Working Paper Series

Working Paper #7

Recurrence of the Same?
Intelligent Design and the Biology Classroom

Jason Borenstein

2005

School of Public Policy
Georgia Institute of Technology
D. M. Smith Building
Room 107
685 Cherry Street
Atlanta, GA 30332 - 0345

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As the complex and heated debates between evolution's supporters and its critics continue, teachers and school boards are struggling to figure out how to handle the issue of the origin of human life within biology classrooms. Controversy circulating around evolution had caused some states, including Georgia, to remove the word "evolution" from the science curriculum and evade teaching about the subject matter.[1] Recently, critics have offered forward a view called intelligent design (ID), which purports to illustrate conceptual and empirical shortcomings in evolutionary theory. Intelligent design supporters argue that students should be made aware of these shortcomings and suggest that alternatives to evolution need to be taught, which may include intelligent design. Yet a key issue that needs to be resolved is whether it is a sound pedagogical approach to teach intelligent design alongside evolution, which may in part be figured out by determining whether it is a true rival (or perhaps compliment) to evolutionary theory. In this article, my primary aim is not to proclaim that the theory of intelligent design is false. Rather, it is to argue that intelligent design does not belong in high school biology classrooms at this point in time.

I) The Challenge of Intelligent Design

Since the time of Charles Darwin, especially following after the trial of John Scopes in 1925, ongoing conceptual battles have been waged between supporters of evolution and creationists. The essence of the legal components of these disputes typically hinge on

whether creationism is properly considered as being science, religion, or something else.[2] More specifically, courts have sought to determine whether discussing creationism in science courses violates the Establishment Clause of the Constitution. Key legal rulings have typically held that creationism is "religion" and thus it is unconstitutional for creationism to be taught as a mandatory part of high school biology curriculums.[3] The *Lemon* test has played a crucial role in such cases. It is a set of criteria that has been used by the courts to ascertain whether the government is favoring religious interests over secular ones.[4] In accordance with the *Lemon* test, an "excessive entanglement" between government and religion should be avoided if secular means could be used to accomplish the same goal.[5]

Even though creationism, in its various forms, has typically failed to pass constitutional muster, the Supreme Court has not categorically forbidden biology teachers from discussing alternatives to evolution as long as those lessons do not cause religion and science to be overly intertwined. ID supporters, creationists, and others typically latch on to the ruling in *Edwards v. Aguillard* (1987) to provide legal grounds for introducing challenges to evolution in the classroom. According to the *Edwards* Court, "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."[6] Thus, the Court has not ruled out the possibility of discussing evidence against evolution.

The *Edwards* case has left open the door for repeated challenges to evolution to be voiced in academic and non-academic circles in the effort to convince the courts and school boards that evolution should not be taught "unopposed" in biology classrooms. It has caused the states and their school boards to approach evolution in vastly different ways.[7] In accordance with their interpretation of relevant legal cases and laws, intelligent design supporters seek to take advantage of this "legal opening" to offer what they argue is a secular, scientific body of claims that can illustrate conceptual and empirical difficulties with evolution.

Although the teaching of intelligent design has not been specifically required in accordance with most states' science standards, several state school boards and legislatures have considered implementing proposals that would encourage teachers to discuss evidence against evolution.[8] Although ID was not made mandatory by the state of Ohio, the state school board explicitly considered incorporating it into the curriculum.[9] Missouri's legislature has considered a bill that would require teachers to discuss alternatives to evolution, including ID.[10] Recently, Dover Pennsylvania became the first school district to *mandate* that ID be taught as part of the biology curriculum.[11] At this point, the Discovery Institute, one of the main organizations defending the notion that ID is a credible scientific theory, has not openly advocated that it should be a mandatory part of biology education.[12] However, ID supporters recommend that teachers be given the discretion to cover secular challenges to evolution, which they say could include ID.

II) Creationism and Intelligent Design

One of the common complaints voiced against intelligent design is that it is merely a repackaged form of creationism. The criticism is offer in part because both views seemingly rely on the existence of a divine being to serve as a foundation for their respective claims. Hence, it has been argued that both are closer to religion than they are to science. Since efforts seeking to require that creationism be taught in schools have consistently been rejected by the courts, critics suggest that ID deserves a similar fate. Yet it needs to be examined whether there are substantive differences between the two. It may be uncharitable to design theorists to conflate their views with the views offered by creationists.

Several different forms of creationism have emerged since the time of the Scopes trial, but the notion typically unifying creationists is that the biblical story of creation provides a guide for determining how life began on earth. Some forms of creationism, such as the one circulating around during 1920's, usually make explicit and direct reference to biblical passages as a foundation for claims about the origins of life. Creationists of this type accept a literal interpretation of the story of creation, which suggests to them that the earth has only been in existence for several thousand years and that species do not significantly change over time.[13] Since these "young earth" creationists reject the major tenets and assumptions grounding evolutionary theory, they have difficulty providing an explanation for the fossil record and accounting for how the vast numbers of different

species on the planet came into existence, which typically causes their view to be dismissed by scientists.

Over the course of the twentieth century, creationists have tried to become more sophisticated and savvy in their attempt to make their theories appear consistent with available scientific evidence. Scientific creationism, for example, endeavors to link scientific evidence from the fossil record and geological surveys to support claims contained within the Bible and, as a by-product, illustrate flaws in evolutionary theory.[14] The Creation Research Society (CRS), one of the main representatives of a scientifically-minded approach to creationism, performs empirical research, which purportedly has uncovered evidence to support the claims of creationists such as that humans and dinosaurs may have existence during the same time period. Yet the CRS explicitly acknowledges that the Bible must be accepted as a true account of history,[15] which is a significant reason why the courts, scientists, and other scholars have been skeptical of the CRS's proposed "scientific" claims.

Unlike creationism, the origin of intelligent design does not stem straightforwardly from the Bible, but the history of ID is unquestionably intertwined with the Judeo-Christian tradition. Formulations of intelligent design theories have existed at least since the time of Plato and Aristotle.[16] Aristotle's teleology significantly influenced the development of Western philosophical thinking. His discussions of "final causes" have undoubtedly shaped how scholars view the world. In order to understand the world adequately, it has been argued, we must determine what function humans and non-humans alike are here to

serve. Teleology has unabashedly been embraced within religious scholarship, especially as articulated through the views of St. Thomas Aquinas. Making use of a teleological framework to support his proofs for the existence of god, Aquinas argued that since "natural bodies" seem to behave in a consistent and directed fashion, a designer must exist to govern regularities in the world.[17] According to Aquinas, this designer is an intelligent being that enables "natural bodies" to fulfill their purpose.

Over the last few centuries, design theories met with various obstacles, including criticisms posed by David Hume. Hume offered several devastating objections against a design view,[18] and it is not clear that his objections have been answered adequately.[19] Further, as James Rachels states, "modern science gives us a picture of the world as a realm of facts, where the only 'natural laws' are the laws of physics, chemistry, and biology, working blindly and without purpose."[20] Arguably, the rise of modern science, especially Newtonian mechanics and Darwinian evolution, has pushed reference to "purpose" or "design" outside the domain of scientific discourse.

Undeterred by common practice within modern science, supporters of intelligent design *claim* that recent "scientific" versions of design theory prove that there can be meaningful discussions alluding to a designer, which can occur within scientific circles. A defense of this type of view is usually done with the end in mind of showing that ID can serve as an alternative, or perhaps a compliment, to evolution. Design theorists, such as Michael Behe, William Dembski, Phillip Johnson, and Stephen Meyer, argue that evolution alone

cannot account for the origin of life on this planet and the complexity of the creatures that exist.

Design theorists assert that there are substantive differences between ID and the views of creationists, such as those provided by the CRS. Unlike the early or more recent scientific forms of creationism, design theorists deny that their theory is based on a religious text or a particular set of religious claims. Creationists typically make explicit reference to the Judeo-Christian beliefs about a divine being within their arguments. Yet, according to Michael Behe, "intelligent design itself says nothing about the religious concept of a creator."[21] Design theorists take great pains to avoid mentioning the identity and traits of the designer and suggest that scientists, regardless of their religious convictions, can accept the evidence offered in support of ID. At first glance, this approach seems noticeably different than one offered by the CRS, because the latter openly and unabashedly demands allegiance to the Bible's claims.

Moreover, whereas creationists typically reject much, if not all, of evolutionary theory,[22] design theorists usually embrace many of evolution's major tenets. Design theorists do not have qualms with claims such as that the earth is billions of years old and that species change occurs. However, at the same time, they assert that there are substantive differences between their views and the views of evolutionary biologists.[23] For instance, design theorists are willing to accept that random mutation and natural selection play a role in determining which species survive, but contend that natural mechanisms alone are not sufficient to account for the existence of human life. As a result, even if creationism

is properly labeled as being "religion", design theorists argue that ID is not the same thing and that their view should be evaluated independently of creationism to determine if it a true rival to evolution.

III) "Teach the Controversy"

A) The Logic of the Approach

One of the main arguments in support of teaching intelligent design in public schools is that students need to be aware of the controversy circulating around evolution. If evolution is truly on shaky ground, then ID supporters suggest that students need to be made aware of this fact. This is the so-called "teach the controversy" approach. Since ID supporters argue that there is substantial evidence contradicting at least some of the claims supporting evolutionary theory, high school students should be apprised of the situation and make up their own minds on what is true. Further, even if there is evidence to support evolutionary theory, ID supporters maintain that there needs to be at least some discussion mitigating the impact that evolution has on students. In other words, the students need to be cautioned against merely assuming evolutionary theory is "fact" just because it is presented in a classroom. According to ID supporters, there is momentum behind the "teach the controversy" approach as evidenced by a document that contains signatures from scientists who believe there are flaws contained within Darwinism.[24] Yet the "teach the controversy" approach, as articulated by Stephen Meyer,[25] is misguided for several key reasons.

To begin, Meyer contends that "When two groups of expert disagree about a controversial subject that intersects the public school curriculum students should learn about both perspectives."[26] According to Meyer:[27]

> In such cases teachers should not teach as true only one competing view, just the Republican or Democratic view of the New Deal in a history class, for example. Instead, teachers should describe competing views to students and explain the arguments for and against these views as made by their chief proponents.

Yet it is not possible to present students with each and every dispute that is ongoing within the expert communities, let alone every dispute that is ongoing between scientists. It would be arduous and impractical to cover, as Meyer's logic implies, each particular political party's arguments, such as the ones offered by libertarians, socialists, the green party, and the reform party, on each controversial political issue. In other words, there are numerous other options beyond "both perspectives" offered by Democrats and Republicans that could be mentioned with reference to the issue. Further, we would certainly want to disregard the opinions of some groups, such as white supremacists and neo-Nazis, even if they do offer a "competing view" on politics. Not every "competing view" warrants consideration even though some might consider it to be a rival.

On a similar note, if the attention of a class is focused on a scientific dispute about health claims, students could be inundated with conflicting information on a daily basis. The ongoing, heated disagreement about the effect of carbohydrates on human health is one such example. It is difficult for publications to keep up with the latest findings on the

issue. Other current health-related debates include whether red wine is good for the heart, whether the occurrence of cancer is connected to drinking coffee,[28] and whether hormones in milk can cause the onset of puberty to occur prematurely.[29] I am not necessarily seeking to deny the truth of these alleged causal connections; the crucial point here is that there are countless disputed claims in the sciences and it is not necessarily wise or practical to try to cover a large percentage of them.

Regarding questions about the origins of life, it is not possible to teach all, or even most, views on how life began. Creationism, or intelligent design for that matter, is not the only account of how life on earth began. In American communities and schools, the *preferred* account of the origin of life usually draws from western religions. Yet selectively discounting other views on the matter, such as views from eastern religions, of how life began would do them a great disservice. Limiting the discussion to a "young earth" version of creationism, for example, would deliberately ignore and impugn views that do not stem from the Judeo-Christian tradition. Also, even if justifiable reasons can be found to limit the scope of the discussion to Judeo-Christian tradition, there is not even remotely a uniform consensus amongst theologians on how the story of creation should be interpreted and whether it should be considered a scientific explanation.

ID supporters defend the notion that students need to be made aware of "the controversy" in part because they see ID as being among the main candidates to be covered alongside evolution. Yet the logic of Meyer's argument opens the door to discussing various alternative views on the origin of life such as the one offered by the Raelians. The

Raelians are a group who has thousands of members spanning across the globe.[30] The Raelians argue that human life emerged on this planet through cloning procedures undertaken by human-like aliens.[31] The Raelian view is undoubtedly a "rival" (in some sense of the term) to evolution since it attempts to explain how human life on this planet emerged; it does challenge a number of evolution's precepts. Raelians proclaim that they can offer a competing explanation for how life began and there are active disputes about whether their view merits serious consideration. As a result, the "teach the controversy" approach implies that such as view would not be discounted as a candidate to be discussed in biology classrooms, which is a profoundly troubling consequence.

Introducing students to each and every rival view as it emerges, such as the one offered by the Raelians, can give them the wrong impression that each expert's or group's opinion is of equal worth and has the same level of supporting evidence behind it. In accordance with the goal of teaching students about controversies, teachers could plan lessons on witchcraft, astrology, and tealeaf reading, as Paul Feyerabend suggests,[32] because there are inquirers who use these approaches in order to acquire evidence. Yet there are good compelling reasons to resist this type of thinking, which in part relates to the value and importance of obtaining evidence to support claims before students learn about them. There are plenty of individuals who purport to be "scientific" experts but the mechanisms of science need time to evaluate and assess the relevant theories in question. It can be unwise to present an expert's arguments until relevant claims have been thoroughly examined by other experts. The implication that rival views are all on even

grounds scientifically (same level of supporting evidence) does a disservice to how science works.

Thomas Murray describes a similar phenomenon within the context of debates over stem cell research.[33] As Murray points out, the manner in which disputes about science are typically presented to the public and to policy makers, by inviting one or two scientists on opposite sides of the spectrum to testify, implies that scientists are evenly divided on an issue. This can grossly distort how much consensus there actually is within the scientific community about an issue like embryonic stem cell research when it is presented in such a manner. Similarly, if the views of an evolutionary biologist and an ID supporter are presented at the same forum, it could mislead the audience to think that the scientists themselves are split, for example, on the issue of whether evolution is accepted as fact. Applying this insight to the biology classroom, presenting "both perspectives" to students implies that each one is on equal footing and that scientists are evenly divided into the two camps. This does not necessarily prove that ID is false, but the high school biology curriculum needs to reflect ID's current standing within the scientific community.

B) Disputing Evolution

Meyer and other ID supporters contend that there is active scientific "controversy" about whether evolution's key tenets are supported by evidence. Yet labeling it as a "controversy" about evolution is misleading because the disputes are not primarily *within* the scientific community per say. The controversy is not purely a scientific dispute in the sense that it often occurs amongst religious groups, politicians, parents, and advocacy

groups. Disputes about whether evolution is a "fact" frequently are waged at school board meetings and at legislative sessions. Instead of letting the scientific community resolve the matters relating to evolution, through research, conferences, and the like, decisions about what constitutes good pedagogy in science are being decided in large part by non-scientists.

There are of course active disputes within scientific communities regarding the specific mechanisms governing evolution, including the issue of how significant the role of natural selection is. There have also been debates about whether evolution works gradually over time or whether there are sharp, drastic changes over the course of short periods of time (at least one version of the latter view is called punctuated equilibrium[34]). Another point of contention is whether "group selection" should be taken seriously as an integral component of evolution.[35]

Although biologists ardently disagree on the details of how evolution works, they are largely convinced that it did in fact occur. According to the National Science Teachers Association, "There is no longer a debate among scientists about whether evolution has taken place."[36] Thus, couching the issue as a "scientific" controversy between the scientists themselves misrepresents how divided the scientific community actual is on the issue.[37] For example, according to Chad Edgington:[38]

> …given the diversity of belief on the subject and the lack of accepted, substantiated evidence supporting any theory, whether one is a creationist or an evolutionist is largely a matter of opinion.

Vocal proponents of intelligent design, such as Behe, Dembski, Johnson, and Meyer, offer coherent defenses of their views but they are noticeably in the minority in the scientific world. Neither creationism nor intelligent design is considered to be a viable alternative to evolution by most scientists. Scientists vehemently and consistently challenge the notion that evolution still needs to overcome the burden of proof to vanquish either "rival" theory.

C) The Public Favors It

The "teach the controversy" approach also hones in on the notion that the public seems comfortable with teaching alternatives to evolution along with the theory. There are some grounds to defend Meyer's statement that "voters overwhelmingly favor this approach."[39] For example, according to one *Gallup* poll, 68% of Americans favor teaching both creationism and evolution in biology classrooms.[40] A *Zogby* poll suggests that 71% of Americans would prefer that evidence both for and against evolutionary theory be taught.[41] However, even though there is some support for Meyer's view, it is not necessarily sound educational policy to allow the public to dictate what is taught within a discipline, especially in the sciences where extensive knowledge of technical concepts and background information is typically needed before claims can be properly assessed.

Along these lines, there is evidence to indicate, in part stemming from the National Science Board's *Science & Engineering Indicators* series, that the public's understanding

of science may be inadequate.[42] Further, merely because a belief is commonly-held by the public that does not necessarily entail that the belief is true or that it should be taught. For example, many individuals operate with the misconception that antibiotics can help treat a viral infection and that having a flu shot immunizes against the various different strains of the virus. Segments of the population believe in the existence of ghosts, that we have interacted with aliens, and that faith healing can successfully remove ailments. For some time, the public believed that AIDS only affected homosexual populations and later that it could be contracted through casual contact. But, it would have been profoundly unsettling if these beliefs about AIDS were perpetuated by teachers in part because they are false (and would contribute to spreading dangerous stereotypes and misconceptions).

Notions like the aforementioned should not be taught to students merely because people believe that they are true. There are good reasons why scientific inquirers are entrusted to investigate matters within their respective field. Good scientific inquirers dedicate much time and energy to acquiring and refining relevant background knowledge and skills so that they can competently assess claims within their field. Although not a guarantee, this increases the likelihood that they will be able to sort through the vast collection of competing scientific claims. As a by-product, their acquired expertise should help provide guidance concerning which claims should be imparted to students in a classroom. Accordingly, ID should not necessarily be taught to students merely because the public demands it. It should be discussed if the scientific community deems that ID has supporting evidence behind it.

D) An Appeal to "Academic Freedom"

It has been commonly argued within the confines of the "teach the controversy" approach that "academic freedom"[43] and "good pedagogy"[44] demand that alternatives to evolution be taught. It is ironic that ID supporters appeal to these notions to support the inclusion of anti-evolution evidence, considering that biology teachers deliberately avoid teaching lessons pertaining to evolution because they fear reprisal from politicians and from parents.[45] Some school administrators have even recommended to teachers that they sidestep the topic.[46] Further, the State Superintendent of Schools, Kathy Cox, temporarily removed the term "evolution" from Georgia's biology curriculum "to give teachers some leeway to teach it without having to use a word that antagonizes some parents."[47] Also, in Dover Pennsylvania, an administrator had to read the school district's policy on evolution and intelligent design to students because teachers refused to do so.[48] Ostensibly, Dover's policy interferes with the freedom of teachers to avoid what they might construe to be bad science or perhaps religion.

Because of the controversy generated by creationists and ID supporters, many biology teachers consciously shy away from teaching evolution. A profound cost associated with the ongoing debates about evolution is that widespread misunderstandings about and ignorance of the different facets of evolutionary theory endure. According to a study by Lawrence Lerner, evolution is poorly taught in at least a third of U.S. states.[49] It seems to be the case that American students do not receive adequate instruction about the fundamentals of evolution and do not appreciate how integral evolution is to numerous scientific and non-scientific fields.

The distinction between different parts of evolution is often not fully acknowledged as critics scoff that it is all "just a theory". Fundamental concepts that provide a foundation for evolutionary theory have been conflated together and lost in the mix.[50] As a result, misconceptions about evolution are abundant, including the notion that humans are merely a product of "random chance", that evolution is inconsistent with laws of thermodynamics, and that there are no transitional fossils.[51] This is not to say that evolutionary theory is beyond reproach. As mentioned previously, there are certainly active controversies about evolution and gaps in biologists' explanations. Rather, it is to assert that evolution must be understood thoroughly by students before its merits can truly be assessed. At that point, students should better able to offer educated criticisms of it. Yet since many students may only be learning a caricature of evolution or perhaps nothing substantive about it, teaching them about challenges to evolution is not nearly as meaningful.

E) An Appeal to "Religious Freedom"

ID supporters contend that discussing evolution without critique would intrude upon the religious convictions of students. For instance, according to Chad Edgington, "the exclusive placement of evolution in the science classroom provides de facto religious instruction because students are taught that science has proven that their religious beliefs are fraudulent."[52] It should be acknowledged that evolution is at odds with at least some religious claims, especially those endorsed by young earth creationists. But it oversimplifies matters to assume that evolution would displace the religious beliefs of

students. In and of itself, evolution does not dismiss the possibility that a divine being exists (although it does not seem to offer evidence in favor of a divine being's existence either). It would be rather arrogant to presume that a collection of scientific theories about how life changes over time could definitely answer one of the most difficult questions humans have grappled with since the beginning of documented history. Humans continually struggle to interpret the broader implications of scientific theories. This process does not reach an end merely because of the advent of evolutionary theory.

Further, at least some of the world's religions seem to accept that evolution is reconcilable with religious belief.[53] In industrialized nations such as Japan and Poland, evolution is largely accepted even among religious believers.[54] Numerous scientists, philosophers, and theologians maintain that there is not an inherent incompatibly between embracing evolution and being religious.[55] Some authors suggest that understanding the implications of evolution may actually lead to a fuller understanding of theology and of a divine being.[56] Keith Ward, a theologian and philosopher, offers a view called "theistic evolution", which is an attempt to incorporate both scientific and religious insights into a coherent worldview.[57] Ward maintains that his version of theistic evolution:[58]

> …takes the findings of modern science and the testimony of the world's ancient religious and philosophical traditions with equal seriousness.

Within the confines of his view, Ward accepts as "an established fact of science that evolution occurs," including the notion that humans descended from simpler forms of life.[59] Although critics and supporters of evolution alike might challenge the specific

tenets of Ward's arguments, his type of view does shed insight on the notion that a "believer" can embrace evolution.

This brief sketch of viewpoints is not intended to resolve the issue of how evolution and religion are interrelated. Rather, it is supposed to illustrate that many scholars believe that there is not an inherent incompatibility between being religious and accepting evolution. Evolution is believed to have vastly different religious implications, some of which are seen as being anti-religious and some as reaffirming religious conviction. Consequently, it should not be hastily assumed that teaching students about evolution interferes with their religious beliefs.

Moreover, even though scientific theories, including evolution, might be incompatible with some religious views, this does not necessarily entail that teachers should avoid discussing them. The potential conflicts between scientific claims and religious belief are countless, especially considering how many different variations of religion exist across the world. Mainstream science indicates that virgin births are extremely improbable, that people do not rise from the dead, and that the story of Noah's ark probably cannot account for the diversity of creatures that exist. Yet avoiding any discussion of issues such as embryology, mortality, and evolution because it might potentially offend someone's religious beliefs would drastically limit and eviscerate science education. It seems unwise to ask teachers to sidestep lessons on the benefits of modern medicine, because someone in the class might believe that medical treatment is "playing god" and thus immoral. Continuing with this line of thought, seemingly teachers would have to

avoid mentioning the nutritional value of eating meat because some religious thinkers, including Jains**,** believe that it is immoral to harm a complex living creature. Of course, biology teachers should not attack a person's or a group's religious views. Lessons on evolution should not be used as an "opportunity" to attack religious beliefs. But teachers should not be immobilized from teaching good science based on the notion that a conflict with religious belief might emerge.

IV) Is the Proposed Solution Worse Than the Alleged Illness?

Even though the "teach the controversy" approach has it flaws, the question still remains whether it is warranted to discuss intelligent design specifically in biology classrooms. Design theorists contend that their view is scientific and thus belongs as a candidate to be taught alongside evolution. Current design arguments are more attuned to scientific evidence than older versions, including the ones offered by Aquinas and Paley. Behe, Dembski, Johnson, and Meyer, for example, have dedicated much time and energy to identifying problems with evolution and then suggesting how design might be compatible with a scientific picture of the world. Yet there are crucial problems associated with current formulations of ID, which indicate that it should not be presented within the confines of a high school biology course. Presenting ID to students would likely generate more problems than benefit it provides.

ID supporters often accuse biologists of teaching evolution as a covert way of attacking religious belief (as a way of promoting materialism and atheism). Yet on the flip side on

the coin, it is hard to ignore the fact that it is difficult, if even possible, to disentangle design from discussions about religion. Even if design theorists could be taken at their word that intelligent design could be taught without religious overtones (which is not a trivial task),[60] questions about the designer will inevitably emerge. Metaphysical and religious assumptions built into any version of intelligent design are not easily separable from "scientific" lessons that would be offered to students. For example, one of the chief assumptions built into current formulations of intelligent design is that the designer is a single entity rather than multiple entities, which already implies that some religious and spiritual views about the nature of the designer(s) are dismissed. This assumption is typically glossed over because monotheism tends to be the preferred view of ID supporters but one could legitimately question whether that assumption should be granted and whether it is appropriate to allude to a subset of religious views at exclusion of others. As Hume asks, "Why may not several Deities combine in contriving and framing a World?"[61]

Discussion of design in a classroom opens, perhaps unintentionally, the door to religious conversation about the identity and traits of the designer. Yet it is not clear that it would be wise for biology teachers to stray into religious instruction. For one, the theoretical underpinnings of ID explicitly and categorically suggest that atheism is false, which is an intrusion on the atheist's beliefs about religion. Evolution, on the other hand, does not provide an explicit and unequivocal answer to the question about whether a divine being exists. Further, it is likely that students will figure out the existence of evil is a quandary that plagues a design view. If a designer created life, it is natural to want to know why

evil exists. Yet is the age-old problem of evil, one which has kept theologians, philosophers, and other scholars busy for centuries, an appropriate issue to discuss in *a biology classroom*? It would be improper for biology teachers to offer lectures on different types of evil and "free will".

Even though ID supporters carefully and deliberately avoid the issue, presumably, the designer is an immaterial being or force. It is reasonable to expect that a designer is not mentioned within the confines of a biology class because it is unclear how its nature could be studied empirically. Within the current limits of human inquiry, there is no obvious way that the interaction between an immaterial being and a material world could be explained. Descartes infamously tried to localize the interaction between an immaterial soul and material body as occurring in the pineal gland.[62] Assuming that some kind of dualism (Cartesian or otherwise) is true, which is not a trivial assumption, we have not progressed much in our understanding of this interaction since his time.

Even if a biology teacher can successfully dodge questions about the nature of designer, how will teachers explain the causal mechanisms of the design process? Science does not provide tools to explain how a designer interacts with created life; design theorists do not offer much in the way of an explanation.[63] Assuming that evolution is accepted to some degree, which ID supporters largely say that they do, at what point does the designer's actions end and evolution begin? One potential hypothesis is that the designer was involved in the initial formation of the universe and that ended the designer's role. Another hypothesis is that the designer is continually involved in designing the universe.

Alternatively, the designer may act intermittently. On what basis should a biology teacher (or any human for the matter) distinguish between these competing explanations? Yet it seems rather crucial that we have some means to sort through these explanations if we are to better understand how the universe works. On a related note, ID supporters are quick to offer scathing criticisms of what they perceive as failings with evolutionary theory. Yet are there any concrete, testable hypotheses or substantive predictions that can be generated in relation to the aforementioned matters? That is not to say that science will never be able to investigate these matters, although it is unlikely, but they are certainly beyond the bounds of our current ability.

Questions about inefficiencies in design would likely emerge as well. Although design theorists argue that complex biological mechanisms such as blood clotting could not happen randomly,[64] there are numerous examples of poorly designed mechanisms and of systems that do not have a clear function, which do not fit well with a design hypothesis. For instance, what is the teleological explanation for why humans have an appendix? As far we know, the appendix does not have a clear purpose that benefits human health. One author notes that "Fewer than one-third of conceptions culminate in live births."[65] This alludes to the conclusion that human reproduction was not designed in the most efficient manner. Further, if an evolutionary picture of the world does contain an element of truth, which design theorists usually do not deny, then most of the species that once inhabited this planet are now extinct. The most plausible inference derived from this data does not seem to support the existence of design. This is not to say that ID is necessarily false.

Rather, it is supposed to highlight significant conceptual problems that accompany a design hypothesis.

VI) Recommendations

When the issue of evolution emerges in the classroom, biology teachers should exercise an appropriate level of caution regarding the religious implications that evolution may have. The teaching of evolution should not be used as an excuse to endorse or criticize religious beliefs. Yet presenting students with a caricature of evolution or with the hopelessly ambiguous catch phrase that evolution is "just a theory"[66] does not convey the importance that the scientific community thinks evolution has to the field of science. At the same time, it is important that teachers acknowledge that not every part of evolutionary theory, or of science for that matter, has the same level of supporting evidence behind it and that reasonable criticisms can be posed against accepted theories.

Rather than specifically identifying evolution as the problematic part of science, the opportunity should be taken to make sure students learn that critical thinking is crucially important to doing good science. Students should not be left with the impression, which much of the current debate might leave them with, that evolution is the only part of science where scientists themselves still have disputes. Hopefully, a broader understanding of the nature of scientific inquiry can be imparted to students. Instead of being left with the false impression that scientific theories are either certain and true or dubious and false, they should begin to understand that science does not usually work that way and that there is not a clear dichotomy into which theories can be easily sorted.

To simplify matters, some theories are accepted as fact, some have supporting evidence but that evidence appears to be inconclusive, and others have not been tested thoroughly but have promise. Students should learn that science is the product of fallible humans working to better understand the world, but there are many backward steps and dead ends along the way.

If the outgrowth of the legal, religious, and scientific disputes about evolution leads to the emergence of a high school class dedicated to the intersection of science and values, that would be a welcomed addition. Considering how central science is to our lives and how often its social, moral, and religious implications are not examined thoroughly enough, a class that looks at the broader aspects of scientific disputes, such as the evolution and anti-evolution debate, might be a wise approach.

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[1] Mary MacDonald, "Georgia may shun 'evolution' in schools," *The Atlanta Journal-Constitution*, January 29, 2004.
[2] For the purposes of the article, the term "creationism" will refer to the views of "young earth creationists" who generally accept a literal interpretation of the Bible and believe that most, if not all, of evolutionary theory conflicts with their beliefs about the origin of life.
[3] For example see *Edwards v. Aguillard*, 482 U.S. 578 (1987); *McLean v. Arkansas*, 529 F. Supp. 1255 (1982).
[4] *Lemon v. Kurtzman*, 403 U.S. 602 (1971).
[5] Id. at 658.
[6] See note 3 at 594.
[7] For a discussion of this issue see Randy Moore, "Teaching Evolution: Do State Science Standards Matter?" *RNCSE* 21 (1-2): 19-21 (2001).
[8] For example, the issue of whether challenges to evolution should be taught is ongoing in Kansas, see Diane Carroll, "Evolution debate enters 'round two'," *The Kansas City Star*, January 30, 2005; it was also debated in Cobb County, Georgia where an adopted policy allowed "disputed views" to be discussed, see Mia Taylor and Mary MacDonald, "Cobb unanimously approves discussion of other theories," *The Atlanta Journal-Constitution*, September 26, 2002.
[9] Scott Stephens, "How state board thinking evolved on biology lesson," *Plain Dealer* (Cleveland, Ohio), March 14, 2004.
[10] "Monkeying with Science," *St. Louis Post-Dispatch*, January 27, 2004.
[11] Martha Raffaele, "School board Oks challenges to evolution," MSNBC.com, November 12, 2004, at http://msnbc.msn.com/id/6470259 (last accessed January 19, 2005).

[12] Stephen C. Meyer, "Teach the Controversy," *Cincinnati Enquirer*, March 30, 2002, at http://www.arn.org/docs/meyer/sm_teachthecontroversy.htm (last accessed February 15, 2005).
[13] For the purposes of this article, I will not address the views of "old earth" creationists who seem to accept a more metaphorical interpretation of the story of creation, which leads them to believe that the earth could be billions of years old.
[14] For example see Henry M. Morris, *Scientific Creationism*, California: Creation-Life Publishers, 1974; Duane Gish, *Evolution: The Fossils Still Say No!*, Master Books, 1985.
[15] *CRS Statement of Belief*, at http://www.creationresearch.org/stmnt_of_belief.htm (last accessed March 10, 2005).
[16] For a more extensive discussion of this issue see Michael Ruse, "The Argument from Design: *A Brief History*," from *Debating Design: From Darwin to DNA*, edited by William A. Dembski and Michael Ruse, Cambridge University Press, 2004, pages 13-31.
[17] Thomas Aquinas, *Summa Theologica*, from *Classics of Western Philosophy* (5th edition), edited by Steven M. Cahn, Indiana: Hackett Publishing Company, Inc., 1999, page 341-42.
[18] David Hume, *Dialogues Concerning Natural Religion* (1779), edited by John Valdimir Price, Oxford: Clarendon Press, 1976, pages 143-261.
[19] One of the most famous responses to Hume was offered by William Paley. See William Paley, *Natural Theology* (1854), Kessinger Publishing, 2003. Scholars dispute whether Paley successfully vanquished Hume's arguments. For a discussion of this issue see Elliott Sober, "The Design Argument," from *Debating Design: From Darwin to DNA*, edited by William A. Dembski and Michael Ruse, Cambridge University Press, 2004, pages 98-129.
[20] James Rachels, *The Elements of Moral Philosophy* (4th Edition), New York: McGraw-Hill, 2003, page 56.
[21] Michael J. Behe, "Design for Living," *The New York Times*, February 7, 2005.
[22] At least "young earth" creationists consistently do.
[23] For a discussion on the conceptual differences between ID and evolution see William Dembski, "The Logical Underpinnings of Intelligent Design," from *Debating Design: From Darwin to DNA*, edited by William A. Dembski and Michael Ruse, Cambridge University Press, 2004, pages 323-27.
[24] "A Scientific Dissent from Darwinism," *Discovery Institute*, at http://www.discovery.org/articleFiles/PDFs/100ScientistsAd.pdf (last accessed February 15, 2005).
[25] See note 12.
[26] Id.
[27] Id.
[28] "Study: Less liver cancer in coffee drinkers," Cnn.com, February 16, 2005, http://www.cnn.com/2005/HEALTH/conditions/02/15/coffee.cancer.ap/index.html (last accessed March 10, 2005).
[29] Anahad O'Connor, "The Claim: Hormones in Milk Cause Early Puberty," *The New York Times*, March 8, 2005.
[30] Brigitte Boisselier, a credentialed chemist, is perhaps one of best known representatives of the movement. See "Brigitte Boisselier: Scientific genius or PR guru?" BBC News (World Edition), January 9, 2003, at http://news.bbc.co.uk/2/hi/science/nature/2643445.stm
[31] See *The Raelian Message*, at http://www.rael.org/english/index.html
[32] Paul Feyerabend, *Against Method*, London: Verso, 1975, pages 295-309.
[33] Thomas H. Murray, "Hard Cell," *The American Prospect*, Vol. 12 No. 17, September 24, 2001 - October 8, 2001.
[34] N. Eldredge and S. J. Gould, "Punctuated equilibria: an alternative to phyletic gradualism," In: *Models In Paleobiology* (Ed. by T. J. M. Schopf), San Francisco: Freeman, Cooper and Co., 1972.
[35] For example see J.L. Sachs, U.G. Mueller, T.P. Wilcox, et al., The evolution of cooperation, QUARTERLY REVIEW OF BIOLOGY 79 (2): 135-160 JUN 2004.
[36] NSTA Position Statement, *The Teaching of Evolution*, at http://www.nsta.org/159&psid=10 (last accessed February 25, 2005).
[37] According to the National Association of Biology Teachers, "Scientists have firmly established evolution as an important natural process," NABT's Statement on Teaching Evolution, at http://www.nabt.org/sub/position_statements/evolution.asp (last accessed February 25, 2005).

[38] Chad Edgington, *Disclaiming Darwin Without Claiming Creation: The Constitutionality of Textbook Disclaimers and Their Mutually Beneficial Effect on Both Sides of the Origins Debate*, 35 Tex. Tech L. Rev. 135, 136 (2004).
[39] See note 12.
[40] David W. Moore, "Americans Support Teaching Creationism as Well as Evolution in Public Schools," *Gallup News Service*, August 30, 1999.
[41] "Zogby America Report," *Zogby International*, August 2001, at http://www.zogby.com (last accessed February 15, 2005).
[42] See National Science Board, *Science & Engineering Indicators*-2000 (Arlington, Virginia: National Science Foundation, 2000 (NSF-00-1)), chapter 8; National Science Board, *Science & Engineering Indicators*-1998 (Arlington, Virginia: National Science Foundation), chapter 7; see also Rene Sanchez, "U.S. Students Do Poorly in Science Test: 40% of Seniors Fail to Meet Minimum Level," *The Washington Post*, 22 October 1997, at 1A & 10A; Cristine Russell, "How Much Do People Know About Health? Not Enough, Say Concerned Scientists, to Understand Research or Public Policy," *The Washington Post*, 1 March 1994, health section page 6.
[43] For example see David J. Hacker, "New Federalism: Recent Development: WARNING! EVOLUTION LIES WITHIN: Preserving Academic Freedom in the Classroom with Secular Evolution Disclaimers," 16 Wash. U. J.L. & Pol'y 333 (2004).
[44] See note 12.
[45] Susan Jacoby, "Caught Between Church and State," *The New York Times*, January 19, 2005.
[46] Cornelia Dean, "Evolution Takes a Back Seat in U.S. Classes," *The New York Times*, February 1, 2005.
[47] Dana Tofig, "Curriculum team to revisit evolution," *The Atlanta Journal-Constitution*, February 10, 2004.
[48] "2 School Boards Push on Against Evolution," *The New York Times*, January 19, 2005.
[49] Lawrence S. Lerner, "Good and Bad Science in US Schools," *Nature*, 407:287-90, September 21, 2000.
[50] Anecdotally, when the debate about evolution, creationism, and intelligent design is discussed within my undergraduate philosophy and public policy courses, much time has to be dedicated to defining the terms "microevolution" and "macroevolution" because, for a variety of reasons, the students in the courses have not learned about these concepts thoroughly enough during their high school education to distinguish between them.
[51] For a discussion about common misconceptions used to construct arguments against evolution see John Rennie, "15 Answers to Creationist Nonsense," *Scientific American*, June 18, 2002.
[52] See note 38 at 154.
[53] It has been argued, for example, that within his speech to the Pontifical Academy of Sciences, Pope John Paul II affirmed that evolution is a scientific fact and that Catholicism and evolution are reconcilable. See *Truth Cannot Contradict Truth*, Address of Pope John Paul II to the Pontifical Academy of Sciences, October 22, 1996, available at http://www.cin.org/jp2evolu.html (last accessed April 27, 2005). Stephen Jay Gould is one author who supports this interpretation of the Pope's speech. See Stephen Jay Gould "Nonoverlapping Magisteria," from *Science and Religion: Are They Compatible?*, New York: Prometheus Books, 2003, pages 191-205.
[54] See note 46.
[55] For example see Michael Ruse, *Can a Darwinian Be a Christian? : The Relationship between Science and Religion*, Cambridge University Press, 2000 and Kenneth Miller, *Finding Darwin's God: A Scientist's Search for Common Ground between God and Evolution*, Perennial, 2000.
[56] For example see John F. Haught, *God After Darwin: A Theology of Evolution*, Westview Press, 2001.
[57] Keith Ward, "Theistic Evolution," from *Debating Design: From Darwin to DNA*, edited by William A. Dembski and Michael Ruse, Cambridge University Press, 2004, pages 261-274.
[58] Id. at 274.
[59] Id. at 261.
[60] See note 21.
[61] See note 18 at 192.
[62] Rene Descartes, *The Passions of the Soul*, translated by Stephen H. Voss, Indianapolis: Hackett Publishing Company, 1989.
[63] Creationists offer a more forthright and direct answer on this issue. Duane Gish "bites the bullet" so to speak and argues that "We cannot discover by scientific investigations anything about the creative

processes used by the Creator." Duane Gish, *Evolution: The Fossils Say No!* (3rd Edition), California: Creation-Life Publishing, 1979, page 40.

[64] For example see Michael J. Behe, "Irreducible Complexity: *Obstacle to Darwinian Evolution*," from *Debating Design: From Darwin to DNA*, edited by William A. Dembski and Michael Ruse, Cambridge University Press, 2004, pages 352-370.

[65] Jim Holt, "The Way We Live Now: Unintelligent Design," *The New York Times*, February 20, 2005.

[66] For example, the state of Georgia temporarily had a sticker in high school biology textbooks which said that "Evolution is a theory, not a fact, regarding the origin of living things." See "Judge: Evolution stickers unconstitutional," *CNN.com*, January 13, 2005, at http://www.cnn.com/2005/LAW/01/13/evolution.textbooks.ruling/index.html (last accessed March 14, 2005).