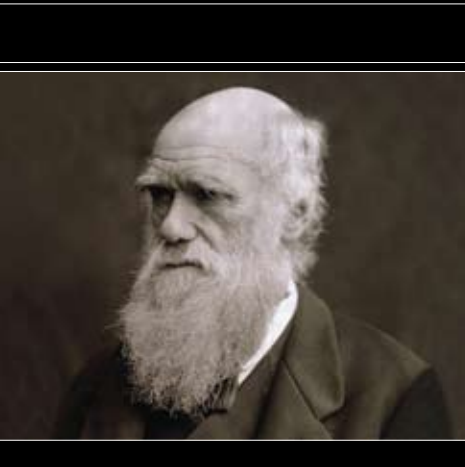


JUDGMENT DAY

INTELLIGENT DESIGN ON TRIAL



Briefing Packet for Educators

Resources to help you meet challenges
to teaching evolution

Briefing Packet for Educators

About this Packet

Evolution is the central organizing principle of all biological science, yet teaching evolution has become controversial in many states. When the National Science Teachers Association recently surveyed its members, 30 percent said they experienced pressure to omit or downplay evolution and related topics in their science curriculum.

What would you do if someone objected to the teaching of evolution in your school or district? Could you defend the teaching of evolution and explain why teaching intelligent design or any other form of creationism in the science

classroom is unacceptable? These materials provide clear, easily digestible information to guide and support you in facing challenges to evolution.

This briefing packet is part of a multimedia set of educational resources. Resources include the two-hour NOVA program *Judgment Day: Intelligent Design on Trial*; a companion Web site; media-rich resources on the Teachers' Domain Web site, including an online professional development course; and an enhanced version of a Web site created to accompany the PBS series *Evolution*.

Contents

Judgment Day: Intelligent Design on Trial Educational Resources

Describes the multimedia resources related to the *Judgment Day* program.

What Is Evolution?

A brief overview of the theory of evolution and the scientific evidence that supports it.

What Is Science?

A primer on what is and is not science, including descriptions of the type of work scientists do and definitions of terms such as scientific theory and the scientific method.

FAQs about Evolution and Intelligent Design

Provides answers to common questions about evolution and intelligent design.

Evolution and Intelligent Design:

Arguments and Responses

Offers responses to frequently heard arguments used to challenge the teaching of evolution.

Timeline: Kitzmiller v. Dover Area School District

Provides a summary of the 2005 Dover, Pennsylvania legal trial that challenged the school board's requirement that teachers read a statement about intelligent design to students before teaching them evolution.

Trials about Evolution and Creationism in the United States

Highlights the legal history of the fight over evolution. Includes **Evolution Trials at-a-Glance**, a chart listing the dates and outcomes of U.S. trials relating to the teaching of evolution.

Comparison of Evolutionary Biology and Intelligent Design

Provides a chart comparing the principles of evolution to the principles of intelligent design.

Support Statements from Scientific Organizations

Presents statements supporting evolution from the nation's leading scientific organizations.

Support Statements from Religious Organizations

Presents statements supporting evolution from diverse religious organizations.

Resources

A selected bibliography of useful books, Web sites, and online teaching resources.

Briefing Packet Credits

Program Credits

Educational Resources

Briefing Packet for Educators

This packet highlights key issues in the evolution versus intelligent design debate. A companion piece to the NOVA program *Judgment Day: Intelligent Design on Trial*, it provides clear, easily digestible background information to guide and support educational leaders and other stakeholders in their understanding of and response to challenges to the teaching of evolution in public schools.

Web Site

The companion Web site to the two-hour NOVA program contains text-based and multi-media features, a teacher's guide, and other resources. In addition, the Web site provides streaming video of the entire NOVA program along with three audio podcasts and one video podcast. Available online at pbs.org/nova/id.

This briefing packet is part of a multimedia set of educational resources.

Evolution Web Site

A companion resource to the PBS series *Evolution*, this Web site provides resources for classroom educators, students, and lifelong learners. It showcases issues in evolutionary biology through streaming imagery, animations, simulations, dynamic timelines, conversations with experts, and extensive links to evolution-related learning resources worldwide. Available online at pbs.org/wgbh/evolution.

Teachers' Domain

Media-rich resources highlighting key issues in evolution and the evolution versus intelligent design debate are incorporated into this growing digital library from WGBH. These are available at teachersdomain.org.

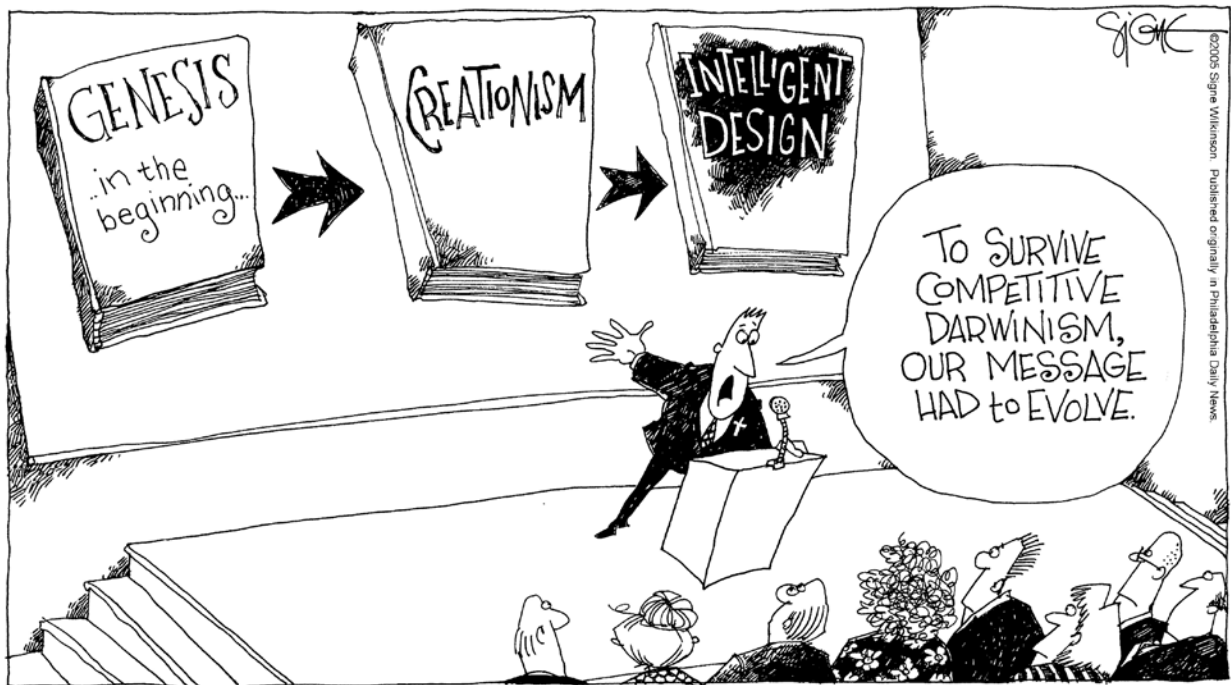
Online Course

A two-session online workshop is available on Teachers' Domain for educators to use for self-study or for professional development credit through a local or national course provider. The workshop focuses on issues related to teaching evolution, including the particular challenges of teaching it amidst the ongoing debate over intelligent design. Available online at pbs.org/nova/id/course.

NOVA Program Description

All of these resources are supported by a two-hour NOVA program, *Judgment Day: Intelligent Design on Trial*. The program highlights one of the latest battles in the war over evolution that took place in a tiny town in eastern Pennsylvania called Dover. In 2004, the local school board ordered science teachers to read a statement to their high school biology students. The statement suggested that there is an alternative to Darwin's theory of evolution called intelligent design, the idea that life is too complex to have evolved naturally and therefore had to have been designed by an intelligent agent. The science teachers refused to comply with the order, and parents filed a lawsuit in federal court accusing the school board of violating the separation of church and state. Suddenly, the small town of Dover was torn apart by controversy, pitting neighbor against neighbor. NOVA captures the emotional

and scientific conflict in interviews with the townspeople, scientists, and lawyers who participated in the historic six-week trial, *Kitzmiller v. Dover Area School District*. With recreations based on court transcripts, NOVA presents the arguments by lawyers and expert witnesses in riveting detail and provides an eye-opening crash course on questions such as "What is evolution?" and "Does intelligent design qualify as science?" The lessons from Dover will continue to have a profound impact on how science is viewed in our society and how it is taught in the classroom.



An editorial cartoon by Signe Wilkinson, first published in the *Philadelphia Daily News* on November 15, 2005, during the deliberations phase of *Kitzmiller v. Dover*. The high volume of press coverage—much of it satirical like this cartoon—shows how the case brought out the conflict over the teaching of evolution like no event since the legendary Scopes trial of the 1920s.

What Is Evolution?

Definition

Biological evolution refers to the cumulative changes that occur in a population over time. These changes are produced at the genetic level as organisms' genes mutate and/or recombine in different ways during reproduction and are passed on to future generations. Sometimes, individuals inherit new characteristics that give them a survival and reproductive advantage in their local environments; these characteristics tend to increase in frequency in the population over time, while those that are disadvantageous decrease in frequency. This process of differential survival and reproduction is known as natural selection.

Principles of Natural Selection

- Genetic mutation continually produces variations among individuals within a species.
- At the same time, a greater number of organisms are born than can survive and reproduce, given the limited resources they share. This can apply both to a given species and to the totality of all species.
- Individuals with specific characteristics best suited to their environment will have the greatest chance of survival and reproduction. If these individuals leave more offspring, over many generations, those characteristics (associated with better survival and reproduction) can become common within the population or species as a whole. This has been termed "survival of the fittest."
- In turn, a group of individuals may eventually acquire characteristics so distinct from others in their population they become a new species.
- This process of new species development is both generated by genetics and affected by geographical and environmental factors. A geographically isolated population will not share its genetic mutations with other groups of organisms, and thus may be especially likely to evolve into a new species.
- A single species may contain multiple population groups which evolve into separate new species of their own, a process called adaptive radiation.

Evolution is defined as descent with modification.

Evidence

Geology

Copious geological evidence indicates the earth is at least 4 billion years old, more than enough time for vast evolutionary changes to occur among organisms. Radiometric dating techniques, which analyze the clock-like deterioration of radioactive isotopes in rocks, are often used to determine the age of geological formations.

The fossil record

A rich record of thousands of fossils shows clear evolutionary paths. These include fossils of extinct ancestral species; "transitional" fossils showing crucial changes in form, such as water-based animals evolving to live on land; and many forms of human ancestral species. Conditions are not always right for fossilization, which can account for many apparent gaps in the fossil record.

Genetics

Modern genetics shows precisely how characteristics are inherited—and how they change. Rigorous studies demonstrate the rate at which a genetic mutation, once introduced into a population, can spread. This mathematical, laboratory-based analysis supports the natural history observations already used as evidence for evolution. The merging of evolutionary theory and biology developed in the 1930s and 1940s. This link, between the internal mechanism of inheritance in organisms and the external changes we see in species, is called neo-Darwinism or the "modern synthesis" of biology.

Biochemistry and metabolism

Basic metabolic reactions (chemical changes in living cells by which energy is provided for vital processes) such as the Krebs cycle (sometimes called the citric acid cycle) are the same in all species. The Krebs cycle is the same in humans, insects (such as the house fly, bumble bee and fruit fly), oak trees, mice, seaweeds, mushrooms, etc. Basic metabolic similarities are a compelling argument for evolution from a common ancestral species.

What Is Evolution? (cont.)

DNA

The 1953 discovery of DNA as the molecular basis of our genes provides evidence for evolution and opens new worlds of biological inquiry. By charting a species' total set of DNA—its “genome”—we can see how much of its total DNA is shared with other species, identify which genes are shared (and specifically where differences occur), and study evolutionary changes and relationships among species more precisely.

Biogeography

Part of evolutionary biology since the 19th century, biogeography is the analysis of the global distribution of species. Many evolutionary changes occur when species are isolated—on islands, for example—and studying the geographical distribution of related species often reveals the course of evolution.

Conclusions

- All life on earth, in every form, is related (shares common ancestry). As humans, we are not only related to all other primates and animals, but to all plants, fungi, bacteria, and microbes.
- Evolution occurs over long time periods. Our species, *Homo sapiens*, has existed in its current physical form for approximately 150,000 to 200,000 years. Our ancestors split off from all other primates 5 to 6 million years ago. Dinosaurs became extinct 65 million years ago; the first true small mammals appeared some 200 million years ago.
- Individuals do not evolve genetically, but populations do. That is, any one organism will not change genetically in its lifetime, but the frequency of certain genes in a population will change over time, leading species to develop particular characteristics.
- There is no permanent set of characteristics that makes a species “fit” in evolutionary terms. “Fitness” is a relative term, referring to the number of surviving offspring an individual produces. Fitness is also relative to the particular environment in which a population lives. A trait that increases fitness in one environment might lower fitness in another environment (or situation). Many well-adapted, long-lasting species have gone extinct because of changes in climate, a lack of resources like food or water, or the introduction of new predators or competitors.
- Evolution is an ongoing process and has been witnessed many times in the field as well as in the laboratory. For example, populations of rats have been shown to build up resistance to rat poison. Individual rats do not build resistance in a single generation. Some individual rats may have a slightly greater natural resistance to poison and survive. If these rats reproduce they may pass on this resistance and build a population with an increased average resistance to poison. The same thing occurs with insects with pesticides, and bacteria with antibiotics. This is sometimes called microevolution.
- Humans evolve like any other species. Indeed, researchers believe they have identified human genes that have changed over the last several thousand years; one enables us to better tolerate milk and may have spread after we domesticated animals. Going further back in time, some scientists are studying a gene sequence called FOXP2, which is slightly different in humans than in other primates, and may have become modified in a way that helped us develop our language skills.

What Is Science?

What is science?

Science is a systematic form of inquiry, based on prediction, reasoning, observation, and testing that explains how the natural universe works and seeks to continually refine our knowledge.

What is the “scientific method” that scientists use?

Science operates by means of the scientific method—the formulation of hypotheses that are consistent with observed phenomena and the subsequent testing of these hypotheses to determine their validity. Scientific knowledge is constantly refined or altered by new evidence; if a hypothesis can be disproved by experimentation, scientists reject it and formulate a new hypothesis that better fits the observed data.

More specifically, what is a “theory” in science?

A scientific theory is not a guess, hunch, or speculation. In science, a theory is a well-supported systematic explanation of some aspect of the natural world that incorporates facts, laws, and tested hypotheses. A theory is the highest order of understanding in science. In science, a fact is an observation that has been repeatedly confirmed. Evolution, defined as descent with modification, is a theory, supported by overwhelming evidence, facts, inferences, and tested hypotheses.

When do theories change?

Scientific theories are only valid as long as the evidence supports them. In any field of science, researchers continually use the scientific method to challenge existing views and determine which explanations fit the evidence best. Extensive work in evolutionary biology in the last 150 years has confirmed that Charles Darwin’s theory of evolution by natural selection best explains the evidence. Atomic theory is an example of a scientific theory that has changed over time. Dalton’s evidence of the atom as an indivisible sphere has been tested and refined over time. We no longer understand the atom to be an indivisible unit but a divisible unit made of electrons surrounding a nucleus of protons and

neutrons, which can be further divided into quarks, gluons, and other subatomic particles. Major scientific theories like atomic theory or evolutionary theory, already supported by multiple lines of independent evidence, are refined over time but not overturned without scientific evidence that discredits them.

People use all kinds of reasoning. What is different about scientific reasoning?

Science involves reasoning about the natural world. It does not involve supernatural explanations of the physical universe around us. Authentic scientific inquiry is based on the things we can study and test.

Science explains how the natural universe works.

What is the relationship of mathematics to science?

Since Galileo in the 17th century, math has been regarded as the common language of science. Most fields of science express large portions of their knowledge in mathematical terms, and evolutionary biology is no exception. Specifically, within biology, the area of genetics has long used mathematical analysis to determine how often specific genes are expressed, how rapidly they may become prevalent within a species, and what the evolutionary prospects are for species under certain conditions.

What do scientists spend their time doing?

Scientific work is largely based on research. New ideas or observations are most useful if they can provide us with specific questions to test. In this vein, scientists who develop a hypothesis try to test it. Other scientists then also test and re-test the hypothesis to see if it stands up to scrutiny. One of the many reasons intelligent design is not an authentic part of biology is because it offers no significant research program; moreover, even the founders of the intelligent design movement have never seriously tried to run scientific experiments based on their ideas.

What Is Science? *(cont.)*

Scientists say they “know” certain things. But haven’t other scientists thought that in the past and been proven wrong?

This is an important point. Science is a largely cumulative enterprise in which our knowledge generally progresses over time. Scientists are typically the first to admit that they do not know everything about the universe; people usually become scientists because they want to learn more. There are, however, particular principles that have stood the test of time and that we know beyond a reasonable doubt: That the earth revolves around the sun, for instance. The principles of evolutionary biology are among these well-established pieces of knowledge. In biology, the abundant evidence accumulated since Charles Darwin’s time has served to prove the basic principles he developed. All told, science is a way of knowing that has shown us many answers, but does not claim to know all of them.

What does science say about the nature of religious beliefs?

By definition science cannot address supernatural causes because its methodology is confined to the natural world. Therefore science has nothing to say about the nature of God or about people’s spiritual beliefs. This does not mean science is anti-religious; rather, it means science simply cannot engage in this level of explanation.

FAQs about Evolution and Intelligent Design

Q: What is evolution?

A: Biological evolution refers to the cumulative changes that occur in a population over time. These changes are produced at the genetic level as organisms' genes mutate and/or recombine in different ways during reproduction and are passed on to future generations. Sometimes, individuals inherit new characteristics that give them a survival and reproductive advantage in their local environments; these characteristics tend to increase in frequency in the population, while those that are disadvantageous decrease in frequency. This process of differential survival and reproduction is known as natural selection.

Q: What is intelligent design?

A: Intelligent design, or ID, is the idea that certain features of the universe and life are too complex to have arisen by natural causes and instead are best explained as being the product of an intelligent designer.

Q: What is science?

A: Science is a systematic form of inquiry, based on observation, prediction, reasoning, and testing, that explains how the natural universe works, and seeks to continually refine our knowledge. Science operates by means of the scientific method—the formulation of hypotheses that are consistent with observed phenomena and the subsequent testing of these hypotheses to determine their validity. Scientific knowledge is constantly refined or altered by new evidence; if a hypothesis can be disproved by experimentation, scientists reject it and formulate a new hypothesis that better fits the observed data.

Q: What is creationism?

A: Creationism is the belief that the universe and life on earth were created by a supernatural entity (such as God). There are a few forms of creationism. “Young earth” creationism is the belief that God created life on earth in its present form no more than 6,000–10,000 years ago, as specified by Genesis in the Bible. “Creation science” claims to use the methods of science to study the Earth from the perspective of Genesis. Intelligent design claims that the complexity of nature supports the existence of an intelligent designer, though it doesn't posit what or who it might be.

Q: Isn't evolution just a theory, not a fact?

A: In science, a theory is a well-supported systematic explanation of some aspect of the natural world that incorporates facts, laws, and tested hypotheses. A fact is an observation that has been repeatedly confirmed. Evolution, defined as descent with modification, is a theory, supported by overwhelming evidence, facts, inferences, and tested hypotheses.

Q: Why teach evolution in schools?

A: The theory of evolution is one of the most well established fields of scientific inquiry—and is fundamental to any type of investigation in the life sciences. Students need to know about evolution because it is key to fully understanding every aspect of the biological sciences, from genetics to animal behavior.

Q: Why not teach intelligent design, or creationism, alongside evolution?

A: The federal courts have ruled that creationism, creation science, and intelligent design are not science, but instead endorse a specific religious belief. Therefore, these topics are not appropriate content for a science classroom. Neither ID nor any other form of creationism has met any of the standards of science and cannot be tested by the scientific method. On the other hand, evolution, like all other sciences, is founded on a growing body of observable and reproducible evidence in the natural world. The state of knowledge in evolutionary biology is the product of 150 years of rigorous challenges using the methods of science, whereas intelligent design is not supported by scientific evidence. Teaching evolution alongside these other approaches would imply that creation science and intelligent design meet these same high standards of testability, and they do not.

**A fact is an observation
that has been repeatedly
confirmed.**

FAQs about Evolution and Intelligent Design (cont.)

Q: Why not just teach biology in school, but skip evolution?

A: Biology is the study of life, and all life has evolved and is continuing to evolve (or change) over time. Because every species bears the mark of its evolutionary history, to truly grasp the depth and implications of biology, evolution must be part of the picture.

Q: What is the legal basis for keeping ID or any form of creationism out of the classroom?

A: The U.S. Constitution states the government “shall make no law respecting an establishment of religion”—the “Establishment Clause” of the First Amendment. Multiple court verdicts, including a 1987 decision by the U.S. Supreme Court, have found that creationism is an attempt to bring religious views into the classroom, and therefore violates the Establishment Clause. It is thus unconstitutional to teach creationism in public schools. In 2005, the judge in the Dover, Pennsylvania case ruled that intelligent design was intended “to promote religion in the public school classroom,” in violation of the constitutional separation between church and state.

Q: But some people say evolution is just another form of religion itself: Darwinism.

A: The idea of evolution did not begin or end with Charles Darwin. Many alternate proposals about evolution already existed when Darwin published *On the Origin of Species* in 1859, but his work was quickly recognized as the most compelling explanation in the field of natural history. Since then, thousands of scientists have added greatly to our understanding of evolution, through research in biology, genetics, paleontology, geology, and more. If modern studies contradicted Darwin’s work, science would follow the evidence. Instead, over and over again, research has confirmed the principles Darwin outlined, while further fleshing out the picture. Evolutionary biology does not depend on the personal authority of one person’s writing. Evidence for evolution comes from many sources, including the fossil record, comparative anatomy, and genetics. The theory of evolution is based on facts. Religion is based on belief. Evolution is science, not religion.

Q: Can you accept evolution and still believe in religion?

A: Yes. The common view that evolution is inherently anti-religious is simply false. All that evolution tells us is that life on this planet could have arisen by natural processes. For many people of various faiths, showing that something is due to a natural process doesn’t take it outside the realm of the divine. Religious thinkers across the ages have written that merely showing that something is natural puts it within the influence of God, the creator of all nature. By definition science cannot address supernatural causes because its methodology is confined to the natural world. Therefore science has nothing to say about the nature of God or about people’s spiritual beliefs. This does not mean science is anti-religious; rather, it means science simply cannot engage in this level of explanation.

Evolution and ID: Arguments and Responses

Evolution is a theory, not a fact.

In science, a theory is a well-supported systematic explanation of some aspect of the natural world that incorporates facts, laws, and tested hypotheses. Evolution, defined as descent with modification, is a theory, supported by overwhelming evidence, facts, inferences, and tested hypotheses. In science, a fact is an observation that has been repeatedly confirmed.

Schools should teach the controversy about evolution.

There is no scientific controversy about the existence of evolution. To be sure, scientists are always trying to refine the precise details of what we know in any field, including evolutionary biology, but this does not cast doubt upon the overall principles of evolution.

There is no scientific controversy about the existence of evolution.

But it is only fair to study alternate theories in addition to evolution, such as intelligent design.

When it comes to science, fairness flows from the facts. Science is built upon a public record of empirical evidence, and in this case, the facts point to the existence of evolution by natural selection beyond a reasonable doubt. By contrast, it would be unfair to teach students intelligent design, which has no way of being tested and claims scientists cannot understand how the natural world works.

There are gaps in the fossil record.

Life on earth dates back approximately 4 billion years—a huge stretch of time. There may not be a fossil for each and every single year of that period, but there are hundreds of thousands of fossils and more are discovered every year. These finds demonstrate the evolution of species, including many remarkably intact examples showing crucial transitions between forms of life. Conditions are rarely ideal for fossilization, which can account for many apparent gaps in the fossil record.

The overall evidence for evolution is largely incomplete.

Actually, it's remarkable how much evidence has been uncovered since Charles Darwin's time that confirms the principles of evolutionary biology. DNA, for instance, provides powerful proof that all living things are related: We share 95–98 percent of our DNA with chimpanzees; 10 percent of human genes are clearly related to genes in flies and worms; and humans even have strings of DNA in common with bacteria. This allows us to confirm how closely related all species are to each other, and to determine

when species separated from each other. Moreover, studying DNA closely allows us to identify particular genes that distinguish species from one another and probably played a key role in evolutionary changes—like human genes that may facilitate our language abilities.

No one has ever seen evolution actually happening.

Not true! In fact, scientists have studied the same kinds of bird species that helped inspire Charles Darwin, the finches of the Galapagos Islands, and observed evolutionary changes and adaptations triggered by a single summer of dry weather. And that's just one example. Scientists have documented evolutionary changes in a multitude of species with short life-spans (such as fruit flies), tracing natural adaptations over a series of generations. Moreover, scientists have documented not just particular adaptations, but the development of new species, from small mammals to birds, fish, plants, and more.

Man cannot be descended from chimps, monkeys, or gorillas.

We're not. Humans, along with chimpanzees, monkeys, gorillas, and other primates, are all descended from a common primate ancestor, which lived tens of millions of years ago and is now extinct. Our own ancestors branched off and formed a new species within the last few million years. In evolutionary terms, chimpanzees, monkeys, and gorillas are like our cousins. Beyond primates, all other species are simply more distantly related cousins.

Evolution and ID: Arguments and Responses (cont.)

Mutations destroy genetic information, but never add information, so evolution cannot explain the increased complexity of organisms.

This is simply untrue. For one thing, the common process of gene duplication, in which sections of DNA are copied, and sometimes mutate, can create new and valuable pieces of genetic materials while preserving the original copies of genes. Thousands of scientists have studied this topic. Moreover, scientists know that complexity can be generated by a relatively small number of genetic changes. For billions of years, all species have retained the same chunks of DNA supporting certain functions necessary for life—reproduction of DNA, metabolism, growth mechanisms—while isolated DNA mutations can produce complex-looking body parts, like an elephant's trunk or elk's antlers. In short, not only can an organism's DNA become more complex, but it does not take a great deal of new genetic information to generate the complexity we see in many species.

Some natural structures, like the bacterial flagellum cited by Michael Behe, are too complex to have evolved for the purposes they serve. There must have been a designer who created them.

Actually, we know a great deal about the development of the very same structures that intelligent design advocates like Behe claim we cannot explain. Complex physiological structures develop from an accumulation of changes over time. They may consist of simpler building blocks, which served other purposes, then become adapted into more complex structures. Behe claims the “flagellar motor” which many bacteria use to propel themselves is too complex to have evolved naturally. In reality, scientists know that a distinct part of the flagellum is used by some bacteria to attack other cells, and can study how this structure may have evolved. Similarly, intelligent design advocates claim the eye is too complex to have evolved. However, scientists have already found that crucial components of the eye, such as light-sensitive structures, are a common element of species ranging from humans to bacteria. Eyes are thus constructed from many basic biological building blocks we can examine in great detail.

Intelligent design advocates are being unfairly shut out of the mainstream corridors of science.

Not so. Scientists typically aim to publish papers in peer-reviewed journals, but intelligent design proponents have never done this. Moreover, as Michael Behe has admitted in court, they have also not attempted to test their own hypotheses in laboratory settings. Finally, although more than 10,000 people earn Ph.D.s in science and engineering from American universities every year, the intelligent design movement has revolved largely around the same small handful of people for two decades. It is not a growing intellectual movement and is not being unfairly denied access to the proper channels of science.

Timeline: *Kitzmiller v. Dover Area School District*

October 18, 2004

The Dover Area school board, in Pennsylvania, becomes first in the country to require materials about intelligent design in science classes.

November 19, 2004

The Dover school board publicly announces its new policy: Science teachers will have to read a statement to students saying evolution is “not a fact,” and that “intelligent design is an explanation of the origin of life that differs from Darwin’s view.” They will also make available a textbook promoting intelligent design, *Of Pandas and People*.

December 14, 2004

Parents of eleven Dover-area students file suit, to prevent intelligent design from becoming a mandated part of the curriculum.

September 26, 2005

As a result of the suit, a trial on the validity of teaching intelligent design—named *Kitzmiller v. Dover*—begins in district court in Harrisburg, Pennsylvania, with Judge John Jones presiding.

September 26—October 14, 2005

Witnesses testify for the plaintiffs, who are trying to remove intelligent design from the classroom. They include biologist Kenneth Miller; Dover science teacher Bryan Rehm; scholars Robert Pennock and Barbara Forrest, who have studied the intelligent design movement and other forms of creationism; and Dover-area parent Tammy Kitzmiller.

October 17—November 4, 2005

Witnesses testify for the defense, who have implemented the pro-intelligent design policy. They include biochemist and intelligent design advocate Michael Behe; William Buckingham, the head of the Dover school board’s curriculum committee; and Alan Bonsell, another school-board member.

November 4, 2005

The main lawyers in the case, Eric Rothschild for the plaintiffs and Patrick Gillen for the defense, make their closing arguments.

November 8, 2005

In elections for the Dover school board, all eight seats being contested (out of nine) are won by candidates running on a pro-evolution, anti-intelligent design platform.

December 20, 2005

Judge Jones issues a 139-page verdict in the trial, finding for the plaintiffs and criticizing the claims made for intelligent design. Jones states that intelligent design is “a religious view, a mere re-labeling of creationism, and not a scientific theory.” He adds that the Dover school board’s claim to be examining an alternate form of science is simply “a pretext for the Board’s real purpose, which was to promote religion in the public school classroom, in violation of the Establishment Clause.” The school board, now consisting of newly-elected, pro-science members, will not appeal the ruling.

The Dover Area school board, in Pennsylvania, requires materials about intelligent design in science classes.
– October 18, 2004

Trials about Evolution and Creationism in the U.S.

Many court cases relating to evolution, creationism, and the separation of church and state have occurred throughout United States history. Here is a core group of notable trials centered on the issue, all of which involved laws passed by state legislatures or policies instituted by school boards. The oldest, the Scopes Trial, remains one of the most famous trials of any kind in U.S. history.

The Scopes Trial, Tennessee, 1925

In 1925, Tennessee's state legislature banned the teaching of evolution in public schools. The new law made it illegal for instructors to discuss "any theory that denies the story of Divine Creation of man as taught in the Bible," or to teach that "man has descended from a lower order of animal."

The American Civil Liberties Union, representing teacher John Scopes, sued to overturn the act.

In court the creationist law was upheld, despite the famous cross-examination that Scopes' lawyer, Clarence Darrow, gave his anti-evolution opponent, former presidential candidate William Jennings Bryan. The jury only heard testimony about whether Scopes had violated the existing anti-evolution law, leaving larger questions about the constitutionality of that law untouched. The Tennessee Supreme Court later threw out Scopes' conviction but did not address the status of the law either. Furthermore, despite the Supreme Court's decision to throw out the conviction, the outcome was that evolution was not taught in schools. Tennessee's anti-evolution measure remained intact until the 1960s.

The Scopes trial generated enormous media coverage in its day, as the first case of its kind, as a symbol of civic divisions in America, and because of the fame of its central figures. In later years, the trial continued to resonate in society: Creationists glorified Bryan and by the 1930s had been spurred on to institute similar laws in other states, while the popular 1960 film about the case, *Inherit the Wind*, portrayed Darrow as a hero.

U.S. Supreme Court: Epperson v. Arkansas, 1965—1968

In 1965, Arkansas still had a law, also dating to the 1920s, forbidding the teaching of evolutionary biology. That year the Arkansas Education Association, allied with science teacher Susan Epperson, challenged the measure. After a brief trial, the presiding judge found the anti-evolution law to violate the U.S. Constitution, which states the government "shall make no law respecting an establishment of religion," its Establishment Clause. This verdict was overturned by the Arkansas Supreme Court in 1967. On appeal, the U.S. Supreme Court agreed with the original decision, declaring in 1968 it was illegal to ban classroom science for reasons of "conflict with a particular religious doctrine."

In McLean v. Arkansas, the presiding judge ruled "creation science" had "no scientific merit or educational value as science."

McLean v. Arkansas, 1981

In 1981, Arkansas' legislature passed Act 590, a so-called "equal-time provision" mandating that the teaching of evolutionary science should be accompanied by the teaching of creationist ideas. The provision's aim was to make classroom time for "creation science," the notion that natural history can be explained through a largely literal reading of religious documents. A coalition of opponents, including clergyman William McLean, challenged the law in a federal district court trial. The verdict: The presiding judge ruled "creation science" had "no scientific merit or educational value as science," and was an illegal attempt to bring particular religious views into the classroom.

Trials about Evolution and Creationism in the U.S. *(cont.)*

U.S. Supreme Court: Edwards v. Aguillard, 1981—1987

In 1981, Louisiana passed its own “equal-time” law, The Louisiana Balanced Treatment Act, mandating the teaching of creationism along with evolution. After four separate rulings against the measure in lower courts, the case was appealed to the U.S. Supreme Court, which also struck down the law. In the majority opinion of Justice William Brennan, the Louisiana law “advances a religious doctrine by requiring either the banishment of the theory of evolution from public school classrooms or the presentation of a religious viewpoint that rejects evolution in its entirety.” In so doing, the court ruled, “creation science” violated the Establishment Clause.

Kitzmiller v. Dover Area School District, 2005

In 2005, the school board in Dover, Pennsylvania mandated that classes on evolutionary science commence with an announcement supporting the study of “intelligent design,” the idea that life is too complex to have evolved due to purely natural causes. A group of parents filed suit to overturn the new policy. After a lengthy trial, presiding Judge John Jones found for the parents, declaring that “intelligent design” is “a religious view, a mere re-labeling of creationism, and not a scientific theory.”

Evolution Trials at-a-Glance

Year(s)	State	At Issue	Outcome
1925	Tennessee	<i>State v. John Scopes</i> (“Scopes Trial”) Law banning teaching of evolution.	Law upheld.
1965–8	Arkansas	<i>Epperson v. Arkansas</i> Law banning teaching of evolution.	Overruled by U.S. Supreme Court.
1981	Arkansas	<i>McLean v. Arkansas</i> Law mandating “creation science” be taught along with evolution.	Struck down by federal district court.
1981–7	Louisiana	<i>Edwards v. Aguillard</i> Law mandating “creation science” be taught along with evolution.	Overruled by U.S. Supreme Court.
2005	Pennsylvania	<i>Kitzmiller v. Dover</i> School policy introducing “intelligent design.”	Struck down by the Harrisburg, PA federal district court.

JUDGMENT DAY

INTELLIGENT DESIGN ON TRIAL

Comparison of Evolutionary Biology and Intelligent Design

	Evolutionary Biology	Intelligent Design
What are the basic principles?	Evolution works by the process of natural selection. Genetic mutations cause variations among living things. The organisms best adapted to their environments will survive and pass on their traits. Over time, groups of organisms with distinct features form new species.	A central tenet of intelligent design is that life forms are the deliberate creation of a “designer.”
What accounts for the complexity of organisms?	The accumulation of evolutionary changes over time leads to the development of complex structures in living things. In turn, those structures may also become adapted for new functions.	The creative intelligence of a supernatural designer accounts for the complexity of organisms.
What is the supporting evidence?	Evolutionary biology involves work in many fields, including paleontology, genetics, chemistry, and geology. Evidence includes fossils, DNA, and geological data showing the earth’s age and the distribution of species around the globe.	Intelligent design is not backed by any standard scientific research or experimental evidence. Instead, its advocates use complex organic structures (such as the bacterial flagellum or the human eye) as examples of structures that they claim are too complex to have evolved.
How are the species related?	Evolutionary biology holds that all life is related, a concept demonstrated by genetics; all life forms, including animals, plants, fungi, and bacteria, contain common elements of DNA.	It depends on the variation of intelligent design being discussed. Intelligent design advocates Michael Behe generally accepts the idea of common descent among species, but other intelligent design proponents tend to view species as being created separately.
How are the concepts being tested?	Research into evolution is limited to observation of the natural world, in the form of testable ideas stemming from collected data. Ideas about evolution are published in peer-reviewed journals and subject to ongoing scrutiny by other scientists.	Intelligent design is based on the idea of supernatural forces creating living things. Intelligent design advocates have never attempted to test their own work through basic research or submitted papers to peer-reviewed journals.
Is natural selection involved?	Yes. Evolution holds that the same types of natural forces have been in play during the history of the earth, and continue to exist in our time as well.	Intelligent design proponents hold differing views about natural selection. Many proponents feel that species or organic structures were created at particular moments in the past.

Support Statements from Scientific Organizations

The following is a list of statements from some of the many nationally and internationally recognized scientific and scholarly organizations that support biological evolution.

American Association for the Advancement of Science, 2002

The AAAS, in existence since 1848, is the world's largest scientific organization. Its position statement asserts that "evolution is one of the most robust products of scientific inquiry" and "an essential element of science education." By contrast, AAAS states, "the ID movement has failed to offer credible scientific evidence" for its views and "has not proposed a scientific means of testing its claims," making intelligent design "improper to include as a part of science education."

www.aaas.org/news/releases/2002/1106id2.shtml

American Institute of Biological Sciences, 1994

The organization, one of the most prominent of such groups in science, notes that "biologists agree that evolution occurred and that the forces driving the evolutionary process are still active today. This consensus is based on more than a century of scientific data gathering and analysis." It concludes: "Because creationism is based almost solely on religious dogma stemming from faith rather than demonstrable facts, it does not lend itself to the scientific process. As a result, creationism should not be taught in any science classroom."

www.ncseweb.org/resources/articles/7403_statements_from_scientific_an_12_19_2002.asp#aaas5

National Academy of Sciences, 1999

Signed into being in 1863, the NAS is an organization of scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. In 1999, after the Kansas Board of Education voted not to include evolution on its state standardized tests, the NAS responded: "Evolution is not only universally accepted by scientists; it has also been accepted by the leaders of most of the world's major religions. The National Academy of Sciences has long been an advocate for the teaching of evolution as a central element in any science education program."

www.nasonline.org/site/PageServer?pagename=NEWS_statement_president_08201999_BA_Kansas_curriculum

National Association of Biology Teachers, 2004

The NABT states that "Scientists have firmly established evolution as an important natural process," and that forms of knowledge "that invoke non-naturalistic or supernatural events or beings, whether called 'creation science,' 'scientific creationism,' 'intelligent design theory,' 'young earth theory,' or similar designations, are outside the realm of science and not part of a valid science curriculum." The organization recommends teaching evolution "in a standards-based instructional framework with effective classroom discussions and laboratory experiences."

www.nabt.org/sites/S1/index.php?p=66

National Science Teachers Association, 2003

The NSTA, with over 55,000 members, states that "evolution is a major unifying concept in science." They say, "evolution has not been emphasized in science curricula" fully enough due to "official policies, intimidation of science teachers, the general public's misunderstanding of evolutionary theory, and a century of controversy. In addition, teachers are being pressured to introduce creationism, 'creation science,' and other nonscientific views, which are intended to weaken or eliminate the teaching of evolution."

www.nsta.org/positionstatement&psid=10

Pennsylvania Academy of Science, 2006

After the conclusion of the Dover trial in Pennsylvania, the state's Academy of Science stated that evolution "is the cornerstone of biological education around the world," while by contrast "there is no scientific evidence or supporting data for the idea of intelligent design." Therefore the academy "rejects the idea that intelligent design as an alternative to modern evolutionary theory be taught in science/biology classes," and "supports the teaching of evolution, as supported by valid scientific evidence" in the state.

www.ncseweb.org/resources/articles/7403_statements_from_scientific_an_12_19_2002.asp#aaas5

Support Statements from Religious Organizations

The following is a list of statements from a wide range of religious organizations that see no conflict between religious beliefs and acceptance of evolutionary biology.

Central Conference of American Rabbis, 1984

In a statement about creationism in school textbooks, the organization said that “the principles and concepts of biological evolution are basic to understanding science... students who are not taught these principles, or who hear ‘creationism’ presented as a scientific alternative, will not be receiving an education based on modern scientific knowledge... these students’ ignorance about evolution will seriously undermine their understanding of the world and the natural laws governing it, and their introduction to other explanations described as ‘scientific’ will give them false ideas about scientific methods and criteria.”

www.ncseweb.org/resources/articles/3677_statements_from_religious_org_12_19_2002.asp

Episcopal Church, General Convention, 2006

This resolution claims there is not an inherent conflict between religious belief and the acceptance of evolutionary biology, noting that “the theory of evolution provides a fruitful and unifying scientific explanation for the emergence of life on earth, that many theological interpretations of origins can readily embrace an evolutionary outlook, and that an acceptance of evolution is entirely compatible with an authentic and living Christian faith.”

www.episcopalarchives.org/e-archives/bluebook/29.html

Presbyterian Church, General Assembly, 2002

A statement issued after the church’s organizational meetings in 2002: “Reaffirms that a natural explanation of the history of nature is fully compatible with the affirmation of God as Creator,” and “Encourages... state bodies across the nation to establish the highest standards for public science education based on the judgment of the scientific community as to what constitutes the most reliable content of scientific knowledge and practice.” See section 09-08 of this document:

www.pcusa.org/ga214/business/09-education.pdf

Roman Catholic Church, 2007

Speaking to a group of Italian priests on July 24, 2007, Pope Benedict XVI again addressed the topic of evolution. Referring to debates over creationism in Germany and the United States, he observed that evolution and belief in God the creator are presented “as if they were alternatives that are exclusive—whoever believes in the creator could not believe in evolution, and whoever asserts belief in evolution would have to disbelieve in God,” as the *New York Post*’s article (July 26, 2007) translated it. “This contrast is an absurdity,” he continued, “because there are many scientific tests in favor of evolution, which appears as a reality that we must see and enriches our understanding of life and being. But the doctrine of evolution does not answer all questions, and it does not answer above all the great philosophical question: From where does everything come?”

For the story in the *New York Post*, visit:

www.nypost.com/seven/07262007/news/worldnews/evolution__god_do_mix__pope_worldnews_bill_sanderson.htm

United Methodist Church, 1984

At an annual conference, the organization declared that “adherence to immutable theories is fundamentally antithetical to the nature of science,” and added that it “opposes efforts to introduce ‘Scientific’ creationism into the science curriculum of the public schools.”

www.ncseweb.org/resources/articles/3677_statements_from_religious_org_12_19_2002.asp

Resources

Books

Evolution

Alters, Brian J. and Sandra M. Alters. *Defending Evolution: A Guide to the Creation/Evolution Controversy*. Sudbury, Mass: Jones and Bartlett, 2001. A classroom guide to teaching evolution and dealing with opposition to it.

Carroll, Sean B. *The Making of the Fittest: DNA and the Ultimate Forensic Record of Evolution*. New York: Norton, 2006. A scientist explains clearly for a general audience how DNA provides compelling evidence of evolution and reveals new details about the evolutionary process.

Forrest, Barbara and Paul R. Gross. *Creationism's Trojan Horse: The Wedge of Intelligent Design*. New York: Oxford University Press, 2003. An informative look at the origins, development, and political goals of the intelligent design movement.

Kirschner, Marc W. and John C. Gerhart. *The Plausibility of Life*. New Haven: Yale University Press, 2005. How recent genetic research has refined our ideas about the mechanisms of evolution and shed new light on the development of complexity among living things.

Larson, Edward J. *Evolution: The Remarkable History of a Scientific Theory*. New York: Modern Library, 2004. An introduction to evolutionary biology, covering both the scientific substance and the political, social, and legal developments related to it.

Miller, Kenneth R. *Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution*. New York: Cliff Street Books, 1999. Analyzes the scientific faults of ID and presents a religious scientist's accommodation of faith and science.

National Academy of Sciences. *Teaching about Evolution and the Nature of Science*. Washington, D.C.: National Academy Press, 1998. A book aimed at helping teachers distinguish between science and religion as different ways of knowing about the world.

Numbers, Ronald. *The Creationists: From Scientific Creationism to Intelligent Design*. Cambridge: Harvard University Press, 2006. A highly-regarded account of creationism in America by a leading historian of science.

Petto, Andrew J. and Laurie R. Godfrey, Eds. *Scientists Confront Intelligent Design and Creationism*. New York: W.W. Norton & Co., 2007. A series of essays from contributors rebutting the arguments of intelligent design and placing the issue in historical and scientific context.

Quammen, David. *The Song of the Dodo: Island Biogeography in the Age of Extinctions*. New York: Simon & Schuster, 1996. Compelling account of the way biogeography influences evolution; also reconstructs the work of Alfred Russel Wallace, co-founder of evolutionary biology.

Scott, Eugenie C. *Evolution vs. Creationism: An Introduction*. Connecticut: Greenwood Press, 2004. Introduction covering many facets of the current dispute, by the head of the National Center for Science Education.

Scott, Eugenie C. and Glenn Branch, Eds. *Not in Our Classrooms: Why Intelligent Design Is Wrong for Our Schools*. Boston: Beacon Press, 2006. A primer on intelligent design, the tactics of its backers, the legal issues at stake in the classrooms, and the strategies schools can employ to keep evolution in the curriculum.

Weiner, Jonathan. *The Beak of the Finch: A Story of Evolution in Our Time*. New York: Vintage, 1995. Vivid account of scientists studying evolution in action in the present day, on the Galapagos Islands.

Zimmer, Carl. *Evolution: The Triumph of an Idea*. New York: HarperCollins, 2001. A companion piece to the PBS series of the same name, offers an overview of the theory of evolution and where it stands today.

Intelligent Design

Behe, Michael J. *Darwin's Black Box: The Biochemical Challenge to Evolution*. New York: The Free Press, 1996. Provides examples of five biochemical systems to argue that life is "irreducibly complex."

Resources (cont.)

Web Sites

Evolution

American Association for the Advancement of Science Resources

aaas.org/news/press_room/evolution

Background information on evolution, classroom benchmarks for students, talking points for teachers, study guides, legal information, statements of support from religious leaders, and more.

Citizens for Science

citizensforscience.org/aggregator

A national group with local state chapters that organizes pro-science community efforts, particularly in response to creationist attempts to alter science education.

Evolution

pbs.org/wgbh/evolution

Information-rich site originally developed as a companion to a 2001 PBS series.

Evolution Teacher's Guide

pbs.org/wgbh/evolution/educators/teachstuds/tguide.html

A guide available for download, with information and teaching suggestions on evolution.

National Academy of Sciences

nationalacademies.org/evolution

This section of the NAS Web site is devoted to evolution resources.

National Association of Biology Teachers

nabt.org/sites/S1/index.php?p=5

Information on publications, workshops, grants, plus instructional materials and more.

National Center for Science Education

natcensci.ed.org

The leading clearinghouse of information and a resource for advice on evolution education.

National Science Teachers Association

nsta.org/publications/evolution.aspx

Resources about evolution and a list of NSTA publications on the subject.

Online Course for Teachers: Teaching Evolution

pbs.org/wgbh/evolution/educators/course

A professional development course that helps teachers examine major evolutionary concepts, explore teaching methodologies, and address obstacles to teaching evolution.

Science and Creationism

books.nap.edu/html/creationism

Guide published by the National Academy of Sciences; provides clear explanation of the facts about evolution and suggestions for dealing with creationist objections to it.

Talk Origins

talkorigins.org

A resource center full of information about evolutionary biology and creationism.

Teaching About Evolution and the Nature of Science

books.nap.edu/readingroom/books/evolution98

Guide published by the National Academy of Sciences; covers many aspects of evolution and offers teaching suggestions.

Understanding Evolution

evolution.berkeley.edu

This educational Web site covers the science and history of evolutionary biology as well as the many ways evolutionary biology factors into people's lives and the way research in evolutionary biology is performed.

Intelligent Design

Discovery Institute's Center for Science and Culture

discoverycsc.org

Provides a blog, reading list, frequently-asked questions and answers, and other information in support of intelligent design.

Intelligent Design Network

www.intelligentdesignnetwork.org

Features press releases, information about events, publications, and more, related to the intelligent design movement.



pbs.org/nova/id

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Briefing Packet Credits

This guide was produced by the Educational Outreach department of the WGBH Educational Foundation.

Director, Educational Outreach

Julie Benyo

Educational Content Manager

Sonja Latimore

Editor

Amy Kittenplan Hubbard

Writer

Peter Dizikes

Advisors

Louise S. Mead, Ph.D.

Maureen Reusche, Ed.D.

Brian Dempsey

*Acton-Boxborough Regional High School
Framingham, MA*

Judith Sumner

*Science Director, K-12
Arlington Public Schools
Arlington, MA*

Richard Benz

*Biology Teacher (ret.)
Science Specialist
Lake County Educational Service Center
Lake County, OH*

Designers

Cathleen Schaad
Vijay Mathews

Photo Researcher

Debby Paddock

Print Production

Lenore Gibson

Program Credits

Senior Executive Producer

Paula S. Apsell

Executives-in-Charge

Paul G. Allen and Jody Patton

Executive Producer

Richard Hutton

Written by

Joseph McMaster

Directed by

Gary Johnstone and Joseph McMaster

Produced by

Joseph McMaster, Gary Johnstone, and Vanessa Tovell

Supervising Producer


Bonnie Benjamin-Phariss

Senior Producer

Susanne Simpson

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