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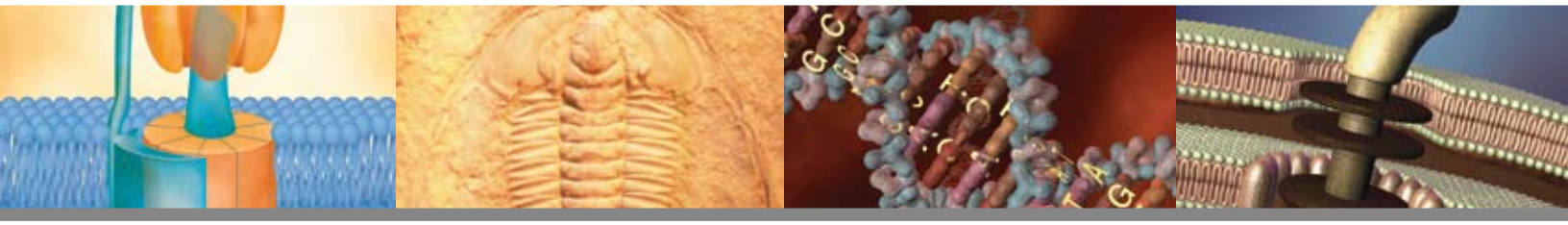
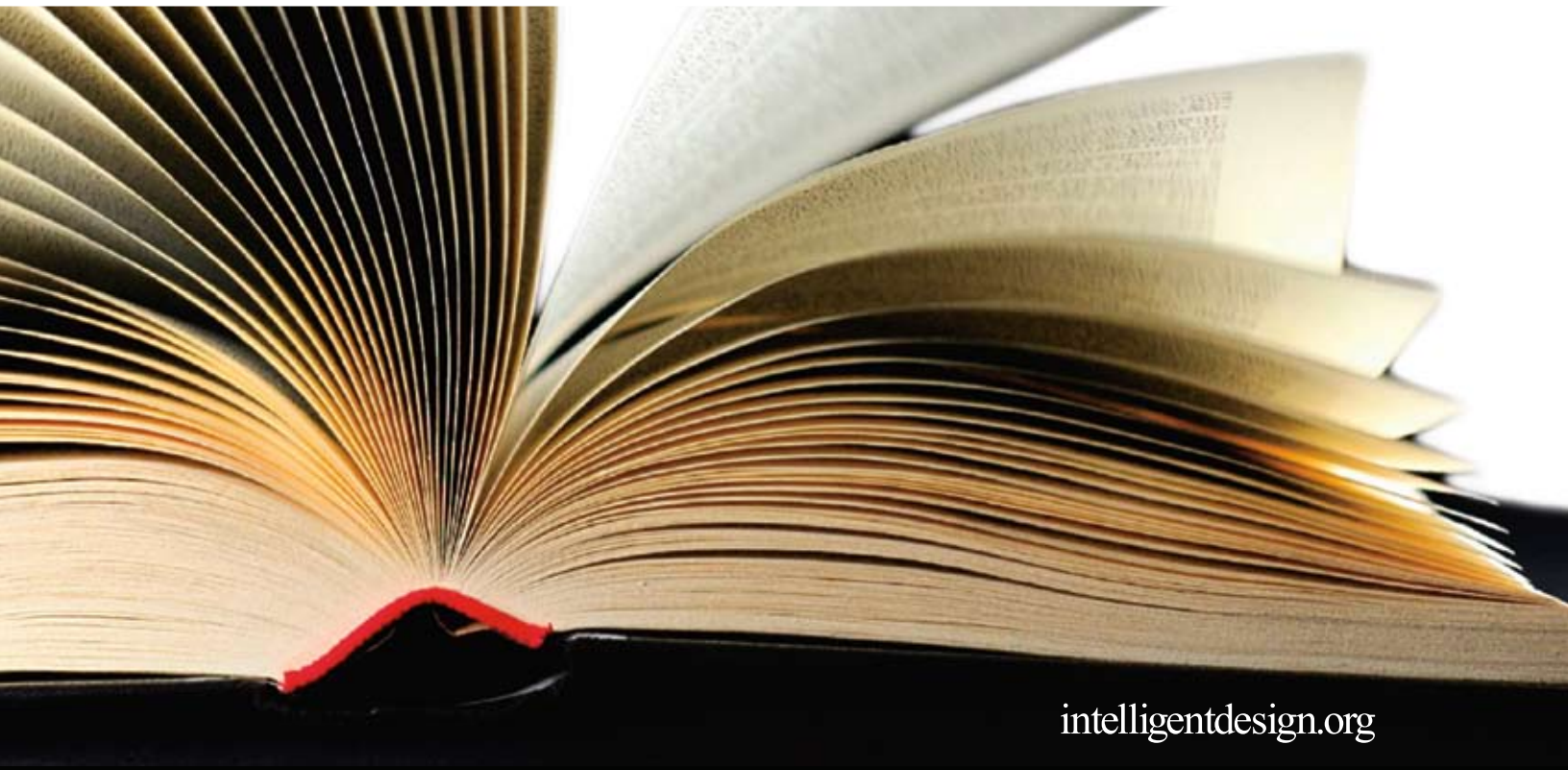


The Theory of Intelligent Design:

A Briefing Packet

FOR EDUCATORS

Resources to help you understand the debate between Darwinian evolution and intelligent design



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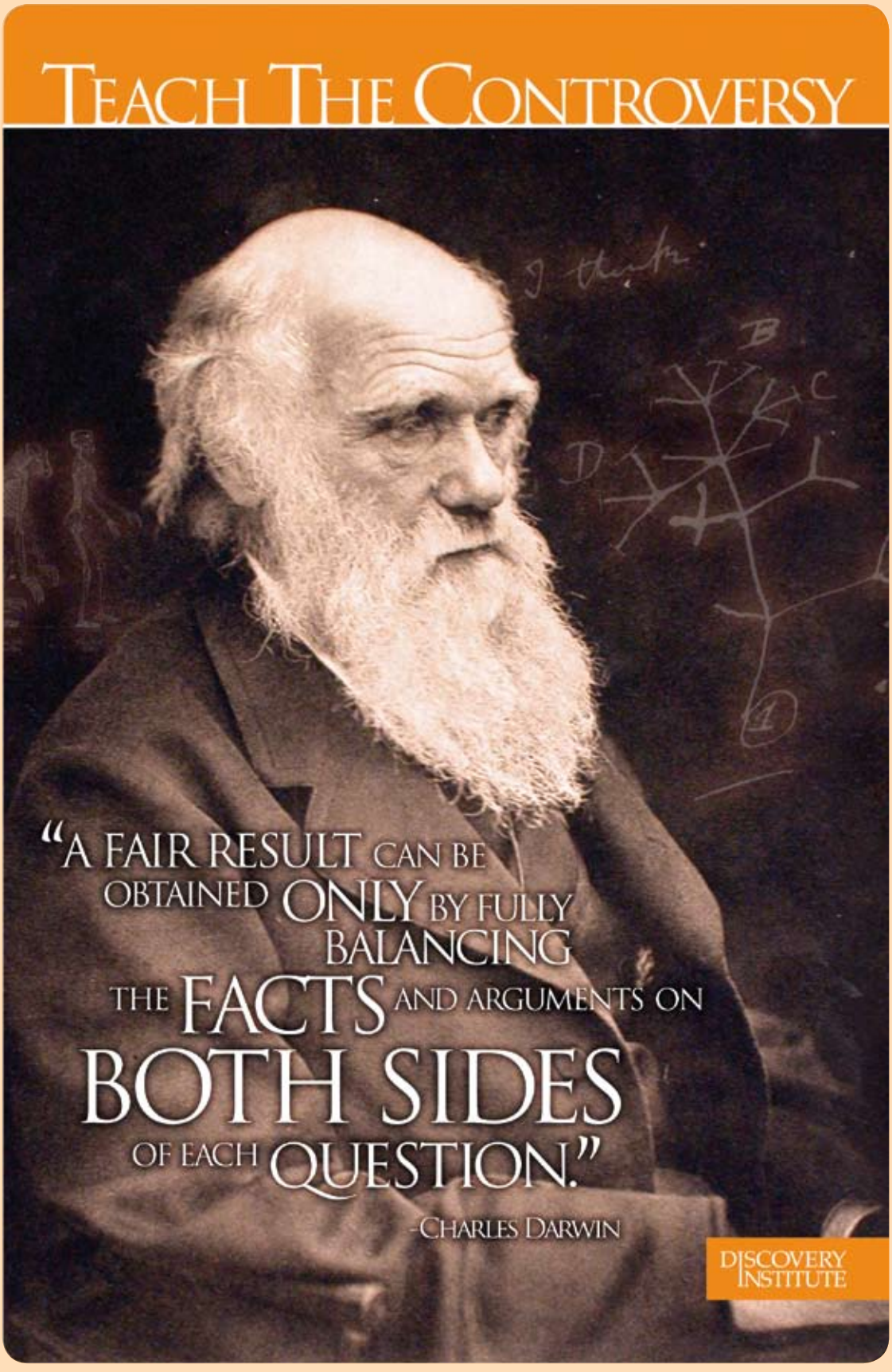

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Introduction

Dear Educator:

This briefing packet was developed in order to provide you with clear and accurate information about the scientific theory of intelligent design: what it is, how it originated, and how it differs from Neo-Darwinism.

As staff members of Discovery Institute, which the science journal *Nature* has recognized as "the nation's leading intelligent design think tank," we developed this packet in response to highly inaccurate materials distributed by PBS's *NOVA* series in conjunction with its one-sided docudrama "Judgment Day: Intelligent Design on Trial."

The materials being distributed by *NOVA* and PBS are riddled with factual errors that misrepresent both the standard definition of intelligent design and the beliefs of those scientists and scholars who support the theory. Furthermore, the *NOVA* materials encourage the injection of religion into the classroom, teaching about evolution in a way that would likely violate current Supreme Court precedents about the First Amendment's Establishment Clause. We therefore urge you to use the *NOVA* materials with extreme caution. While the *NOVA* materials certainly provide a good summary of what the critics of intelligent design believe, they are grossly inaccurate and biased in the information they present about the views of those who support intelligent design. Indeed, they read more like propaganda materials than educational materials.

For the record, we do not propose that intelligent design should be mandated in public schools, which is why we strongly opposed the school district policy at issue in the *Kitzmiller v. Dover* case. *However, if you voluntarily choose to raise the issue of intelligent design in your classroom, it is vitally important that any information you present accurately convey the views of the scientists and scholars who support intelligent design, not a caricature of their views.* Otherwise you will be engaging in indoctrination, not education.

Whether you support or oppose intelligent design, the following materials will help you better understand what it actually proposes and correct common misunderstandings and misrepresentations about the concept often found in the newsmedia.

Here are some of the major points you will find discussed in the following pages:

» The theory of intelligent design holds that certain features of the universe and of living things are best explained by an intelligent cause, not an undirected process such as natural selection.

» The idea of intelligent design has deep roots in the history of science. Indeed, the co-discoverer of the theory of evolution by natural selection — Alfred Wallace —strongly disagreed with Darwin and believed that nature exhibited evidence of intelligent design, especially when it came to the development of the human mind.

» Intelligent design is not "anti-evolution" depending on how one defines evolution.

» Evolution has a number of different definitions, and it is important to clearly distinguish which definition is being used when discussing evolution in the classroom.

» Although some claims made by modern evolutionary theory are strongly supported by empirical evidence, others are not. In particular, there are scientific debates going on about the limits of the Darwinian mechanism of natural selection and random mutations and what kind of changes it can actually produce. It is perfectly appropriate—and constitutional—to teach about these scientific debates regarding the limits and weaknesses of Neo-Darwinism.

» Instead of mandating intelligent design, Discovery Institute urges teachers and school districts to teach objectively about both the scientific strengths and weaknesses of modern evolutionary theory. Adopted by states and local school districts around the nation, this common-sense approach represents good pedagogy and good science education, and it is clearly constitutional.

» Discovery Institute actively opposed the Dover school district policy featured in PBS's "Judgment Day" and urged that the policy be repealed even before a lawsuit was filed. **In continuing to promote their policy to require the mention of intelligent design in the classroom, both the Dover school board and the law firm representing it were going against the express wishes and policy recommendations of the intelligent design community.** Thus, they should not be regarded as legitimate spokespersons for intelligent design.

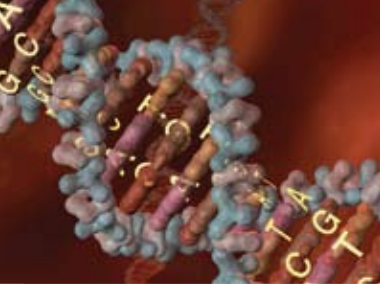
» Suggestions that public school teachers tell students that evolution is either compatible or incompatible with religion raise serious First Amendment issues. **The question of whether evolution is compatible with religion is essentially a *theological* question, and public schools are forbidden from endorsing any particular theological position regarding evolution.** Objective discussions of religious views are permitted (in relevant courses), but giving students materials that present only one religious position (e.g., that good theology favors evolution) is clearly unconstitutional and may place teachers and school districts in legal jeopardy.

We hope these materials will be helpful in providing you with a fuller understanding of what intelligent design proponents actually believe. You can find additional information at ***www.intelligentdesign.org*** and ***www.discovery.org/csc***.

Sincerely,

John G. West, Ph.D.
Vice President for Public Policy and Legal Affairs
Center for Science and Cutlure, Discovery Institute

Casey Luskin, J.D., M.S. (Earth Sciences)
Program Officer, Center for Science and Culture



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What Is The Center For Science And Culture?

The Center for Science & Culture (CSC) at Discovery Institute is a team of scientists and scholars worldwide who are advancing scientific research, exploring the worldview implications of science, and influencing public policy relating to the growing debate between intelligent design and Darwinian evolution.

CSC Fellows publish scientific texts, peer-reviewed articles in science journals, popular books, and news articles in the mainstream media; they engage in radio and television interviews, radio broadcasts, podcasts, and the production of television and educational documentaries; and they teach and debate at leading universities and research institutions. CSC Fellows and staff also provide guidance for state school boards, legislators and others considering the public policy implications of science.

The Center is part of Discovery Institute's broader mission to defend the ideas that have made Western civilization exceptional, including representative democracy, limited government, free enterprise, the Judeo-Christian moral tradition, and science and technology. As a charitable non-profit research and education institution under 501(c)(3) of the IRS code, the Institute does not endorse political candidates or lobby for legislation, but it does disseminate the work of its fellows to policymakers and the general public, develop solutions to important public problems, and defend the right of scientists and other scholars to articulate their ideas free from persecution.

The Discovery Institute...

"...the nation's leading intelligent design think tank."
—*Nature*, an international weekly journal of science.

"...has almost single-handedly put intelligent design on the map."
—*Newsweek*

"...has...transformed the debate [over evolution] into an issue of academic freedom."
—*The New York Times*

"...has done an absolutely brilliant job of taking a difficult position and...infusing the mass culture with it about as effectively as anything I've seen..."
—former ABC Nightline anchor, Ted Koppel

www.discovery.org/csc

FAQ on ID and Evolution

What Is Evolution?

The debate over evolution can be confusing because equivocation has crept into the discussion. Some people use "evolution" to refer to something as simple as small changes in the sizes of bird beaks. Others use the same word to mean something much more far-reaching. Used one way, the term "evolution" isn't controversial at all; used another way, it's hotly debated. Used equivocally, "evolution" is too imprecise to be useful in a scientific discussion. Darwin's theory is not a single idea. Instead, it is made up of several related ideas, each supported by specific arguments:

» *Evolution #1:* First, evolution can mean that the life forms we see today are different than the life forms that existed in the distant past. Evolution as "change over time" can also refer to minor changes in features of individual species — changes which take place over a short amount of time. Even skeptics of Darwin's theory agree that this type of "change over time" takes place.

» *Evolution #2:* Some scientists associate the word "evolution" with the idea that all the organisms we see today are descended from a single common ancestor somewhere in the distant past. The claim became known as the Theory of Universal Common Descent. This theory paints a picture of the history of life on earth as a great branching tree.

» *Evolution #3:* Finally, some people use the term "evolution" to refer to a cause or mechanism of change, the biological process Darwin thought was responsible for this branching pattern. Darwin argued that natural selection had the power to produce fundamentally new forms of life. Together, the ideas of Universal Common Descent and natural selection form the core of Darwinian evolutionary theory. "Neo-Darwinian" evolution combines our knowledge of DNA and genetics to claim that mutations in DNA provide the variation upon which natural selection acts.

When you see the word evolution, you should ask yourself, "Which of the three definitions is being used?" Most critics of neo-Darwinism today focus on Evolution #2 or Evolution #3. But the discussion gets confusing when someone takes evidence for Evolution #1 and tries to make it look like it supports Evolution #2 or Evolution #3. Conversely, someone may discuss problems with Evolution #2 or Evolution #3, but is then falsely accused of rejecting Evolution #1, as well. This is simply not the case, for even biologists who dissent from neo-Darwinism accept Evolution #1.

What Is Intelligent Design?

Intelligent design (ID) refers to a scientific research program as well as a community of scientists, philosophers and other scholars who seek evidence of design in nature. The theory of intelligent design holds that certain features of the universe and of living things are best explained by an intelligent cause, not an undirected process such as natural selection. Through the study and analysis of a system's components, a design theorist is able to determine whether various natural structures are the product of chance, natural law, intelligent design, or some combination thereof. Such research begins by observing the types of information produced when intelligent agents act. Scientists investigating design then seek to find objects which have those same types of informational properties which we commonly know come from intelligence. Intelligent design has applied these scientific methods to detect design in irreducibly complex biological structures, the complex and specified information content in DNA, the life-sustaining physical architecture of the universe, and the geologically rapid origin of biological diversity in the fossil record during the Cambrian explosion approximately 530 million years ago.

Is Intelligent Design the Same as Creationism?

No. The theory of intelligent design is simply an effort to empirically detect whether the "apparent design" in nature acknowledged by virtually all biologists is genuine design (the product of an intelligent cause) or is simply the product of an undirected process such as natural selection acting on random variations. Creationism typically starts with a religious text and tries to see how the findings of science can be reconciled to it. ID starts with the empirical evidence of nature and seeks to ascertain what scientific inferences can be drawn from that evidence. Unlike creationism, the scientific theory of intelligent design does not claim that modern biology can identify whether the intelligent cause detected through science is supernatural. The charge that ID is "creationism" is a rhetorical strategy on the part of Darwinists who wish to delegitimize ID without actually addressing the merits of its case.

Is Intelligent Design a Scientific Theory?

Yes. The scientific method is commonly described as a four-step process involving observations, hypothesis, experiments, and conclusion. ID begins with the observation that intelligent agents produce complex and specified information (CSI). Design theorists hypothesize that if a natural object was designed, it will contain high levels of CSI. Scientists then perform experimental tests upon natural objects to determine if they contain complex and specified information. One easily testable form of CSI is irreducible complexity, which can be discovered by experimentally reverse-engineering biological structures to see if they require all of their parts to function. When ID researchers find irreducible complexity in biology, they conclude that such structures were designed.

Does Intelligent Design Conflict with Evolution?

It depends on what one means by the word "evolution." If one simply means "change over time," or even that living things are related by common ancestry (Evolution #1 or Evolution #2), then

FAQ on ID and Evolution

there is no inherent conflict between evolutionary theory and the theory of intelligent design. However, the dominant theory of evolution today is neo-Darwinism (Evolution #3), which contends that evolution is driven by natural selection acting on random mutations, an unpredictable and purposeless process that "has no discernable direction or goal, including survival of a species" (NABT Statement on Teaching Evolution). It is this specific claim made by neo-Darwinism that intelligent design directly challenges.

Can Darwinism Be Questioned in Public Schools?

Yes. Science teachers have the right to teach science, and there are legitimate scientific critiques of neo-Darwinian theory. As long as teachers fulfill all other required aspects of the curriculum and stick to teaching science, they have the right to teach about the many scientific critiques of neo-Darwinism and chemical evolutionary theories.

Should Public Schools Mandate Intelligent Design?

No. The priority of the ID movement has long been focused on developing the theory of intelligent design through scientific research, scientific publication, and other forms of scientific discussion and does not seek to push ID into schools. In today's politically charged climate, attempts to mandate teaching about intelligent design only politicize the theory and will hinder fair and open discussion of the merits of the theory among scholars and within the scientific community. Furthermore, most teachers at the present time do not know enough about ID to teach about it accurately and objectively.

Has ID Been Banned from Public Schools?

No. Science teachers have the right to teach science. Since ID is a legitimate scientific theory, it should be constitutional to discuss in science classrooms and it should not be banned from schools. If a science teacher wants to voluntarily discuss ID, she should have the academic freedom to do so.

Should Schools Require Biology Teachers to Teach Both the Strengths and Weaknesses of Darwinism?

Yes. Evolution should be fully and completely taught in public schools, and schools need to teach more about evolution, not less. Unfortunately, most biology classrooms teach a one-sided, pro-evolution-only curriculum that censors serious scientific critique of neo-Darwinism. Instead, schools should teach about both the strengths and weaknesses of neo-Darwinian and chemical evolutionary theories.

Teaching students about both the scientific evidence for and against Darwinism turns the classroom instruction away from indoctrination and into education. Critically analyzing evolution teaches students more about the facts of biology and produces scientifically minded students with good critical thinking skills. As Charles Darwin himself wrote in The Origin of Species: "A fair result can be obtained only by fully stating and balancing the facts and arguments on both sides of each question."

Some school districts have made it clear that teachers can be required to teach scientific critique of Darwin's theory while not being required to teach about ID. As one district in Grantsburg, Wisconsin has stated, "Students shall be able to explain the scientific strengths and weaknesses of evolutionary theory. This policy does not call for the teaching of Creationism or Intelligent Design."

What Are the Benefits of Teaching the Controversy over Evolution?

Courts and legislative bodies have found that it is legitimate to pass evolution policies in order to:

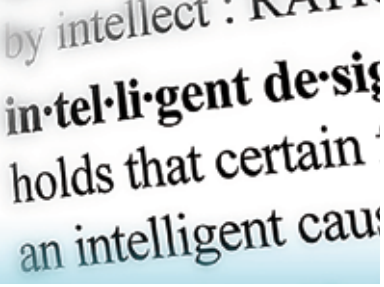
- Enhance the effectiveness of science education and encourage critical thinking;
- Help defuse the controversy caused by teaching evolution;
- Teach students to be informed citizens who can distinguish the data and testable theories of science from religious or philosophical claims that are made in the name of science.

Should Schools Protect Teacher Academic Freedom?

Yes. Teachers nationwide have faced unfair and probably illegal punishments for teaching students about scientific critiques of Darwin. School districts should adopt policies to protect teacher academic freedom so teachers know they have the right to teach about the problems with evolution, unhindered by the Darwinian thought police. One school district has adopted a model policy supporting teacher academic freedom to question Darwin that states, "[T]he teaching of some scientific subjects, such as biological evolution, the chemical origins of life, global warming, and human cloning, can cause controversy … [T]eachers shall be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths **and weaknesses** of existing scientific theories pertinent to the course being taught."

Should Schools Inject Religion into the Science Curriculum?

No. The science classroom is for teaching science. However, many scientific critiques of Darwinism have a legitimate scientific basis in peer-reviewed scientific studies and teaching students



FAQ on ID and Evolution

about these scientific arguments against Darwinian evolution in no way injects religion into the classroom.

Must a Teacher Cover Evolution When It Is Part of the Required Curriculum?

Yes. Public school teachers must fulfill the required curriculum, and if evolution is part of the curriculum, they must teach it.

What Are Some Scientific Problems with Darwinian Evolution and Chemical Evolution?

Genetics: Mutations Tend to Cause Harm and Do Not Build Complexity. Darwinian evolution relies on random mutations which are selected by natural selection, a blind and unguided process that has no goals. Such a random and undirected process tends to harm organisms. It does not seem capable of improving organisms and does not seem capable of building new, complex systems.

Biochemistry: Unguided and Random Processes Cannot Produce Cellular Complexity. Cells contain incredible complexity, similar to machine technology but dwarfing anything produced by humans. Cells use circuits, miniature motors, feedback loops, encoded language, and even error-checking machinery which decodes and repairs our DNA. Many scientists have claimed that Darwinian evolution does not appear capable of building this type of integrated complexity.

Paleontology: The Fossil Record Lacks Intermediate Fossils. The fossil record's overall pattern is one of abrupt explosions of new biological forms, and possible candidates for evolutionary transitions are the exception, not the rule. For example, the Cambrian Explosion is an event in life's history over 500 million years ago where nearly all the major body plans of animals appear in a geological instant without any apparent evolutionary precursors.

Taxonomy: Biologists Have Failed to Construct Darwin's Tree of Life. Biologists hoped that DNA evidence would reveal a grand tree of life where all organisms are clearly related. Yet trees describing the alleged ancestral relationships between organisms based upon one gene or biological characteristic commonly conflict with trees based upon a different gene or characteristic. This implies a challenge to universal common descent, the hypothesis that all organisms share a single common ancestor.

Chemistry: The Chemical Origin of Life Remains an Unsolved Mystery. The mystery of the origin of life is unsolved, and all existing theories of chemical evolution face major problems. Basic deficiencies in chemical evolution include a lack of explanation for how a primordial soup could arise on the early earth's hostile environment, or how the information required for life could be generated by blind chemical reactions.

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[i] Ouachita Parish Science Curriculum Policy, at http://www.opsb.net/downloads/forms/Ouachita_Parish_Science_Curriculum_Policy.pdf

The Truth About Kitzmiller vs. Dover

Overview

» In fall 2004, the school board in Dover, Pennsylvania adopted a policy requiring teachers to read a statement to students informing them that intelligent design (ID) "is an explanation of the origin of life that differs from Darwin's view" and that "[t]he reference book, *Of Pandas and People*, is available for students who might be interested in gaining an understanding of what Intelligent Design actually involves."

» **Discovery Institute opposed the Dover policy from the start and urged the Dover school board to repeal it.** Although the Institute believes that teachers should have the right to voluntarily discuss ID in an objective and pedagogically appropriate manner, it opposes efforts to mandate its discussion because it thinks that such mandates are counterproductive. They politicize what first of all should be a scientific and intellectual debate, and they harm the efforts of scientists to gain a fair hearing for their ideas about intelligent design in the scientific community.

» **The Dover board rejected Discovery Institute's advice.**

» In December 2004, attorneys working with the ACLU and Americans United for the Separation of Church and State filed suit claiming that the Dover policy violated the Establishment Clause of the First Amendment and was therefore unconstitutional.

» In December 2005, federal district judge John Jones issued a 139-page ruling striking down the Dover policy and asserting that intelligent design is not scientific.

» **The Dover decision was not appealed, and so it is not a binding legal precedent anywhere outside of the Dover school district.**

Discovery Institute's Approach to Teaching Evolution

» Discovery Institute's recommended approach to the teaching about evolution, which the Dover school board rejected, is:
1. Make sure the evidence schools present for Darwin's theory is scientifically accurate.
2. Teach the scientific evidence for and against the key claims of Darwin's theory, but don't mandate the study of alternative theories such as intelligent design.

» This is a common ground approach that focuses on science, and that all reasonable people should be able to accept.

» This approach focuses on debates over Darwin's theory that are already well-represented in the standard scientific literature (such as questions about the creative power of natural selection, the ability of random mutations to generate useful biological changes, and the origination of animal body plans during the "Cambrian Explosion"). If scientists can read about these debates in their science journals, why can't students hear about them in biology class?

Problems with the Dover Decision

» At the very least, the Dover decision is overbroad. Judge Jones found that the Dover board acted for religious rather than secular reasons. That finding was enough under existing Supreme Court precedents to strike down the Dover policy. **There was no legal reason for Judge Jones to address the broader question of what is science and whether intelligent design met his definition of science.**

» Jones' ruling is poorly argued and its discussion of intelligent design as science is largely inaccurate, possibly due to the fact that more than 90% of the ruling's section analyzing intelligent design was copied virtually verbatim from a document submitted to him by attorneys working with the ACLU.*i*

» Judge Jones even copied the factual errors contained in this document, which was known as "Plaintiffs' Proposed 'Findings of Fact and Conclusions of Law." *ii* For example:

  » Jones claimed that biochemist Michael Behe, when confronted with articles supposedly explaining the evolution of the immune system, replied that these articles were "not 'good enough.'" **In reality, Behe said the exact opposite at trial: "it's *not* that they aren't good enough. It's simply that they are addressed to a different subject."** (emphasis added) The answer cited by Jones came not from Behe, but from the attorneys working with the ACLU, who misquoted Behe.

  » Jones claimed that "ID is not supported by **any** peer-reviewed research, data or publications." (emphasis added) Again, the actual court record shows otherwise. University of Idaho microbiologist Scott Minnich testified at trial that there are between "seven and ten" peer-reviewed papers supporting ID, and he specifically discussed Stephen Meyer's explicitly pro-intelligent design article in the peer-reviewed biology journal, *Proceedings of the Biological Society of Washington*. Additional peer-reviewed publications, including William Dembski's peer-reviewed monograph, *The Design Inference* (published by Cambridge University Press), were described in an annotated bibliography of peer-reviewed and peer-edited publications supporting ID submitted in an *amicus brief* accepted as part of the official record of the case. Jones' false assertions about peer-review simply copied false claims made by attorneys working with the ACLU.

  » Again following plaintiffs' attorney, Jones insisted that ID "requires supernatural creation," that "ID is predicated

The Truth About Kitzmiller vs. Dover

on supernatural causation," and that "ID posits that animals... were created abruptly by a ... supernatural, designer." He further claimed that "[d]efendants' own expert witnesses acknowledged this point." **In fact, defendants' expert witnesses did nothing of the sort.** ID proponents—**including the defendants' expert witnesses at the *Kitzmiller* trial**—have consistently explained that ID as a scientific theory does **not** require a supernatural designer. For example, when asked at trial "whether intelligent design requires the action of a supernatural creator," biochemist Scott Minnich replied, "It does not."

What legal scholars are saying

» "The part of *Kitzmiller* that finds ID not to be science is **unnecessary, unconvincing, not particularly suited to the judicial role, and even perhaps dangerous both to science and to freedom of religion**,"—Jay D. Wexler, Professor of Law, Boston University Law School, "Kitzmiller and the 'Is it Science?' Question," 5 *First Amendment Law Review* 90, 93 (2006), emphasis added. Note: Prof. Wexler is a strong critic of teaching ID.

» **"[I]nvalidating the teaching of intelligent design in public schools is flatly inconsistent with free speech principles**... If the Supreme Court ever gets a case, unlike *Kitzmiller*, where the School Board of Legislature's apparent motive for integrating intelligent design into the curriculum is to maximize student exposure to different ideas about the origin of the species, and not to indoctrinate religion, the Court should uphold the provision."—Arnold Loewy, self-described First Amendment "liberal" and George R. Killam Jr. Chair of Criminal Law, Texas Tech Law School, 5 *First Amend. Law Review*, 89, emph. added.

» "Despite Judge Jones's apparent desire to have the final word on ID for the judiciary, future jurists encountering efforts to address the topic of ID will have not only the right, but the obligation to think for themselves and determine whether the reasoning used by Judge Jones is accurate, necessary, or even relevant. ...ID will survive *Kitzmiller* not only because the ruling itself is unpersuasive and is owed no deference, but because the scientific evidence pointing to design in nature is just as powerful today as it was before Judge Jones ruled."—David K. DeWolf, John West, Casey Luskin, "Intelligent Design will Survive Kitzmiller v. Dover," 68 *Montana Law Review* 7, 17, 57 (Winter, 2007).

For more information

» *Dover Intelligent Design Trial Information*, http://www.traipsingingintoevolution.com. Extensive collection of materials relating to the Dover case, including legal briefs filed by Discovery Institute, a group of scientists for academic freedom, and the Foundation for Thought and Ethics.

» *Traipsing Into Evolution: Intelligent Design and the Kitzmiller vs. Dover Decision* (Discovery Institute Press, 2006). The first book critiquing the Dover decision in detail. Available from Amazon.com or your favorite bookseller.

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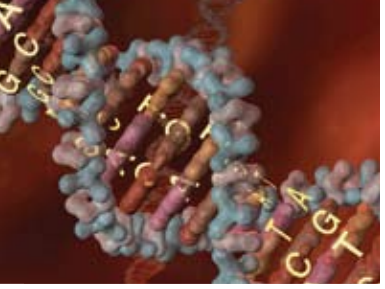
i John G. West and David K. DeWolf, "A Comparison of Judge Jones' Opinion in *Kitzmiller v. Dover* with Plaintiffs' Proposed 'Findings of Fact and Conclusions of Law,'" *http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3829*.

ii Documentation of the information that follows can be found in ibid.



Teaching About Evolution in the Public Schools: *A Short Summary of the Law*

By Prof. David K. DeWolf, J.D., and Seth L. Cooper, J.D.
Discovery Institute
June 20, 2006

Few educational issues have sparked such continuing controversy and debate as the teaching of evolution. In the past, the debate has been polarized between those who advocate teaching only the positive case for evolution and those who ask either to remove evolution or from the curriculum or to require teaching some form of creationism alongside evolution. (By "evolution" we mean both neo-Darwinian evolutionary theory in biology and chemical evolutionary theories for the origin of the first life from non-living chemicals.) School boards have been forced to address concerns about good science education as well as conflicting claims about constitutional limitations. But in the last decade a new approach to teaching about evolution has been developed to meet the test of good science and satisfy the courts' standards of constitutionality. This new approach uses the phrase "teach the controversy." The idea is to use scientific disagreements over evolution to help students learn more about evolution, and about how science deals with controversy. According to this approach, students should learn the scientific case for evolution, but in doing so they should study the scientific criticisms of various aspects of evolutionary theory.

The Constitution permits scientific critiques of prevailing scientific theories.

It is clear from U.S. Supreme Court precedents that the Constitution permits both the teaching of evolution as well as the teaching of scientific criticisms of prevailing scientific theories. Those who would like to remove evolution from the curriculum altogether have been told in no uncertain terms that the right to teach about this subject is inherent in the First Amendment. (Epperson v. Arkansas, 1967) At the same time, the U.S. Supreme Court has made clear that criticism of the theory of evolution may also be a required part of the curriculum. In the case of Edwards v. Aguillard (1987), the Court explicitly stated: "We do not imply that a legislature could never require that scientific critiques of prevailing scientific theories be taught."

Public schools have broad discretion in developing curricula. Including more scientific information about evolutionary theory, even scientific information that raises questions about its explanatory power, can satisfy the goal of improving science education. Particularly where the effect of a "teach the controversy" approach is to help both advocates and critics of evolutionary theory to have a better understanding of the claims of evolutionary theory and its supporting evidence, the test of constitutionality can easily be met.

It is important to note that legal scholars and groups with differing views about evolution have conceded the constitutionality of presenting scientific criticisms of evolutionary theory. In 1995 a broad range of legal, religious and non-religious organizations (including the American Civil Liberties Union, Americans United for Separation of Church and State and the Anti-Defamation League) signed a statement called "Religion in the Public Schools: A Joint Statement of Current Law." The joint statement of over 30 organizations agreed that "any genuinely scientific evidence for or against any explanation of life may be taught." (See ***http://www.aclu.org/ReligiousLiberty/ReligiousLiberty.cfm?ID=9007&c=139***)

At the same time, school boards and administrators need to bear in mind that any presentation of a science curriculum dealing with evolutionary theory should focus on scientific evidence and theories reasonably inferable from that evidence, rather than upon claims that rest upon religious beliefs. Resources discussing scientific criticisms of aspects of neo-Darwinian and chemical evolutionary theories include the Icons of Evolution Study Guide and the Icons of Evolution Curriculum Modules. (See ***http://www.arn.org/arnproducts/books/b090.htm*** and ***http://www.arn.org/arnproducts/videos/v054.htm***)

The Constitution prohibits the censoring of scientific ideas.

In Epperson v. Arkansas (1967), the Supreme Court stated that while shaping public school curricula is within a state's power, that power "does not carry with it the right to prohibit, on pain of criminal penalty, the teaching of a scientific theory or doctrine where that prohibition is based upon reasons that violate the First Amendment." To be sure, that case dealt with a statute that prohibiting the teaching of "...the theory or doctrine that mankind ascended or descended from a lower order of animals..." But the same principle could be applied to the prohibition of teaching any criticism of such a theory.

In his analysis of Epperson, Dr. Francis J. Beckwith stated the following: "the Court is not saying that publicly supported criticism of Darwinism (or evolution) is unconstitutional, but rather, that prohibiting academic discussion of these issues in the classroom—discussions necessary for the advancement of human knowledge—is inconsistent with the First Amendment if the prohibition has the effect of advancing sectarian religious or antireligious beliefs." (Francis J. Beckwith, Law, Darwinism, and Public Education: The Establishment Clause and the Challenge of Intelligent Design (Rowman and Littlefield, 2003), p. 12.)

Under Epperson, it is unconstitutional to exclude a theory simply because it is incompatible with the religious or anti-religious beliefs of a dominant group. At the same time, as noted above, curriculum must be chosen based upon the educational needs and resources available to the school board. Thus, the ideal standard for science education regarding evolutionary theory is to present both the case for mainstream evolutionary theory as well as the salient criticisms that are appropriate for the age group under consideration. Teaching students both the scientific strengths and weakness of neo-Darwinian and chemical evolutionary theories is consistent with academic freedom and avoids the problematic approach to the issue that the Court faced in Epperson.

Teaching About Evolution in the Public Schools: *A Short Summary of the Law*

States have called for critical thinking about evolutionary theory, following Congress's advice.

The No Child Left Behind Act (NCLB) requires all states to implement state-wide science standards by the 2005-06 school year. States are currently creating or revising science standards, which will dictate how evolution is taught in each state for the foreseeable future.

The Conference Committee Report of the No Child Left Behind Act of 2001 addressed the question of whether the implementation of state standards should result in a narrowing of science education. The Report says that where controversial topics like biological evolution exist, students should be able to "understand the full range of scientific views that exist."

Five states (Kansas, New Mexico, Pennsylvania, South Carolina, and Minnesota) have already adopted science standards that require learning about some of the scientific controversies relating to evolution. In a March, 2003 letter on science curriculum under NCLB, the Acting Deputy Secretary of the U.S. Department of Education stated that "The Department...embraces the general principles—reflected in the [NCLB report language]—of academic freedom and inquiry into scientific views or theories." It also made clear that "The NCLB does not contain any language that requires or prohibits the teaching of any particular scientific views or theories either as part of a state's science curriculum or otherwise..." (See: ***http://www.discovery.org/scripts/viewDB/index.php?command=view&id=1899 and http://www.discovery.org/scripts/viewDB/index.php?command=view&id=1897***).

What about intelligent design?

In recent years a number of scientists, philosophers of science, and other scholars have developed a theory known as intelligent design. The theory of intelligent design argues that some features of the universe are best explained as the products of an intelligent cause. Many scholars working on intelligent design are affiliated with Discovery Institute, a non-profit, non-partisan think tank in Seattle, a leading advocate of the "teach the controversy" approach.

As a matter of public policy, Discovery Institute opposes any effort to mandate or require the teaching the theory of intelligent design by school districts or state boards of education. Recognizing the potential for sharp conflict in this area, Discovery Institute believes that a curriculum that aims to provide students with an understanding of the strengths and weaknesses of neo-Darwinian and chemical evolutionary theories (rather than teaching an alternative theory, such as intelligent design) represents a common ground approach that all reasonable citizens can agree on.

Beyond the question of what a school board should mandate as part of its science curriculum, there is the question of a teacher has a constitutional right to teach more than the school board requires with regard to theory of intelligent design. In December, 2005, a federal trial judge in Pennsylvania made a controversial ruling that it would be unconstitutional to teach the theory of intelligent design in public school science class. However, the decision in that case, Kitzmiller v. Dover Area School Board (M.D. Penn. 2005), was never appealed to an appellate court. Beyond the actual parties to a lawsuit, trial opinions such as Kitzmiller do not have the force of law. Moreover, the decision in the *Kitzmiller* ruling was based upon evidence and characterizations of intelligent design that have been sharply contested by leading proponents of intelligent design. Accordingly, the U.S. Supreme Court's decision in Edwards v. Aguillard remains the federal courts' authoritative pronouncement on the teaching of scientific alternatives to evolutionary theory.

Without attempting to predict specific outcomes in specific cases that might arise in the future, a few general comments can be made. First, the U.S. Supreme Court's opinion in Edwards v. Aguillard contains a strong affirmation of the individual teacher's right to academic freedom. It also recognized that, while the statute requiring the teaching of creationism in that case was unconstitutional, "...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." On the other hand, courts have recognized that teachers in K-12 public schools are subject to reasonable curricular guidelines, so long as those guidelines are applied! consis tently to all teachers and issues. Moreover, courts are aware of the danger that a teacher will use the classroom to advance personal religious (or anti-religious) views. As a result, science teachers should avoid even the appearance of exploiting a captive audience as distinguished from helping students develop critical thinking skills.

For a detailed discussion about the constitutionality of teaching intelligent design, see David K. DeWolf et. al., "Teaching the Origins Controversy: Science, Religion, or Speech?" in the Utah Law Review (2000); Jeffrey F. Addicott, "Storm Clouds on the Horizon of Darwinism: Teaching the Anthropic Principle and Intelligent Design in the Public Schools," in the Ohio State Law Journal (2002). (See article available here: ***http://www.discovery.org/scripts/viewDB/index.php?command=view&id=2110&program=CSC%20-%20Science%20and%20Education%20Policy%20-%20Legal%20Resources***) Also see Francis J. Beckwith's Law, Darwinism, and Public Education: The Establishment Clause and the Challenge of Intelligent Design (Rowman & Littlefield, 2003) (Available here: ***http://www.arn.org/arnproducts/books/b071.htm***)

For a critical response to the anti-ID trial court ruling in Kitzmiller v. Dover Area School Board, see Traipsing into Evolution: Intelligent Design and the Kitzmiller v. Dover Decision claiming to be ***http://www.arn.org/arnproducts/php/book_show_item.php?id=97***.) Also see John G. West, Dover in Review (***http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3135***).

Discovery Institute's Science Education Policy

What does the Discovery Institute's Center for Science and Culture recommend for science education curriculum?

As a matter of public policy, Discovery Institute *opposes* any effort require the teaching of intelligent design by school districts or state boards of education. Attempts to mandate teaching about intelligent design only politicize the theory and will hinder fair and open discussion of the merits of the theory among scholars and within the scientific community. Furthermore, most teachers at the present time do not know enough about intelligent design to teach about it accurately and objectively.

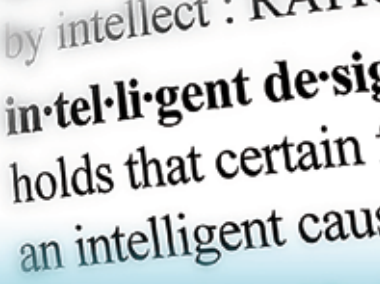
Instead of mandating intelligent design, Discovery Institute seeks to **increase** the coverage of evolution in textbooks. It believes that evolution should be fully and completely presented to students, and they should learn more about evolutionary theory, including its unresolved issues. In other words, evolution should be taught as a scientific theory that is open to critical scrutiny, not as a sacred dogma that can't be questioned.

Discovery Institute believes that a curriculum that aims to provide students with an understanding of the strengths and weaknesses of neo-Darwinian and chemical evolutionary theories (rather than teaching an alternative theory, such as intelligent design) represents a common ground approach that all reasonable citizens can agree on.

Four states (Minnesota, New Mexico, Pennsylvania, and South Carolina) have science standards that require learning about some of the scientific controversies relating to evolution.

Although Discovery Institute does not advocate requiring the teaching of intelligent design in public schools, it does believe there is nothing unconstitutional about voluntarily discussing the scientific theory of design in the classroom. In addition, the Institute opposes efforts to persecute individual teachers who may wish to discuss the scientific debate over design in an objective and pedagogically appropriate manner.

The U.S. Supreme Court in *Edwards v. Aguillard* strongly affirmed the individual teacher's right to academic freedom. It also recognized that, while the statute requiring the teaching of creationism in that case was unconstitutional, "…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."



Should We Teach the Scientific Criticisms of Neo-Darwinism?

Should we Teach Scientific Criticisms of Neo-Darwinism? Many Authorities say YES!

Congress supports such a policy:
"The Conferees recognize that a quality science education should prepare students to distinguish the data and testable theories of science from religious or philosophical claims that are made in the name of science. *Where topics are taught that may generate controversy (such as biological evolution), the curriculum should help students to understand the full range of scientific views that exist,* why such topics may generate controversy, and how scientific discoveries can profoundly affect society."[1]

The U.S. Department of Education supports such a policy:
"The department, of course, embraces the general principles – reflected in the Senate Resolution – of academic freedom and inquiry into scientific views and theories.[2]

Various States and School Districts have successfully implemented such a policy:

Minnesota: "The student will be able to explain how scientific and technological innovations as well as new evidence can challenge portions of or entire accepted theories and models including... [the] theory of evolution...."[3]

New Mexico: Students will "critically analyze the data and observations supporting the conclusion that the species living on Earth today are related by descent from the ancestral one-celled organisms."[4]

Pennsylvania: Critically evaluate the status of existing theories (e.g., germ theory of disease, wave theory of light, classification of subatomic particles, theory of evolution, epidemiology of aids).[5]

South Carolina: "Summarize ways that scientists use data from a variety of sources to investigate and critically analyze aspects of evolutionary theory."[6]

Grantsburg, Wisconsin: "Students shall be able to explain the scientific strengths and weaknesses of evolutionary theory. This policy does not call for the teaching of Creationism or Intelligent Design."

Ouachita Parish, Louisiana: "[T]he teaching of some scientific subjects, such as biological evolution, the chemical origins of life, global warming, and human cloning, can cause controversy…

[T]eachers shall be permitted to help students understand, analyze, critique, and review in an objective manner the scientific strengths and weaknesses of existing scientific theories pertinent to the course being taught."[7]

The United States Supreme Court has sanctioned such a policy:
"We do not imply that a legislature could never require that scientific critiques of prevailing scientific theories be taught."[8]

Charles Darwin himself would have supported such a policy:
"A fair result can be obtained only by fully stating and balancing the facts and arguments on both sides of each question."[9]

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1 Conference report to No Child Left Behind Act; House Committee of Conference, *Report to Accompany H.R. 1*, 107th Cong. 1st sess., 78 (2001) H. Rept. 334, 78 (emphasis added). This language was originally supported by a 91-8 vote by the U.S. Senate.

2 Letter from Gene Hickock, Acting Deputy Secretary, U.S. Dept. of Education, March 8, 2004. The "Senate Resolution" is the resolution which formed the basis for the Congressional statement cited above in the first citation.

3 Minnesota Academic Standards, History and Nature of Science, Grades 9-12, *available at* tis.mpls.k12.mn.us/Science.html (last visited Sept. 9, 2005).

4 New Mexico Science Content Standards, Benchmarks and Performance Standards, Standard II (Life Science) (Biological Evolution) (9), *available at* nmlites.org/standards/science/index.html (last visited Sept. 9, 2005).

5 Pennsylvania, Academic Standards for Science and Technology, Standard 3.2.12.

6 South Carolina Biology Science Standards, indicator B-5.6 available at: http://www.myscschools.com/offices/cso/standards/science/ documents/scienceStandardsNov182005trackingremovedwbiofootnote_000.doc

7 http://www.opsb.net/downloads/forms/Ouachita_Parish _Science_Curriculum_Policy.pdf

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

9 Charles Darwin, *The Origin of Species*, ed. J. W. Burrow (London: Penguin Group, 1985), (1859), 66.

The Scientific Controversy Over the Cambrian Explosion

Darwin called his theory "descent with modification." The phrase reflected Darwin's belief that all organisms are modified descendants of a common ancestor that lived in the distant past. The only illustration in Darwin's book *The Origin of Species* shows the "tree of life" pattern one would expect to find in the fossil record if his theory were true. The common ancestor would come first, as a single species at the base of the tree. Minor differences among individuals would appear first, and these differences would eventually increase until one species had become two or more. Differences among species would then grow until some species became so different they would be classed as separate genera; genera would diverge to become separate families, families would diverge to become separate orders, and so on. Eventually differences would become so great that where there had originally been one major division or "phylum," there would now be two. Today there are several dozen animal phyla. The major ones include the nematodes (roundworms), annelids (earthworms and leeches), mollusks (clams and snails), arthropods (lobsters and insects), echinoderms (starfish and sea urchins) and chordates (fishes and mammals).

If Darwin's theory were true, then a long accumulation of minor differences must have preceded the major differences we now see among the animal phyla. As Darwin himself wrote, before the different phyla appeared there must have been "vast periods" during which "the world swarmed with living creatures" (Excerpt A, p. 83). In the fossil record, however, most of the major animal phyla appear fully formed at the beginning of the geological period known as the Cambrian, with no fossil evidence that they branched off from a common ancestor. Darwin was aware of this, acknowledging in *The Origin of Species* that "several of the main divisions of the animal kingdom suddenly appear in the lowest known fossiliferous rocks." He called this a "serious" problem which "at present must remain inexplicable; and may be truly urged as a valid argument against the views here entertained" (Excerpt A, pp. 82, 85).

(A) Charles Darwin, *The Origin of Species*, Sixth Edition (New York: D, Appleton, 1890), Chapter X.

Darwin remained convinced that his theory was true, however. He speculated that ancestors of the different phyla had not been found because the fossil record was imperfect. If, as it seemed, rocks before the Cambrian had been deformed by heat and pressure, or eroded away, then fossil ancestors might never be found. He acknowledged, though, that he really had "no satisfactory answer" to the problem (Excerpt A, p. 84).

Subsequent fossil collecting, however, has yielded many fossils of organisms that lived before the Cambrian. Fossil beds in Canada (the Burgess shale) and China (the Chengjiang fauna) have also yielded much richer collections of Cambrian fossils than were available to Darwin and his contemporaries. Reviewing the evidence in 1991, Berkeley paleontologist James Valentine and his colleagues noted: "During the past 40 years, rocks older than what had now been considered to be the base of the Cambrian have indeed yielded fossils that now permit much more detailed assessments of early metazoan [i.e., multicellular animal] evolution" (Excerpt B, p. 280). Valentine and his colleagues found that "it has not proven possible to trace transitions" between the phyla, and the evidence points to a Cambrian "explosion" that "was even more abrupt and extensive than previously envisioned" (Excerpt B, pp. 281, 294). The authors concluded that "the metazoan explosion is real; it is too big to be masked by flaws in the fossil record" (Excerpt B, p. 318).

Some scientists have suggested that fossil ancestors for the animal phyla are missing not because the rocks have been deformed or eroded, but because animals before the Cambrian lacked hard parts, and thus never fossilized in the first place. According to this hypothesis, the Cambrian explosion merely represents the sudden appearance of shells and skeletons in animal that had evolved long before. The fossil evidence, however, does not support this hypothesis. First, as Harvard paleontologist Stephen Jay Gould and Cambridge paleontologist Simon Conway Morris have pointed out, the majority of Cambrian explosion fossils are soft-bodied (Stephen Jay Gould, *Wonderful Life* [New York: Norton, 1989]; Simon Conway Morris, The Crucible of Creation [Oxford: Oxford University Press, 1998). Second, the fossil evidence points to the appearance of many new body plans in the Cambrian, not just the acquisition of hard parts by existing phyla. According to Berkeley paleontologist James Valentine, the Cambrian explosion "involved far more major animal groups than just the durably skeletonized living phyla." It was "new kinds of organisms, and not old lineages newly donning skeleton-armor, that appeared" (Excerpt C, p. 533). Valentine concluded: "the record that we have is not very supportive of models that posit a long period of the evolution of metazoan phyla" before the Cambrian (Excerpt C, p. 547).

(B) James W. Valentine et al., "The Biological Explosion at the Precambrian-Cambrian Boundary," *Evolutionary Biology* 25 (1991): 279-356.

(C) James W. Valentine, "The Macroevolution of Phyla," pp. 525-553 in Jere H. Lipps & Philip W. Signor (editors), *Origin and Early Evolution of the Metazoa* (New York: Plenum Press, 1992).

Recent studies have also emphasized the abruptness of the Cambrian explosion. After reviewing the geological dating of rocks near the Precambrian-Cambrian boundary, Bowring and his colleagues reported in 1993 that the Cambrian explosion of animal phyla was "unlikely to have exceeded 10 million years" (Excerpt D, p. 1297). As Valentine, Jablonski and Erwin pointed out in 1999, this is "less than 2% of the time from the base of the Cambrian to the present day" (Excerpt E, p. 852). Since the time from the Cambrian to the present is only about one seventh of the time since the origin of life on Earth, this means the Cambrian explosion was geologically very abrupt, indeed.

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According to Valentine, Jablonski and Erwin, extensive new data "do not muffle the explosion, which continues to stand out as a major feature in early metazoan history" (Excerpt E, p. 851).

(D) Samuel A. Bowring et al., "Calibrating Rates of Early Cambrian Evolution," *Science* 261 (1993): 1293-1298.

(E) James W. Valentine, David Jablonski & Douglas H. Erwin, "Fossils, molecules and embryos: new perspectives on the Cambrian explosion," *Development* 126 (1999): 851-859.

What significance does the Cambrian explosion have for evaluating Darwin's theory that all animals are modified descendants of a common ancestor? As we have seen, Darwin himself considered it a serious problem (Excerpt A). Although Darwin's theory predicts that animal evolution should proceed from the "bottom up," with the largest differences emerging last, James Valentine and his colleagues wrote in 1991 that the pattern of the Cambrian explosion "creates the impression that metazoan evolution has by and large proceeded from the 'top down' " (Excerpt B, p. 294). Harry Whittington, an expert on the Cambrian fossils from the Burgess shale, wrote in 1985: "It may well be that metazoan animals arose independently in different areas. I look sceptically upon diagrams that show the branching diversity of animal life through time, and come down at the base to a single kind of animal" (Excerpt F, p. 131). Evolutionary biologist Jeffrey Levinton, though convinced of the common ancestry of animals, acknowledged in 1992 that the Cambrian explosion -- "life's big bang," as he called it -- remains "evolutionary biology's deepest paradox" (Excerpt G, p. 84). Although "the body plans that evolved in the Cambrian by and large served as the blueprints for those seen today," Levinton saw "no reason to think that the rate of evolution was ever slower or faster than it is now. Yet that conclusion still leaves unanswered the paradox posed by the Cambrian explosion and the mysterious persistence of those ancient body plans" (Excerpt G, pp. 84, 90). In 1999, University of California biologist Malcolm Gordon wrote: "Recent research results make it seem improbable that there could have been single basal forms for many of the highest categories of evolutionary differentiation (kingdoms, phyla, classes)" (Excerpt H, p. 331). Gordon concluded: "The traditional version of the theory of common descent apparently does not apply to kingdoms [i.e., plants, animals, fungi, bacteria] as presently recognized. It probably does not apply to many, if not all, phyla, and possibly also not to many classes within the phyla" (Excerpt H, p. 335).

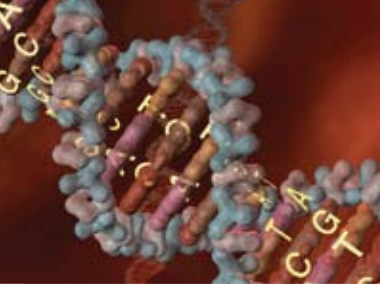
(F) Harry B. Whittington, *The Burgess Shale* (New Haven, CT: Yale University Press, 1985).

(G) Jeffrey S. Levinton, "The Big Bang of Animal Evolution," *Scientific American* 267 (November, 1992): 84-91.

(H) Malcolm S. Gordon, "The Concept of Monophyly: A Speculative Essay," *Biology and Philosophy* 14 (1999): 331-348.

So the Cambrian explosion is real, and for some biologists it is at least paradoxical and mysterious from the perspective of Darwin's theory. For other biologists, it actually constitutes evidence against Darwin's hypothesis that all animals evolved from a single common ancestor. Yet some scientists continue to defend Darwin's theory by arguing that the Cambrian explosion is perfectly consistent with it. One of these is Alan Gishlick of the National Center for Science Education, a group that opposes any criticisms of Darwinian evolution in biology classrooms. In written comments submitted to the Texas State Board of Education at their textbook-adoption hearing July 9, 2003, Gishlick criticized a book by biologist Jonathan Wells, *Icons of Evolution* (Washington, DC: Regnery Publishing, 2000). In his comments, Gishlick wrote that the Cambrian explosion actually occurred "over a 15-20 million year period" and that "the 'top-down' appearance of body plans is, contrary to Wells, compatible with the predictions of evolution" (Excerpt I, p. 15). Gishlick's claim about the duration of the Cambrian explosion is at odds, however, with the published views of James Valentine and his colleagues (Excerpt B, p. 279; Excerpt E, pp. 851-853) and Samuel Bowring and his colleagues (Excerpt D). Furthermore, if by "evolution" Gishlick means "Darwinian evolution," then his claim that a "top-down" pattern is consistent with evolution conflicts with the published views of Harry Whittington (Excerpt F) and Malcolm Gordon (Excerpt H). Clearly, Gishlick's disagreements are not just with Wells.

Gishlick also argued that the major differences between animal phyla are not so major after all. He wrote: "The most primitive living chordate *Amphioxus* is very similar to the Cambrian fossil chordate *Pikia* [sic -- actually *Pikaia*]. Both are basically worms with a stiff rod (the notochord) in them. The amount of change between a worm and a worm with a stiff rod is relatively small, but the presence of a notochord is a major 'body-plan' distinction of a chordate. Further, it is just another small step from a worm with a stiff rod to a worm with a stiff rod and a head (e.g., *Haikouella*; Chen et al., 1999) or a worm with a **segmented** stiff rod (vertebrae), a head and fin folds (e.g., *Haikouichthyes*; Shu et al., 1999). Finally add a fusiform body, fin differentation, and scales; the result is something resembling a 'fish' " (Excerpt I, p. 15). Yet Gishlick's fanciful scenario ignores most of what biologists know about worms and chordates. There are several fundamental anatomical differences between worms and chordates, which can be found in any good biology textbook; possession of a notochord is only one of them. If chordates were simply worms with a stiff rod, they might not even be classed as a separate phylum. Furthermore, from an evolutionary perspective worms and chordates are not closely related. In standard evolutionary trees (such as the ones reproduced here from the Sixth Edition of Campbell & Reece's *Biology*), chordates (green arrow at top of pp. 636 & 640 in Excerpt J) are considered closer to echinoderms (starfish and sea urchins) than they are to any of the worm phyla (two of which are indicated by the pink and orange arrows at the top of the same diagrams in Excerpt J). Gishlick cites two scientific articles to support his argument: The first points out that the most primitive chordates might have rudimentary brains and thus be closer to chordates with heads than previously thought, but it doesn't not address the



The Scientific Controversy Over the Cambrian Explosion

problem of how the first chordate originated (Excerpt K, p. 522). The second article actually **contradicts** Gishlick's suggestion that once a worm posses a stiff rod it could easily evolve into a vertebrate. According to Shu and his colleagues, "the derivation of the first vertebrates from the cephalochordates [i.e., more primitive chordates] must have entailed a major reorganization of the body" (Excerpt L, p. 46). Once again, Gishlick's disagreements are not just with Wells.

(I) Alan Gishlick, "Comments on the Discovery Institute's 'Analysis of the Treatment of Evolution in Biology Textbooks'," submitted to the Texas Education Agency in connection with their July 9, 2003 public hearing on textbook adoption.

(J) Neil A. Campbell & Jane B. Reece, *Biology*, Sixth Edition (San Francisco: Benjamin Cummings, 2002).

(K) J.-Y. Chen, Di-ying Huang & Chia-Wei Li, "An early Cambrian craniate-like chordate," *Nature* 402 (1999): 518-522.

(L) D.-G. Shu et al., "Lower Cambrian vertebrates from South China," *Nature* 402 (1999): 42-46.

Since the abruptness and extensiveness of the Cambrian explosion are so well documented, there is no excuse for a biology textbook to deal with the animal fossil record without even mentioning it. Furthermore, since some biologists maintain that the Cambrian explosion presents a challenge -- or at least a "paradox" -- for one of the fundamental tenets of Darwin's theory, any biology textbook that doesn't discuss that challenge fails to provide students with the resources to think critically about the most widely taught scientific explanation for evolution.

The Scientific Controversy Over Whether Microevolution Can Account For Macroevolution

When Charles Darwin published *The Origin of Species* in 1859, it was already known that existing species can change over time. This is the basis of artificial breeding, which had been practiced for thousands of years. Darwin and his contemporaries were also familiar enough with the fossil record to know that major changes in living things had occurred over geological time. Darwin's theory was that a process analogous to artificial breeding also occurs in nature; he called that process natural selection. Darwin's theory was also that changes in existing species due primarily to natural selection could, if given enough time, produce the major changes we see in the fossil record.

After Darwin, the first phenomenon (changes within an existing species or gene pool) was named "microevolution." There is abundant evidence that changes can occur within existing species, both domestic and wild, so microevolution is uncontroversial. The second phenomenon (large-scale changes over geological time) was named "macroevolution," and Darwin's theory that the processes of the former can account for the latter was controversial right from the start. Many biologists during and after Darwin's lifetime have questioned whether the natural counterpart of domestic breeding could do what domestic breeding has never done -- namely, produce new species, organs, and body plans. In the first few decades of the twentieth century, skepticism over this aspect of evolution was so strong that Darwin's theory went into eclipse. (See Chapter 9 of Peter Bowler's *Evolution: The History of an Idea*, University of California Press, revised edition, 1989).

In the 1930s, "neo-Darwinists" proposed that genetic mutations (of which Darwin was unaware) could solve the problem. Although the vast majority of mutations are harmful (and thus cannot be favored by natural selection), in rare instances one may benefit an organism. For example, genetic mutations account for some cases of antibiotic resistance in bacteria; if an organism is in the presence of the antibiotic, such a mutation is beneficial. All known beneficial mutations, however, affect only an organism's biochemistry; Darwinian evolution requires large-scale changes in morphology, or anatomy. Midway through the twentieth century, some Darwinian geneticists suggested that occasional "macromutations" might produce the large-scale morphological changes needed by Darwin's theory. Unfortunately, all known morphological mutations are harmful, and the larger their effects the more harmful they are. Scientific critics of macromutations took to calling this the "hopeful monster" hypothesis. (See Chapter 12 of Bowler's book.)

The scientific controversy over whether processes observable within existing species and gene pools (microevolution) can account for large-scale changes over geological time (macroevolution) continues to this day. Here are a few examples of peer-reviewed scientific articles that have referred to it just in the last few years:

» **David L. Stern, "Perspective: Evolutionary Developmental Biology and the Problem of Variation," *Evolution* 54 (2000): 1079-1091.**

"One of the oldest problems in evolutionary biology remains largely unsolved...Historically, the neo-Darwinian synthesizers stressed the predominance of micromutations in evolution, whereas others noted the similarities between some dramatic mutations and evolutionary transitions to argue for macromutationism."

» **Robert L. Carroll, "Towards a new evolutionary synthesis," *Trends in Ecology and Evolution*, 15 (January, 2000): 27.**

"Large-scale evolutionary phenomena cannot be understood solely on the basis of extrapolation from processes observed at the level of modern populations and species."

» **Andrew M. Simons, "The continuity of microevolution and macroevolution," *Journal of Evolutionary Biology* 15 (2002): 688-701.**

"A persistent debate in evolutionary biology is one over the continuity of microevolution and macroevolution -- whether macroevolutionary trends are governed by the principles of microevolution."

It should be noted that all of the scientists quoted above are believers in Darwinian evolution, and that all of them think the controversy will eventually be resolved within the framework of that theory. Stern, for example, believes that new developmental studies of gene function will provide "the current missing link." (p. 1079) **The important point here is that the controversy has not yet been resolved, precisely because the evidence needed to resolve it is still lacking.** It is important for students to know what the evidence does or does not show — not just what some scientists hope the evidence will eventually show.

Since the controversy over microevolution and macroevolution is at the heart of Darwin's theory, and since evolutionary theory is so influential in modern biology, it is a disservice to students for biology curricula to ignore the controversy entirely. Furthermore, since the scientific evidence needed to settle the controversy is still lacking, it is inaccurate to give students the impression that the controversy has been resolved and that all scientists have reached a consensus on the issue.

Peer Reviewed Sciences Articles

Scientists and theorists who support the theory of intelligent design have published their work in a variety of appropriate technical venues, including peer-reviewed scientific journals, peer-reviewed scientific books (some published by university presses), peer-edited scientific anthologies, peer-edited scientific conference proceedings and peer-reviewed philosophy of science journals and books. Following is an annotated bibliography of selected technical publications of various kinds that support, develop or apply the theory of intelligent design.

Selected Peer-Reviewed Publications that Directly Support Intelligent Design

1. Stephen Meyer, "The Origin of Biological Information and the Higher Taxonomic Categories," PROCEEDINGS OF THE BIOLOGICAL SOCIETY OF WASHINGTON 117 (2004): 213-239.
2. Lönnig, W.-E. "Dynamic genomes, morphological stasis and the origin of irreducible complexity," DYNAMICAL GENETICS (2004), pp. 101-119.
3. William A. Dembski, THE DESIGN INFERENCE: ELIMINATING CHANCE THROUGH SMALL PROBABILITIES (Cambridge: Cambridge University Press, 1998).
4. John Angus Campbell and Stephen C. Meyer, DARWINISM, DESIGN, & PUBLIC EDUCATION (Michigan State University Press, 2003). [Hereafter, "DDPE."]

This is a collection of interdisciplinary essays that addresses the scientific and educational controversy concerning the theory of intelligent design.

a. Meyer, S. C. "DNA and the origin of life: Information, specification and explanation," DDPE, pp. 223-285.
b. Behe, M. J., "Design in the details: The origin of biomolecular machines," DDPE pp. 287-302.
c. Nelson, P. & J. Wells, "Homology in biology: Problem for naturalistic science and prospect for intelligent design," DDPE, pp. 303-322.
d. Meyer, S. C., Ross, M., Nelson, P. & P. Chien, "The Cambrian explosion: biology's big bang," DDPE, pp. 323-402.
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5. Øyvind Albert Voie, "Biological function and the genetic code are interdependent," CHAOS, SOLITONS AND FRACTALS, Volume 28, Issue 4, May 2006, pp. 1000-1004.
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Selected Peer-Reviewed Publications that Support ID Concepts by Citations or Conclusions

1. M.J. Behe and D.W. Snoke, "Simulating Evolution by Gene Duplication of Protein Features That Require Multiple Amino Acid Residues," PROTEIN SCIENCE, 13 (2004): 2651-2664.
2. W.-E. Lönnig & H. Saedler, "Chromosome Rearrangements and Transposable Elements," ANNUAL REVIEW OF GENETICS, 36 (2002): 389-410.
3. D.K.Y. Chiu & T.H. Lui, "Integrated Use of Multiple Interdependent Patterns for Biomolecular Sequence Analysis," INTERNATIONAL JOURNAL OF FUZZY SYSTEMS, 4(3) (September 2002): 766-775.
4. Behe, M.J., "Self-Organization and Irreducibly Complex Systems: A Reply to Shanks and Joplin," Philosophy of Science 67 (2000): 155-162.
5. Behe, M.J., "Reply to my critics: A response to reviews of Darwin's Black Box: The Biochemical Challenge to Evolution," Biology and Philosophy 16 (2001): 685-709.

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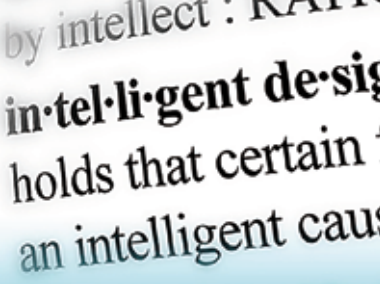
1. Scott Minnich and Stephen C. Meyer, "Genetic Analysis of Coordinate Flagellar and Type III Regulatory Circuits," Proceedings of the Second International Conference on Design & Nature, Rhodes Greece, edited by M.W. Collins and C.A. Brebbia (WIT Press, 2004).
2. W. A. Dembski & M. Ruse, eds., DEBATING DESIGN: FROM DARWIN TO DNA (Cambridge, United Kingdom, Cambridge University Press, 2004) (hereinafter DEBATING DESIGN).
   a. Dembski, W.A., "The logical underpinnings of intelligent design," DEBATING DESIGN, pp. 311-330.
   b. Bradley, W. L., "Information, Entropy, and the Origin of Life," DEBATING DESIGN, pp. 331-351.
   c. Behe, M., "Irreducible complexity: obstacle to Darwinian evolution," DEBATING DESIGN, pp. 352-370.
   d. Meyer, S. C., "The Cambrian information explosion: evidence for intelligent design," DEBATING DESIGN, pp. 371-391.



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Science Resources About Evolution and Intelligent Design

Introduction to Intelligent Design

Intelligent Design Encyclopedia Entry by William Dembski
>>http://www.designinference.com/documents/2003.08.Encyc_of_Relig.htm

Not by Chance by Stephen C. Meyer, National Post of Canada
>>http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3059

Defining intelligent design from ResearchID.org
>>http://www.researchintelligentdesign.org/wiki/Intelligent_design

The Positive Case for Design by Casey Luskin
>>http://www.ideacenter.org/stuff/contentmgr/files/becbbb/miscdocs/thepositivecasefordesign_v3.pdf

What's the Big Deal About Intelligent Design? By Dan Peterson in American Spectator
>>http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3063

The Origin of Intelligent Design by Jonathan Witt
>>http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3207

Intelligent Design revisited by David Limbaugh
>>http://www.discovery.org/scripts/viewDB/index.php?command=view&id=2799

Michael Behe on Molecular Machines
>>http://www.arn.org/mm/mm.htm

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>>http://www.ideacenter.org/contentmgr/showdetails.php/id/1136

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>>http://www.intelligentdesignnetwork.org/NCBQ3_3HarrisCalvert.pdf

Intelligent Design Coming Clean by William Dembski
>>http://www.designinference.com/documents/2000.11.ID_coming_clean.htm

Access Research Network Intelligent Design FAQ
>>http://www.arn.org/id_faq.htm

What Is Intelligent Design? By Casey Luskin in Human Events
>>http://www.discovery.org/scripts/viewDB/index.php?command=view&id=3093

Three Frequently Asked Questions about Intelligent Design by William Dembski
>>http://www.designinference.com/documents/2003.09.ID_FAQ.pdf

Life: By Evolution or Design?
>>http://www.ideacenter.org/stuff/contentmgr/files/fb3830611255b7/miscdocs/lifebyevolutionordesign.pdf

Science and Philosophy Articles About Intelligent Design

Stephen C. Meyer, "The Origin of Biological Information and the Higher Taxonomic Categories," Proceedings of the Biological Society of Washington, Vol. 117(2):213-239 (2004)
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William A. Dembski and Robert J. Marks II, "Active Information in Evolutionary Search,"
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Michael Behe and David W. Snoke, "Simulating evolution by gene duplication of protein features that require multiple amino acid residues," Protein Science (2004), 13
>>http://www.proteinscience.org/cgi/reprint/ps.04802904v1.pdf

The Intelligent Design Paradigmatic and Heuristics by Joseph C. Campana and ResearchID.org Contributors
>>http://www.researchintelligentdesign.org/wiki/The_Intelligent_Design_Paradigmatic_and_Heuristics

William A. Dembski, Intelligent Design as a Theory of Information
>>http://www.arn.org/docs/dembski/wd_idtheory.htm

Stephen C. Meyer, Marcus Ross, Paul Nelson and Paul Chien, "The Cambrian Explosion: Biology's Bang," in Darwinism, Design, and Public Education (Michigan State University Press, 2003).
>>http://www.discovery.org/scripts/viewDB/filesDB-download.php?command=download&id=639

Wolf-Ekkehard Lönnig, "The Evolution of the Long-Necked Giraffe (Giraffa camelopardalis L.) What do we really know? (Part 1),"
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William A. Dembski and Robert J. Marks II, "Conservation of Information in Search: Measuring the Cost of Success,"
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Jonathan Wells, "Using Intelligent Design Theory to Guide Scientific Research," Progress in Complexity, Information, and

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>>http://www.iscid.org/papers/Wells_TOPS_051304.pdf

Casey Luskin, "Human Origins and Intelligent Design," Progress in Complexity, Information, and Design, Volume 4.1 (July, 2005).
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Articles Critical of Darwinian Evolution and Chemical Evolution

Jonathan Wells, "Survival of the Fakest," American Spectator (December 2000 / January, 2001)
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David Berlinski, "The Deniable Darwin," Commentary, Vol. 101(6) (June 1, 1996).
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David Berlinski, "On the Origins of Life," Commentary (June 14, 2007)
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Philip L. Skell, "Why do we invoke Darwin?," The Scientist, Vol. 19(16):10 (August 29, 2005)
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Jonathan Wells, "An Evaluation of Ten Recent Biology Textbooks,"
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>>http://www.arn.org/docs/odesign/od182/hobi182.htm

William A. Dembski, Five Questions Evolutionists Would Rather Dodge, Citizen Magazine
>>http://www.designinference.com/documents/2004.04.Five_Questions_Ev.pdf

Granville Sewell, A Mathematician's View of Evolution, The Mathematical Intelligencer 22, no. 4 (2000)
>>http://www.math.utep.edu/Faculty/sewell/articles/mathint.html

Jonathan Wells, "Second Thoughts about Peppered Moths," The Scientist, Vol. 13(11):13 (May 24, 1999).
>>http://www.arn.org/docs/wells/jw_pepmoth.htm

Jonathan Wells, "Haeckel's Embryos and Evolution: Setting the Record Straight," The American Biology Teacher, Vol. 61(5):345-349 (May, 1999)
>>http://www.discovery.org/scripts/viewDB/filesDB-download.php?command=download&id=629

Education Resources About Evolution and Intelligent Design

Darwinian Evolution, Intelligent Design and Education Policy

Don't Require The Teaching of Intelligent Design
All of the major pro-intelligent design organizations oppose any efforts to require the teaching of intelligent design by school districts or state boards of education. The mainstream ID movement agrees that attempts to mandate teaching about intelligent design only politicize the theory and will hinder fair and open discussion of the merits of the theory among scientists and within the scientific community.

Teach More About Evolution
Instead of mandating intelligent design, the major pro-ID organizations seek to increase the coverage of evolution in textbooks by teaching students about both scientific strengths and weaknesses of evolution. Most school districts today teach only a one-sided version of evolution which presents only the facts which supposedly support the theory. But most pro-ID organizations think evolution should be taught as a scientific theory that is open to critical scrutiny, not as a sacred dogma that can't be questioned.

Protect Academic Freedom Although pro-ID organizations do not advocate requiring the teaching of intelligent design in public schools, they also believe there is nothing unconstitutional about voluntarily discussing the scientific theory of design in the classroom. Pro-ID organizations oppose efforts to persecute individual teachers who may wish to discuss the scientific debate over design in an objective and pedagogically appropriate manner. ***For more on academic freedom issues click here.***

Click here for a short video explaining these policy recommendations.

Law Reviews and Other Resources

Discovery Institute's Science Education Policy

David K. DeWolf, John G. West, and Casey Luskin"Intelligent Design will Survive Kitzmiller v. Dover," 68 Montana Law Review 7 (Winter, 2007).

Traipsing Into Evolution: Intelligent Design and the Kitzmiller v. Dover ruling, by David K. DeWolf, John G. West, Casey Luskin, and Jonathan Witt

Francis J. Beckwith, "Law, Darwinism, and Public Education; The Establishment Clause and the Challenge of Intelligent Design," (Rowman & Littlefled, 2003)

Francis Beckwith, "A Liberty Not Fully Evolved? The Case of Rodney Levake and the Right of Public School Teachers to Criticize Darwinism," 39(4) San Diego Law Review 1311 (Fall, 2002).

David K. DeWolf, Stephen C. Meyer, Mark Edward DeForrest, "Teaching the Origins Controversy: Science, Or Religion, Or Speech?" 2000 Utah Law Review 39

H. Wayne House, "Darwinism and the Law: Can Non-Naturalistic Scientific Theories Survive Constitutional Challenge" 13 Regent University Law Review 355 (Spring 2001).

Francis Beckwith, "Science and Religion Twenty Years After McLean v. Arkansas: Evolution, Public Education, and the New Challenge of Intelligent Design." 26.2 Harvard Journal of Law & Public Policy 455-499 (Spring 2003).

Francis Beckwith, "Public Education, Religious Establishment, and the Challenge of Intelligent Design." 17.2 Notre Dame Journal of Law, Ethics, & Public Policy 461-519 (2003).

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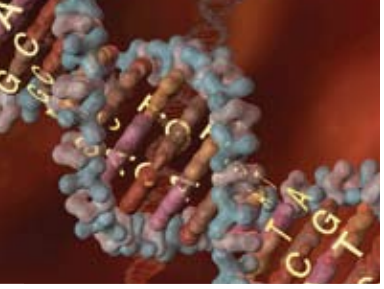
Casey Luskin, "Alternative Viewpoints about Biological Origins as Taught in Public Schools," 47 Journal of Church and State 583 (Summer, 2005). "Contact Casey Luskin for reprints."



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Internet Resources About Evolution and Intelligent Design

Intelligent Design Organizations

- Access Research Network
- (Center for Science & Culture at) Discovery Institute
- Intelligent Design & Evolution Awareness (IDEA) Center
- Intelligent Design Network
- International Society for Complexity, Information, & Design
- Physicians and Surgeons for Scientific Integrity
- Intelligent Design Undergraduate Research Center
- ResearchID.org

State Based Organizations

- Science Excellence for All Ohioans
- Intelligent Design Network New Mexico Division
- Texans for Better Science Education
- Intelligent Design Network of Ohio

Worldwide Intelligent Design Organizations

- Intelligent Design Network Australia
- Progetto Cosmo Truth in Science
- Ciencia-Alternativa
- ID Korea Research Association for Intelligent Design
- ÄLYKKÄÄN SUUNNITELMAN
- Cell Intelligence
- Intelligent Design
- Wort Und Wissen

FAQs on Intelligent Design

- Discovery Institute's Center for Science & Culture FAQ
- Intelligent Design & Evolution Awareness (IDEA) FAQ
- Access Research Network FAQ
- Intelligent Design Network FAQ
- Ten Questions to Ask Your Biology Teacher about Design by William Dembski

Scientists and Scholars

- David DeWolf Homepage
- Design Inference
- Michael Behe's Amazon Blog
- Ralph Seelke's Homepage
- Richard Weikart's Homepage
- TeleoLogic The Emperor Has No Clothes
- Robert Koons' Homepage Christopher Langan's Homepage
- John Mark Reynolds Homepage

The views expressed on these websites do not necessarily represent the views of Discovery Institute.

Blogs Covering Intelligent Design

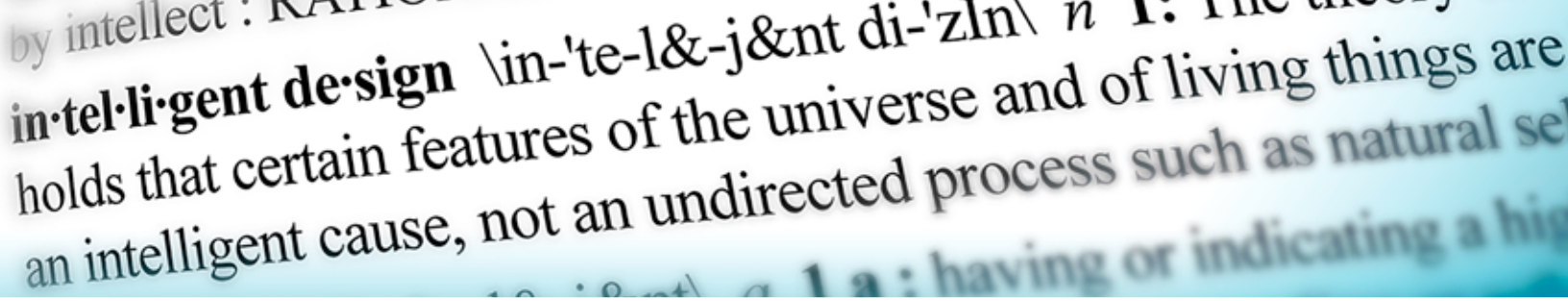
- Academic Freedom Blog
- Brains on Purpose
- Darwinian Fundamentalism
- Desafiando a Nomenklatura Científica
- Design Paradigm
- Doubting Darwin
- Evolution Minute
- Evolution News & Views
- ID The Future Intelligently Sequenced
- Mindful Hack
- Overwhelming Evidence
- Post-Darwinist
- Reasonable Kansans
- Sequenced by Design
- Telic Thoughts
- The Design Matrix
- The ID Update
- Uncommon Descent
- Wittingshire
- The White Path
- The British Centre for Science Education: Revealed

Intelligent Design Book and Film Websites

- A Meaningful World
- By Design or By Chance?
- Darwin, Design and Public Education
- Politically Incorrect Guide to Darwinism & Intelligent Design
- Darwin's Conservatives
- Icons of Evolution
- The Design Matrix
- From Darwin to Hitler
- The Privileged Planet
- Expelled the Movie
- Darwin Day in America
- Traipsing into Evolution

Intelligent Design Video/Multimedia Sites

- ARN YouTube Account Homepage
- Discovery Institute YouTube Account Homepage
- Expelled Movie Trailer The Dawkins Delusion
- Interview with Michael Behe
- Darwin vs Design Molecular Machines
- Bacterial Flagellum - Evolution's Nightmare & Demise
- The Design Inference Part 1
- The Design Inference Part 2
- Veritas Forum: Science
- Expelled YouTube Account Homepage



For more information, or if you have questions about issues related to teaching evolution, please contact:

Casey Luskin, J.D., M.S. (Earth Sciences)
Program Officer for Public Policy and Legal Affairs
Center for Science and Culture
Discovery Institute
1511 Third Ave.
Suite 808
Seattle, WA 98101
(206) 292-0401 x119
cluskin@discovery.org

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