Religious doctrine in U.S. public school science classes: An on-going and costly debate.

Introduction

Since the teaching of evolution in American public schools met its first legal challenge in the Scopes monkey trial of 1925 (*Scopes v. Tennessee*, 1927; Linder, 2008), an on-going debate has been in effect over the *manufactured controversy* as to whether theories of *creationism*—also called *creation science, intelligent design* (ID), *abrupt appearance theory,* and *evidence against evolution*—can legally be taught as part of the United States science curriculum. I use the term *manufactured controversy*, since at first examination, it would appear that no such controversy should exist. My research seeks to investigate the history, and explain the reasons for, this on-going, hotly debated topic; which one United States Supreme Court Judge referred to as a "legal maelstrom, with its resulting utter waste of monetary and personal resources" (*Kitzmiller v. Dover*, 2005, pp. 137–138).

Purpose

The overarching aim of this study is to examine why—given the weight of scientific evidence, government policy and legal precedent—attempts are still made to teach Christian doctrine—in the form of creationism and ID—in United States public school science curricula (Berkman & Plutzer, 2011; Moore, 2000, 2004; NCSE, 2014).

I have chosen to focus specifically upon the United States public education system, purely because of the wealth of documentation relating to the topic, freely available from public sources, such as the National Centre for Science Education (NCSE), National Academy of Sciences (NAS), and U.S. caselaw databases such as Leagle Inc (http://www.leagle.com). Whilst this debate has garnered considerably more attention in the U.S. than Canada, this does not mean that Canadian public science education is entirely immune to the issue. For example, the Ontario

Ministry of Education curriculum documentation for science at grades 9, 10, 11 and 12, makes no mention of evolution in relation to the biological sciences. However, the documentation for these grades does state:

> There may be cultural sensitivities for some students in areas such as the use of biological specimens. For example, a number of religions have prohibitions regarding pigs. Although it is impossible to anticipate every contingency, teachers should be open to adjusting their instruction, if feasible, when concerns are brought to their attention. (Ontario Ministry of Education, 2008a, p. 37; 2008b, p. 35)

This clause leaves room for the advocacy of creationist instruction, or at the very least, the avoidance of evolutionary science due to the possibility of offending religious beliefs. The latter has been the crux of arguments put forward by Canadian science educators, who have charged that Canadian students are not studying evolutionary science, simply because teachers wish to avoid the controversy (Alters & Alters, 2001). A situation replicated in the U.S. and reported on more recently by Berkman and Plutzer (2011).

In addition, this study investigates why—despite the illegality of teaching creationism as part of U.S. public school science classes—a large number of U.S. high school science teachers, administrators, and school board officials continue to make the deliberate effort to work creationism into U.S. public science classes as part of an undocumented, or *hidden*, curriculum (Berkman & Plutzer, 2011; Davis & Kenyon, 1993; Donnelly & Boone, 2007; Long, 2011; Moore, 2000, 2004; Scott & Branch, 2006).

Research Questions

To address the above aims, two main research questions guide this study:

1. What arguments have been put forward by advocates of creationism, to make the case for creationist ideology in the American science curriculum? Are these arguments scientifically plausible? Do they withstand the assault of academic rigour and empirical reasoning?
2. What impact have the arguments of proponents of creationism had on American public education policy and the law? For example, have these arguments curtailed—or enabled—the overt, legalised teaching of intelligent design in American public science classes? What rationale could justify denying—what appears to many—to be a major challenge to established scientific theory, and fuel such a heated, expensive controversy, for almost a century?

By analyzing court material such as expert witness depositions, testimony and judicial opinion, it is possible to extract the arguments that have been used to make the case for creationism in U.S. public education, thereby addressing research question 1. The results of these cases, their relative success in setting judicial precedent, and the detailed opinion of presiding judges, similarly contain the rationale sought by research question 2.

Creationist advocates have included expert witnesses in U.S. court cases, textbook authors, teachers, and school board representatives. Arguments from these sources are historically part of public record (e.g., expert witness testimony, minutes of school board meetings, journal articles, textbook content, and online discussion), and may be extracted from relevant documentation. Similarly, the impact of this discourse can be followed through legal precedent, judicial opinion, and the on-going status of public debate.

Why the Controversy?

Creationism and its pseudoscientific notions of intelligent design and creation science, have been shown to be founded in theology and inherently non-scientific, by organisations such as the National Academy of Sciences and Institute of Medicine, and to the standards of evidence required by the United States Supreme Court. By the same reasoning, evolution is held to be science (*Kitzmiller v. Dover*, 2005; *McLean v. Arkansas*, 1982; NAS, 2008). Given that the Establishment Clause of the American Constitution forbids the teaching of religion in U.S. public school science curricula, and there is ample legal precedent for rejecting its inclusion (*Epperson v. Arkansas*, 1968; *Edwards v. Aguillard*, 1987; *Freiler v. Tangipahoa*, 2000; *Kitzmiller v. Dover*, 2005; *LeVake v. ISD*, 2002; *McLean v. Arkansas*, 1982; *Peloza v. Capistrano*, 1994; *Seagraves v. California*, 1981; *Selman v. Cobb County*, 2005; and *Webster v. New Lenox*, 1990), the issue of whether to teach creationism in U.S. public school science classes would appear to be self-evident. Yet creationist proponents continue to argue that sub-sets of creationism, such as ID are valid scientific theories.

Can Creationism be Considered Science?

Intelligent design is a subset of creationist belief, as are the concepts of *creation science*, *abrupt appearance theory*, and *evidence against evolution*, which seek to fit theological hypotheses into a scientific framework. Essentially leading ID proponents, such as Professor of Biochemistry, Michael J. Behe of Lehigh University, Pennsylvania, argue that many aspects of molecular systems are too complex to be explained by current science and that "such systems were deliberately designed by an intelligent agent" (Behe, 2010, p. 1; Davis & Kenyon, 1993).

Science and *scientific theories*, as opposed to the *hypothesis* of ID, are based upon experience of the natural world, including (a) systematic observation; (b) analysis; (c) consistent

results of well-designed, controlled, double-blinded—where applicable—experiment; (d) they are *tentative*, that is, they cannot be proven absolutely, but with every positive observation, the validity of the theory increases (Ben-Ari, 2005; Kuhn, 1996; Popper, 1959). Scientific theory has the ability to predict further observations and is testable and falsifiable (Popper, 1959). That is, if the theory is incorrect, just one contradictory observation will show it to be false, for example, J. B. S. Haldane's now much over-used, but equally succinct response to the question of what could falsify the theory of evolution: "Fossil rabbits in the Precambrian!" (Dawkins, 2009, p. 147). Meaning that the discovery of evidence of a mammal existing in an era long before evolutionary science showed that even vertebrates were present, would render the theory to be false. It is a process—referred to by the philosopher David Hume (1711–1776)—as *methodological naturalism* (Hume, 2000). The product of which is open to peers—*peer reviewed*—and must be accurately repeated with consistent results—*replicable*—before a consensus can be reached, and a hypothesis declared a *scientific theory*.

As Wendel (2007) rightly points out, the terms *testable* and *falsifiable* are not identical. For example, it may be possible to test a hypothesis, and return with a level of probability that does not completely guarantee that hypothesis to be false—the result is *tentative*. Testability is therefore a pre-requisite of falsifiability, but not *vice versa*. A thousand carefully crafted trials of prayer to cure cancer, may indicate the probability of its success as an intervention, but one single positive or negative result could not falsify a *null hypothesis*. In contrast, more than one hundred and fifty years of observation and successful experiment have not completely guaranteed the *scientific theory* of evolution by natural selection, but one fossilized, Precambrian rabbit, would show it to be false. I would therefore contend that, given the nature of probability,

the scientific definition of *testability* also implies an inherent level of *predictability* from the results.

Whilst evolutionary science has proven resilient to all of the above criteria, notions of creationism and their pseudoscientific hypotheses (e.g., intelligent design), are ultimately faith-based and cannot say the same. Creationists claim that their arguments, some of which may be based in testable, falsifiable formats, constitute science. Nevertheless, each argument for ID has failed at the hurdle of scientific scrutiny (*Kitzmiller v. Dover*, 2005; Miller, 2004), and the ultimate conclusion of a supernatural causative agent falls outside of the boundaries of science. Intelligent design therefore remains a wholly faith-based idea.

Theoretical Framework

Constructivism and worldview. Both *sides* of the creationism and evolution debate have presented their own arguments, and with them, constructed their own *ontological reality*—determined by their own interpretation of what they consider to be *fact* or *truth*. This is the definition of s*ocial construction*, or *constructivism*, as discussed by Patton (2002), where "two people can live in the same empirical world, even though one's world is haunted by demons, and the other's, by subatomic particles" (Patton, 2002; Sagan, 1997).

In the world constructed of empirical evidence occupied by evolutionary biologists, the fossil record reaches back more than 3 billion years (Schopf, 1999; Noffke, Christian, Wacey & Hazen, 2013). During this immense period of time from ancient fossilized bacteria to the more recent hominin fossils of only 5-10,000 years ago, there are understandable gaps in the fossil record. Ancestors of organisms today which we have yet to find. Evolutionary science predicts that we will find fossilized common ancestors of groups such as reptiles and birds. And scientists have, according to prediction, found fossils such as *Archaeopteryx* which fit in such a gap

(Dawkins, 2006; Pojeta & Springer, 2001; Schopf, 1999). Yet creationist interpretation of their construction of the fossil evidence evolution, calls for more *intermediate forms* to fill the gaps (Luskin, 2008; Meyer, 2013), created by a fallacious argument. One species does not *evolve from another*. Species are distinct and different—most often to the point where they cannot inter-breed—species simply share common ancestry:

> [H]umans are not descended from monkeys. We share a common ancestor with monkeys. As it happens, the common ancestor would have looked a lot more like a monkey than a man, and we would indeed probably have called it a monkey if we had met it, some 25 million years ago. But even though humans evolved from an ancestor that we could sensibly call a monkey, no animal gives birth to an instant new species, or at least not one as different from itself as a man is from a monkey, or even from a chimpanzee. That isn't what evolution is about. (Dawkins, 2009, p. 155).

Thus has evolved the construction of the creationist worldview, based on one interpretation of empirical evidence, gathered and constructed to form an entirely different interpretation and worldview by evolutionary scientists. One person's demons are another's subatomic particles.

Historically, religion has constructed a worldview which has "aspired to *explain* our own existence and the nature of the universe in which we find ourselves. In this role it is now completely superseded by science" (Dawkins, 2006, p. 347). Proponents of both sides therefore represent a *worldview, "*a knowledge about reality, not reality itself" (Patton, 2002, p. 96), filtered through social context, as discussed by Long (2012).

By identifying the arguments used to promote the teaching of creationism in U.S. public schools, and the influence of these arguments on law and education policy, science educators may better understand the existential anxiety inflicted upon creationist students and their families (Long, 2012), when confronted by the teaching of modern evolutionary biology. Such an understanding may then be applied in discourse beyond the U.S. education system.

Methodology and Method

This research relies on the collection and analysis of publically available documentation as the means of data collection. Given the contentious nature of the evolution versus creationism debate in American education, it was felt that it would be unlikely that many school boards, administrators or teachers would welcome an investigative analysis of this kind. Documentation addressing both research questions, was selected from a shortlist of ten major United States District, Appeal and Supreme Court rulings from 1968 to the most recent of 2005 (as detailed in Table 1). This included judicial opinion, expert witness testimony and published works referred to in direct questioning and cross-examination of witnesses. By analyzing such material, it is possible to extract arguments that have been used to make the case for creationist ideology (research question 1), and reasons provided in attempts to move U.S. legal opinion and thus overt, documented education policy (research question 2). Such testimony has the advantage of cross-examination by legal counsel under oath to enhance the clarity and validity of the argument. As this documentation is a matter of public record and openly available, ethical considerations with regard to data collection are not applicable.

Table 1

Summarizing ten major court decisions on the teaching of evolution versus creationism in United States public schools.

Case Reference	Level of Court	Ruling
Epperson v. Arkansas (1968) 393 U.S. 97, 37 U.S. Law Week 4017, 89 S. Ct. 266, 21 L. Ed 228	Supreme Court	Breach of the Establishment Clause of the First Amendment.
Seagraves v. California (1981) Sacramento Superior Court #278978	Superior Court of California	Requirement to teach evolution *did not* violate freedom to practice religion rights, conferred by the First Amendment.
McLean v. Arkansas Board of Education (1982) 529 F. Supp. 1255, 50 U.S. Law Week 2412	District Court	Balanced treatment statute breached the establishment Clause of the First Amendment. Court declared that creation science is not science.
Edwards v. Aguillard (1987) 482 U.S. 578	Supreme Court	Breach of the Establishment Clause of the First Amendment.
Webster v. New Lenox School District #122, 917 F. 2d 1004	Court of Appeal	Prohibition of teaching creationism *did not* violate free speech rights of the First Amendment.
John E. Peloza v. Capistrano Unified School District, (1994) 37 F. 3rd 517	Court of Appeal	Requirement to teach evolution *did not* violate freedom to practice religion rights, conferred by the First Amendment.
Freiler v Tangipahoa Board of Education, No. 94-3577 (E.D. La. Aug. 8, 1997	District Court	Failed the Endorsement Test. Breach of the Establishment Clause of the First Amendment. Intelligent design is the equivalent of creation science.
LeVake, R. v. Independent School District #656, 625 N.W.2d 502 (MN Ct. of Appeal 2000), cert. denied, 534 U.S. 1081 (2002)	Court of Appeal	Requirement to teach evolution *did not* violate freedom to practice religion rights, conferred by the First Amendment.
Selman et al. v. Cobb County School District and Cobb County Board of Education 390 F. Supp. 2d 1286, 1313 [N.D. Ga. 2005]	District Court	Breach of the Establishment Clause of the First Amendment.
Tammy Kitzmiller, et al. v. Dover Area School District, et al., Case No. 04cv2688	Supreme Court	Breach of the Establishment Clause of the First Amendment. Intelligent Design is creationism and religious.

Three criteria were set for inclusion in this analysis, these were that all cases should:

1. Include expert witness testimony from both creationist adherents and proponents of evolutionary science. Testimony should be examined in detail and a judicial opinion reached on the validity of those arguments.
2. Be finalized, including all relevant appeal stages.
3. Be at the U.S. Supreme Court level, with decisions setting national precedent.

As a result of these inclusion criteria, only one case was selected for analysis, that of *Kitzmiller v. Dover* (2005), providing a total of 4955 pages of witness testimony and judicial opinion for analysis.

***Kitzmiller v. Dover* (2005).** In October 2004, the Dover Area School District (Pennsylvania, defendants) added the following statement to their biology curriculum "[s]tudents will be made aware of gaps/problems in Darwin's theory and of other theories of evolution including, but not limited to, intelligent design" (*Kitzmiller v. Dover*, 2005, p. 1). Another statement was read to ninth grade biology classes offering intelligent design as an alternative to evolution and referring students to an overtly creationist text book—*Of Pandas and People: The Central Question of Biological Origins* (Davis & Kenyon, 1993)—held in the school library.

Eleven parents (Tammy Kitzmiller *et al*., plaintiffs), represented by Pepper Hamilton LLP (attorneys), the American Civil Liberties Union (ACLU) and Americans United for Separation of Church and State (AU) sued the school board, alleging contravention of the Establishment Clause of the First Amendment to the United States Constitution. The National Centre for Science Education (NCSE) acted as *pro bono* consultants for the plaintiffs. In previous Supreme Court cases (e.g., *Edwards v. Aguillard*, 1987; *Epperson v. Arkansas*, 1968), the Supreme Court had ruled against teaching creationism in public schools on the basis that creationism was religious in nature. Decisions on these grounds have meant that courts did not

have to provide a detailed breakdown of the religious nature of ideas such as intelligent design, and why these differ from science. By avoiding such a discussion, this has allowed further challenges to policy and law, meticulously phrased to avoid the religious basis of the First Amendment. Intelligent design for example, avoids making direct references to a *designer*, thereby attempting to circumvent the Establishment Clause.

In December 2005, Judge John E. Jones III, a conservative Republican appointed by George W. Bush, delivered his 139 page judgement in favor of the plaintiffs. His judgement was based partly on the grounds that the board's decision was motivated by the religious views of a number of members, and was thereby in violation of the Establishment Clause of the First Amendment, and partially on the basis pf the theistic nature of intelligent design. As a result of the *Kitzmiller v. Dover* (2005) ruling, a precedent was set by the U.S. Supreme Court, such that future attempts to legalise the teaching of creationism in U.S. public school science curricula, would have to show that they do not contravene the First Amendment of the U.S. Constitution, and that their rationale is fundamentally *science* as opposed to *theology*.

Document Analysis Findings

Data was sorted into themes with textual sub-categories which arose from within the data, e.g., conceptual categories such as a critique of Darwinian evolution, with sub-categories of direct criticism, the logical fallacy of personal incredulity and the mistaken representation of evolution as just a theory. Qualitative research methods literature provides little definitive guidance on building categories (see, for example, Charmaz 2006).

Seven major themes arose from the Supreme Courts' judgment of *Kitzmiller v. Dover* (2005), showing a historical perspective of the effects of creationist arguments on existing U.S. law and public education policy; and how precedent set by past cases has influenced the most

recent decision-making processes and either curtailed—or enabled—the overt, legalised teaching of intelligent design creationism in American public science classes.

First Theme—Balanced Treatment. The term *balanced treatment* refers to arguments for the teaching of intelligent design and evolution to be equal in time and resources. As an argument for including creationism in U.S. science lessons, balanced treatment is a failed construct. It clearly violates the First Amendment to the American Constitution, and the U.S. Supreme Court has previously considered and rejected its argument *(Epperson v. Arkansas*, 1968). Yet testimony shows that the argument was clearly relied upon by more than one senior Board member, as an argument to sway other school board officials, if not the court. In addition, the weight of evidence from plaintiff and defendant testimony, suggests that Board members arguing for such balance, were fully aware of the contentious and unconstitutional nature of the topic (*Kitzmiller v. Dover*, 2005).

Second Theme—Criticism of Darwinian Theory and the Scientific Method. As Judge John Jones III stated, creationist arguments for the rationale of intelligent design throughout the *Kitzmiller v. Dover* (2005) trial, were mostly a critique of perceived flaws in evolutionary science. Yet these criticisms were met and thoroughly refuted by expert witnesses for the plaintiffs. Creationist proponents would assume the fallacy that, if insufficient evidence existed for one aspect of evolutionary science, then it must be concluded that there must be a supernatural explanation (*Kitzmiller v. Dover*, 2005). A "contrived dualism— which has no scientific factual basis or legitimate educational purpose" (*McLean v. Arkansas*, 1982, § IV.A)—identified more than thirty years previously, whereby only two explanations for life were possible, the scientific theory of evolution and biblical creationism. If one was not accepted, then the other had to be true.

In addition, the criticisms leveled at evolutionary science and the scientific method, would often require a change in what *defined* science, in order for *alternatives* (such as intelligent design), to be considered as science (*Kitzmiller v. Dover*, 2005, p. 29).

Third Theme—The Nature of Science. Gieryn et al. (1985), remarked that creationist proponents try to use the trappings of science for their own agendas, which are not those pursued by the professional scientific community. This was clearly exemplified by the manner in which creationist academics protested against the very nature of scientific inquiry, in order to allow their own disadvantaged theories to be included amongst others that have the sole advantage of being supported by more evidence. Expert witness for the defendants, U.K. sociologist Steven Fuller, discussed the scientific community as a cloistered hierarchy of specialists that predominantly ignored those theories which did not fit their classic model of observation or experimental protocol (*Kitzmiller v. Dover*, 2005). This is similar to the ideas proposed by Gieryn (1983), when he proposed that a demarcation existed between different providers of knowledge, with scientists using that demarcation to increase public support and financial resources for scientific education. From the perspective described by creationist supporters such as Fuller, science maintains a prestige, an authority, and access to resources by intimidating what it portrays as lesser forms of knowledge production.

Fourth Theme—Creation science/intelligent design is not religion. Arguments for intelligent design as science and not religion failed to sway judicial opinion during the *Kitzmiller v. Dover* (2005) trial for three major reasons. Firstly, intelligent design proponents argued that ID constituted a valid scientific theory, without being able to show that ID met the requirements of such a theory, as defined by the scientific community (*Kitzmiller v. Dover*, 2005, p. 79). Secondly ID had no history of peer-reviewed work, published in reliable scientific journals (pp.

87–88), and lastly, that ID supporters themselves had recognized the connections between ID and creationism, and had a history of using the terms synonymously.

Intelligent design has been consistently argued to be science, as evidenced by the expert witness testimonies for the defendants, provided by Professor of biochemistry Michael Behe, Professor of sociology Steven W. Fuller, Associate professor of microbiology Scott Minnich, and their associated works (Behe, 2006; Dembski, 2004, 2009; Dembski & Ruse, 2006; Manson, 2003; Meyer, 2009, 2013; Poole, 2012). Yet these arguments were soundly refuted by expert witnesses for the plaintiffs, Professor Kenneth Miller, Associate Professor Robert Pennock, Professor Barbara Forrest, Associate Professor Brian Alters, Professor Kevin Padian, and their own body of associated literature (Alters, 2005; Alters & Alters, 2001; Alters & Nelson, 2002; Dawkins, 1996, 2005, 2009; Forrest & Gross, 2004; Horner, Padian, & de Ricqlès, 2001; Miller, 1999, 2004; Padian, 1999; Padian, & Chiappe, 1998; Padian, de Ricqlès, & Horner, 2001; Padian, & Horner, 2002; Padian & Rayner, 1993; Pennock, 1999, 2001; Ricqlès, Padian, Horner, & Francillon-Vieillot, 2000) and an acceptance by the scientific community not shared by the intelligent design movement.

Members of the Dover Area School Board voted for intelligent design to share time in the high school science curriculum with evolution, because—according to testimony—they believed it to be a viable alternative to evolutionary science. They also argued under oath that they did not believe intelligent design to be religion. Yet testimony revealed that some members of the Board did not understand what intelligent design was, and simply followed the lead of Board leaders that they believed understood the issues involved (*Kitzmiller v. Dover*, 2005).

Even expert supporters of the intelligent design movement were shown to acknowledge the relationship between ID and the religious doctrine of creationism. Steven Fuller confirmed

this relationship as part of his expert witness testimony. In addition, the authors of the Dover Area School Board's recommended text, Davis & Kenyon (1993), were shown to use the terms creation and intelligent design, interchangeably over the various editions of their work. And to systematically alter the content of their text in response to the ruling of *Edwards v. Aguillard* (1987), so as not to be seen to violate the establishment Clause of the First Amendment, if the book was used in a public school science classroom (Forrest, 2004; *Kitzmiller v. Dover*, 2005).

Fifth Theme—The First Amendment. Violation of the Establishment Clause of the First Amendment of the U.S. Constitution, depended upon the Court's decision regarding the nature of intelligent design and its centrepiece idea of irreducible complexity. When Judge Jones concluded that irreducible complexity was little more than a criticism of evolution, that intelligent design was not science "and moreover that ID cannot uncouple itself from its creationist, and thus religious, antecedents" (*Kitzmiller v. Dover*, 2005, p.136), then the plaintiffs were seen to have violated both the First Amendment to the United States Constitution and the Pennsylvania State Constitution.

The result of the case was that no change to existing education policy and the law would be made. However, at the cost of a six-week Supreme Court trial, nation-wide precedent had been set. Intelligent design and irreducible complexity had, after all evidence had been heard and analysed, been found to be utterly lacking in science, and religious in its foundations, thereby violating the U.S. Constitution. This was the first Supreme Court decision that had addressed the "seminal question of whether ID is science" (*Kitzmiller v. Dover*, 2005, p.136), and has therefore set the bar for future argument.

Sixth Theme—Impact on U.S. public education policy and the law. None of the arguments used by creationist proponents to further their objective of including religious notions

of the origins of life, in the Dover Area High School science curriculum, were without precedent. All arguments necessary to illustrate the violation of the First Amendment, including the idea of intelligent design, had been proposed in earlier hearings Epperson v. Arkansas, 1968; Edwards v. Aguillard, 1987; Freiler v. Tangipahoa, 2000; Kitzmiller v. Dover, 2005; LeVake v. Independent School District (ISD), 2002; McLean v. Arkansas, 1982; Peloza v. Capistrano, 1994; Seagraves v. California, 1981; Selman v. Cobb County, 2005; and Webster v. New Lenox, 1990; Wallace v. Jaffree, 1985.

The only argument that had not been fully addressed in the U.S. Supreme Court, because that had been introduced in the district court of McLean v. Arkansas (1982), was that of whether intelligent design was a valid scientific theory. However, McLean had rejected this argument as unscientific and religiously based more than two decades previously. Thus, after a six-week trial, and an expenditure estimated at $2,067,226 (NCSE, 2006), U.S. education policy and the law remained unaltered—with one exception. Intelligent design was now, with national precedent, ruled to be religious in foundation and without scientific merit.

Seventh Theme—Social discord. Social discord was not an argument for creationist instruction *per se*. However, whilst analyzing witness testimony throughout the case. The effects of the board's actions on the local community became a recurring theme which could not be ignored. The testimonies of the plaintiffs, all citizens of the Dover area, and some even teachers at the high school in question, clearly described a community which had been divided by the actions of the School Board. The community-wide newsletter of February 2005 demeaned parents of students attending the high school, simply for protecting their First Amendment rights (*Kitzmiller v. Dover*, 2005, p. 52). Hundreds of people within the Dover area responded in the local press and attended public meetings, illustrating the strength of feeling within the

community. Pressure was applied to Board members, who were coerced into following the path set by the President of the Board of Directors, and the Chair of the Curriculum Committee (*Kitzmiller v. Dover*, 2005, p. 131–132).

Parents complained that the education of their children was adversely affected by delays in purchasing textbooks, whilst the Board searched for suitably creationist material. A number of families felt that the Board had usurped the position of parents to instill faith, and their own standard of religious belief in their children, and were upset by the discord this had caused between family members. Teachers complained of disrespect shown to themselves and their profession, of having to remove students from lessons to avoid the reading of the Board's disclosure, and of bullying amongst students as a result of the controversy (*Kitzmiller v. Dover*, 2005, p. 128–129).

The actions of the School Board had clearly been the instigating factor of a deep and heated divide in the Dover community. The testimony of Joel Leib, another high school parent and plaintiff, summarized the impact of the Board's education agenda on the local community:

> Well, it's driven and a wedge where there hasn't been a wedge before.
>
> People are afraid to talk to people for fear, and that's happened to me.
>
> They're afraid to talk to me because I'm on the wrong side of the fence.
>
> (*Kitzmiller v. Dover*, 2005, p. 129)

Discussion

In the 139 page judgement, addressing approximately 5000 pages of witness testimony, Judge John Jones III spent 27 lines specifically discussing the "effect of Board's actions on plaintiffs" (*Kitzmiller v. Dover*, 2005, p. 128–130). Yet the harm caused to this community was

testified to by each of the eleven plaintiffs. Only in her book, *The Devil in Dover: An Insider's Story of Dogma v. Darwin in Small Town America*, did the local journalist Lauri Lebo, fully address the widespread disruption caused to the Dover area community (Lebo, 2008). She eloquently describes a Dover Board meeting, in June 2004 where a local pastor addressed the Board, she wrote:

> He begged them not to do what he feared they were about to do. He warned them they would only divide the town. He warned them they would turn neighbor against neighbour. (Lebo, 2008, p. 25)

Whilst it is not the purpose of the U.S. Supreme Court to research and address such harm, this aspect of the public controversy surrounding the evolution versus creationism debate, represents an unequivocally deleterious effect on not just the curriculum of the school and students effected, but the social fabric of the community at large, and has not been sufficiently investigated. The debate itself represents a serious challenge to school administrators, principals, teachers, students and their families; whilst the fallout from public confrontation—not necessarily at the Supreme Court level—represents an undeniable challenge to the community of which any school is part. I would suggest that the leadership of any school can and should play a key role in relations between the school and the community at large, without demonstrating what the Supreme Court in *Kitzmiller v. Dover* (2005), referred to as the "breathtaking inanity of the Board's decision" (p. 138), in light of an extremely well-established historical and factual backdrop.

References

Alters, B. (2005). *Teaching biological evolution in higher education: Methodological, religious, and nonreligious issues.* Sudbury, MA: Jones and Bartlett.

Alters, B. & Alters, S. (2001). *Defending evolution: A guide to the creation/evolution controversy.* Sudbury, MA: Jones and Bartlett.

Alters, B. & Nelson, C. (2002). Teaching evolution in higher education. *Evolution, 56*(10), 1891–1901.

Behe, M. (1996). *Darwin's black box: The biochemical challenge to evolution*. (1st ed.). New York, NY: Free Press, Simon & Schuster Inc.

Behe, M. (2000, July 31). Philosophical objections to intelligent design: Response to critics [Web log post]. http://www.arn.org/docs/behe/mb_philosophicalobjectionsresponse.htm

Behe, M. (2001). Reply to my critics: A response to reviews of Darwin's black box: The biochemical challenge to evolution. *Biology and Philosophy*, *16*(5), 685–709. Retrieved from http://www.lehigh.edu/~inbios/pdf/Behe/Behe_reply_to_my_critics.pdf.

Behe, M. (2006). *Darwin's black box: The biochemical challenge to evolution*. (10th anniversary ed.). New York, NY: Free Press, Simon & Schuster Inc.

Behe, M. (2010). Lehigh University, Department of Biological Sciences—Faculty: Michael J. Behe, Ph.D., Professor of biochemistry [Research Summary]. Retrieved from http://lehigh.edu/~inbios/faculty/behe.html.

Ben-Ari, M. (2005). *Just a theory—exploring the nature of science*. New York, NY: Prometheus.

Berkman, B. & Plutzer, E. (2011). Defeating creationism in the courtroom, but not in the classroom. *Science, 331*(6016), 404–405. Doi: 10.1126/science.1198902. Supporting

online material retrieved from http://www.sciencemag.org/content/suppl/2011/01/24/331.6016.404.DC1/Berkman.SOM.pdf

Charmaz, K. (2006). Constructing grounded theory: A practical guide through qualitative analysis. London, England: Sage Publications.

Davis, P., & Kenyon, D. (1993). *Of pandas and people: The central question of biological origins*. (2nd ed.). Richardson, Texas: Foundation for Thought and Ethics (FTE).

Dawkins, R. (1996). *Climbing mount improbable*. London, England: Penguin Books.

Dawkins, R. (2006). *The god delusion*. Boston, MA: Houghton Mifflin.

Dawkins, R. (2009). *The greatest show on earth: The evidence for evolution*. New York, NY: Free Press, Simon & Schuster Inc.

Dembski, W. (2004). The design revolution: Answering the toughest questions about intelligent design. Nottingham, England: Inter-Varsity Press.

Dembski, W. (2009, September 12). *Intelligent design as a theory of information. Access Research Network*. Retrieved from: http://www.arn.org/docs/dembski/wd_idtheory.htm.

Dembski, W., & Ruse, M. (Eds.), (2006). *Debating design: From Darwin to DNA*. Cambridge, England: Cambridge University Press.

Donnelly, L. & Boone, W. (2007). Biology teachers' attitudes toward and use of Indiana's evolution standards. *Journal of Research in Science Teaching, 44*(2), 236–257. Doi: 10.1002/tea.20150

Edwards v. Aguillard, 482 U.S. 578 (1987). Retrieved from http://www.law.cornell.edu/supct/html/historics/USSC_CR_0482_0578_ZS.html.

Epperson v. Arkansas, 393 U.S. 97, 37 U.S. Law Week 4017, 89 S. Ct. 266, 21 L. Ed 228 (1968). Retrieved from http://www.law.cornell.edu/supremecourt/text/393/97.

Forrest, B., & Gross, P. (2004). *Creationism's Trojan horse: The wedge of intelligent design*. Oxford, England: Oxford University Press.

Freiler v. Tangipahoa Parish Board of Education, 530 U.S. (2000).

Fuller, S. (2008). Dissent over descent: Intelligent design's challenge to Darwinism. Cambridge, England: Icon Books.

Gieryn, T. (1983). Boundary-work and the demarcation of science from non-science: Strains and interests in professional ideologies of scientists. *American Sociological Review*, *48,* 781–795. Retrieved from http://www.jstor.org/stable/2095325.

Gieryn, T., Bevins, G., & Zehr, S. (1985). Professionalization of American scientists: public science in the creation/evolution trials. *American Sociological Review*, *50*(3), 392–409. Retrieved from http://www.jstor.org/stable/2095548.

Horner, J., Padian, K., & de Ricqlès., A. (2001). Comparative osteohistology of some embryonic and perinatal archosaurs: phylogenetic and behavioral implications for dinosaurs. *Paleobiology*, *27*(1), 39–58. Doi: 10.1666/0094-8373(2001)027<0039:COOSEA>2.0.CO;2

Hume, D. (2000). Of Miracles. In *An Enquiry Concerning Human Understanding*. T. L. Beauchamp (Ed.), pp. 83–99. Oxford, England: Oxford University Press.

Kitcher, P. (1984). *Abusing science: The case against creationism*. Cambridge, MA: MIT Press.

Kitcher, P. (2007). *Living with Darwin: Evolution, design and the future of faith*. Oxford, England: Oxford University Press.

Kitzmiller v. Dover Area School District, No. 04cv2688, 2005 U.S. Dist. (M.D. Pa. 2005). Retrieved from http://www.pamd.uscourts.gov/opinions/jones/04v2688d.pdf.

Kuhn, T. (1996). *The structure of scientific revolutions (*3rd ed.). Chicago, IL: University of Chicago Press.

Lebo, L. (2008). The devil in Dover: An insider's story of dogma v. Darwin in small-town America. New York, NY: The New Press.

LeVake, R. v. Independent School District #656, 625 N.W.2d 502 (MN Ct. of Appeal 2000), cert. denied, 534 U.S. 1081 (2002). Retrieved from http://caselaw.findlaw.com/mn-court-of-appeals/1085860.html

Linder, D. (2008). Tennessee vs. John Scopes: The monkey trial. *Famous trials in American history*. Retrieved from http://law2.umkc.edu/faculty/projects/ftrials/scopes/scopes.htm

Long, D. (2011). Evolution and religion in American education: An ethnography. In K. Tobin & C. Milne (Eds.), *Cultural Studies of Science Education: Vol. 4*. Dordrecht: Springer.

Long, D. (2012). The politics of teaching evolution, science education standards, and being a creationist. *Journal of Research in Science Teaching*, *49*(1), 122–139. Doi: 10.1002/tea.20445

Luskin, C. (2009). Does challenging Darwin create constitutional jeopardy? A comprehensive survey of case law regarding the teaching of biological origins. *Hamline Law Review, 32*(1), p. 1–64. Retrieved from http://heinonline.org.proxy.queensu.ca/HOL/Page?handle=hein.journals/hamlrv32&collection=journals&id=3.

Manson, N. (Ed.). (2003). The teleological argument and modern science. New York, NY: Routledge.

McLean v. Arkansas Board of Education, 529 F. Supp. 1255, 50 U.S. Law Week 2412 (1982). Retrieved from http://www.leagle.com/xmlResult.aspx?xmldoc=19821784529FSupp 1255_11613.xml&docbase=CSLWAR1-1950-1985.

Meyer, S. (2009). Signature in the cell: DNA and the Evidence for Intelligent Design. London, England: Harper Collins eBooks.

Meyer, S. (2013). Darwin's doubt: The explosive origin of animal life and the case for intelligent design. London, England: Harper Collins eBooks.

Miller, K. (1999). Finding Darwin's God: A scientist's search for common ground between God and evolution. New York, NY: Cliff Street Books.

Miller, K. (2004). The flagellum unspun: The collapse of "irreducible complexity." In W. Dembski & M. Ruse, (Eds.), *Debating design: from Darwin to DNA*, pp. 81–97. Cambridge, England: Cambridge University Press.

Miller, J., Scott, E., & Okamoto, S. (2006). Public acceptance of evolution. *Science, 313*(5788), 765–766. Doi: 10.2307/3846903

Moore, R. (2000). The revival of creationism in the United States. *Journal of Biological Education, 35*(1), 17–21. Doi: 10.1080/00219266.2000.9655730

Moore, R. (2004). How well do biology teachers understand the legal issues associated with the teaching of evolution? *Bioscience, 54*, 860–865. Doi: 10.1641/0006-3568(2004)054[0860:HWDBTU]2.0.CO;2

National Academy of Sciences and Institute of Medicine (NAS). (2008). *Science, evolution, and creationism* (3rd ed.). Washington, D.C.: The National Academies Press.

National Center for Science Education (NCSE). (2006, February 24). *"Intelligent design" costs Dover over $1,000,000*. Retrieved from http://ncse.com/news/2006/02/intelligent-design-

costs-dover-over-1000000-00899.

National Center for Science Education (NCSE). (2014). *News: Anti-evolution*. Retrieved from http://ncse.com/news/anti-evolution.

Noffke, N. Christian, D. Wacey, D. & Hazen, R. (2013). Microbially induced sedimentary structures recording an ancient ecosystem in the *ca.* 3.48 billion-year-old dresser formation, Pilbara, Western Australia. *Astrobiology, 13*(12), 1103–1124. Doi:10.1089/ast.2013.1030

Ontario Ministry of Education. (2008b). *The Ontario Curriculum Grades 11 and 12 Science*. Retrieved from http://www.edu.gov.on.ca/eng/curriculum/secondary/2009science11_12.pdf.

Ontario Ministry of Education. (2008a). *The Ontario Curriculum Grades 9 and 10 Science*. Retrieved from http://www.edu.gov.on.ca/eng/curriculum/secondary/science910_2008.pdf.

Padian, K. (1999). Charles Darwin's views of classification in theory and in practice. *Systematic Biology, 48*(2), 352–364. Retrieved from http://www.jstor.org/stable/2585359.

Padian, K., & Chiappe, L. (1998). The origin and early evolution of birds. *Biological Reviews of the Cambridge Philosophical Society*, *73*(1), 1–42. Doi: 10.1017/S0006323197005100

Padian, K., de Ricqlès, A., & Horner, J. (2001). Dinosaurian growth rates and bird origins. *Nature*, *412*(6845), 405–408. Doi: 10.1038/35086500

Padian, K., & Horner, J. (2002). Typology versus transformation in the origin of birds. *Trends in Ecology and Evolution, 17*(3), 120–124. Doi: 10.1016/S0169-5347(01)02409-0

Padian, K., & Rayner, J. (1993). The wings of pterosaurs. *American Journal of Science, 293-A*, 91–166. Doi: 10.2475/ajs.293.A.91

Patton, M. (2002). *Qualitative Research & Evaluation Methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Peloza v. Capistrano Unified School District, 37 F.3d 517 (9th Cir. 1994).

Pennock, R. (1999). Tower of Babel: The evidence against the new creationism. Cambridge, MA: MIT Press.

Pennock, R. (2001). 'Naturalism, evidence, and creationism: the case of Phillip Johnson', in R. Pennock (Ed.), *Intelligent Design Creationism and Its Critics: Philosophical, Theological, and Scientific Perspectives*, pp. 77–97. Cambridge, MA: MIT Press.

Pojeta, J., & Springer, D. (2001). *Evolution and the fossil record*. Virginia, VA: American Geological Institute, and Boulder, CO: The Paleontological Society.

Poole, V. (2012). *A comprehensive introduction to intelligent design*. Delhi, India: White Word Publications.

Popper, K. (1959). Experience as a Method. In *The Logic of Scientific Discovery*, pp. 39–40. London, England: Hutchinson Education.

Ricqlès, A., Padian, K., Horner, J., & Francillon-Vieillot, H. (2000). Paleohistology of the bones of pterosaurs (Reptilia: Archosauria): anatomy, ontogeny, and biomechanical implications. *Zoological Journal of the Linnean Society, 129*(3), 349–385. Doi: 10.1111/j.1096-3642.2000.tb00016.x

Sagan, C. (2006). Second view: Sagan on encounters. In *Conversations with Carl Sagan*, T. Head (Ed.), p. 47. Mississippi, MS: University Press of Mississippi.

Schopf, J. (1999). *Cradle of life: The discovery of Earth's earliest fossils*. Princeton, NJ: Princeton University Press.

Scopes v. Tennessee, 289 S.W. 363, 154 Tenn. 105, 154 Tennessee 105 (1927). Retrieved from: http://law2.umkc.edu/faculty/projects/ftrials/scopes/statcase.htm.

Seagraves v. California Department of Education, Dkt. No. 278978 (Sup. Ct. Cal. 1981).

Selman v. Cobb County School District. 390 F. Supp.2d 1286 (N. D. Ga. 2005).

U.S. Constitution. Amendment I, (ratified, 1791). Retrieved from http://www.usconstitution.net/xconst_Am1.html.

Wallace, Governor of Alabama, *et al*. v. Jaffree, I., *et al.* 472 U.S. 38 (1985). Retrieved from http://scholar.google.ca/scholar_case?case=2471425569650729212&q=Wallace+v.+Jaffree,+472+US+38+(1985)&hl=en&as_sdt=2006.

Webster v. New Lennox School District #122, 917 F.2d 1003 (7th Cir. 1990).

Wendel, P. (2007, June). *Falsifiability as a science/non-science demarcation criterion in the battle against creationism*. Paper presented at the Ninth International History, Philosophy, and Science Teaching Conference, University of Calgary, Alberta, Canada.