Abstract
In order to effectively teach evolution to all students, even those resistant to learning evolution, science teachers may question the extent to which religion can legally be discussed in the public high school science classroom. Evolution is taught from a variety of approaches, each of which has legal implications. Four approaches to teaching socioscientific issues like evolution are provided, along with the legal implications of enacting each approach.

Keywords: Evolution; law; legal issues; pedagogy.

The theory of evolution provides scientists with the best explanation for the diversity and interrelatedness of species on earth and has been supported by empirical research across scientific fields ranging from anatomy to zoology. The fact that evolution is supported by a vast and diverse amount of empirical research – and, in turn, provides support for other areas of research – is largely unquestioned by scientists. Because evolution is a central theme within the biological sciences, it holds a prominent place in the National Science Education Standards (National Research Council, 1996), the Framework for K–12 Science Education (National Research Council, 2012), and drafts of the Next Generation Science Standards (Bybee, 2012). Many states also emphasize the importance of teaching biological evolution to secondary science students (Gross, 2005), though the extent to which states address evolution is inconsistent (Cavanagh, 2005; Skoog, 2005). In assigning grades to each state’s standards, Lerner et al. (2012) highlighted the undermining of evolution as a major issue leading to poor state science standards. Evolution standards that are ambiguous or inconsistent may leave to individual teachers the decision to teach or avoid evolution (Goldsten & Kyzer, 2009). Therefore, it is increasingly important that individual teachers are aware of the legal issues surrounding the teaching of – or avoidance of teaching – evolution. The purpose of this article is to increase that awareness.

Legal Challenges to the Teaching of Evolution
In 1925, a young physics teacher substituted for an ill biology teacher and assigned the reading of chapters on evolution from the class textbook, A Civic Biology by George William Hunter (Gould, 1999). That act led to the monumental trial in which the substitute teacher, John T. Scopes, was found guilty of teaching evolution in Tennessee. To this day, challenges to the teaching of evolution in public schools emerge and are contested in courts of law. Many teachers may not be fully aware of the extent to which they are in accordance with the legal parameters afforded them when teaching evolution (Moore, 2004).

In Lemon v. Kurtzman (403 U.S. 602 [1971]), the U.S. Supreme Court developed a test (the Lemon test) to determine whether state action violates the Establishment Clause of the First Amendment. The test includes three prongs: (1) the act must have a bona fide secular purpose, (2) the act’s principal or primary effect must be one that neither advances nor inhibits religion, and (3) the act must not result in an excessive entanglement of government with religion (Lofaso, 2009). Despite consistent rulings by the Supreme Court that the teaching of creationism in public school science classes is unlawful (Edwards v. Aguillard, 482 U.S. 578 [1987]), individual state leaders have put forth anti-evolution challenges. In some instances, lawsuits have been filed when teachers followed the law; in other instances, when they have defied the law; and in others, when they were ignorant of the law (Moore, 2004). In order to provide the best instruction to students, protect oneself and one’s school system, and identify and enact pedagogical approaches to teaching evolution that are consistent with current scientific understandings and legal parameters, it is imperative that science teachers are well informed of what they can and cannot legally do within the public school classroom. Below, I provide four approaches to teaching evolution.
evolution, along with the legal implications of enacting each approach in public schools.

**Four Approaches to Teaching Evolution**

Evolution is a socioscientific controversy, having several characteristics that define controversial issues: there are at least two opposing groups; there is a heated disagreement between supporters on both sides of the issue; the answer is not clear to all reasonable people; and there is acknowledged uncertainty and disagreement about evolution from a societal perspective (Hermann, 2008). Owing, in part, to the socioscientific nature of evolution, the pedagogical approaches to teaching it vary greatly. Reiss (1992) reported on three possible instructional approaches, modified from Bridges (1986), for addressing controversial issues in science classrooms: advocacy, affirmative neutrality, and procedural neutrality. Advocacy occurs when the teacher argues for the position he or she holds. **Affirmative neutrality** occurs when the teacher presents multiple sides of the controversy without revealing which side he or she supports. **Procedural neutrality** occurs when information about the controversy and different points of view are elicited from students and from resource material. Hermann (2008) extended this framework to include avoidance. Here, I provide a description of the legal issues surrounding each of these pedagogical approaches.

**Avoidance**

A recent study of 926 teachers indicated that 60% avoid endorsing either evolution or alternatives to avoid controversy (Berkman & Plutzer, 2011). Teachers may avoid teaching evolution because (1) they do not believe evolutionary theory and do not want to teach it, (2) they want to avoid controversial issues to minimize discipline problems (Nicholls & Nelson, 1992), or (3) they lack training with regard to teaching controversial issues (Levinson, 2002).

**Legal implications of not teaching evolution.** – Teachers who avoid the teaching of evolution without the perception of doing so for religious reasons may not violate any laws, but they are not adhering to national standards and, in most cases, state standards. Given the explanatory power of the theory of evolution, teachers who avoid covering it may be called into question for not adequately addressing the standards of the discipline. Teachers who avoid teaching evolution can be required to do so by their school district (Peloza v. Capistrano Unified School District, 37 F. 3d 517 [9th Cir. 1994]).

**Advocacy**

**Advocating evolution.** – Public school teachers who advocate evolution do so by teaching the science of evolution only. Advocates of evolution do not address the religious and political issues surrounding it. Berkman and Plutzer (2011) reported that 28% of the 926 practicing teachers surveyed were strong advocates of teaching evolution. Teachers who are advocates are likely to thoroughly cover the topic (Trani, 2004).

There is limited research on how advocates of evolution are received by students who are resistant to learning evolution for religious reasons, though students with stronger religious beliefs are less likely to understand evolution (Moore et al., 2011). Students who perceive a conflict with their beliefs are often not vocal and internalize the conflict, which can result in disdain or complete withdrawal (Scharmann, 1994). Hermann (2012) interviewed public high school AP Biology students who had sophisticated understandings of evolution but did not believe in evolution because they thought that it ran counter to their religious beliefs. The students felt somewhat alienated because their religious beliefs were often ignored or omitted from class discussions. Meadows (2009) cautioned that when students are told they will be sticking to the science and not discussing faith, they often interpret this as implying that their faith is not important.

**Legal implications of advocating evolution.** – Advocating the teaching of evolution is within legal parameters. The theory of evolution falls within the definition of science (Lofaso, 2006), and schools cannot outlaw the teaching of evolution (Epperson v. Arkansas, 393 U.S. 97 [1968]). The Supreme Court stated that public schools do not have the right to prohibit the teaching of a scientific theory when the prohibition is based on reasons that violate the First Amendment (Epperson v. Arkansas). Moreover, public high school science teachers cannot be asked to provide equal time for evolution and creation science (Edwards v. Aguillard) or be asked to read statements that are disclaimers that endorse a particular religion prior to teaching evolution (Freiler v. Tangipahoa Parish Board of Education, 185 F.3d 337 [5th Cir. 1999], cert. denied, 530 U.S. 1251 [2000]). Further, evolution consistently appears in national science standards and is considered to be a foundational topic to biology specifically, but to other disciplines within science as well.

**Advocating creationism or intelligent design.** – Berkman and Plutzer (2011) reported that 13% of 926 practicing teachers surveyed explicitly advocated the teaching of creationism or intelligent design, and another 5% endorsed alternatives to a lesser extent. Here, I define advocates of creationism or intelligent design as those science teachers who teach creationism or intelligent design and limit discussion of biological evolution within the classroom. Given the aforementioned variation in state and national standards, it should not be surprising that teachers are less likely to teach evolution if the state or national standards are not clear or leave evolution out (Goldston & Kyzer, 2009, BouJaoude et al., 2011). When not cognizant of state and national standards and the legality of doing so, science teachers are likely to include creationism or intelligent design in their instruction. Moore (2004) found that 27% of 103 biology teachers in Minnesota believed that they had the choice to teach creationism in the science curriculum.

**Legal implications of advocating creationism or intelligent design.** – Public school science teachers who advocate creationism, intelligent design, or other alternatives to evolution in the classroom are violating the law. The U.S. Supreme Court unanimously declared Arkansas’ anti-evolution statute prohibiting the teaching of evolution unconstitutional because it violated the Establishment Clause (Epperson v. Arkansas). Laws mandating that time be spent teaching alternatives to evolution alongside evolution have been found to violate the Establishment Clause (Edwards v. Aguillard). Additionally, the teaching of intelligent design was found to be unconstitutional by a federal district court in Pennsylvania (Kitzmiller v. Dover Area School District, 400 F. Supp. 2d 707 [M.D. Pa. 2005]). In that case, the court concluded that intelligent design is not science because (1) it violates the ground rules of science by invoking and permitting supernatural causation; (2) the central tenant of intelligent design employs a flawed and illogical contrived dualism; and (3) it has been deemed unscientific by the scientific community.
Nor can public school science teachers invoke the claim of academic freedom to teach their personal beliefs (Peloa v. Capistrano Unified School District). The court concluded that a school teacher is not an “ordinary citizen” while in contact with students and, therefore, cannot deny the theory of evolution or discuss personal religious views within a science class. Likewise, public school teachers cannot invoke the right of free speech to reference personal religious beliefs while teaching, even if the stated purpose is to help students develop an open mind (Webster v. New Lenox School District no. 122, 917 F2d 1004 [7th Cir. 1990]). Actions that can be perceived as unconstitutional have been found to be unconstitutional. For example, keeping a copy of a Bible on a teacher's desk during the school day was perceived as a way for the teacher to communicate religious beliefs to students (Roberts v. Madigan, 921 F2d 1047 [10th Cir. 1990]).

Affirmative Neutrality

Affirmative neutrality occurs when teachers present multiple sides of the controversy without revealing which side they support. Teachers utilizing an affirmative neutrality approach inform students that there is a socioscientific controversy surrounding evolution. They provide students with multiple sides of the controversy. They may discuss creation stories of different religions, differences between science and religion or other ways of knowing about the world, and/or religious affiliations that support the teaching of evolution (Sager, 2008; http://www.clergyproject.org). An affirmative neutrality approach utilizes the established framework that evolution is science and, as such, should be taught within a science classroom whereas other ways of knowing are not science and should not be taught within a science classroom. These teachers are not “teaching the controversy” but are acknowledging that the controversy exists and that it may influence students’ ability or willingness to learn evolution. They may use an inquiry approach like that of Meadows (2009) to teach evolution without undermining students’ religious beliefs.

Reiss (2010) suggested that “Teaching about aspects of religion in science classes could potentially help students better understand the strengths and limitations of the ways in which science is undertaken, the nature of truth claims in science, and the importance of social contexts for science” (p. 97). Donnelly et al. (2009) conducted a study of high school students in which students suggested that religious explanations should be included in science instruction on evolution. They found that some evolution rejecters where able to learn evolution by justifying it as one possible perspective.

Legal implications of affirmative neutrality. – Teachers who teach evolution from an affirmative neutrality approach must remain within the confines of the law. Affirmative neutrality is a teacher-centered approach that helps teachers ensure that instruction stays within the parameters of the law, and knowing the legal parameters is critical. Teachers must be aware that when they discuss the difference between science and non-science, students may perceive that they are doing so to advance a particular religion. Enacting this approach requires teachers to ensure that, if they have a particular religious view, it is not communicated to the students to a greater or less extent than other views. At the heart of the affirmative neutrality approach is the desire to teach evolution to those students who may be reluctant to learn about evolution because of their religious beliefs. Thus, teachers must clearly teach the theory of evolution and spend much more instructional time on evolution than on a discussion of different views on evolution. The discussion should assure students that what they will learn is not aimed at replacing their religious beliefs. Teachers must not provide equal discussion of creationism or intelligent design when teaching evolution. To remain within the legal parameters, teachers must provide a neutral approach when discussing the creation stories of various religions (Epperson v. Arkansas). The Lemon test was clarified to ask whether the purpose is to convey a message of endorsement or disapproval of religion (Lynch v. Donnelly, 465 U.S. 668 [1984]). The Supreme Court “approvingly discussed the idea that public schools can instruct students on the role that religion has played in history and its role in historical controversies so long as the school does not teach religious dogma as true or attempt to inculcate religious values” (Lofaso, 2009, p. 79).

Procedural Neutrality

Procedural neutrality occurs when information about the controversy and different points of view are elicited from students and resource material. This approach differs from affirmative neutrality in that the students rather than the teacher provide different points of view. This student-centered approach may engage students who are resistant to learning evolution. Several researchers (Meadows et al., 2000; Brem et al., 2003; Ingram & Nelson, 2006; Woods & Scharmann, 2001; Hermann, 2013) have suggested that students should be provided with the opportunity to discuss their views of the interaction between science and religion in order to better understand why evolution is scientifically valid.

Oulton et al. (2004) stated that students should explore how individuals can arrive at different perspectives on an issue that encourages students to accommodate new information in their schemata and alter their worldview. Procedural neutrality permits a discussion of the nature of the controversy surrounding evolution education. Science teachers should not teach the controversy, but they might acknowledge that the controversy exists and permit students to discuss their understandings of the controversy. Even the National Center for Science Education, a group dedicated to the teaching of evolution, stated that “it might, on occasion, be appropriate to mention antievolutionism briefly in a science class, if only to say that religious objections to evolution exist but are not within the scope of the class” (Scott & Branch, 2003, p. 502). As with affirmative neutrality, the purpose of this approach is to reduce the feeling of alienation among students who are resistant to learning evolution. The expectation is that the theory of evolution is the focus of science instruction, and discussions of different views are conducted to prime all students for learning evolution, regardless of the students’ religious beliefs. To that end, Glennan (2009) suggested that it is difficult to separate science from religion in the classroom when students hold religious beliefs that are inconsistent with scientific evidence, and teachers must be prepared to tell students when their faith-based claims about the natural world are most likely wrong, even though such statements contradict students’ religious beliefs. Addressing the differences between religions and science through the procedural neutrality approach may help students understand how they can maintain their religious beliefs while developing a stronger understanding of the scientific evidence for evolution.

Legal implications of procedural neutrality. – The legal implications of teaching evolution from a procedural neutrality approach are similar to those for teaching through an affirmative neutrality approach. Science teachers must ensure that discussion is neutral and does not advance any particular religion and provides much more
instructional time to the theory of evolution and much less time to aspects of the controversy. The purpose in discussing the controversy should clearly be perceived as purposeful in establishing the difference between science and non-science, with the aim of increasing student understanding of evolution.

One critical difference is that the student-centered nature of the procedural neutrality approach may result in the need for teachers to be more diligent in filtering what is done and what is said in the science classroom. Students may object to the teaching of evolution, and this approach provides a format for students to raise religious objections. Teachers can suppress student objections if their expression will interfere with schoolwork or discipline (Tinker v. Des Moines Independent Community School District, 393 U.S. 503 [1969]). If there are legitimate pedagogical concerns, schools can regulate student speech even in the absence of a significant disruption (Hazelwood School District v. Kuhlmeier, 484 U.S. 260 [1988]). Given the results of these two court cases, it is within the teacher's purview to guide the discussion away from anti-evolution statements and toward the development of an understanding of the limitations of both science and religion, in that faith-based arguments are not permissible with science.

**Summary**

There is a range of approaches to teaching socioscientific issues such as evolution, each with legal implications. I encourage teachers to consider their approach to teaching evolution and evaluate the extent to which they are within the legal parameters. Similarly, I encourage public school science teachers to consider the extent to which their instruction is increasing all students' understanding of evolution, including those reluctant to learn about evolution. Teachers who advocate alternatives to evolution are not teaching within the confines of the law and must select other approaches that lead to an increase in student understanding of evolution. Likewise, avoiding evolution may be unlawful if teachers appear to be doing so for religious reasons. Even if teachers are avoiding evolution without the perception of doing so for religious beliefs, they can be ordered to do so to ensure that state and national standards are addressed. There may be a host of factors that influence teachers' approaches to evolution, but teachers must remain within the law when discussing the socioscientific controversy of evolution and teach only accepted science.

**References**


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