THE THEORY OF INTELLIGENT DESIGN:

EDUCATOR'S BRIEFING PACKET

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Part 1:

A Letter of Introduction

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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 and its Center for Science & Culture, we developed this packet to help teachers understand the issue. However, it's vital to understand that just because intelligent design is a growing scientific theory backed by much evidence, that does not mean it's smart or appropriate to push it into public schools.

For the record, we do not propose that intelligent design 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 conveys the views of the scientists and scholars who support intelligent design, rather than 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 the theory of intelligent design actually proposes and correct common misunderstandings and misrepresentations often found in the newsmedia.

DISCOVERY INSTITUTE URGES TEACHERS AND SCHOOL DISTRICTS TO TEACH OBJECTIVELY ABOUT BOTH THE SCIENTIFIC STRENGTHS AND WEAKNESSES OF MODERN EVOLUTIONARY THEORY.

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.

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 public school teachers and 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.

- In 2005, the Dover school district in central Pennsylvania adopted a policy which required the teaching of intelligent design. Discovery Institute actively opposed the Dover school district policy 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. *For more information on the Kitzmiller v. Dover lawsuit, see Part 4.*

- 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., "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 or www.discovery.org/id.

Sincerely,

John G. West, PhD
Vice President,
Discovery Institute

Casey Luskin, JD, MS (Earth Sciences)
Research Coordinator,
Center for Science and Culture

Part 2:

The Center for Science & Culture

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The Center for Science & Culture (CSC) at Discovery Institute is the institutional hub for scientists, educators, and inquiring minds who think that nature supplies compelling evidence of intelligent design. Our mission is to advance the understanding that human beings and nature are the result of intelligent design rather than a blind and undirected process. We seek long-term scientific and cultural change through cutting-edge scientific research and scholarship; education and training of young leaders; communication to the general public; and advocacy of academic freedom and free speech for scientists, teachers, and students.

The CSC has 40 affiliated academic Fellows representing disciplines such as physics, astronomy, chemistry, molecular and cellular biology, biochemistry, microbiology, mathematics, history and philosophy of science, law, and political science programs. 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 research, teach, and debate at universities and research institutions. CSC Fellows and staff also provide guidance for state and local school boards, legislators, and others considering the public policy implications of science.

The CSC is part of Discovery Institute's broader mission to advance a culture of purpose, creativity and innovation. As a charitable nonprofit research and education institution under 501(c)(3) of the IRS code, the Institute does not endorse political candidates, 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.

Discovery Institute...

"...has...transformed the debate [over evolution] into an issue of academic freedom."

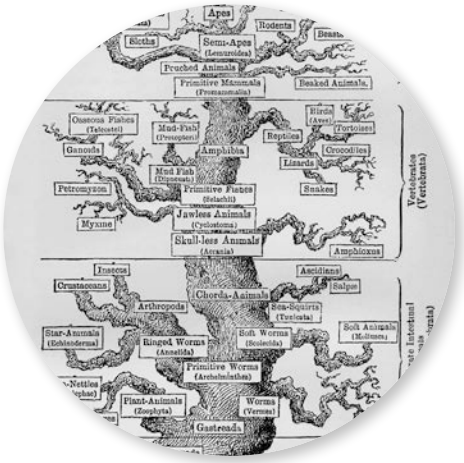
—The New York Times

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

—Newsweek

" ...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



Part 3:

FAQ on Intelligent Design, Evolution, and Education

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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. This 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.

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.

Is Intelligent Design the Same as Creationism?

No. The theory of intelligent design is 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 merely 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 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" (2000 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 ID movement has long been focused on developing the theory of intelligent design through scientific research, scientific publications, 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 likely 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 scientific 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. Two states (Louisiana and Tennessee), and multiple local school districts have adopted policies that protect the rights of teachers and students to question Darwinism. As Tennessee's model academic freedom law states, teachers have the freedom to help students

"understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught" such as topics "including, but not limited to, biological evolution, the chemical origins of life, global warming, and human cloning."

Should Schools Inject Religion Into the Science Curriculum?

No. The science classroom is for teaching science. However, many critiques of Darwinism have a legitimate scientific basis in peer-reviewed scientific studies and teaching students about these arguments against Darwinian evolution does not inject 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 Does Objective Evolution Education Look Like?

Teaching this subject objectively means presenting both the scientific evidence for and against neo-Darwinian evolution. This does not mean simply criticizing evolution or only presenting the case against the neo-Darwinian model. Rather, objective instruction means:

- Fully teaching the evidence for neo-Darwinian evolution from the textbook.
- Covering the entire required curriculum.
- Helping students understand the scientific arguments in favor of neo-Darwinian evolution as well as the scientific criticisms as they are presented in the scientific literature.

Teachers who personally support the standard neo-Darwinian view should not refuse to cover scientific criticisms of that position. In fact, what the teacher personally thinks doesn't matter. If taught properly, students may not even know exactly where the teacher stands on this topic. Regardless of where the teacher personally stands, the goal of presenting students with both the scientific evidence for and against neo-Darwinian evolution is never to indoctrinate students in one particular view. Rather, the goals of teaching this debate objectively include:

- Increasing student knowledge of the scientific evidence
- Improving critical thinking skills and scientific reasoning
- Encouraging student interest in science
- Defusing classroom controversy caused by the one-sided presentation of neo-Darwinian evolution
- Promoting scientific literacy and enhancing the effectiveness of science education

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

Genetics

Mutations Tend to Cause Harm and Do Not Build Complexity. Darwinian evolution relies on random mutations which are acted on by natural selection, a blind and unguided process that has no goals. Such a random and undirected process tends to harm organisms. They do not seem capable of improving organisms or 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.

For additional details on scientific problems with neo-Darwinian evolution and chemical evolution, see Part 9.

What is a Suggested Plan for Teaching a Unit on Neo-Darwinian Evolution?

Objective education means that students must be allowed to form and express their own opinions. An objective unit covering neo-Darwinian evolution might look something like this:

- First, cover the required curriculum by teaching the material in the textbook. Ensure that students understand the scientific arguments for neo-Darwinian evolution. (1-2 weeks)

- Next, spend a few days discussing scientific criticisms of neo-Darwinian evolution. The supplementary textbook *Explore Evolution*, the DVD *Investigating Evolution*, and the *Icons of Evolution Study Guide* are potential resources. Encourage students to think critically. (2-3 days)

- Finally, consider allowing students to spend a couple days wrestling with the data and forming their own opinions. This could include in-class debates, or an assignment where students write a position statement on neo-Darwinian evolution. In these exercises, students may defend whatever position they wish, but must justify it using only scientific evidence and scientific arguments. (1-2 days)

Most public school curricula stop after step 1, missing out on the benefits from steps 2 and 3. Some might claim those extra steps would take too much time. But teaching the modern neo-Darwinian theory of evolution in an objective fashion need not take any more time than the 2-3 weeks typically spent on an evolution unit.

More importantly, any extra time taken to teach this topic objectively is not wasted—it will help students better understand the evidence, better appreciate scientific reasoning, and fulfill standards requiring critical thinking and use of the inquiry method. Finally, this approach will be welcomed by students who find this topic engages their interest in science.

Part 4:

The Truth About the *Kitzmiller v. Dover* Intelligent Design Case

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 School Board Rejected Discovery Institute's Advice

The Dover school board rejected Discovery Institute's advice and adopted a policy that required the teaching of ID. 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 Middle District of Pennsylvania.

Discovery Institute's Approach to Teaching Evolution

Discovery Institute's recommended approach to teaching about evolution, which the Dover school board rejected, is:

- Make sure the evidence schools present for Darwin's theory is scientifically accurate.
- 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 class?

Problems With the Dover Decision

- At the very least, the Dover decision is overboard. Judge Jones found that the Dover school 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.**

- Judge 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.[1] Judge Jones even copied the factual errors contained in this document, which was known as "Plaintiffs' Proposed 'Findings of Fact and Conclusions of Law'."[2] For example:

  - Judge 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 the judge came not from Behe, but from the attorneys working with the ACLU, who misquoted Behe.

  - Judge Jones claimed that "ID is not supported by any peer-reviewed research, data or publications." 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. The judge's false assertions about peer-review simply copied false claims made by attorneys working with the ACLU.

  - Again following the plaintiffs' attorneys, Judge Jones insisted that ID "requires supernatural creation," that "ID is predicated 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," Scott Minnich replied, "It does not."

- The judge ignored the positive case for design and falsely claimed that ID proponents make their case solely by arguing against evolution.

- Judge Jones adopted an unfair double-standard of legal analysis where religious implications, beliefs, and motives count against ID but never against Darwinism.

- The judge overstepped the bounds of the judiciary and engaged in judicial activism by declaring that ID had been refuted when the judge was presented with

credible scientific witnesses and publications on both sides showing evidence of a scientific debate. In fact, Judge Jones engaged in textbook judicial activism by presuming that it is permissible for a federal judge to define science, settle controversial social questions, settle controversial scientific questions, and settle issues for parties outside of the case at hand so that his ruling would be "a primer" for people "someplace else."

- Finally, Judge Jones used poor philosophy of science by dangerously trying to turn science into a voting contest by ruling that popularity is required for an idea to be scientific. Stephen Jay Gould, writing with other scientists, eloquently explained why science should never be a popularity contest: "Judgments based on scientific evidence, whether made in a laboratory or a courtroom, are undermined by a categorical refusal even to consider research or views that contradict someone's notion of the prevailing 'consensus' of scientific opinion... Automatically rejecting dissenting views that challenge the conventional wisdom is a dangerous fallacy, for almost every generally accepted view was once deemed eccentric or heretical. Perpetuating the reign of a supposed scientific orthodoxy in this way, whether in a research laboratory or in a courtroom, is profoundly inimical to the search for truth. … The quality of a scientific approach or opinion depends on the strength of its factual premises and on the depth and consistency of its reasoning, not on its appearance in a particular journal or on its popularity among other scientists."[3]

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," George R. Killam Jr. Chair of Criminal Law, Texas Tech Law School; "The Wisdom and Constitutionality of Teaching Intelligent Design in Public Schools," 5 *First Amend. Law Review* 82, 89 (2006), Emphasis added.

"Despite Judge Jones' 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

- www.traipsingintoevolution.com provides an extensive collection of materials relating to the Dover case, including legal briefs filed by Discovery Institute, a group of scientists promoting academic freedom, and the Foundation for Thought and Ethics.

- For the definitive technical legal critique of the *Kitzmiller v. Dover* ruling, see: "Intelligent Design Will Survive *Kitzmiller v. Dover*," 68 *Montana Law Review* 7 (Winter, 2007), David DeWolf, John West, and Casey Luskin, www.discovery.org/f/1372

- *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.

Part 5:

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

By: Prof. David K. DeWolf, JD and Seth L. Cooper, JD

Updated June, 2011

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 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."[4]

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[5] and the *Icons of Evolution* Curriculum Modules.[6]

The Constitution Prohibits the Censoring of Scientific Ideas

In *Epperson v. Arkansas* (1968), 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."[7]

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*.

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."

Seven states (Texas, New Mexico, Missouri, Alabama, Pennsylvania, South Carolina, and Minnesota) have already adopted science standards that require or expressly permit learning about some of the scientific controversies relating to evolution. Two states (Louisiana and Mississippi) have policies that protect academic freedom to challenge 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…"[8]

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 of 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 whether a teacher has a constitutional right to teach more than the school board requires with regard to the 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 consistently 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:

"Teaching the Origins Controversy: Science, Religion, or Speech?" David K. DeWolf et. al., in the *Utah Law Review* (2000);

"Storm Clouds on the Horizon of Darwinism: Teaching the Anthropic Principle and Intelligent Design in the Public Schools," Jeffrey F. Addicott, in the *Ohio State Law Journal* (2002).

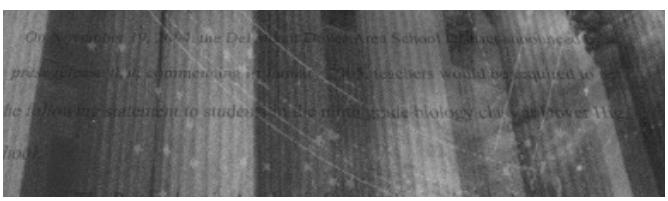
Law, Darwinism, and Public Education: The Establishment Clause and the Challenge of Intelligent Design, Francis J. Beckwith (Rowman & Littlefield, 2003)[9] at www.discovery.org/a/3572

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 by David K. DeWolf, John G. West, Casey Luskin, and Jonathan Witt.

"Dover in Review." John G. West, www.discovery.org/a/3135

"Intelligent Design Will Survive *Kitzmiller v. Dover*," David DeWolf, John West, and Casey Luskin, 68 *Montana Law Review* 7 (Winter, 2007), www.discovery.org/f/1372.



Part 6:

Discovery Institute's Science Education Policy

As a matter of public policy, Discovery Institute *opposes* any effort to 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.

Seven states (Alabama, Minnesota, Missouri, New Mexico, Pennsylvania, South Carolina and Texas) 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."

Part 7:

DOs and DON'Ts of Evolution Education

7

In *Origin of Species*, Charles Darwin cautioned that "a fair result can be obtained only by fully stating and balancing the facts and arguments on both sides of each question."[10] Unfortunately, the vast majority of public schools today reject Darwin's advice, and only teach students about the pro-evolution view. Controlled, pressured, and intimidated by the Darwin Lobby—a powerful coalition of politically-oriented scientific organizations, educators associations, and activist groups—most public schools effectively censor from students any scientific evidence which challenges neo-Darwinism. Even many private schools which use mainstream biology textbooks wittingly or unwittingly teach only the Darwinian view. The result is not education, but indoctrination.

As a teacher, you might feel justifiably concerned, or even outraged about this situation. You want objectivity in classroom instruction regarding origins, and don't want students being misinformed. You may wish to press your public school district and advocate for positive changes in how evolution is taught. But it's important to channel your desire for change in a productive and helpful direction. What follows are some crucial DOs and DON'Ts to follow whenever trying to positively influence education:

DO contact Discovery Institute before commencing your efforts. *This is a must.* We have extensive experience working with public schools, and can provide you with many resources. There are many unforeseen obstacles you'll encounter when dealing with public education, and we can offer important information unique to your specific situation to help you navigate these tricky areas.

DO NOT push intelligent design into the public school curriculum. 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.

While we do feel ID is considered constitutional to teach in public schools, pushing ID into public schools politicizes this scientific debate, and does long-term damage to the ability of pro-ID scientists to gain a fair hearing. As Discovery Institute's Science Education Policy page states:

> As a matter of public policy, Discovery Institute opposes any effort to 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.[11]

DO teach both the scientific evidence for and against neo-Darwinian evolution in an objective fashion. As our Science Education Policy page continues:

> 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.[12]

DO protect teacher academic freedom to teach good science on this topic. Discovery Institute can offer you examples of successful state and local academic freedom policies that permit teachers to teach both the scientific evidence for and against Darwinian evolution. 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.

DO NOT ask that evolution be removed or diminished from the curriculum. Even if you personally disagree with it, the scientific case for Darwinian evolution should still be presented to students. Students need to learn about evolution to be informed citizens—especially if they plan to attend college. However students shouldn't only learn the pro-Darwin view. **Rather than taking this subject out of the classroom, students should study Darwinian evolution objectively, learning about both the scientific evidence for and against the theory.**

DO explain that the case for objectivity in evolution education comes from science—and isn't an argument based upon religion. There is credible scientific dissent from Darwinian evolution: over 900 Ph.D. scientists have signed a statement that they "are skeptical of claims for the ability of random mutation and natural selection to account for the complexity of life," and therefore " [c]areful examination of the evidence for Darwinian theory should be encouraged."[13] Moreover, many peer-reviewed scientific papers dispute core tenets of biological and chemical evolution.[14]

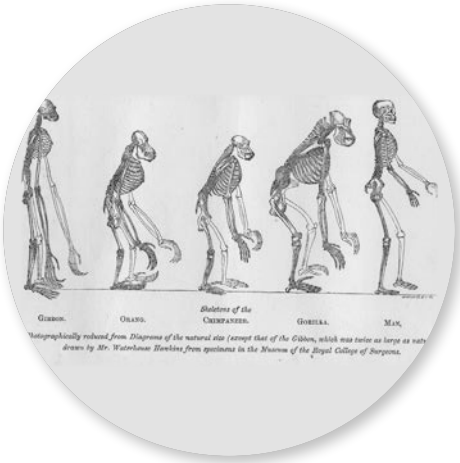
DO point out that leading science education theorists agree that the best way to teach science is to let students engage in critical thinking where they can weigh alternative evidence and debate controversial issues. As a 2010 paper in the journal *Science* explained, students learn science best when taught "to discriminate between evidence that supports … or does not support"[15] a scientific concept. When science is taught in this manner, students learn the critical thinking skills they need to think like good scientists.

DO NOT try to do this alone. In addition to getting help from Discovery Institute, try to identify like-minded parents, students, scientists, educators, college faculty, and other members of your community who support objective evolution instruction. Your chances of success are much higher if you can build a coalition of people who want to make positive changes.

DO be prepared for negativity from the media (and perhaps angry bloggers) who want to maintain the *status quo* through threats of ridicule and personal attacks. Their goal is to intimidate you into silence. Stay true to your convictions—and remember you're doing this for students, so they won't be misinformed and indoctrinated on the topic of origins.

DO it for the students. Science education authorities warn of two primary deficiencies facing American science education today. First, insufficient numbers of students are being inspired to pursue careers in science. Second, students aren't being taught the critical thinking skills they need to succeed in science.[16]

If there are problems with science education, it stands to reason they are linked to the *status quo*. But in American public education today, the *status quo* teaches evolution in a dogmatic, pro-Darwin-only fashion which fails to help students use critical thinking on this topic. Teaching students about the scientific debate over evolution will not only improve their critical thinking skills, but it will get them interested in science. In essence, teaching the controversy over neo-Darwinian theory might be part of the solution to some of the biggest problems facing American science education.



Part 8:

Should We Teach Scientific Criticisms of Neo-Darwinism?

Many Authorities say YES!

U.S. 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**…"[17]

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."[18]

Various States and School Districts Have Successfully Implemented Such a Policy:

Texas

Students must "analyze, evaluate and critique scientific explanations … including examining all sides of scientific evidence of those scientific explanations so as to encourage critical thinking," and also "analyze and evaluate" core evolutionary claims, including "common ancestry," "natural selection," "mutation," "sudden appearance," the origin of the "complexity of the cell," and the formation of "long complex molecules having information such as the DNA molecule for self-replicating life."[19]

Minnesota

"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..."[20]

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."[21]

Alabama

"[E]volution by natural selection is a controversial theory. ... Instructional material associated with controversy should be approached with an open mind, studied carefully, and critically considered."[22]

STUDENTS MAY "UNDERSTAND, ANALYZE, CRITIQUE, AND REVIEW IN AN OBJECTIVE MANNER THE SCIENTIFIC STRENGTHS AND SCIENTIFIC WEAKNESSES OF EXISTING SCIENTIFIC THEORIES" INCLUDING "BIOLOGICAL EVOLUTION, THE CHEMICAL ORIGINS OF LIFE, GLOBAL WARMING, AND HUMAN CLONING."

–Tennessee Academic Freedom Law

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)."[23]

Missouri
"Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., theories of evolution…)."[24]

South Carolina
"Summarize ways that scientists use data from a variety of sources to investigate and critically analyze aspects of evolutionary theory."[25]

Mississippi:
"No local school board, school superintendent or school principal shall prohibit a public school classroom teacher from discussing and answering questions from individual students on the origin of life."[26]

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."[27]

Louisiana Science Education Act
Louisiana public schools shall "create and foster an environment...that promotes critical thinking skills, logical analysis, and open and objective discussion of scientific theories being studied including, but not limited to, evolution, the origins of life, global warming, and human cloning."[28]

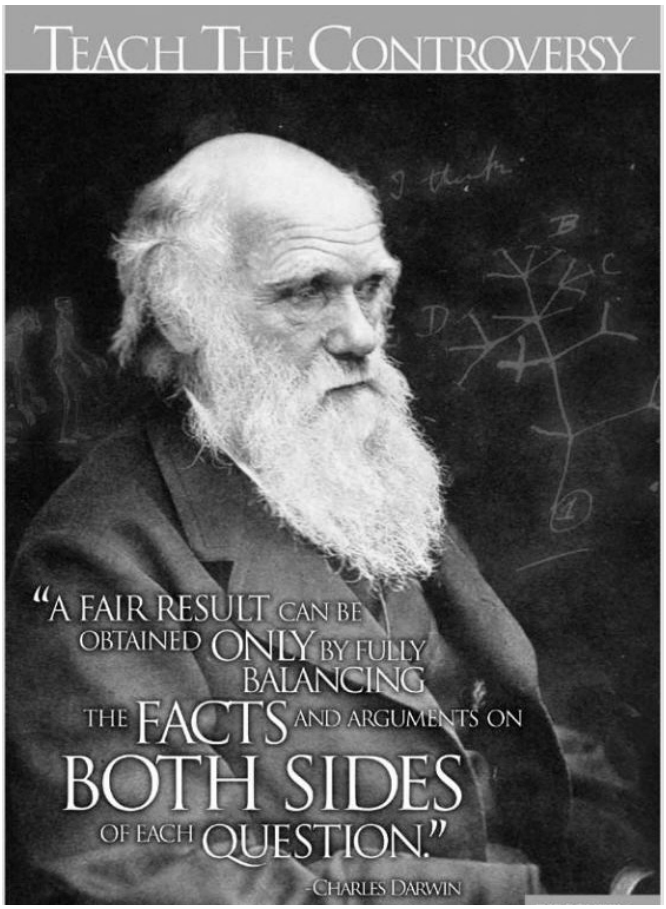
Tennessee Academic Freedom Law
Students may "understand, analyze, critique, and review in an objective manner the scientific strengths and scientific weaknesses of existing scientific theories covered in the course being taught" such as topics "including, but not limited to, biological evolution, the chemical origins of life, global warming, and human cloning."[29]

Science Education Theorists Support Critical Thinking:

A *Science* paper reflected the consensus by observing students learn science best when they "discriminate between evidence that **supports** (inclusive) **or does not support** (exclusive)" a concept.[30]

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."[31]



Part 9:

The Scientific Controversy Over Biological and Chemical Evolution

9

There are many legitimate scientific criticisms of the standard models of biological and chemical evolution.

Genetics

Mutations cause harm and do not build complexity

Darwinian evolution relies on random mutations that are selected by a blind, unguided process of natural selection that has no goals. Such a random and undirected process tends to harm organisms and does not improve them or build functional complexity. As past president of the French Academy of Sciences, Pierre-Paul Grasse, contended that "[m]utations have a very limited 'constructive capacity'" because "[n]o matter how numerous they may be, mutations do not produce any kind of evolution."[32] Similarly, biologist Lynn Margulis has said, "new mutations don't create new species; they create offspring that are impaired."[33] She continues:

> [N]eo-Darwinists say that new species emerge when mutations occur and modify an organism. I was taught over and over again that the accumulation of random mutations led to evolutionary change – led to new species. I believed it until I looked for evidence.[34]

Many other scientists feel this way. Over 900 PhD scientists have signed a statement agreeing they "are skeptical of claims for the ability of random mutation and natural selection to account for the complexity of life."[35] Indeed, two biologists wrote in *Annual Review of Genomics and Human Genetics*: "it remains a mystery how the undirected process of mutation, combined with natural selection, has resulted in the creation of thousands of new proteins with extraordinarily diverse and well optimized functions. This problem is particularly acute for tightly integrated molecular systems that consist of many interacting parts…"[36] This leads to the next problem.

Biochemistry

Unguided and random processes cannot produce cellular complexity

Our cells contain incredible complexity, like miniature factories using machine technology but dwarfing the complexity and efficiency of anything produced by humans. Cells use miniature circuits, motors, feedback loops, encoded language, and even error-checking machinery to decode and repair our DNA. Past U.S. National Academy of Sciences President Bruce Alberts (who opposes ID) has described this complexity in the journal *Cell* as an elaborate factory: "The entire cell can be viewed as a factory that contains an elaborate network of interlocking assembly lines, each of which is composed of a set of large protein machines."[37] But could such integrated complexity evolve in a stepwise, Darwinian fashion? Michael Behe recalls that in *Origin of Species*, Darwin admitted that if "any complex organ existed which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down."[38] According to Behe, "by opening the ultimate black box, the cell," modern science "has pushed Darwin's theory to the limit."[39]

The simplest cell requires hundreds of genes, numerous complex biological machines and biochemical pathways, and a fully functional genetic code in order to survive. Darwinian evolution—blind natural selection acting on random mutations—has failed to provide Darwinian explanations for how basic cellular biochemistry might have evolved. Five years after Behe published *Darwin's Black Box*, biochemist Franklin Harold stated in an Oxford University Press monograph that "there are presently no detailed Darwinian accounts of the evolution of any biochemical or cellular system, only a variety of wishful speculations."[40] Indeed, one paper about the evolution of one molecular machine admitted, "the flagellar research community has scarcely begun to consider how these systems have evolved."[41]

But it's not just multi-part machines which are beyond reach of Darwinian evolution. The protein-parts themselves which build these machines would also require multiple simultaneous mutations in order to arise. In 2000 and 2004, protein scientist Douglas Axe published experimental research in the *Journal of Molecular Biology* on mutational sensitivity tests he performed on enzymes in bacteria.[42] Enzymes are long chains of amino acids which fold into a specific, stable, three-dimensional shape in order to function. Mutational sensitivity experiments begin by mutating the amino acid sequences of those proteins, and then testing the mutant proteins to determine whether they can still fold into a stable shape, and function properly. Axe's research found that amino acid sequences which yield stable, functional protein folds may be as rare as 1 in 10^{74} sequences, suggesting that the vast majority of amino acid sequences will not produce stable proteins, and thus could not function in living organisms.

Because of this extreme rarity of functional protein sequences, it would be very difficult for random mutations to take a protein with one type of fold, and evolve it into another, without going through some non-functional stage. Darwin said his theory only worked if structures could be built through "numerous, successive, slight modifications," but *many* changes would need to occur *simultaneously* to "find" the rare and unlikely amino acid sequences that yield functional proteins. To put the matter in perspective, Axe's results suggest that the odds of blind and unguided Darwinian processes producing a functional protein fold are less than the odds of someone closing his eyes and firing an arrow into the Milky Way galaxy, *and hitting one pre-selected atom.*

Proteins commonly interact with other molecules through a "hand-in-glove" fit, but these interactions often require multiple amino acids to be 'just right' before they occur. In 2004, Behe, along with University of Pittsburgh physicist David Snoke, simulated the Darwinian evolution of such protein-protein interactions. Behe and Snoke's calculations found that for multicellular organisms, evolving a simple protein-protein interaction which required more than two mutations in order to function would require more organisms and generations than would be available over the entire history of the Earth. They concluded that "the mechanism of gene duplication and point mutation alone would be ineffective…because few multicellular species reach the required population sizes."[43]

Four years later during an attempt to refute Behe's arguments, two Cornell scientists ended up begrudgingly confirming he was basically correct. After calculating the likelihood of two simultaneous mutations arising via Darwinian evolution in a population of humans, they found that such an event "would take > 100 million years." Given that humans supposedly diverged from their supposed common ancestor with chimpanzees only 6-8 million years ago, they granted that such mutational events are "very unlikely to occur on a reasonable timescale."[44] The information required for proteins and enzymes to function is too great to be generated by Darwinian processes on any reasonable evolutionary timescale.

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. This has been recognized by many paleontologists such as Ernst Mayr who explained in 2000 that "[n]ew species usually appear in the fossil record suddenly, not connected with their ancestors by a series of intermediates."[45] Similarly, a zoology textbook observed that "Many species remain virtually unchanged for millions of years, then suddenly disappear to be replaced by a quite different, but related, form. Moreover, most major groups of animals appear abruptly in the fossil record, fully formed, and with

no fossils yet discovered that form a transition from their parent group."[46]

The eventual realization that the fossil record is not entirely incomplete has forced evolutionary biologists to accept that the record shows *a pattern of explosions, not gradual evolution of living organisms.* Probably the most famous instance of abrupt appearance is the Cambrian explosion, where nearly all of the major living animal phyla appear in the Cambrian period. An invertebrate biology textbook explains this:

> Most of the animal groups that are represented in the fossil record first appear, 'fully formed' and identifiable as to their phylum, in the Cambrian, some 550 million years ago. These include such anatomically complex and distinctive types as trilobites, echinoderms, brachiopods, molluscs, and chordates. … The fossil record is therefore of no help with respect to the origin and early diversification of the various animal phyla...[47]

Evolutionary scientists acknowledge that they cannot explain this rapid appearance of diverse animal body plans by classical Darwinian processes, or other known material mechanisms. Paleontologist Robert Carroll argues in *Trends in Ecology and Evolution* that "The extreme speed of anatomical change and adaptive radiation during this brief time period requires explanations that go beyond those proposed for the evolution of species within the modern biota."[48] Another paper likewise maintains that "microevolution does not provide a satisfactory explanation for the extraordinary burst of novelty during the Cambrian Explosion" and concludes "the major evolutionary transitions in animal evolution still remain to be causally explained."[49] Likewise a 2009 paper in *BioEssays* concedes that "elucidating the materialistic basis of the Cambrian explosion has become more elusive, not less, the more we know about the event itself."[50]

But the Cambrian explosion is by no means the only explosion of life recorded in the fossil record. Regarding the origin of major fish groups, former Columbia University geoscientist Arthur Strahler writes that, "This is one count in the creationists' charge that can only evoke in unison from paleontologists a plea of nolo contendere [no contest]."[51] A paper in *Annual Review of Ecology and Systematics* explains that the origin of land plants "is the terrestrial equivalent of the much-debated Cambrian 'explosion' of marine faunas."[52] Regarding the origin of angiosperms (flowering plants), paleontologists have discovered a "big bloom" type of explosion event. As one paper states:

> In spite of much research and analyses of different sources of data (e.g., fossil record and phylogenetic analyses using molecular and morphological characters), the origin of the angiosperms remains unclear. Angiosperms appear rather suddenly in the fossil record... with no obvious ancestors for a period of 80-90 million years before their appearance.[53]

In a similar way, many orders of mammals appear in an explosive manner. Niles Eldredge explains that "there are all sorts of gaps: absence of gradationally intermediate 'transitional' forms between species, but also between larger groups—between, say, families of carnivores, or the orders of mammals."[54] There is also a bird explosion, with major bird groups appearing in a short time period.[55] Biologist Jeffrey Schwartz explains:

> We are still in the dark about the origin of most major groups of organisms. They appear in the fossil record as Athena did from the head of Zeus—full-blown and raring to go, in contradiction to Darwin's depiction of evolution as resulting from the gradual accumulation of countless infinitesimally minute variations.[56]

This pattern of explosions directly contradicts the expectations of Darwinian biology.

Taxonomy

Biologists have failed to construct a "tree of life"

Evolutionary biologists hoped that DNA evidence would reveal a grand tree of life where all organisms are clearly related. It hasn't. Darwin's tree of life—the notion that all living organisms share a universal common ancestor—has faced increasing difficulties in the past few decades. Trees describing the alleged ancestral relationships between organisms based upon one gene or biological characteristic very commonly conflict with trees based upon a different gene or characteristic. A 2009 article in *New Scientist* observes, the tree of life "lies in tatters, torn to pieces by an onslaught of negative evidence," leading one scientist to say "We've just annihilated the tree of

life." It concludes: "[m]any biologists now argue that the tree concept is obsolete and needs to be discarded." The article explains the basic problem: "different genes told contradictory evolutionary stories."[57] This implies a challenge to universal common descent, the hypothesis that all organisms descend from a single common ancestor.

Many other papers concur that the tree of life hypothesis is in peril. W. Ford Doolittle explains in *Science*, "Molecular phylogenists will have failed to find the 'true tree,' not because their methods are inadequate or because they have chosen the wrong genes, but because the history of life cannot properly be represented as a tree."[58] Doolittle attributes the non-tree-like data to gene-swapping among microorganisms at the base of the tree. But Carl Woese, the father of evolutionary molecular systematics, finds that such problems exist beyond the base of the tree: "Phylogenetic incongruities [conflicts] can be seen everywhere in the universal tree, from its root to the major branchings within and among the various taxa to the makeup of the primary groupings themselves."[59] Many other papers have uncovered similar data.

A June 2012 article in *Nature* reported that short strands of RNA called microRNAs "are tearing apart traditional ideas about the animal family tree." Dartmouth biologist Kevin Peterson who studies microRNAs lamented, "I've looked at thousands of microRNA genes, and I can't find a single example that would support the traditional tree." According to the article, microRNAs yielded "a radically different diagram for mammals: one that aligns humans more closely with elephants than with rodents." Peterson put it bluntly: "The microRNAs are totally unambiguous ... they give a totally different tree from what everyone else wants."[60] As a 2012 paper stated, "Phylogenetic conflict is common, and frequently the norm rather than the exception."[61] Again, the problem is one gene or physical trait yields one version of the tree of life, but another gene or trait suggests a conflicting tree. So severe are the problems that a 2013 paper reported "the more we learn about genomes the less tree-like we find their evolutionary history to be,"[62] and a 2012 paper proposed "life might indeed have multiple origins."[63] This implies a breakdown in the common ancestry hypothesis.

Evolutionists will sometimes cite the congruence of the cytochrome c tree with standard evolutionary trees as confirming theories of common descent. They rarely discuss the cytochrome b tree, which has severe conflicts with the standard phylogeny of animal groups.[64] Cherry-picking data does not inspire confidence in the methods used to construct phylogenetic trees and advocate for common descent. An article in *Nature* reported that "disparities between molecular and morphological trees" lead to "evolution wars" because "evolutionary trees constructed by studying biological molecules often don't resemble those drawn up from morphology."[65]

Evolutionists often argue that shared amino acid sequences in genes across different organisms indicates that they must share a common ancestor. This circular argument rests upon the assumption that shared genetic similarities must be the result of common descent. As conflicts between phylogenetic trees show, this assumption frequently fails.

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 have been generated by blind chemical reactions. Leading evolutionary biologist Massimo Pigliucci has admitted that "we really don't have a clue how life originated on Earth by natural means,"[66] and leading origin of life researcher David Deamer asserts that "genetic information more or less came out of nowhere by chance assemblages of short polymers."[67]

Origin of life theorists have struggled simply to account for the origin of pre-biological organic chemicals on the early earth, with little success. For example, it is now known that the gasses used in the famous Miller-Urey experiments were not present on the early earth.[68] But this is only the beginning of the problem. When trying to "make" the first life-form, scientists cannot rely upon Darwinian processes. Darwinian evolution requires replication, and prior to the origin of life

there was no replication. Origin of life theorist Robert Shapiro explains that an explanation for the first self-replicating molecule "has not yet been described in detail or demonstrated" but "is taken for granted in the philosophy of dialectical materialism."[69] Accounting for the origin of a self-replicating molecule would still not explain how modern cells arose. Our DNA code requires an irreducibly complex system requiring the information in DNA, the enzymes that assist DNA's replication and protection, a protective cell membrane, and a complex system of machinery used to transcribe and translate language of DNA into protein. Faced with the complexity of this system, biologist Frank Salisbury lamented in 1971 that "the entire system must come into being as one unit, or it is worthless. There may well be ways out of this dilemma, but I don't see them at the moment."[70] In 1995, leading biologists John Maynard Smith and Eörs Szathmary explained that accounting for the origin of this system remains "perhaps the most perplexing problem in evolutionary biology" because "the existing translational machinery is at the same time so complex, so universal and so essential that it is hard to see how it could have come into existence or how life could have existed without it."[71]

Scientists may one day create life in the lab, but they will have done so using guided processes rather than material causes alone. The theory that life could have originated via blind natural chemical processes and sheer dumb luck remains unexplained. As Harvard chemist George Whitesides stated: "The Origin of Life. This problem is one of the big ones in science. It begins to place life, and us, in the universe. Most chemists believe, as do I, that life emerged spontaneously from mixtures of molecules in the prebiotic Earth. How? I have no idea."[72] Likewise, a 2011 book by the leading biologist Eugene Koonin stated: "[T]he origin of life field is a failure – we still do not have even a plausible coherent model, let alone a validated scenario, for the emergence of life on Earth."[73]

Icons of Evolution

Textbooks often overstate or misstate the evidence for modern evolutionary theory

Modern biology textbooks often paper over scientific evidence that dissents from the standard lines of evidence—or "icons"—used to support Darwinian evolution. For example, when attempting to demonstrate common ancestry, textbooks frequently portray drawings of vertebrate embryos which *inaccurately* overstate the similarities between different organisms in their earliest stages of development.[74] Textbooks also often present examples of small-scale "microevolution" and overextrapolate the evidence to make unwarranted claims about "macroevolution." They discuss minute changes in the sizes of beaks on the Galápagos finches or small changes in the colors of peppered moths[75] to claim that fundamentally new types of organisms can evolve via Darwinian processes. As Robert Carroll asks: "Can changes in individual characters, such as the relative frequency of genes for light and dark wing color in moths adapting to industrial pollution, simply be multiplied over time to account for the origin of moths and butterflies within insects, the origin of insects from primitive arthropods, or the origin of arthropods from among primitive multicellular organisms?"[76] Many scientists feel the answer is "no"—but biology textbooks never inform students of this fact.

> ***"[T]HE ORIGIN OF LIFE FIELD IS A FAILURE – WE STILL DO NOT HAVE EVEN A PLAUSIBLE COHERENT MODEL, LET ALONE A VALIDATED SCENARIO, FOR THE EMERGENCE OF LIFE ON EARTH."***
>
> –Eugene V. Koonin

Neo-Darwinian evolution is strongly critiqued by mainstream scientists:

The mainstream scientific and academic literature is becoming saturated with papers challenging the central tenets of neo-Darwinian theory. A 2011 paper in *Biological Theory* stated, "Darwinism in its current scientific incarnation has pretty much reached the end of its rope,"[77] and in 2012, the noted atheist philosopher Thomas Nagel argued in an Oxford University Press book that "the materialist neo-Darwinian conception of nature is almost certainly false."[78]

An article in *Trends in Ecology and Evolution* from 2008 acknowledge that there exists a "healthy debate concerning the sufficiency of neo-Darwinian theory to explain macroevolution."[79] In 2009, Günter Theißen wrote in the journal *Theory in Biosciences* that modern Darwinian theory has not fully explained biological complexity:

> [W]hile we already have a quite good understanding of how organisms adapt to the environment, much less is known about the mechanisms behind the origin of evolutionary novelties, a process that is arguably different from adaptation. Despite Darwin's undeniable merits, explaining how the enormous complexity and diversity of living beings on our planet originated remains one of the greatest challenges of biology.[80]

An even more striking criticism of what he called the "dogmatic science" of neo-Darwinian thinking can be found in a 2006 paper by Theißen:

> Explaining exactly how the great complexity and diversity of life on earth originated is still an enormous scientific challenge . . . . There is the widespread attitude in the scientific community that, despite some problems in detail, textbook accounts on evolution have essentially solved the problem already. In my view, this is not quite correct.[81]

In 2008, scientists convened at the "Altenberg 16" conference where critics of neo-Darwinism gathered in Altenberg, Austria to discuss insufficiencies of the modern synthesis of evolution. *Nature* published an article covering the Altenberg 16 conference,[82] quoting biologist Scott Gilbert stating that "[t]he modern synthesis is remarkably good at modeling the survival of the fittest, but not good at modeling the arrival of the fittest." Stuart Newman stated in the same article, "You can't deny the force of selection in genetic evolution . . . but in my view this is stabilizing and fine-tuning forms that originate due to other processes." Evolutionary paleobiologist Graham Budd was similarly open in the article about deficiencies in explanations of key evolutionary transitions: "When the public thinks about evolution, they think about the origin of wings and the invasion of the land, . . . [b]ut these are things that evolutionary theory has told us little about."

Also in 2008, William Provine, a Cornell University historian of science and evolutionary biologist, gave a talk before the History of Science Society arguing that "[e]very assertion of the evolutionary synthesis below is false":

> 1. Natural selection was the primary mechanism at every level of the evolutionary process. Natural selection caused genetic adaptation... 4. Evolution of phenotypic characters such as eyes and ears, etc, was a good guide to protein evolution: or, protein evolution was expected to mimic phenotypic evolution. 5. Protein evolution was a good guide to DNA sequence evolution. Even Lewontin and Hubby thought, at first, that understanding protein evolution was the key to understanding DNA evolution. 6. Recombination was far more important than mutation in evolution. 7. Macroevolution was a simple extension of microevolution. 8. Definition of "species" was clear[—]the biological species concept of Dobzhansky and Mayr. 9. Speciation was understood in principle. 10. Evolution is a process of sharing common ancestors back to the origin of life, or in other words, evolution produces a tree of life. 11. Inheritance of acquired characters was impossible in biological organisms. 12. Random genetic drift was a clear concept and invoked constantly whenever population sizes were small, including fossil organisms. 13. The evolutionary synthesis was actually a synthesis.[83]

The following year, Eugene Koonin of the National Center for Biotechnology Information stated in *Trends in Genetics* that due to breakdowns in core neo-Darwinian tenets such the "traditional concept of the tree of life" or the view that "natural selection is the main driving force of evolution" indicate that "the modern synthesis has crumbled, apparently, beyond repair" and "all major tenets of the modern synthesis have been, if not outright overturned, replaced by a new and incomparably more complex vision of the key aspects of evolution." Koonin concludes, "not to mince words, the modern synthesis is gone."[84]

Given this mass of credible scientific dissent from neo-Darwinism, Stephen Meyer observed in his 2013 book *Darwin's Doubt* that "Rarely has there been such a great disparity between the popular perception of a theory and its actual standing in the relevant peer-reviewed scientific literature."[85]

Why Aren't Problems With Darwinism More Widely Discussed?

As seen, standard models of biological and chemical evolution lack supporting evidence in many scientific fields. Yet even some evolutionary scientists report that they are pressured to remain silent about the problems with evolutionary biology. Computer scientist W. Daniel Hillis acknowledges:

> There's a feeling in biology that scientists should keep their dirty laundry hidden, because the religious right are always looking for any argument between evolutionists as support for their creationist theories. There's a strong school of thought that one should never question Darwin in public.[86]

Likewise, cognitive scientists Jerry Fodor and Massimo Piattelli-Palmarini admit:

> We've been told by more than one of our colleagues that, even if Darwin was substantially wrong to claim that natural selection is the mechanism of evolution, nonetheless we shouldn't say so. Not, anyhow, in public. To do that is, however inadvertently, to align oneself with the Forces of Darkness, whose goal is to bring Science into disrepute. ... [N]eo-Darwinism is taken as axiomatic; it goes literally unquestioned. A view that looks to contradict it, either directly or by implication is ipso facto rejected, however plausible it may otherwise seem. Entire departments, journals and research centres now work on this principle.[87]

Günter Theißen of the Department of Genetics at Friedrich Schiller University in Jena, Germany explains what happens when he critiques neo-Darwinian biology:

> It is dangerous to raise attention to the fact that there is no satisfying explanation for macroevolution. One easily becomes a target of orthodox evolutionary biology and a false friend of proponents of non-scientific concepts.[88]

Finally, a 2014 paper in *Nature* admitted that some biologists self-censor criticisms of the neo-Darwinian paradigm out of fear of lending support for ID:

> Yet the mere mention of the EES [Extended Evolutionary Synthesis, a non-Darwinian model of biological evolution] often evokes an emotional, even hostile, reaction among evolutionary biologists. Too often, vital discussions descend into acrimony, with accusations of muddle or misrepresentation. **Perhaps haunted by the spectre of intelligent design, evolutionary biologists wish to show a united front to those hostile to science.**[89]

It's disturbing to hear biologists report that they self-censor their own criticisms of Darwinism simply because they don't like the perceived alternative, intelligent design. It's also noteworthy that problems with the Darwinian viewpoint exist, and that they are more severe than what is usually admitted. These admissions show that the field of evolutionary biology is in an incredibly unhealthy state: not only is the science flawed, but dogmatism is preventing scientists from moving past Darwinism and following the evidence where it leads.

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Additional Resources

We encourage you to continue your exploration of intelligent design using the free web resources listed below.

Intelligent Design Gateway Portal:
www.intelligentdesign.org

Evolution News & Views:
www.evolutionnews.org

ID the Future Podcast:
www.idthefuture.com

Peer-Reviewed Scientific Publications Supporting Intelligent Design
www.discovery.org/id/peer-review/

Books on Intelligent Design and Darwinian Evolution
www.discovery.org/id/books/

Curricula on Intelligent Design and Darwinian Evolution
www.discovery.org/id/curricula/

Videos on Intelligent Design and Darwinian Evolution
www.discovery.org/id/videos/

Resources for Parents and School Boards
www.discovery.org/a/2112

Scientific Dissent from Darwinism List:
www.dissentfromdarwin.org

Center for Science and Culture at Discovery Institute:
www.discovery.org/id

Faith and Evolution:
www.faithandevolution.org

Academic Freedom Issues:
www.academicfreedompetition.org

IDEA Student Clubs:
www.ideacenter.org

Access Research Network:
www.arn.org

Uncommon Descent (Blog):
www.uncommondescent.com

The College Student's Back to School Guide to ID:
www.evolutionnews.org/BacktoSchoolGuide.pdf

A Parents' Guide to Intelligent Design:
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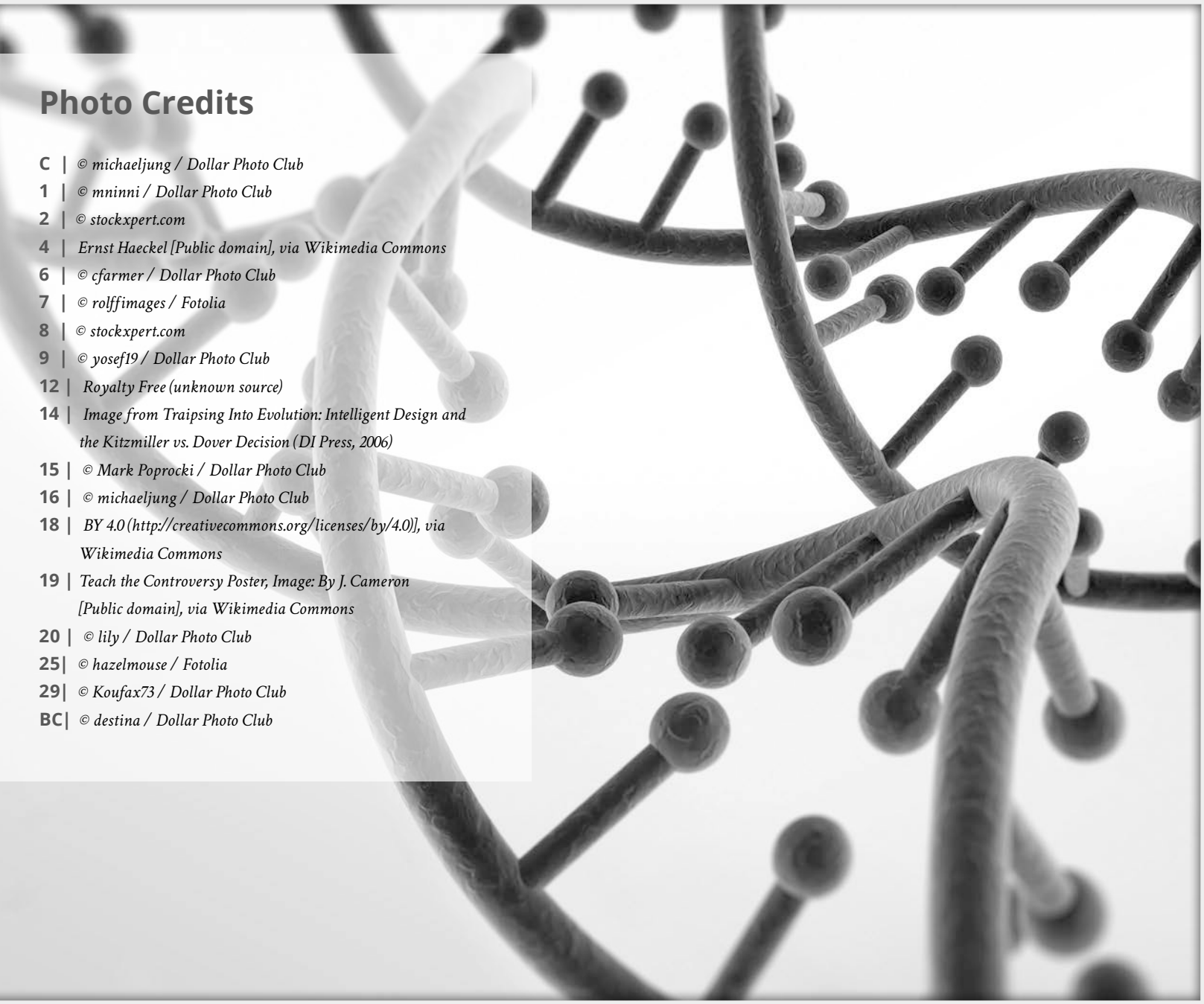
For more information, or if you have questions about issues related to teaching evolution, please contact cscinfo@discovery.org.



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