve arguments based on 'the Book of Genesis', 'a young earth', or 'a catastrophic Noaich flood [sic].'"¹³⁸

Claims that ID is not creationism because it does not explicitly reject a 4.55-billion-year-old earth or because it takes no position on the identity of the designer are irrelevant, and either naive or misleading about the history of creationism. Young-earth creationism did not become the most widespread form of creationism until the 1960s, halfway through the modern history of creationism.¹³⁹ William Jennings Bryan, who promoted the first anti-evolution legislation in the U.S. and prosecuted John Scopes for violating Tennessee's anti-evolution law in 1925 was not himself a young-earth creationist.¹⁴⁰ Any definition of creationism which excludes one of that movement's founding figures is surely inadequate. Moreover, creationism—the belief that the universe and living organisms originated

135. *Id.* at 1258–64.

136. See generally, ROBERT T. PENNOCK, *TOWER OF BABEL: THE EVIDENCE AGAINST THE NEW CREATIONISM* (1999) (comparing the views of the new creationists with those of the old, and discussing the insubstantiality of their arguments).

137. DEWOLF, WEST, LUSKIN, & WITT, *TRAIPSING*, *supra* note 116, at 15.

138. *Id.*

139. NUMBERS, *supra* note 4; NOLL, *supra* note 6.

140. NUMBERS, *supra* note 4, at 58.

from specific acts of divine creation¹⁴¹—is a part of Native American¹⁴² and Hindu¹⁴³ traditions among others, so it is false to claim that the absence of belief in any specific religious text (or any specific interpretive structure for a given Biblical passage) rules something out from being creationism, or even fundamentalism.¹⁴⁴ Any endorsement of a supernatural designer is an endorsement of sectarian belief in special creation, a belief rejected theologically by some theists and all nontheists.¹⁴⁵ How old the earth is not the decisive legal question any more than the details of which religious tradition is setting itself against science.

III. THE SCIENCE OF EVOLUTION

Before examining the policies supported by creationists post-*Kitzmiller*, it is worth reviewing the status of evolution in modern biology to provide a framework for discussing the supposed weaknesses cited by creationists. It is also necessary to ask whether the weaknesses offered differ from those alleged by ID or earlier forms of creationism. Within this context, two questions will be addressed: (1) whether it is constitutionally acceptable to teach these supposed weaknesses, and (2) whether doing so is good policy?

A. EVOLUTIONARY THEORY

In science, “theory” means something different than it does in common discussion, where it is roughly synonymous with “conjecture” or “speculation.”¹⁴⁶ A scientific theory, like evolution or gravity, is an explanatory framework which integrates observations and hypotheses, and which generates new hypotheses and predictions which future studies can evaluate. In current scientific parlance, a theory is considered stronger even than a law, as laws are generally regarded as simple descriptions of

141. NOLL, *supra* note 6, at 188 (“The word *creationism* by rights should define all who discern a divine mind at work in, with, or under the phenomena of the natural world”).

142. See, e.g., VINE DELORIA JR., *RED EARTH, WHITE LIES: NATIVE AMERICANS AND THE MYTH OF SCIENTIFIC FACT* (Fulcrum 1997) (1995); Robert W. Lannan, *Anthropology and Restless Spirits: The Native American Graves Protection and Repatriation Act, and the Unresolved Issues of Prehistoric Human Remains*, 22 HARV. ENVTL. L. REV. 369, 402 (1998).

143. See MICHAEL A. CREMO & RICHARD L. THOMPSON, *FORBIDDEN ARCHEOLOGY* (rev. ed., 1997).

144. See generally, *FUNDAMENTALISMS OBSERVED*, *supra* note 8 (discussing a range of Christian and non-Christian fundamentalisms).

145. See *VOICES FOR EVOLUTION* (Carrie Sager, ed., 2008) (collecting statements from religious leaders about evolution and human origins). Consider that Thomas Jefferson himself edited the Christian Bible to remove Jesus’ miracles. THOMAS JEFFERSON, *THE JEFFERSON BIBLE: THE LIFE AND MORALS OF JESUS OF NAZARETH* (Dover Publ’ns 2006) (1902).

146. Glenn Branch & Louise S. Mead, “Theory” in *Theory and Practice*, 1 *EVOLUTION: EDUCATION AND OUTREACH* 287 (2008).

regularities in observations, while theories explain those patterns.¹⁴⁷ Science is centrally a process of generating predictions which, if wrong, would undermine a proposed theory and then testing those predictions.¹⁴⁸ Thus, the success of a theory is generally measured first by its ability to withstand extensive testing with new data and under as many different circumstances as possible, and second, by its ability to generate surprising predictions and new questions for scientists to study. The ability to make predictions is important to any scientific theory because a theory that makes no novel or surprising predictions cannot be distinguished from other theories that purport to predict the same data.

Though the term “evolution” can be used broadly to refer to “change over time,” it has a more specific meaning in biology,¹⁴⁹ where it refers to both a pattern of descent and a process for generating variation.¹⁵⁰ While some researchers focus more on the former, for example, studying a particular group of species and how they are related, others focus more on the process by looking at the evolutionary pressures acting on extant species and testing hypotheses about the ways in which lineages change and diverge over time. All biologists, however, recognize that both components are crucial to the theory’s success. And the theory has been successful, as evolution’s explanatory framework—as developed and refined by generations of scientists—closely parallels the scientific evidence from explorations of new regions of the globe to the inner details of the cell.¹⁵¹ Novel evolutionary predictions emerged in parallel with new discoveries in molecular biology and genetics over the twentieth century, as it became possible to measure not just anatomical variation, but variation in molecular sequences between species, behavioral patterns, ecological requirements, and a host of other traits.¹⁵² That these predictions arose so readily and

147. SCOTT, *supra* note 14, at 14.

148. Defining “science” is a process fraught with debate, and no comprehensive definition is attempted here. Physicist Richard Feynman reputedly quipped that the philosophy of science is about as useful to scientists as ornithology is to birds. Like ornithologists, philosophers study the behavior of scientists and non-scientists, seeking consistent and predictive explanations for the diversity of their subjects. Debate is inevitable, but a definition like what I lay out here will serve as an admittedly simplified account of how philosophers generally understand science. See generally, ELLIOTT SOBER, *PHILOSOPHY OF BIOLOGY* (2nd ed. 2000); BUT IS IT SCIENCE?, *supra* note 38.

149. For an excellent presentation of evolutionary theory for nonscientists, see JERRY COYNE, *WHY EVOLUTION IS TRUE* (2009); ERNST MAYR, *WHAT EVOLUTION IS* (2001). RICHARD DAWKINS, *THE GREATEST SHOW ON EARTH* (2009); CARL ZIMMER, *THE TANGLED BANK* (2009). For an excellent exploration of evolution’s history, see Bowler, *supra* note 10.

150. See SOBER, *supra* note 10, at 1–5.. In fact, Darwin referred to his ideas as “evolution” only once in the first edition of *On the Origin of Species by Means of Natural Selection*, preferring to call it “descent with modification.” CHARLES DARWIN, *ON THE ORIGIN OF SPECIES* (1859).

151. Nat’l Acad. of Scis. & Inst. of Med., *Science, Evolution, and Creationism* (2008)

152. Zimmer, *supra* note 152, Dawkins, *supra* note 152.

proved so accurate speaks to the power of evolution as a theory.¹⁵³

Moreover, the growth of evolutionary knowledge over the last 150 years has led to advancements in such economically important fields as biotechnology, biomedicine, pharmacology, and agriculture.¹⁵⁴ Medical students are taking courses in evolutionary medicine.¹⁵⁵ Computer scientists and engineers are using evolutionary principles to build better software,¹⁵⁶ better airplanes,¹⁵⁷ and even better space probes.¹⁵⁸ Scientists at NASA use the ability to undergo biological evolution as a defining trait of life when determining whether it exists on other planets.¹⁵⁹ Because of the importance evolutionary principles play in what has been called “the century of biology,” policies that prevent or interfere with educating students in the field are best regarded as pedagogically inappropriate and economically suicidal.¹⁶⁰

B. CASE STUDY: *TIKTAALIK*

A recent example of evolution’s explanatory power occurred with the discovery of the fossil species *Tiktaalik roseae*.¹⁶¹ Paleontologists and

153. For a detailed account, see Douglas Theobald, 29+ *Evidences for Macroevolution: The Scientific Case for Common Descent*, THE TALK ORIGINS ARCHIVE, June 19, 2007, <http://www.talkorigins.org/faqs/comdesc/>. See also VOICES FOR EVOLUTION, *supra* note 148 (providing explanations of evolution’s growing scientific importance by numerous scientific societies).

154. See generally, DAVID MINDELL, *THE EVOLVING WORLD* (2007) (providing an account of how evolutionary principles are applied in everyday life).

155. Steve Jones, *Foreward*, 372 THE LANCET S1 (2008) (introducing a special issue of the journal on evolution’s role in modern medicine).

156. MELANIE MITCHELL, *AN INTRODUCTION TO GENETIC ALGORITHMS* 35 (1996) (discussing evolving computer programs).

157. John H. Holland, *Genetic Algorithms*, 267 SCIENTIFIC AMERICAN, July 1992, at 66 (1992).

158. J. D. Lohn, D. S. Linden, G. S. Hornby, W. F. Kraus, A. Rodriguez, & S. Seufert, *Evolutionary Design of an X-Band Antenna for NASA’s Space Technology 5 Mission*, 3 PROC. OF THE 2004 IEEE ANTENNA & PROPAGATION SOC’Y INT’L SYMP. & USNC/URSI NAT’L RADIO SCI. MEETING 2313–16 (2004).

159. Gerald Joyce. *Foreword*, in ORIGINS OF LIFE xi, xi–xii, (David Deamer & Gail Fleischaker, eds., 1994).

160. See, e.g., John Carey, *We are Now Starting the Century of Biology*, BUSINESSWEEK, Aug. 31, 1998, at 86, 86 ([J]ust as information technology undergirds today’s booming economy, biology may drive tomorrow’s. In fact, biology could transform information technology through such developments as DNA-based computers and software that repairs flaws as nature does. “We are now starting the century of biology,” says J. Craig Venter, president of the Institute for Genomic Research and pioneering gene finder”); Lawrence H. Summers, Presidential Installation Address, *The Adventure of our Times* (Oct. 12, 2001) in HARV. MAG. Nov.–Dec. 2001, at 61, 64 (“[A]s a consequence of science, we have seen life expectancy come close to doubling in the last century, from the mid forties to the long life expectancies that await the young people who are here today—and all of that was before what looks to be the century of biology and life science”).

161. For an excellent popular account of this discovery and its significance, see NEIL SHUBIN, *YOUR INNER FISH* (2008).; for a scientific description, see, Edward B. Daeschler, Neil H. Shubin & Farish A. Jenkins, Jr., *A Devonian Tetrapod-Like Fish and the Evolution of the Tetrapod Body*

developmental biologists interested in the origins of four-legged land animals with backbones (tetrapods) study modern lobe-finned fish (like the coelacanth or lungfish) and modern tetrapods to construct a family tree, or “phylogeny,” hypothesizing the relationship between the two groups.¹⁶² This hypothesis allows them to predict the traits of the common ancestor of these species, just as looking at a group of cousins suggests what their grandparents would have looked like, which can be tested against a detailed fossil record. Paleontologists have discovered a series of fossils showing fishlike species with increasingly leg-like fins, as well as a series of species with legs that bore many resemblances to those fins.¹⁶³ These species shared similarities in how the fins attached to the shoulders, how the skull was formed, and in other anatomical traits.¹⁶⁴ By comparing these species and the ages of the rocks in which they were found, it was possible to predict the anatomical details of intermediate species which would have descended from the earlier species and whose offspring would have given rise to the later species.¹⁶⁵

To test these predictions, it was necessary to locate fossils of such an intermediate species. By examining the ages of the known species, it was possible to estimate the ages of the rocks in which to look. Paleontologist Neil Shubin and his research team looked at the ecological conditions which characterized the rocks in which the known fossil relatives lived, and predicted that this intermediate form would have lived under similar conditions.¹⁶⁶ Rocks formed at the right time in similar marshy conditions could be found deep in the modern Arctic, and Shubin obtained funding to bring a team to explore those geological deposits.¹⁶⁷ In the fifth and final year of the study, one of Shubin's students noticed a fossilized snout shaped like those of known tetrapod ancestors, and brought the rest of the team in to help excavate the fossil.¹⁶⁸ Once back in the lab, the team took careful measurements of these fossils, compared those measurements to those from known tetrapod ancestors, and found that the new species, named *Tiktaalik*

Plan, 440 NATURE 757 (2006); Neil H. Shubin, Edward B. Daeschler & Farish A. Jenkins, Jr., *The Pectoral Fin of Tiktaalik Roseae and the Origin of the Tetrapod Limb* 440 NATURE 764–71 (2006). The following account draws on those sources throughout.

162. A detailed account of systematics, the method for reconstructing life's family tree, is not possible here, but the popular works discussed above provide useful summaries of the methods. See also T. Ryan Gregory, *Understanding Evolutionary Trees*, 1 EVOLUTION: EDUCATION AND OUTREACH 121 (for an accessible introduction to evolutionary trees).

163. See generally CARL ZIMMER, *AT THE WATER'S EDGE* (1998) (providing a popular account of how macroevolution occurs).

164. *Id.*

165. See e.g., Per Erik Ahlberg & Jennifer A. Clack, *Palaeontology: A firm step from water to land*, 440 NATURE 747–49 (2006) (for a lay scientific account of this context).

166. SHUBIN, *supra* note 164.

167. *Id.*

168. *Id.*

roseae, was exactly what they had been looking for.¹⁶⁹ The bones of the wrist were more like those of modern tetrapods than were the earlier species, but were more similar to those earlier fishlike ancestors than any later fossils.¹⁷⁰ The bones of the skull and of the shoulder also matched the predicted shapes.¹⁷¹

It is remarkable that our understanding of the descent of modern tetrapods – including humans – from fishlike ancestors could guide a research team to the exact ridge in the middle of the Canadian Arctic where those fossilized ancestors would be found. It is yet more remarkable that the fossils they found at that site matched so elegantly the predictions made by scientists, and that scientists are able to use these fossils to generate novel hypotheses about how the wrists and limbs form in modern tetrapods. Because the genes controlling wrist development in all tetrapods evolved from those possessed by species *Tiktaalik*, it is possible to infer what the genetic state was in *Tiktaalik* by examining how those genes change across the tree of life, and therefore how *Tiktaalik* grew from an egg to an adult.¹⁷² Such developmental patterns often constrain evolution, as evolutionary processes work with available variation, often effecting major changes by varying the timing or activation of specific developmental patterns.¹⁷³

By examining these fossils, we answer questions and confirm basic predictions offered by Charles Darwin in the *Origin*:

What can be more curious than that the hand of a man, formed for grasping, that of a mole for digging, the leg of the horse, the paddle of the porpoise, and the wing of the bat, should all be constructed on the same pattern, and should include similar bones, in the same relative positions?

....

The explanation is manifest on the theory of the natural selection of successive slight modifications—each modification being profitable in some way to the modified form, but often affecting by correlation of growth other parts of the organisation. In changes of this nature, there will be little or no tendency to modify the original pattern, or to transpose the parts. The bones of a limb might be shortened and widened to any extent, and become gradually enveloped in thick membrane, so as to serve as a fin; or a webbed

169. *Id.*

170. Neil H. Shubin, Edward B. Daeschler & Farish A. Jenkins, Jr., *supra* note 164.

171. MARY JANE WEST-EBERHARD, DEVELOPMENTAL PLASTICITY AND EVOLUTION (2003).

172. Neil Shubin, Cliff Tabin & Sean Carroll, *Deep Homology and the Origins of Evolutionary Novelty*, 457 NATURE 818 (2009).

173. WEST-EBERHARD, *supra* note 174. For a popular accounts of this important field—evolutionary developmental biology or “evo-devo”—see SHUBIN *supra* note 164; SEAN CARROLL, ENDLESS FORMS MOST BEAUTIFUL (2005).

foot might have all its bones, or certain bones, lengthened to any extent, and the membrane connecting them increased to any extent, so as to serve as a wing; yet in all this great amount of modification there will be no tendency to alter the framework of the bones or the relative connexion of the parts. If we suppose that the ancient progenitor, the archetype as it may be called, of all mammals, had its limbs constructed on the existing general pattern, for whatever purpose they served, we can at once perceive the plain signification of the homologous construction of the limbs throughout the whole class.¹⁷⁴

In discovering *Tiktaalik*, Shubin and his colleagues helped illuminate the properties of that early progenitor. In tracing the development of modern species from *Tiktaalik*, scientists have developed a better understanding of the molecular and genetic forces which produced the anatomical changes seen throughout the fossil record and in the modern diversity of life.

C. THE EVOLUTION OF EVOLUTION

The consistent success of evolution as a scientific theory does not mean that modern evolutionary theory is identical to what Darwin proposed,¹⁷⁵ or that the theory will remain constant into the future. Science is a tentative process which does not claim absolute certainty.

The greatest shift in evolutionary theory occurred in the 1930s and 1940s, as biologists began integrating the field of genetics into a Darwinian conception of the tree of life. Darwin's model of inheritance as described in the *Origin* and later works was flawed. It held that traits from both parents blended in the offspring through some sort of averaging mechanism.¹⁷⁶ Critics in Darwin's day noted that this process could never produce traits more extreme than those of the parent, which would make it impossible to explain the patterns of divergence which evolution was introduced to explain.¹⁷⁷ It was not until the rediscovery of Gregor Mendel's concept of particulate inheritance of genes that it became possible to envision how evolutionary forces generate novelty.¹⁷⁸ At that time, biologists came to see that traits are inherited not by averaging, but as discrete chunks.¹⁷⁹ The effects of several chunks might be averaged when multiple genes control a trait, as with height where a child will tend to be intermediate in height

174. DARWIN, *supra* note 153, at 435.

175. Glenn Branch & Eugenie Scott, *Don't Call it "Darwinism"* 2 EVOLUTION: EDUCATION AND OUTREACH 90 (2009).

176. BOWLER, *supra* note 10, at 182–83.

177. Branch & Scott, *supra* note 178.

178. Bowler, *supra* note 10.

179. *Id.* at 271–74.

between his or her parents. However, the offspring of a white pea and a purple pea will yield offspring with either white or purple flowers, not an intermediate color. Thus, a mutation in gene which, for instance, changes a purple pea plant into one which produces blue flowers can be passed on and persist in the population, but will not be diluted to nonexistence over a few generations.¹⁸⁰

As biologists studied how genetic traits were passed on in populations, they came to see how genetics could explain the variation and diversity of new lineages. A mutation to a gene could alter some trait about the organism and its descendants, introducing the initial variation to a population. The shuffling of genes during reproduction (a process called recombination) could bring together different combinations of genes, and the altered interactions of one gene with a novel variant of another could produce radical change in an organism. If such variation caused an individual to leave more descendants in the next generation (or even in more distant generations), then that variant would tend to spread through a population—a process called natural selection. If a trait tended to cause possessors to leave fewer offspring, it would decline in frequency. In addition, irrespective of whether a trait was helpful, harmful, or even neutral in its effect on reproductive success, statistical fluctuations—called genetic drift—would cause its frequency to shift up and down, possibly driving it out of the population or causing it to become ubiquitous.¹⁸¹ These discoveries provided an understanding of the mechanisms necessary for the kind of hereditary variation that is essential to the evolutionary processes.

The integration of genetics with Darwinian evolution became known as the modern, or neo-Darwinian, synthesis.¹⁸² Since then, new discoveries and an improved understanding of biological processes have allowed refinements to that synthesis. The discovery of continental drift in the 1950s allowed more precise understanding of how the movements of continents had divided and united species and communities of species over millions of years.¹⁸³ From the late 1960s through the early 1980s, biologist Lynn Margulis suggested that a new evolutionary mechanism known as endosymbiosis (literally: “living together within”), could explain the existence and peculiar structures of certain organelles in plant cells, and others found in both plants and animals.¹⁸⁴ Margulis’s new mechanism

180. Douglas Allchin, *Mending Mendelism*, 62 AM. BIOLOGY TEACHER 632 (2000).

181. These topics are covered in a range of sources, including the popular works on evolution discussed above, and in textbooks such as KENNETH MILLER & JOSEPH LEVINE, *BIOLOGY* (2009).

182. See, e.g., Bowler *supra* note 10; JULIAN HUXLEY, *EVOLUTION: THE MODERN SYNTHESIS* (3rd ed., Allen & Unwin 1974). *EVOLUTIONARY SYNTHESIS: PERSPECTIVES ON THE UNIFICATION OF BIOLOGY* (Ernst Mayr & William Provine, eds., 1998).

183. *PLATE TECTONICS* (Naomi Oreskes, ed., 2003).

184. Jan Sapp, *Symbiosis in Evolution: An Origin Story*, 7 *ENDOCYTOBIOSIS & CELL RES.* 5 (1990).

suggested that these organelles formed when an early single-celled organism engulfed another single-celled organism, and instead of digesting it, the two shared resources.¹⁸⁵ Eventually, the two became dependent on one another in order to process sunlight into energy, or to use oxygen to extract more energy from sugars.¹⁸⁶

Also during this time, scientists studying the pattern of the tree of life developed a new approach to naming species that reflects patterns of evolutionary descent. This system went on to replace the system of assigning generally similar species to the same taxonomic group that had been in use since Linnaeus introduced the basic vocabulary of modern species naming in the eighteenth century. Biologists used new molecular sequence data to show that what had once been classified as the bacterial kingdom actually included two groups (Archaea and Eubacteria) less similar to one another than either was to organisms which possess nuclei in the cell (Eukarya). This required a reorganization of the base of the tree of life and the introduction of a taxonomic level above the kingdom: the domain.¹⁸⁷ Where textbooks in the 1980s referred to five kingdoms of life (animals, plants, fungi, protists, bacteria), modern textbooks typically discuss six kingdoms divided across three domains: eubacteria, archaea, and eukarya (organisms with nucleated cells, including animals, plants, fungi, and protists).¹⁸⁸

Since the mid-1990s, biologists have been proceeding toward a new evolutionary synthesis.¹⁸⁹ This synthesis incorporates new understanding of how certain genes control the activation of other genes, how networks of these genes regulate one another, and how these networks control the way that multicellular organisms develop from a single cell to an adult organism.¹⁹⁰ Understanding that process brings us closer to understanding

185. LYNN MARGULIS, ORIGIN OF EUKARYOTIC CELLS (1970); Michael Gray, *The Endosymbiont Hypothesis Revisited*, 141 INT'L REV. CYTOLOGY 233 (1992); Geoffrey McFadden, *Primary and Secondary Endosymbiosis and the Origin of Plastids*, 37 J. PHYCOLOGY 951-59 (2001) (reviewing the history and explaining, "the idea took deeper and deeper root in the literature, propelled largely by the persuasive writings of Margulis (1970). For example, the microbiologist Woese (1977) asserted that 'the case for [the origin of plastids and mitochondria from endosymbiotic eubacteria] is a clear cut one, and it has now been proven.' Pace et al. (1986) also stated that plastid origin by endosymbiosis was 'beyond reasonable doubt.' Gray (1991) went further by saying that 'it seems pointless to consider seriously alternative explanations'"); Lynn Sagan, *On the Origin of Mitosing Cells*, 14 J. THEORETICAL BIOLOGY 225 (1967).

186. McFadden, *supra* note 188.

187. Carl Woese, Otto Kandler, & Mark Wheelis, *Towards a Natural System of Organisms: Proposal for the Domains Archaea, Bacteria, and Eucarya*, 87 PROCE. NAT' ACAD. SCI. U.S. AM. 4576 (1990).

188. Emily Case, *Teaching Taxonomy: How Many Kingdoms?*, AM. BIOLOGY TCHR. 472 (2008).

189. Massimo Pigliucci, *Do we need an extended evolutionary synthesis?*, 61 EVOLUTION 2743 (2007).

how biological novelties are formed, and gives insights into how novel structures would have originated millions of years ago.¹⁹¹

All the changes in evolution described above are signs of the theory's strength. These shifts in our understanding happened contemporaneously with the growth of ID, and illustrate the differences between evolution as a science and ID as a religious non-science. Advocates for the three-domain model of taxonomy, for instance, conducted detailed research, formed hypotheses, and used the results to build new research programs on top of old results. While their proposals were met with initial resistance, they continued to conduct research and publish papers, accumulating evidence in support of their hypothesis.¹⁹² Within a few years, they had enough support that graduate seminars in universities were discussing their work. A few years later, the work was being incorporated into college textbooks as a frontier worth watching. Soon, as research continued to support the finding of three domains, and the scientific community came to accept the new idea, college textbooks omitted any discussion of the old five kingdom model, and the new idea showed up in high school textbooks.¹⁹³ ID arguments have produced no comparable body of scientific research or hard-won scientific acceptance, but promoters continue to seek their introduction into high school science classes.

This difference illustrates a critical point about measuring the strength of a scientific theory—a challenging task for nonscientists. The presence of peer-reviewed publications is an important component of that evaluation, but peer-review does not cease with the publication of a paper.¹⁹⁴ To understand a theory's impact and scientific validity, it is necessary to review how it fares when later researchers examine its claims, and how much new research is generated by insights from a given line of thinking. In the case of those few papers claimed as peer-reviewed defenses of ID, none has met any favorable response, or been cited as generating successful

191. See Armin Moczek, *On the Origin of Novelty in Development and Evolution*, 5 BIOESSAYS 432 (2008) (providing a readable introduction to this research). See also Carroll, *supra* note 176; *supra* note 174, West-Eberhard (for a broader discussion of the topic).

192. Virginia Morell (1997) "Microbiology's Scarred Revolutionary" *Science* 276 (5313): 699–702.

193. Case, *supra*

194. Susan Haack, *Peer Review and Publication: Lessons for Lawyers*, 36 STETSON L. REV. 789 (2007) ("The phrase "peer review" connotes the evaluation ("review") of scientific or other scholarly work by others presumed to have expertise in the relevant field ("peers"). ...it refers to the evaluation of submitted manuscripts to determine what work is published in professional journals and what books are published by academic presses... Occasionally, however, the phrase is used in a much broader sense, to cover the whole long-run history of the scrutiny of a scientist's work within the scientific community, and of others' efforts to build on it, a long-run process of which peer review in the narrower sense is only a small part").

Cf. Catriona J. MacCallum, *ONE for All: The Next Step for PLoS*, 4 PLOS BIOLOGY 1875, 1876 (2006) (observing that "peer review doesn't, and shouldn't, stop there [with pre-publication review]," and laying out a new model for scientific publication).

predictions for future researchers.¹⁹⁵ By contrast, the number of papers building on evolutionary theory and deepening our knowledge of the field has grown rapidly in recent years, due in part to the theory's ability to generate new insights into the burgeoning fields of molecular biology, genomics, and developmental genetics. This reflects a community-wide consensus among relevant scientists on the merits of evolution, a consensus further strengthened by assessments of scientific bodies. Groups including the National Academy of Sciences and its international counterparts, the American Association for the Advancement of Science, and professional societies representing groups with special knowledge of evolution, including biologists of many sorts, geologists, physicists, historians, philosophers, and many others, have issued statements representing their members' agreement that evolution is foundational to modern biology, is well-supported, and belongs in science classes.¹⁹⁶ As further evidence of evolution's central role in science education, consider the rising number of states placing evolution in statewide science standards and the rising quality of its coverage in those standards.¹⁹⁷ Such standards form the basis for textbook selection and standardized testing, decisions which in turn dictate school funding.

195. DISCOVERY INST. THE COLLEGE STUDENT'S BACK TO SCHOOL GUIDE TO INTELLIGENT DESIGN (2009), available at http://www.evolutionnews.org/BacktoSchoolGuide_Sept2009_FN.pdf. The pamphlet states, "Critics [sic] often claim that intelligent design proponents do not publish peer-reviewed scientific papers or that they do not do scientific research." *Id.* at 14. To rebut this claim, 6 papers are cited, none from later than 2004. One of those was discussed at length in testimony by *Kitzmiller* defense witnesses, with the court describing that paper as "The one article referenced [by defense's scientific witnesses]... as supporting ID A review of the article indicates that it does not mention ... ID. In fact, Professor Behe admitted that the study which forms the basis for the article did not rule out many known evolutionary mechanisms and that the research actually might support evolutionary pathways if a biologically realistic population size were used." *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707, 745 n.17 (M.D. Pa. 2005). Another proffered article was repudiated by the journal which published it, with the editors noting that it "represents a significant departure from the nearly purely taxonomic content for which this journal has been known throughout its 124-year history. ... We have met and determined that all of us would have deemed this paper inappropriate for the pages of the Proceedings." A review of the other papers listed by the Discovery institute in Science Citation Index finds two of the papers have no citations at all, and the few citations garnered by the remainder are either self-citation by the same ideologically driven group of authors, or are citations rejecting the paper's findings. For context, the 254 papers turned up in a search for the narrow topic "evolutionary developmental biology" published in 2004 have been cited an average of 13 times, compared to an average 7 citations for ID's top papers, some of which have had many more years to accumulate citations. The marketplace of ideas has spoken.

196. See VOICES FOR EVOLUTION, *supra* note 148 (anthologizing these statements).

197. Louise Mead & Anton Mates, *Why Science Standards are Important to a Strong Science Curriculum and How States Measure Up*, 2 EVOLUTION: EDUC. & OUTREACH 359 (2009).

IV. CREATIONISM AFTER *KITZMILLER*

A. STRATEGY SHIFT

ID's legal strategy draws on two ideas from the *Edwards* opinion. First, the court stated that "teaching a variety of scientific theories about the origins of humankind to schoolchildren might be validly done with the clear secular intent of enhancing the effectiveness of science instruction."¹⁹⁸ ID's attempt to fit within this statement failed in *Kitzmiller*.¹⁹⁹ Thus, some ID strategists have moved on a second statement by the Court—"We do not imply that a legislature could never require that scientific critiques of prevailing scientific theories be taught"²⁰⁰—and focused on bringing critiques of evolution into the classroom.

On its face, this would seem to offer little to creationists, but in their dualist view, any evidence against evolution implicitly becomes evidence for creationism.²⁰¹ By taking advantage of the decentralized nature of the public schools system, creationists can remain below the radar and encourage a more cryptic approach to promoting creationism. ID promoters now sponsor bills or state education policies encouraging teachers to present "weaknesses" of evolution; such a policy may be drafted in hopes of surviving a facial challenge by simply permitting (not requiring) a range of lessons involving "arguments against evolution."²⁰² Such legislation could insulate state officials or broad statewide policies from the discretionary actions of individual school districts or teachers. If local policy or the acts of an individual teacher cross the constitutional line, supporters hope the law itself might go unscathed. However, so long as the law itself survives, it will invite other teachers and districts to go beyond the carefully drawn limits laid out by the Supreme Court, and the lax supervision and review of school districts and classrooms could allow constitutional infringements to persist for years, or even decades, before a suit is brought.²⁰³

These dangers are well-illustrated by the history of the Santorum Amendment to the No Child Left Behind Act of 2001, named for

198. *Edwards v. Aguillard*, 482 U.S. 578, 594 (1987).

199. *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707 (M.D. Pa. 2005).

200. *Edwards*, 482 U.S. at 593.

201. *McLean v. Ark. Bd. Of Educ.*, 529 F. Supp. 1255, 1266 n.22 (E.D. Ark. 1982).

202. *Edwards*, 482 U.S. at 593.

203. Such incidents are surprisingly common. See, e.g., Jill Hoffman, *An Evolving Controversy*, ROANOKE TIMES & WORLD NEWS, June 09, 2005 at A1 ("The title of the homemade textbook alone, 'Creation Battles Evolution,' should have raised eyebrows. But no one complained in the 15-plus years that teacher Larry Boohar distributed the 500-page text, which counters the theory of evolution and says that God created the universe. School officials say they had no idea about the book...").

sponsoring Senator Rick Santorum.²⁰⁴ The amendment, drafted by ID godfather Phillip Johnson,²⁰⁵ was passed by the Senate, rejected by the House, and relegated to a nonbinding conference report.²⁰⁶ The Amendment, which is often wrongly cited as if it were binding on teachers and school districts,²⁰⁷ attacked evolution with dangerous subtlety. The amendment originally read:

- (1) good science education should prepare students to distinguish the data or testable theories of science from philosophical or religious claims that are made in the name of science; and
- (2) where biological evolution is taught, the curriculum should help students to understand why this subject generates so much continuing controversy, and should prepare the students to be informed participants in public discussions regarding the subject.²⁰⁸

The amendment was added to the bill without warning or significant objection.²⁰⁹ When the science community saw the language, there was instant outrage for several reasons.²¹⁰ First, Congress does not specify in this level of detail how any other topic should be taught, and more significantly, the language singles out evolution from all other scientific theories, labeling it as “controvers[ial],” and implying that evolution – more so than other sciences – is rooted in “philosophical or religious claims” rather than “data or testable theories.”²¹¹ No evidence was presented justifying these claims or their implications. Second, there was concern that the bill indicated the advent of federal micromanagement of educational policy. Given the Act’s broad expansion of the federal role in local education policymaking, the amendment’s intrusion on the kinds of decisions long left to state and local control could have raised complex constitutional issues, implicating the federal Commerce Clause²¹² and Tenth

204. 147 Cong. Rec. S6147–48 (daily ed. June 13, 2001).

205. Scott Stephens, *Federal Law Ignites Evolution Debate*, CLEVELAND PLAIN DEALER, Sept. 16, 2002.

206. Dennis Hirsch, *Science vs. Intelligent Design: The Law*, NAT’L CTR. FOR SCI. EDUC., Dec. 30, 2008, <http://ncseweb.org/taking-action/science-vs-intelligent-design-law>. (last visited Jan. 25, 2010).

207. Glenn Branch & Eugenie Scott *The Anti-evolution Law That Wasn’t* 65 AM. BIOLOGY TCHR.165 (2003); Kenneth R. Miller, *A Law by Any other Name - The Truth About the “Santorum Amendment” Language on Evolution*, <http://www.millerandlevine.com/km/evol/santorum.html> (last visited Jan. 22, 2010).

208. Anne Marie Lofaso, *Does Changing the Definition of Science Solve the Establishment Clause Problem for Teaching Intelligent Design as Science in Public Schools? Doing an End-Run Around the Constitution*, 4 PIERCE L. REV. 219 (2006).

209. *Id.*

210. Glenn Branch & Eugenie Scott, *Anti-evolution Law*, *supra* note 209.

211. Hirsch, *supra* note 208.

212. *Cf. United States v. Lopez*, 514 U.S. 549 (1995) (the link between interstate commerce and concealed handguns in school zones is too tenuous to trigger the commerce clause).

Amendment.²¹³

In conference committee, the amendment was revised and relegated to the conference report, with the first sentence unchanged and the second reading, “Where topics are taught that may generate controversy (such as biological evolution), the curriculum should help students to understand the full range of scientific views that exist, why such topics may generate controversy, and how scientific discoveries can profoundly affect society.”²¹⁴ Here, evolution is treated as one theory among many, though still the only one named, and it is specified that students should learn about the “scientific views,” not about the broader social controversies that might surround any topic (would be better discussed in social studies classes). Still, the revised language remained troubling on many levels. Congressman Rush Holt, one of the few PhD scientists to serve in Congress (a physicist by training),²¹⁵ laid out his concerns saying:

Outside of the scientific community, the word “theory” is used to refer to a speculation or guess that is based on limited information or knowledge. Among scientists, however, a theory is not a speculation or guess, but a logical explanation of a collection of experimental data. Thus, the theory of evolution is not controversial among scientists. It is an experimentally tested theory that is accepted by an overwhelming majority of scientists, both in the life sciences and the physical sciences.

The implication in this language that there are other scientific alternatives to evolution represents a veiled attempt to introduce creationism—and, thus, religion—into our schools. Why else would the language be included at all? In fact, this objectionable language was written by proponents of an idea known as “intelligent design.” This concept, which could also be called “stealth creationism,” suggests that the only plausible explanation for complex life forms is design by an intelligent agent. This concept is religion masquerading as science. Scientific concepts can be tested; intelligent design can never be tested. This is not science, and it should not be taught in our public schools.²¹⁶

Though the language of the conference report carries no legal weight apart from an effort of the courts to interpret the actual bill,²¹⁷ policies drawing on the Santorum language have cropped up in school boards across

213. Matt Miller, *First, Kill All the School Boards: A Modest Proposal to Fix the Schools*, ATLANTIC MONTHLY, Jan.-Feb. 2008, at 92..

214. Hirsch, *supra* note 208.

215. Rep. Rush Holt: Biography, <http://holt.house.gov/about.shtml> (last visited Jan. 22, 2010).

216. 147 Cong. Rec. E2365–01 (Dec. 20, 2001)

217. Hirsch, *supra* note 208.

the country.²¹⁸ For example, the Ohio state school board was challenged to include ID as supposedly required by law.²¹⁹ Schools in Nebraska and Minnesota, the legislature in Georgia, and the state school board in Nevada each suggested that they might have to implement the provisions of this nonexistent law.²²⁰ The Dover Board cited the Santorum language to support their unconstitutional ID policy.²²¹ All this from a non-binding resolution which never even made it into the final bill.²²² The potential for confusion resulting from laws modeled on this amendment must be considered and weighed against whatever policy benefits are supposed to arise from them.²²³

This same post-ID strategy can be seen in state and local policy decisions. For example, the Cobb County Board of Education in Georgia adopted a sticker to be placed on certain science textbooks which stated, "This textbook contains material on evolution. Evolution is a theory, not a fact, regarding the origin of living things. This material should be approached with an open mind, studied carefully, and critically considered."²²⁴ The use of this sticker was challenged in *Selman v. Cobb County School District*,²²⁵ and the School District later withdrew its plan and settled the case.²²⁶ Likewise, the post-ID strategy is reflected in language calling for a "critical analysis" of evolution which was inserted into the Ohio science standards and hastily removed after the *Kitzmiller* ruling.²²⁷ Similarly, it is reflected in demands made in Texas that textbooks present the strengths and weaknesses of evolution,²²⁸ and the recent addition of detailed listings of evolution's perceived weaknesses to the state's science standards.²²⁹ The strategy is also seen in a series of at least thirty

218. *Id.*; Glenn Branch & Eugenie Scott, *Anti-evolution Law*, *supra* note 209; Lofaso, *supra* note 210.

219. Miller, *supra* note 206.

220. Glenn Branch & Eugenie Scott, *Anti-evolution Law*, *supra* note 209.

221. Def.'s Answer, 2-3, 2004 WL 3646143.

222. Lofaso, *supra* note 210.

223. This article sets aside any constitutional concerns or detailed legal analysis in favor of a detailed examination of the policy issues.

224. *Selman v. Cobb County Sch. Dist.*, 390 F. Supp. 2d 1286, 1292 N.D. Ga. 2005), *rev'd and remanded*, 449 F.3d 1320 (holding that the district court's findings of fact were unsupported by the record and remanding for new evidentiary hearings).

225. *Id.*

226. Joan DelFattore, *Speaking of Evolution: The Historical Context of Kitzmiller v. Dover Area School District*, 9 RUTGERS J. L. & RELIGION 3, 69 (2007).

227. Nicholas Matzke & Paul Gross, *Analyzing Critical Analysis: The fallback anti-evolution strategy*, in NOT IN OUR CLASSROOMS: WHY INTELLIGENT DESIGN IS WRONG FOR OUR SCHOOLS 31, 31-32 (Eugenie Scott & Glenn Branch, eds., 2006).

228. Skip Evans, *Evolution: Still Deep in the Heart of Textbooks*, 23 REPORTS OF THE NCSE (Nat'l Ctr. for Sci. Educ., Oakland, Cal.) 5-6 (2003).

229. Steven Schafersman, *Texas Science Standards and March Madness: Did We Win or Lose?* 29 REPORTS OF THE NCSE (Nat'l Ctr. for Sci. Educ., Oakland, Cal.) 4 (2009); Steven Newton, *Creationism in the New Texas Science Standards for Earth and Space Science*, 25

bills endorsing critiques of evolution in the classroom – many drawing language from the Santorum amendment—filed in eleven states over the last five years, with one enacted in Louisiana.²³⁰ The common thread among these policies is their reliance upon language in *Edwards* which suggested that the legislature may require that teachers address scientific critiques of prevailing theories provided there is an appropriate secular purpose for doing so.²³¹ These bills are often justified on the basis of academic freedom, mirroring the arguments found to be a sham by the *McLean*²³² and *Edwards*²³³ courts.

B. SINGLING OUT EVOLUTION

Previous courts have examined a narrow focus on evolution, and found that it may represent *prima facie* evidence of religious motives. In *Epperson*, the Supreme Court held that it is improper to “select[] from the body of knowledge a particular segment [to] proscribe[] for the sole reason that it is deemed to conflict with a particular religious doctrine.”²³⁴ In *Edwards*, the Court found the law at issue unconstitutionally “advances a religious doctrine by requiring . . . the banishment of the theory of evolution from public school classroom” unless balanced with a religious alternative.²³⁵ This suggests that, even when a policy has some claimed secular purpose, the singling out of a specific theory that is contested on religious grounds could be taken as *prima facie* evidence of religious endorsement.

This line of reasoning has not been fully explored by the courts, though the district court in *Selman v. Cobb County* did conclude in 2005 that a school board’s requirement that textbooks bear a sticker stating, in part, “[e]volution is a theory, not a fact, concerning the origin of living things” had the unconstitutional effect of “sid[ing] with the proponents of religious theories of origin in violation of the Establishment Clause.”²³⁶ The court found:

[A]n informed, reasonable observer would interpret the Sticker to convey a message of endorsement of religion. That is, the Sticker

EARTH SCIENTIST 25(2):30–33, (2009); Joshua Rosenau, *Don’t Mess With Textbooks*, SEED MAGAZINE, May 20, 2009, http://seedmagazine.com/content/article/dont_mess_with_textbooks/.

230. The broad outlines of these bills are discussed below. Details on individual bills are available at <http://ncseweb.org/creationism/general/academic-freedom-legislation>.

231. *Edwards v. Aguillard*, 482 U.S. 578, 593–94 (1987).

232. *McLean v. Ark. Bd. Of Educ.*, 529 F. Supp. 1255, 1272 (E.D. Ark. 1982).

233. *Edwards*, 482 U.S. at 586–87.

234. *Epperson v. Arkansas*, 93 U.S. 97, 103 (1968).

235. *Edwards*, 482 U.S. at 596.

236. *Selman v. Cobb County Sch. Dist.*, 390 F. Supp. 2d 1286, (1301-03 N.D. Ga. 2005), *rev’d and remanded*, 449 F.3d 1320 (holding that the district court’s findings of fact were unsupported by the record and remanding for new evidentiary hearings).

sends a message to those who oppose evolution for religious reasons that they are favored members of the political community, while the Sticker sends a message to those who believe in evolution that they are political outsiders. This is particularly so in a case such as this one involving impressionable public school students who are likely to view the message on the Sticker as a union of church and state. Given that courts should be particularly vigilant in monitoring compliance with the Establishment Clause in elementary and secondary schools, the Court is of the opinion that the Sticker must be declared unconstitutional.²³⁷

To reiterate, the court's argued that simply singling out evolution from all of science can be taken as evidence of a religious motive, given the long history of religious anti-evolution sentiment, and the scientific community's overwhelmingly favorable assessment of evolution. This does not mean that evolution could not be subjected to special scrutiny under any circumstances, but courts are rightly vigilant when evolution is treated differently than other, equally valid, theories.

In addition, including topics like stem cells testing global warming along with evolution in a list of topics for special scrutiny should not satisfy a court. These topics, like evolution, are subject to objections on religious grounds, not on any scientific basis. There is no scientific dispute about the basic facts about stem cells that might be appropriately discussed in high school science class: what they are, where they come from, what they do, what varieties of them there are, how they might be used for development of new medical treatments, and so forth. The only controversy surrounding stem cells involves the principally religious objection to using human stem cells extracted from frozen human embryos.²³⁸ This raises complex moral concerns for certain religious groups, rooted partly in their belief that the human soul is created divinely at the moment of conception. A consideration of the moral and societal factors influencing science may be valid topics to discuss in a social studies class and potentially in a science class (assuming students have the necessary background to engage the complex issues at play). However, they are not topics that contribute uniquely to a student's ability to apply critical thinking to science, and there is no reason for state law to specify one topic for such consideration over

238. See, e.g., John Burn, *Can a Cell Have a Soul?*, 336 *British Medical J.* 1132 (2008) (Geneticist and self-described Christian writes: "Just as protests about cadaver organ donation were addressed rationally and led to the widespread acceptance that the definition of death could no longer depend on biblical interpretation, so medical need dictates that the origin of human individuality must be defined with similar pragmatic precision. A cell cannot have a soul"); Wesley J. Smith, Editorial, *Stem Cell Debate is Over Ethics, Not Science*, *SACRAMENTO BEE*, March 19, 2009 at A19 (Discovery Institute staffer frets over "an ever-deepening erosion of the unique moral status of human life").

others with fewer religious overtones.

Similarly, it is scientifically uncontroversial to note that global warming is happening, that it is a result of human activities, and that rises in global temperature of certain amounts are likely if those activities are not changed.²³⁹ Controversy over global warming derives from policy debates over what actions can or should be taken to avert such warming—a question more appropriate for social studies than science classes—and from religious opposition to the notion that human activities can influence the divinely crafted balance of the earth's climate.²⁴⁰ Notably, stem cell research and global warming are topics which creationist groups have publicly attacked on overtly religious grounds, and the resistance to these ideas tends to emanate from overlapping sets of religious denominations.

Singling out evolution—on its own or in combination with other topics found objectionable by a common set of religious groups—is likely to make observers feel that certain religious groups are having their views endorsed by the state. In the absence of clear secular reasons to select those scientific topics (while ignoring a multitude of legitimate scientific controversies in existence), courts could properly find a lack of secular purpose for the policy as a whole by the same logic applied in *Edwards*. Reasonable observers can be expected to know about creationism's history of "contrived dualism," after all, and the *Edwards* court was clear that "Whatever the academic merit of particular subjects or theories, the Establishment Clause limits the discretion of state officials to pick and choose among them for the purpose of promoting a particular religious belief."²⁴¹

239. Int'l Panel on Climate Change [IPCC], Working Group I to the Fourth Assessment Report of the IPCC, *Climate Change 2007: The Physical Science Basis* (2007) ("Warming of the climate system is unequivocal," and "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations"). See also Naomi Oreskes, *Beyond the Ivory Tower: The Scientific Consensus on Climate Change*, 306 SCIENCE 1686 (2004) (validating claims of consensus on the latter point from an earlier report).

240. See Andy Crouch, *Environmental Wager: Why evangelicals are—but shouldn't be—cool toward global warming*, CHRISTIANITY TODAY, Aug. 2005, at 66, 66 (evangelical advocate for action on climate change links global warming denial to creationist beliefs); Larry Vardiman, *Evidence for Global Warming*, ACTS & FACTS (Inst. for Creation Research, El Cajon, Cal.), Apr. 2007 ("Earth has a stable environmental system with many built-in feedback systems to maintain a uniform climate. It was designed by God and has only been dramatically upset by catastrophic events like the Genesis Flood. Catastrophic climate change will occur again in the future, but only by God's intervention in a sudden, violent conflagration of planet Earth in the end times (II Peter 3:1-12)"); Russ Humphreys, *God's Global Warming Worked Just Fine: Evidence from the Pre-Flood World Suggests That We Need Not Fear Global Warming from Carbon Dioxide*, CREATION MINISTRIES INTERNATIONAL Aug. 11, 2009, <http://creation.com/global-warming-facts-and-myths>. But see Michael Oard, *Christian Reluctance to Jump on Global Warming Bandwagon Attributed to Skepticism of Evolution*, ANSWERS IN GENESIS, Sept. 5, 2005, <http://www.answersingenesis.org/docs2005/0908ct.asp> (responding to Crouch's article).

241. *Edwards*, 482 U.S. at 605.

C. ACADEMIC FREEDOM

One strategy being adopted by the ID movement to mitigate the threat of court scrutiny is a shift away from policies that mandate any particular educational content, instead simply expanding the rights of teachers and students to introduce topics or material not authorized by school districts or state departments of education. Under the guise of “academic freedom,” these laws and policies name evolution specifically but apply themselves more broadly to science education in general, and propose to profoundly rearrange the way that schools are administered.

In summary, these bills purport to defend and expand the academic freedom of teachers and students in public school science classes to present and state views at variance with district curriculum, statewide standards, or approved textbooks. These laws draw on sources like the Santorum amendment, model legislation circulated by the Discovery Institute²⁴² and a local school district policy drafted by a creationist organization in Louisiana.²⁴³ The bills single out the science classroom without specifying how or why there is a greater need for academic freedom in this subject. It could well be the case that these bills might simply be intended to restate the extant ability of teachers and districts to encourage critical thinking in all classes (despite mentioning to only science classes) and to introduce supplementary materials into classes (another power already granted to and widely used by teachers across all subjects). However, if this is, in fact, their only purpose these bills are, at best, irrelevant

Given that these academic freedom bills target only science classes, and single out evolution, it is much more likely that the bills are intended to open the door to creationist lessons, and their narrow focus will likely drawn special scrutiny from the courts.²⁴⁴ No bill has clarified why evolution should be singled out, or explained why science classes deserve more scrutiny than math, history, English language, or art classes. The danger of granting blanket approval for teachers to deviate from the curriculum is clear. Such provisions would make it impossible to restrict a history teacher from advocating Holocaust denial, or to discipline a math teacher who insists that π is exactly 3, rather than 3.14159. It is fair to ask why equally unacceptable ideas should be permitted in science classes, and whether this tradeoff justifies the stated goals of the bill.

242. MODEL ACADEMIC FREEDOM STATUTE ON EVOLUTION (Discovery Inst. Ctr. for Sci. & Culture).

243. See BOARD OF EDUCATION OF OUACHITA PARISH, OUACHITA PARISH SCIENCE CURRICULUM POLICY (La. 2006), *available at* http://www.opsb.net/downloads/forms/Ouachita_Parish_Science_Curriculum_Policy.pdf.

244. See *Epperson v. Arkansas*, 93 U.S. 97 (1968); *Selman v. Cobb County Sch. Dist.*, 390 F. Supp. 2d 1286 N.D. Ga. 2005), *rev'd and remanded*, 449 F.3d 1320 (holding that the district court's findings of fact were unsupported by the record and remanding for new evidentiary hearings).

Some proponents of the bills have been clear about their intent for teachers to challenge evolution and promote ID or other creationist models.²⁴⁵ Others, however, have been unwilling to discuss whether the bill is designed to protect the teaching of creationism: in Florida, the sponsor of an “academic freedom” bill was perceptibly unwilling to address the question of whether it would permit the teaching of creationism, instead simply reciting its text.²⁴⁶ However, she was willing to descant on the need for the bill, making claims about how it would save teachers from persecution.²⁴⁷ The state’s Department of Education was asked if any teachers had been disciplined under circumstances where the bill might apply: none could be found.²⁴⁸

Many of the bills contain language like that found in model legislation provided by the Discovery Institute “Nothing in this act shall be construed as promoting any religious doctrine, promoting discrimination for or against a particular set of religious beliefs, or promoting discrimination for or against religion or non-religion.”²⁴⁹ Such disclaimers do not change the evidence of such intent, and courts need not accept them at face value. For example, the Supreme Court in *McLean* showed no deference to the challenged law’s assertion that “[t]his Act does not require or permit instruction in any religious doctrine or materials.”²⁵⁰ Courts would do well

245. E.g. Bill Sherman, *Critics Say Science-Education Measure Has Hidden Agenda*, TULSA WORLD, Mar. 23 2006 at A8 (bill sponsor “Kern said by phone ...that her bill is necessary because teachers tell her they fear they will get in trouble if they teach honestly about the controversy over evolution”); Matt Soergel, *Wise to Introduce Bill on Intelligent Design: The Senator Wants It to Balance Florida Science Standards that Require the Teaching of Evolution*, FLORIDA TIMES UNION, Feb. 8, 2009, at A1 (“Wise, the chief sponsor of the bill, expects the Senate to take it up when it meets in March. He said its intent is simple: ‘If you’re going to teach evolution, then you have to teach the other side’”); Posting of Ron Matus to TheGradebook, <http://blogs.tampabay.com/schools/2008/03/the-persecution.html> (Mar. 6, 2008) (quoting bill sponsor Rep. D. Alan Hays, “You and I both know there are holes in Darwin’s theory. No one yet has found a half-animal of this or a half-insect of that...And they certainly haven’t found any half ape and half man”).

246. Posting of Linda Kleindienst to BrowardPolitics http://weblogs.sun-sentinel.com/news/politics/broward/blog/2008/04/if_intelligent_design_ok_in_cl.html (Apr. 19, 2008) (Opponents have voiced concerns that Storms’ bill would open the door to teaching religious-based theories, like intelligent design, in public school classrooms. But Storms, one of the Senate’s most conservative members, repeatedly refused to answer questions on whether that could happen. ... Senate Democratic leader Steve Geller, of Cooper City, frustrated at her answers, later said, “We could have stuck bamboo shoots under her fingernails and she wouldn’t have answered.”).

247. Nicola M. White, *Senate Approves Evolution Bill*, TAMPA TRIBUNE, Apr. 24, 2008, at 1.

248. PROF’L STAFF OF THE EDUC. PRE-K – 12 COMM., FLORIDA SENATE BILL ANALYSIS AND FISCAL IMPACT STATEMENT FOR CS/SB 2692 (2008) (“According to the Department of Education, there has never been a case in Florida where a public school teacher or public school student has claimed that they have been discriminated against based on their science teaching or science course work”).

249. MODEL ACADEMIC FREEDOM STATUTE ON EVOLUTION (Discovery Inst. Ctr. for Sci. & Culture).

250. Treatment for Creation-Science and Evolution-Science Act, ARK. CODE ANN. §17- 80-1663 (1981). Some ID promoters argue that academic freedom bills can be presumed to be

to regard such disclaimers as an act of protesting too much. Unlike the disclaimer in *McLean*, the disclaimer in these “academic freedom” acts fails even to make clear that religious instruction is not, and cannot be, protected in public schools by any state law.

These laws are an attempt to revive a long-standing and unsuccessful creationist strategy of defending creationist policies with claims of academic freedom. A stated legislative purpose of the laws overturned in *Edwards*²⁵¹ and *McLean*²⁵² was “protecting academic freedom.” Both courts found such justifications a sham, but did so in part due to the explicitly religious nature of the alternatives offered. In *Selman*, the school board justified a sticker warning students that a book contained evolution by citing “academic freedom” and its wish to “foster critical thinking.” In *Peloza v. Capistrano*,²⁵³ the court rejected a teacher’s desire to teach creationism based on a claimed “academic freedom to teach the truth in the classroom, and to teach science in the classroom, and the academic freedom rights of his students to be taught the truth.”²⁵⁴ In *LeVake v. ISD 656*,²⁵⁵ a teacher unsuccessfully asserted a right to teach evolution in a way not specified by district policy, citing rights to free speech, religious expression, and academic freedom.

These laws appear designed to change the balance in similar lawsuits down the road, but would have the effect of dramatically redrawing the traditional boundaries of academic freedom as applied to primary and secondary education. Academic freedom is not a constitutionally enumerated right, and courts have struggled to determine its breadth.²⁵⁶

constitutional because they have not been challenged in court. *See, e.g.,* Casey Luskin, *Does Challenging Darwin Create Constitutional Jeopardy? A Comprehensive Survey of Case Law Regarding the Teaching of Biological Origins*, 32 *HAMLINE L. REV.* 1 (2009). In other words, the absence of direct evidence for these policies’ unconstitutionality is evidence for the absence of their unconstitutionality. This twisted logic parallels that which is applied by creationists to as-yet-undiscovered fossils, and should be treated as dismissively “gaps” in the legal record are no more convincing than those in the fossil record.

251. 482 U.S. 578 (1987).

252. *McLean v. Ark*, 529 F. Supp. 1255 (E.D. Ark. 1982).

253. *Peloza v. Capistrano Unified Sch. Dist* 37 F.3d 517 (9th Cir. 1994).

254. Pl.’s Compl. 4, *available at* http://ncse.com/webfm_send/957.

255. *LeVake v. Indep. Sch. Dist. No. 656*, 625 N.W.2d 502, 504–05 (Minn. App. 2001).

256. Todd DeMitchell & Vincent Connelly, *Academic Freedom and the Public School Teacher: An Exploratory Study of Perceptions, Policy, and the Law* 2007 BYU EDUC. & L. J. 83 (2007). This review shows the schizophrenic nature of academic freedom rulings: “The academic freedom of professors and teachers is much discussed, but its borders remain stubbornly indistinct and blurred. ... The courts’ view of academic freedom impacts policy-making and practice, yet the impact is inconsistent and not easily discerned. ... Despite academic freedom’s influence on policy, there is no black letter law definition of this right. ... While the Supreme Court has stated that academic freedom is a special concern of the First Amendment, it has yet to articulate a coherent analytical framework for protecting that concern. The Court’s pronouncements on academic freedom are majestic but not very helpful in establishing a definition. Consequently, a case analysis reveals its tenuous rather than robust support of academic freedom.” (internal

Academic freedom's principal definition comes from the American Association of University Professors (AAUP), and their understanding of academic freedom principally oriented toward post-secondary education, and, even there, it applies with greater weight to research and publishing than to teaching.²⁵⁷ Given AAUP's strong defense of academic freedom, it is worth noting their resolution on "Academic Freedom and Teaching Evolution" reiterating that "It is for scientists and not legislatures to say what is science," and opposing the supposed "academic freedom" bills.²⁵⁸

Neither is academic freedom a right granted exclusively to teachers and students. Courts have consistently ruled that school boards and other government educational institutions have broad academic freedom to select the subjects to be taught, who shall teach those subjects, and in what manner they may be taught, though that freedom is constrained by the First Amendment.²⁵⁹ This constraint has been consistently applied in cases concerning the teaching of creationism in the public schools, as in the *Edwards*²⁶⁰ and *McLean*²⁶¹ cases discussed above.

The courts have long held, and for good reason, that the state's obligation to prevent proselytization of students increases with younger students.²⁶² Thus, cases involving high school students often reflect a greater leeway given to potentially religious expressions than cases involving middle or elementary school.²⁶³ It is hardly surprising that jurisprudence related to primary and secondary schools takes a harder line on academic freedom. Ironically, the sole holding from the Tennessee Supreme Court's ruling upholding the anti-evolution law under which John Scopes was prosecuted is its finding that he had no academic freedom to deviate from state law and district curricular policy.

quotations and citations omitted).

257. Amn. Ass'n of Univ. Professors, 1940 STATEMENT OF PRINCIPLES ON ACADEMIC FREEDOM AND TENURE (academics "are entitled to full freedom in research and in the publication of the results, subject to the adequate performance of their other academic duties"; by contrast, they are "entitled to freedom in the classroom in discussing their subject, but they should be careful not to introduce into their teaching controversial matter which has no relation to their subject").

258. Amn. Ass'n of Univ. Professors, *Academic Freedom and Teaching Evolution*, 2005 RESOLUTIONS OF THE 94TH ANNUAL MEETING, <http://www.aaup.org/AAUP/about/events/past/2008/am/resol.htm> (last visited Jan. 25, 2010).

259. See Todd DeMitchell & Vincent Connelly, *supra* note 257.

260. *Edwards*, 482 U.S. at 578.

261. *McLean v. Ark.*, 529 F. Supp. 1255 (E.D. Ark. 1982).

262. Compare *Lee v. Weisman*, 505 U.S. 577 (1992) (invocations and benedictions at a public high school commencement are unconstitutionally coercive toward students), with *Tanford v. Brand*, 104 F.3d 982 (7th Cir. 1997). (religious content at a university commencement does not violate students' rights because adult students have the maturity to choose among competing beliefs.)

263. See generally Anne Marie Lofaso, *RELIGION IN THE PUBLIC SCHOOLS* (2009) (providing a review of these and related topics).

Thus, states claiming to promote academic freedom by encouraging narrow attacks on evolution, and districts seeking that same stated goal, have been rebuffed in court. In *Peloza*, the court rejected claims regarding both the teacher's and students' academic freedoms, noting that *McLean's* holding that creationism is religion "debunks [Plaintiff's] idea that he can teach creationism as a part of academic freedom"²⁶⁴ a ruling upheld on appeals to the 9th Circuit and the Supreme Court.²⁶⁵ In *LeVake*, a teacher asserted First Amendment rights and a right of academic freedom to deviate from his district's curriculum on evolution. In a paper explaining how he wished to teach evolution, he explained that he would only present it at all if he could present "the difficulties and inconsistencies of the theory." His supervisor determined that this would not meet the district's requirements and transferred the teacher to a different class. The teacher sued, claiming violations of his right to free exercise, free speech, due process, and academic freedom. The First Amendment claims failed, as they always have when used to challenge evolution in the science curriculum. The district court ruled that the academic freedom claim "has essentially the same flaws as his free speech claim," adding "academic freedom is not a license for uncontrolled expression at variance with established curriculum content." A state appellate court concurred, making clear that "the established curriculum and LeVake's responsibility as a public school teacher to teach evolution in the manner prescribed by the curriculum overrides his First Amendment rights as a private citizen." This follows the reasoning of *Edwards*²⁶⁶ that "teachers are not free, absent permission, to teach courses different from what is required. 'Academic freedom,' at least as it is commonly understood, is not a relevant concept in this context." The *Selman* court found that a stated desire to encourage academic freedom did not constitute sufficient secular purpose to single out evolution from all other scientific theories.²⁶⁷

Laws purporting to expand academic freedom in primary and secondary education upset this balance, taking power from elected school boards and the consensus-building process used by teachers and administrators to craft a curriculum. In urging the adoption of supplementary materials, the laws urge schools to travel the path chosen so disastrously by the Dover Area School Board, either by selecting an ID textbook like *Pandas*, ensuring another expensive loss in court for the imprudent school district, or by

264. *Peloza v. Capistrano Unified Sch. Dist.*, 782 F. Supp. 1412, 1416 (C.D. Cal. 1992), *aff'd in part & rev'd in part*, 37 F.3d 517 (9th Cir. 1994).

265. *Peloza v. Capistrano Unified Sch. Dist.*, 37 F.3d 517 (9th Cir. 1994) (affirming the dismissal of *Peloza's* complaint), *cert. denied*, 115 U.S. 1173 (1995).

266. *Edwards*, 482 U.S. at 586 n.6.

267. *Selman v. Cobb County Sch. Dist.*, 390 F. Supp. 2d 1286 (N.D. Ga. 2005), *rev'd and remanded*, 449 F.3d 1320 (holding that the district court's findings of fact were unsupported by the record and remanding for new evidentiary hearings).

selecting a book like *Explore Evolution*, which would likely have the same result.

V. EVALUATING THE ARGUMENTS AGAINST EVOLUTION

Before considering the particular evidence offered against evolution, courts and policymakers would be rightly suspicious of a policy specifying that evolution be challenged in ways that other, less religiously fraught topics, are not. An examination of the evidence typically suggested for pedagogical use in such policies reveals additional reasons for concern. The post-ID arguments against evolution bear many resemblances to those evaluated by McLean and Kitzmiller. To illustrate the similarities, I will discuss *Explore Evolution: The arguments for and against Neo-Darwinism*,²⁶⁸ a textbook promoted by the Discovery Institute as a supplement for use in classrooms where evolution is being taught as an example of the kind of examination of evolution being promoted.

*Explore Evolution*²⁶⁹ is nearly identical in size and approach to *Pandas*.²⁷⁰ Like *Pandas*, *Explore Evolution* is glossy, with copious full-color illustrations. Both address themselves to a small selection of topics from evolutionary biology, each in a separate chapter: origins of life, natural selection and mutation, speciation, the fossil record, homology, and molecular homology (*Pandas*); the fossil record, homology, molecular homology, developmental biology, biogeography, natural selection and mutation, and irreducible complexity (*Explore Evolution*).²⁷¹ Whereas *Pandas* uses this structure to promote a contrived dualism by arguing against evolution and for ID (or creation science in earlier drafts),²⁷² *Explore Evolution* takes this a step further by simply presenting “the arguments for and against neo-Darwinism,” allocating to each “side” one half of a chapter.²⁷³ In this respect, both books seek to exploit the dicta from *Edwards* protecting the teaching of “scientific critiques of prevailing scientific theories.”²⁷⁴

A detailed critique of *Explore Evolution* is in preparation by the National Center for Science Education,²⁷⁵ and I will briefly review some of

268. MEYER, et al. *supra* note 22. Note that the subtitle is a perhaps unintentional reference to Bird, *supra* note 41, urging a post-*Edwards* strategy of exhorting teachers to “stress the scientific evidences and arguments *against evolution* in their classes (not just arguments against some proposed evolutionary mechanism, but against evolution *per se*).”

269. MEYER, et al., *supra* note 22.

270. DAVIS, *supra* note 60.

271. MEYER, *supra* note 22, at IV; DAVIS, *supra* note 60, at table of contents.

272. Forrest, *supra* note 62.

273. MEYER, *supra* note 22 at ii-iii.

274. *Edwards v. Aguillard*, 482 U.S. 578, 593 (1987).

275. Nat'l Ctr. for Sci. Educ., *Critique: “Explore Evolution,”* Oct. 17, 2008, <http://ncse.com/>

the larger errors. In summary, the “cases for” ID are often extremely weak, frequently misrepresenting the views of scientists quoted and rarely making any accurate presentation of the scientific evidence, let alone the best case possible. In at least one case, the book plagiarizes from a creationist letter to the editor. The “cases against” are predictably argued more forcefully, but continue to misrepresent scientists, misquoting them as arguing against positions that they actually hold, or as supporting ideas that they actually reject. In general, the supposed evidence does not meet the standard for scientific evidence against a claim.²⁷⁶ *Explore Evolution* presents unknowns—fossils we do not yet have, developmental genetic mechanisms not yet fully understood, molecular pathways not yet described, etc.—as data which will never be known, and therefore as evidence against evolution.²⁷⁷

Requiring students to learn that certain topics are unknown and unknowable mis-educates students about science and weakens the foundation of their future learning. By presenting missing evidence as if it were evidence itself, *Explore Evolution* repeats its predecessor's errors and leaves students with a flawed foundation for understanding the scientific process. The dangers are readily illustrated. In 1994, echoing arguments from *Pandas*, ID advocate Michael Behe argued:

[I]f random evolution is true, there must have been a large number of transitional forms between the Mesonychid [ancestor of modern whales] and the ancient whale. Where are they? It seems like quite a coincidence that of all the intermediate species that must have existed between Mesonychid and whale, only species that are very similar to the end species have been found.²⁷⁸

As Behe was writing, researchers were in the field excavating fossils that beautifully illustrate the generational changes between fully land-living mammals to fully aquatic whales. *Explore Evolution*, published thirteen years after Behe's claim, now cites this sequence as a rare counterexample, waving off continued scientific discoveries rather than using them as an opportunity to educate students about how science actually works.²⁷⁹ A student learning from a book like *Pandas* or *Explore Evolution*, which

creationism/analysis/explore-evolution.

276. Brian Metscher, *Postcards from the Wedge: review and commentary on Explore Evolution*, 11 EVOLUTION & DEVELOPMENT, Jan. 19, 2009 at 124, 124–25. “The point-counterpoint organization is used to give the appearance of a comprehensive treatment, but the substance is thin, fragmented, and demonstrably biased. Every talking point in the book has been dealt with already, and none is a legitimate scientific issue.”

277. MEYER, *supra* note 22.

278. Michael Behe, *Experimental Support for Regarding Functional Classes of Proteins to Be Highly Isolated from Each Other*, 1994 Proceedings of the symposium, *Darwinism, Science or Philosophy?*, available at <http://www.leaderu.com/orgs/fte/darwinism/>.

279. Metscher, *supra* note 278, at 125.

teaches that current gaps in the fossil record are indicative of the genuine absences of evidence for evolution, would be unprepared to understand, let alone seek out, new fossil sequences or other unknown answers to scientific questions. This is both bad pedagogy, and bad science.

As discussed above, the ability of a theory to generate predictions and novel research questions is central to its strength as a theory. To disprove evolution, it does not suffice to show that the data needed to test a hypothesis is not available; it is necessary to show evidence which contradicts that hypothesis. And even then the evidence challenging a given hypothesis does not invalidate the entire theory.²⁸⁰ Contradictory evidence challenges the immediate assumptions which generated a prediction, leading to revision of the narrow hypothesis and data used for that prediction. Researchers spiral out from the most specific hypotheses and data pertinent to a falsified prediction until they find which of the many auxiliary hypotheses made was erroneous.

To return to the example of *Tiktaalik*, the absence of such fossils before Shubin's expedition did not falsify any hypothesis, as data did not yet exist to test it. Had an exhaustive search of the field site revealed no fossil like *Tiktaalik*, it would force the researchers to test a widening circle of hypotheses that brought them to that field site. First, they would examine the possibility that the species existed there but did not fossilize. They would also have to examine hypotheses auxiliary to the central claim about tetrapod evolution: what environment a species like *Tiktaalik* would live in, what its geographical location might have been, and what age rock strata to examine. Thorough searches of numerous viable fossil beds where such a fossil might have been preserved would cause scientists to rethink their hypothesis, but the only evidence which would conclusively falsify a particular hypothesis about tetrapod origins would be a fossil which better fit the predictions of some clear alternative.

As *Explore Evolution* sedulously avoids presenting any predictions as an alternative to evolution,²⁸¹ it is impossible to credit any of the supposed evidence as an argument against evolution. This is not to say that no such evidence could exist; rather, only that it is not offered in *Explore Evolution*,²⁸² and biologists do not generally feel that it exists or that it is

280. As, for instance, when a hypothesis about relationships between species—or other taxonomic groups—generated from one set of data is an imperfect match with that predicted by other data.

281. John Timmer, *A biologist reviews an evolution textbook from the ID camp*, Sept. 25, 2008, <http://arstechnica.com/tech-policy/news/2008/09/discovery-textbook-review.ars>. “The text assiduously avoids suggesting that any conclusion can be reached at all.... Despite its pervasive appearance in the book, where it's suggested as an alternative whenever a problem with evolution is supposedly identified, the orchard is apparently not to be subjected to any inquiry.”

282. *Id.* “in a book that's supposed to be about presenting evidence, there's a curious silence: nothing is said about how to identify what [the limits of evolution might be], or what the

likely to be found.²⁸³

Indeed, the sole positive argument for any alternative to evolution advanced in *Explore Evolution* is an explicit reference to creation science – the orchard model of life.²⁸⁴ *Explore Evolution* asks about the relationship of life on earth: whether it is a “tree or orchard?”²⁸⁵ Rather than the single tree of life described by the evolutionary biology community,²⁸⁶ it is suggested that “the history of life should . . . be represented . . . as a series of parallel lines representing an orchard of distinct trees. In the orchard view, each of the trees has a separate beginning.”²⁸⁷ A figure illustrates the “polyphyletic (orchard)” model, in which there is evolutionary “branching within major groups, but no connections between them.”²⁸⁸ This model is presented implicitly throughout the book, with misleading references to scientific backing for this model.²⁸⁹

While *Explore Evolution* cites scientists publishing in the non-

biological basis for the limits are.”

283. Saeger, *supra* note 145, at 45–46 (consider the Federation of American Societies for Experimental Biology statement on evolution: “Evolution is among the most thoroughly tested theories in the biological sciences. It is supported by volumes of scientific evidence in numerous fields, including genetics, biochemistry, developmental biology, comparative anatomy, immunology, geology, and paleontology. Moreover, evolution lays the foundation for much of what we know about genetics, immunology, antibiotic resistance, human origins, and the adaptation of species to a changing environment. Removing evolution from the classroom, or misrepresenting evolution as a flawed theory, deprives students of one of the most important tenets of science and the basis of our understanding of biology and medicine, including pandemic influenza and AIDS”).

284. MEYER *supra* note 22, at 9–10, 34, 76, 79, 128. Cf. Kurt Wise, *Baraminology: A Young-Earth Creationist Biosystematic Method*, 2 THE PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON CREATIONISM 345 (1990) (Introducing the Orchard Model. The reference to this as an “orchard” is intriguing, as a group of trees could also be referred to as a wood, a forest, a glade, a copse, a spinney, etc. An orchard is distinguished by having been planted and tended, like a garden. The retention of the phrase “orchard model” by the ID movement is suggestive of a religious agenda).

285. MEYER, *supra* note 22, at 9–10.

286. The shape of this tree is not undisputed, with some scientists proposing multiple origins of life and a long period of such ubiquitous sharing of genes that the lineages wrapped themselves together into single trunk, which then split into the separate lineages we now recognize. For accessible introductions to the challenges of early life, see generally Robert Hazen, GENESIS: THE SCIENTIFIC QUEST FOR LIFE'S ORIGINS (2006); W. Ford Doolittle, *Uprooting the tree of life*, 282 SCIENTIFIC AMERICAN 90–95 (2000).

287. MEYER, *supra* note 22, at 9–10.

288. *Id.*

289. Timmer, *supra* note 283:

This presentation can also be considered a ‘bait and switch’—take a real scientific controversy, tell your readers that it exists, and then substitute in the controversy you'd like them to think exists . . . [One] section contains a long list of academic discussions of the limitations in our collections of fossils. That section wraps up by claiming these limitations, ‘have led some scientists to doubt that the fossil record supports the case for common descent.’ Who are those scientists? . . . [One scientist] who actually wrote in favor of common descent gets dragged out again, but the rest aren't actually scientists, nor are their publications peer-reviewed science.... The bait of real issues has been switched to a statement that isn't actually supported by the footnote.

creationist literature to support its claim that there are advocates for multiple trees of life with “branching within major groups, but no connections between them,” the scientists they cite actually acknowledge substantial connections between the trees.²⁹⁰ To the extent that any cited scientific papers suggest that the tree of life may be more divided than is widely accepted among scientists, they do not question that plant and animal cells were formed by the combination of an archaeal cell and a bacterial cell,²⁹¹ nor that there has been extensive gene flow among bacterial lineages,²⁹² nor that all modern organisms share descent from one common ancestor (or a small population sharing genes promiscuously).²⁹³ Moreover, no research findings challenge the notion that multicellular animals and multicellular plants fit fully into the traditional vision of a tree of life. In fact, these papers observe so much shared genetic material between lineages that some regard many varieties of life in existence before three domains split entirely apart as if they were a single tree trunk, strands so tightly bound together as to make it impossible to trace any one in isolation.²⁹⁴ On a metaphorical level, this is closer to the “entangled bank”²⁹⁵ described by Charles Darwin than to an orderly orchard.

In addition, the idea that there are limits to how much an animal can change cannot be justified scientifically. The study of the origins of anatomical novelty is an active and exciting field, and as with the fossil examples discussed above, it is pedagogically harmful to insist that students simply learn a list of things that are not yet known, especially when some of those topics are well-understood by scientists²⁹⁶ and active scientific research is illuminating the remaining topics.²⁹⁷ Take, for example, Michael

290. *Id.*

291. Timmer, *supra* note 283: “There are a number of different ideas regarding the origin of the Archaea, All of the proposals... exist within an evolutionary framework where there are a limited number of origins-of-life, and organisms are related to their origin by common descent. Somehow, these arguments over the details are inflated [in *Explore Evolution*] to the point where they encompass controversies that don't exist in the scientific community, such as the plethora of origins required in the orchard model.”

292. *Id.*

293. *Id.*

294. Doolittle, *supra* note 288.

295. Darwin, *supra* note 150, at 189.

296. Timmer, *supra* note 283: “An entire section of the book is devoted to ... [the] contention that complex, multiprotein systems cannot evolve, a concept called ‘irreducible complexity.’ ... Indeed, scientists have proposed at least three mechanisms by which irreducibly complex systems can evolve, any one of which would invalidate [the] contention that they can’t.”

297. *Id.*

[T]he book argues that, ‘the first fossil bat appears suddenly.’ But this year, an early fossil bat species was discovered, one that has short wings and claws at the end of its digits adapted for climbing. The discovery of this primitive bat species doesn’t simply point out problems with the book’s argument; it highlights the problem with this entire class of arguments. Specifically, such arguments are essentially an attempt to rule out evolution by assuming that something (such as a bat ancestor) will never be discovered.

Behe's argument for irreducible complexity, to which *Explore Evolution* devotes an entire chapter.²⁹⁸ If Lynn Margulis had not already discovered the endosymbiotic origin of organelles called the mitochondria and the chloroplast (discussed above), Michael Behe might have been able to claim them as "irreducibly complex." Fortunately, when Margulis recognized that existing evolutionary mechanisms could not account for these cellular structures, she did not declare evolution to have failed and invoke supernatural causation (as Michael Behe does). Instead, she developed a hypothesis that the organelles had once been free-living single-celled organisms which were engulfed by other single-celled organisms. This relationship was evolutionarily advantageous, and came to be so tight a connection that the two cells replicated as one, and genes moved from the organelle to the nucleus of the host. The two cells became a single cell, and from that union came the eukaryotes, including humans. This model made a variety of predictions about the structure of the organelle, the content of the organelle and the host's genome, and the relationship of the genes remaining in the organelle to related, free-living single-celled organisms. By testing these predictions, Margulis and other scientists testing and developing these hypotheses were able to establish that endosymbiosis was the best available explanation for certain relevant facts in cell biology, and further research has uncovered this same process at work in nature today.²⁹⁹ It should be noted, however, that Margulis proposed that endosymbiosis explained not just mitochondria and chloroplasts, but eukaryotic flagellae, although the scientific community has found the evidence for the latter insufficient compared to the first two.

A book purporting to "explore evolution" would do well to examine how evolutionary biologists faced and overcame a challenge of this magnitude, but no mention of the mechanism (endosymbiosis) or the organelles known to result from it is presented in the text. Also absent is any discussion of an ongoing debate among evolutionary biologists about whether molecular evolution is dominated by the effects of natural selection or by genetic drift. Indeed, genetic drift is never referred to in the text as an evolutionary mechanism, nor are mechanisms like recombination, gene flow, or sexual selection. Only two mechanisms are discussed by *Explore Evolution*, natural selection and mutation, and it is suggested that evolution predicts that all change results from those two mechanisms alone.³⁰⁰ This is categorically false, a point noted in *McLean*³⁰¹ and in *Kitzmiller*,³⁰² not to

298. MEYER, *supra* note 22, at 115–24. As mentioned above, irreducible complexity is an argument based upon the idea that some structures are simply too complex to be the product of natural processes.

299. Okamoto, N. & Inouye, I., *A Secondary Symbiosis in Progress?*, 310 SCIENCE 287 (2005).

300. MEYER, *supra* note 22, at 8.

301. *McLean v. Ark. Bd. of Educ.*, 529 F. Supp. 1255, 1267. (E.D. Ark. 1982).

mention in numerous critiques of ID and creation science arguments.

A detailed review of even a few of the errors and creationist parallels in *Explore Evolution* is beyond the scope of this article, but such a review – due to be published by the end of the year reveals numerous basic errors, from erroneous statements about reproduction in mammals,³⁰³ to erroneous concepts carried over from earlier creation science writings,³⁰⁴ and even to wholesale and uncredited copying of content from creation science documents.³⁰⁵ Perhaps the only component of *Explore Evolution* which addresses genuine contemporary controversies within the evolutionary biology community is its discussion of developmental biology and evolution's ability to shape it.³⁰⁶ While this discussion shows the same flaws as the rest of the book, the topic of evolutionary developmental biology is certainly exciting and at the cutting edge of a new evolutionary synthesis. However, the topic is rarely discussed in high school biology textbooks, and the discussion in *Explore Evolution*³⁰⁷ does not provide students with anything like the additional background needed to understand, let alone evaluate, results from this fast-changing body of research.

*Explore Evolution*³⁰⁸ recapitulates a form of religiously rooted reasoning found fatal to policies in *McLean*³⁰⁹ and *Kitzmiller*,³¹⁰ echoes a pseudoscientific model explicitly rooted in creation science, makes erroneous statements of fact, misrepresents the words, research, and views of practicing scientists, and presents a flawed and pedagogically harmful account of science as a process. By the standards that courts have traditionally applied in evaluating the merits of an anti-evolution policy, the adoption of this book or any part of it could not be interpreted as serving a valid secular purpose of improving the quality of science education. If districts adopt this style of argument, either through *Explore Evolution*³¹¹ itself or simply by deriving their own religiously driven “evidences against evolution,” they are sure to face intense court scrutiny.

302. *Kitzmiller v. Dover Area Sch. Dist.*, 400 F. Supp. 2d 707, 739 (M.D. Pa. 2005).

303. MEYER, *supra* note 22, at 129 (claiming “mammals carry fertilized eggs internally in a placenta and bear live young.” In fact, there is a branch of mammals which lays eggs (monotremes, including the platypus and echidnas), and a large branch which possess no placenta (many marsupials)).

304. Nat'l Ctr. for Sci. Educ., *Marsupials*, September 30, 2008, <http://ncse.com/creationism/analysis/marsupials>.

305. Nat'l Ctr. for Sci. Educ., *Hopeful Monsters*, October 14, 2008, <http://ncse.com/creationism/analysis/hopeful-monsters>.

306. MEYER *supra* note 22, at 65–72.

307. *Id.*

308. MEYER *supra* note 22.

309. *McLean*, 529 F. Supp. at 1267.

310. *See Edwards*, 482 U.S. at 600–04.

311. MEYER, *supra* note 22.

CONCLUSION

Even before Intelligent Design was ruled unconstitutional in science classes,³¹² a new strategy to advance creationism had been formulated. This strategy consists of state laws which radically reshape the concept of “academic freedom” to allow public secondary school teachers and students unprecedented leeway in their presentation of science (and only science), and encouraging science teachers to present creationist-inspired “evidence against evolution” rather than advocating teaching creationism by name. These strategies have yet to be directly tested in court, but it would be an error to regard this absence of evidence as evidence for the constitutionality of the new approach. Courts are rightly skeptical of claimed “academic freedom” to present creationism³¹³ as no statutory claim of academic freedom could justify an abuse of the First Amendment rights of students. The rhetoric used to promote these new laws, policies, and educational supplements produced to support them, shows many of the same constitutional flaws which courts found in earlier creationist tactics. Given the extensive similarities between these and earlier creationist strategies, school districts and courts are wise to be as cautious about this latest version of creationism as they were of creationism’s previous incarnations.

312. *Kitzmiller*, 400 F. Supp. 2d at 739.

313. *Edwards*, 482 U.S. 578.