

CHAPTER THREE

CREATIONIST PERSPECTIVES

Creationist views reject scientific findings and methods.

Advocates of the ideas collectively known as “creationism” and, recently, “intelligent design creationism” hold a wide variety of views. Most broadly, a “creationist” is someone who rejects natural scientific explanations of the known universe in favor of special creation by a supernatural entity. Creationism in its various forms is not the same thing as belief in God because, as was discussed earlier, many believers as well as many mainstream religious groups accept the findings of science, including evolution. Nor is creationism necessarily tied to Christians who interpret the Bible literally. Some non-Christian religious believers also want to replace scientific explanations with their own religion’s supernatural accounts of physical phenomena.

In the United States, various views of creationism typically have been promoted by small groups of politically active religious fundamentalists who believe that only a supernatural entity could account for the physical changes in the universe and for the biological diversity of life on Earth. But even these creationists hold very different views. Some, known as “young Earth” creationists, believe the biblical account that the universe and the Earth were created just a few thousand years ago. Proponents of this form of creationism also believe that all living things, including humans, were created in a very short period of time in essentially the forms in which they exist today. Other creationists,

known as “old Earth” creationists, accept that the Earth may be very old but reject other scientific findings regarding the evolution of living things.

No scientific evidence supports these viewpoints. On the contrary, as discussed earlier, several independent lines of evidence indicate that the Earth is about 4.5 billion years old and that the universe is about 14 billion years old. Rejecting the evidence for these age estimates would mean rejecting not just biological evolution but also fundamental discoveries of modern physics, chemistry, astrophysics, and geology.

Some creationists believe that Earth’s present form and the distribution of fossils can be explained by a worldwide flood. But this claim also is at odds with observations and evidence understood scientifically. The belief that Earth’s sediments, with their fossils, were deposited in a short period does not accord either with the known processes of sedimentation or with the estimated volume of water needed to deposit sediments on the top of some of Earth’s highest mountains.

Creationists sometimes cite what they claim to be an incomplete fossil record as evidence that living things were created in their modern forms. But this argument ignores the rich and extremely detailed record of evolutionary history that paleontologists and other biologists have constructed over the past two centuries and are continuing to construct. Paleontological research has filled in many of the parts of the fossil record that were incomplete in Charles Darwin’s time. The claim that the fossil record is “full of gaps” that undermine evolution is simply false. Indeed, paleontologists now know enough about the ages of sediments to predict where they will be able to find particularly significant transitional fossils, as happened with *Tiktaalik* and the ancestors of modern humans. Researchers also are using new techniques, such as computed axial tomography (CT), to learn even more about the internal structures and composition of delicate bones of fossils. Exciting new discoveries of fossils continue to be reported in both the scientific literature and popular media.

[CT: *A medical imaging technique that generates a three-dimensional view of some object by combining a series of two-dimensional X-ray images of “slices” of that object.*]

Another compelling feature of the fossil record is its consistency. Nowhere on Earth are fossils from dinosaurs, which went extinct 65 million years ago, found together with fossils from humans, who evolved in just the last few million years. Nowhere are the fossils of mammals found in sediments that are more than about 220 million years old. Whenever creationists point to sediments where these relationships appear to be altered or even reversed, scientists have clearly demonstrated that this reversal has resulted from the folding of geological strata over or under others. Sediments containing the fossils of only unicellular organisms appear earlier in the fossil record than do sediments containing the remains of both unicellular and multicellular organisms. The sequence of fossils across Earth’s sediments points unambiguously toward the occurrence of evolution.

Creationists sometimes argue that the idea of evolution must remain hypothetical because “no one has ever seen evolution occur.” This kind of statement also reveals that some creationists misunderstand an important characteristic of scientific reasoning. Scientific conclusions are not limited to direct observation but often depend on inferences that are made by applying reason to observations. Even with the launch of Earth-orbiting spacecraft, scientists could not directly see the Earth going around the Sun. But they inferred from a wealth of independent measurements that the Sun is at the center of the solar system. Until the recent development of extremely powerful microscopes, scientists could not observe atoms, but the behavior of physical objects left no doubt about the atomic nature of matter. Scientists hypothesized the existence of viruses for many years before microscopes became powerful enough to see them.

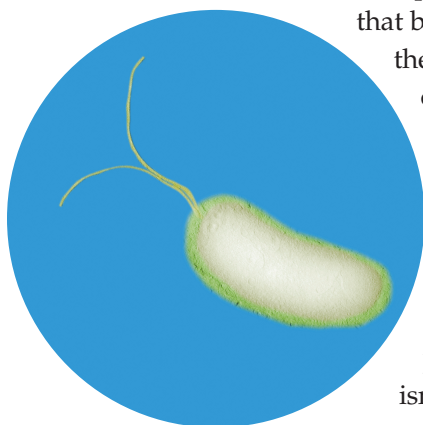
Thus, for many areas of science, scientists have not directly observed the objects (such as genes and atoms) or the phenomena (such as the Earth going around the Sun) that are now well-established facts. Instead, they have confirmed them indirectly by observational and experimental evidence. Evolution is no different. Indeed, for the reasons described in this booklet, evolutionary science provides one of the best examples of a deep understanding based on scientific reasoning.

This contention that nobody has seen evolution occurring further ignores the overwhelming evidence that evolution has taken place and is continuing to occur. The annual changes in influenza viruses and the emergence of bacteria resistant to antibiotics are both products of evolutionary forces. Another example of ongoing evolution is the appearance of mosquitoes resistant to various insecticides, which has contributed to a resurgence of malaria in Africa and elsewhere. The transitional fossils that have been found in abundance since Darwin’s time reveal how species continually give rise to successor species that, over time, produce radically changed body forms and functions. It also is possible to directly observe many of the specific processes by which evolution occurs. Scientists regularly do experiments using microbes and other model systems that directly test evolutionary hypotheses.

Creationists reject such scientific facts in part because they do not accept evidence drawn from natural processes that they consider to be at odds with the Bible. But science cannot test supernatural possibilities. To young Earth creationists, no amount of empirical evidence that the Earth is billions of years old is likely to refute their claim that the world is actually young but that God simply made it *appear* to be old. Because such appeals to the supernatural are not testable using the rules and processes of scientific inquiry, they cannot be a part of science.

“Intelligent design” creationism is not supported by scientific evidence.

Some members of a newer school of creationists have temporarily set aside the question of whether the solar system, the galaxy, and the universe are billions or just thousands of years old. But these creationists unite in contending that the physical universe and living things show evidence of “intelligent design.” They argue that certain biological structures are so complex that they could not have evolved through processes of undirected mutation and natural selection, a condition they call “irreducible complexity.” Echoing theological arguments that predate the theory of evolution, they contend



Electron micrograph of a bacterium with hair-like flagella.

that biological organisms must be designed in the same way that a mousetrap or a clock is designed — that in order for the device to work properly, all of its components must be available simultaneously. If one component is missing or changed, the device will fail to operate properly. Because even such “simple” biological structures as the flagellum of a bacterium are so complex, proponents of intelligent design creationism argue that the probability of all of their components being produced and simultaneously available through random processes of mutation are

infinitesimally small. The appearance of more complex biological structures (such as the vertebrate eye) or functions (such as the immune system) is impossible through natural processes, according to this view, and so must be attributed to a transcendent intelligent designer.

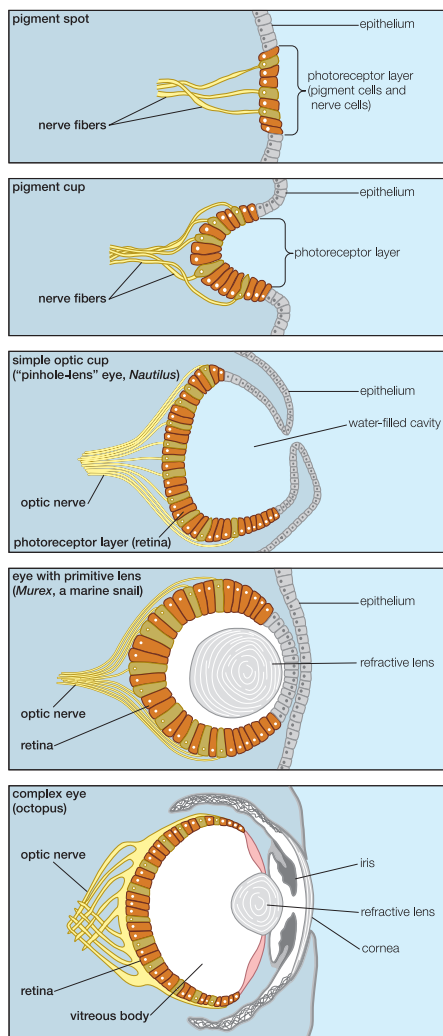
However, the claims of intelligent design creationists are disproven by the findings of modern biology. Biologists have examined each of the molecular systems claimed to be the products of design and have shown how they could have arisen through natural processes. For example, in the case of the bacterial flagellum, there is no single, uniform structure that is found in all flagellar bacteria. There are many types of flagella, some simpler than others, and many species of bacteria do not have flagella to aid in their movement. Thus, other components of bacterial cell membranes are likely the precursors of the proteins found in various flagella. In addition, some bacteria inject toxins into other cells through proteins that are secreted from the bacterium and that are very similar in their molecular structure to the proteins in parts of flagella. This similarity indicates a common evolutionary origin, where small changes in the structure and organization of secretory proteins could serve as the basis

for flagellar proteins. Thus, flagellar proteins are not irreducibly complex.

Evolutionary biologists also have demonstrated how complex biochemical mechanisms, such as the clotting of blood or the mammalian immune system, could have evolved from simpler precursor systems. With the clotting of blood, some of the components of the mammalian system were present in earlier organisms, as demonstrated by the organisms living today (such as fish, reptiles, and birds) that are descended from these mammalian precursors. Mammalian clotting systems have built on these earlier components.

Existing systems also can acquire new functions. For example, a particular system might have one task in a cell and then become adapted through evolutionary processes for different use. The *Hox* genes (described in the box on page 30) are a prime example of evolution finding new uses for existing systems. Molecular biologists have discovered that a particularly important mechanism through which biological systems acquire additional functions is gene duplication. Segments of DNA are frequently duplicated when cells divide, so that a cell has multiple copies of one or more genes. If these multiple copies are passed on to offspring, one copy of a gene can serve the original function in a cell while the other copy is able to accumulate changes that ultimately result in a new function. The biochemical mechanisms responsible for many cellular processes show clear evidence for historical duplications of DNA regions.

In addition to its scientific failings, this and other standard creationist arguments are fallacious in that they are based on a false dichotomy. Even if their negative arguments against evolution were correct, that would not establish the creationists' claims. There may be alternative explanations. For example, it would be incorrect to conclude that because there is no evidence that it is raining outside, it must be sunny. Other explanations also might be possible. Science requires testable evidence for a hypothesis, not just challenges against



Eyes in living mollusks. The octopus eye (bottom) is quite complex, with components similar to those of the human eye, such as a cornea, iris, refractive lens, and retina. Other mollusks have simpler eyes. The simplest eye is found in limpets (top), consisting of only a few pigmented cells, slightly modified from typical epithelial (skin) cells. Slit-shell mollusks (second from top) have a slightly more advanced organ, consisting of some pigmented cells shaped as a cup. Further elaborations and increasing complexity are found in the eyes of *Nautilus* and *Murex*, which are not as complex as the eyes of the squid and octopus.

Over millions of years, the Colorado River has cut through the rocks of the Colorado plateau, revealing sedimentary rocks deposited more than a billion years ago.



one's opponent. Intelligent design is not a scientific concept because it cannot be empirically tested.

Creationists sometimes claim that scientists have a vested interest in the concept of biological evolution and are unwilling to consider other possibilities. But this claim, too, misrepresents science. Scientists continually test their ideas against observations and submit their work to their colleagues for critical peer review of ideas, evidence, and conclusions before a scientific paper is published in any respected scientific journal. Unexplained observations are eagerly pursued because they can be signs of important new science or problems with an existing hypothesis or theory. History is replete with scientists challenging accepted theory by offering new evidence and more comprehensive explanations to account for natural phenomena. Also, science has a competitive element as well as a cooperative one. If one scientist clings to particular ideas despite evidence to the contrary, another scientist will attempt to replicate relevant experiments and will not hesitate to publish conflicting evidence. If there were serious problems in evolutionary science, many scientists would be eager to win fame by being the first to provide a better testable alternative. That there are no viable alternatives to evolution in the scientific literature is not because of vested interests or censorship but because evolution has been and continues to be solidly supported by evidence.

The potential utility of science also demands openness to new ideas. If petroleum geologists could find more oil and gas by interpreting the record of

sedimentary rocks (where deposits of oil and natural gas are found) as having resulted from a single flood, they would certainly favor the idea of such a flood, but they do not. Instead, petroleum geologists agree with other geologists that sedimentary rocks are the products of billions of years of Earth's history. Indeed, petroleum geologists have been pioneers in the recognition of fossil deposits that were formed over millions of years in such environments as meandering rivers, deltas, sandy barrier beaches, and coral reefs.

The arguments of creationists reverse the scientific process. They begin with an explanation that they are unwilling to alter — that supernatural forces have shaped biological or Earth systems — rejecting the basic requirements of science that hypotheses must be restricted to testable natural explanations. Their beliefs cannot be tested, modified, or rejected by scientific means and thus cannot be a part of the processes of science.

The pressure to downplay evolution or emphasize nonscientific alternatives in public schools compromises science education.

Despite the lack of scientific evidence for creationist positions, some advocates continue to demand that various forms of creationism be taught together with or in place of evolution in science classes. Many teachers are under considerable pressure from policy makers, school administrators, parents, and students to downplay or eliminate the teaching of evolution. As a result, many U.S. students lack access to information and ideas that are both integral to modern science and essential for making informed, evidence-based decisions about their own lives and our collective future.

Regardless of the careers that they ultimately select, to succeed in today's scientifically and technologically sophisticated world, *all* students need a sound education in science. Many of today's fast-growing and high-paying jobs require a familiarity with the core concepts, applications, and implications of science. To make informed decisions about public policies, people need to know how scientific evidence supports those policies and whether that evidence was gathered using well-established scientific practice and principles. Learning about evolution is an excellent way to help students understand the nature, processes, and limits of science in addition to concepts about this fundamentally important contribution to scientific knowledge.

Given the importance of science in all aspects of modern life, the science curriculum should not be undermined with nonscientific material. Teaching creationist ideas in science classes confuses what constitutes science and what does not. It compromises the objectives of public education and the goal of a high-quality science education.

Excerpts from Court Cases

Since the 1925 trial of John Scopes, which investigated the legality of a Tennessee law that forbade the teaching in public schools of “any theory that denies the story of the Divine Creation of man as taught in the Bible,” a number of court cases have looked at laws involving the teaching of creationist ideas. Several court decisions, including the 1987 Supreme Court case *Edwards v. Aguillard* and, more recently, the 2005 federal district court case (in central Pennsylvania) of *Kitzmiller v. Dover Area School District*, have ruled that the various forms of creationism, including intelligent design creationism, are religion, not science, and that it is therefore unconstitutional to include them in public school science classes. Below are excerpts from three of the most prominent cases.

Supreme Court of the United States, *Epperson v. Arkansas*, 1968

“Government in our democracy, state and national, must be neutral in matters of religious theory, doctrine, and practice. It may not be hostile to any religion or to the advocacy of non-religion, and it may not aid, foster, or promote one religion or religious theory against another or even against the militant opposite.”

Supreme Court of the United States, *Edwards v. Aguillard*, 1987

“[The] primary purpose [of the Louisiana ‘Creation Act,’ which required the teaching of ‘creation science’ together with evolution in public schools] was to change the public school science curriculum to provide persuasive advantage to a particular religious doctrine that rejects the factual basis of evolution in its entirety. Thus, the Act is designed either to promote the theory of creation science that embodies a particular religious tenet or to prohibit the teaching of a scientific theory disfavored by certain religious sects. In either case, the Act violates the First Amendment.”

U.S. District Court for the Middle District of Pennsylvania,
Kitzmiller v. Dover Area School District, 2005

“[W]e find that ID [intelligent design] is not science and cannot be adjudged a valid, accepted scientific theory, as it has failed to publish in peer-reviewed journals, engage in research and testing, and gain acceptance in the scientific community. ID, as noted, is grounded in theology, not science. . . . Moreover, ID’s backers have sought to avoid the scientific scrutiny which we have now determined that it cannot withstand by advocating that the controversy, but not ID itself, should be taught in science class. This tactic is at best disingenuous, and at worst a canard. The goal of the IDM [intelligent design movement] is not to encourage critical thought, but to foment a revolution which would supplant evolutionary theory with ID.”

U.S. law does not forbid the mention or study of religion as an academic subject in public schools, and creationism might be discussed in, for example, a comparative religion class. But, as civil servants, public school teachers must be neutral with respect to religion, which means that they can neither promote nor inhibit its practice. If intelligent design creationism were to be discussed in public school, then Hindu, Islamic, Native American, and other non-Christian creationist views, as well as mainstream religious views that are compatible with science, also should be discussed. Because the Constitution of the United States forbids a governmental establishment of religion, it would be inappropriate to use public funds to teach the views of just one religion or one religious subgroup to all students. Moreover, even in such a class it would be improper to teach these viewpoints as though they were scientific.



C H A P T E R F O U R

CONCLUSION

Science and science-based technologies have transformed modern life. They have led to major improvements in living standards, public welfare, health, and security. They have changed how we view the universe and how we think about ourselves in relation to the world around us.

Biological evolution is one of the most important ideas of modern science. Evolution is supported by abundant evidence from many different fields of scientific investigation. It underlies the modern biological sciences, including the biomedical sciences, and has applications in many other scientific and engineering disciplines.

As individuals and societies, we are now making decisions that will have profound consequences for future generations. How should we balance the need to preserve the Earth's plants, animals, and natural environment against other pressing concerns? Should we alter our use of fossil fuels and other natural resources to enhance the well-being of our descendants? To what extent should we use our new understanding of biology on a molecular level to alter the characteristics of living things?

None of these decisions can be made wisely without considering biological evolution. People need to understand evolution, its role within the broader scientific enterprise, and its vital implications for some of the most pressing social, cultural, and political issues of our time.

Science and technology are so pervasive in modern society that students increasingly need a sound education in the core concepts, applications, and implications of science. Because evolution has and will continue to serve as a critical foundation of the biomedical and life sciences, helping students learn about and understand the scientific evidence, mechanisms, and implications of evolution are fundamental to a high-quality science education.

Science and religion are different ways of understanding. Needlessly placing them in opposition reduces the potential of both to contribute to a better future. ■

FREQUENTLY ASKED QUESTIONS

Aren't evolution and religion opposing ideas?

Newspaper and television stories sometimes make it seem as though evolution and religion are incompatible, but that is not true. Many scientists and theologians have written about how one can accept both faith and the validity of biological evolution. Many past and current scientists who have made major contributions to our understanding of the world have been devoutly religious. At the same time, many religious people accept the reality of evolution, and many religious denominations have issued emphatic statements reflecting this acceptance. (For more information, see http://www.ncseweb.org/resources/articles/1028_statements_from_religious_org_12_19_2002.asp.)

To be sure, disagreements do exist. Some people reject any science that contains the word “evolution”; others reject all forms of religion. The range of beliefs about science and about religion is very broad. Regrettably, those who occupy the extremes of this range often have set the tone of public discussions. Evolution is science, however, and only science should be taught and learned in science classes.

The “Additional Readings” section of this publication cites a number of books and articles that explore in depth the intersection of science and faith.

Isn't belief in evolution also a matter of faith?

Acceptance of evolution is not the same as a religious *belief*. Scientists' confidence about the occurrence of evolution is based on an overwhelming amount of supporting evidence gathered from many aspects of the natural world. To be accepted, scientific knowledge has to withstand the scrutiny of testing, retesting, and experimentation. Evolution is accepted within the scientific community because the concept has withstood extensive testing by many thousands of scientists for more than a century. As a 2006 “Statement on the Teaching of Evolution” from the Interacademy Panel on International Issues, a global network of national science academies, said, “*Evidence-based* facts about the origins and evolution of the Earth and of life on this planet have been established by numerous observations and independently derived

experimental results from a multitude of scientific disciplines” (emphasis in original). (See <http://www.interacademies.net/Object.File/Master/6/150/Evolution%20statement.pdf>.)

Many religious beliefs do not rely on evidence gathered from the natural world. On the contrary, an important component of religious belief is faith, which implies acceptance of a truth regardless of the presence of empirical evidence for or against that truth. Scientists cannot accept scientific conclusions on faith alone because all such conclusions must be subject to testing against observations. Thus, scientists do not “believe” in evolution in the same way that someone believes in God.

How can random biological changes lead to more adapted organisms?

Contrary to a widespread public impression, biological evolution is not random, even though the biological changes that provide the raw material for evolution are not directed toward predetermined, specific goals. When DNA is being copied, mistakes in the copying process generate novel DNA sequences. These new sequences act as evolutionary “experiments.” Most mutations do not change traits or fitness. But some mutations give organisms traits that enhance their ability to survive and reproduce, while other mutations reduce the reproductive fitness of an organism.

The process by which organisms with advantageous variations have greater reproductive success than other organisms within a population is known as “natural selection.” Over multiple generations, some populations of organisms subjected to natural selection may change in ways that make them better able to survive and reproduce in a given environment. Others may be unable to adapt to a changing environment and will become extinct.

Aren’t there many questions that still surround evolution? Don’t many famous scientists reject evolution?

As with *all* active areas of science, there remain questions about evolution. There are always new questions to ask, new situations to consider, and new ways to study known phenomena. But evolution itself has been so thoroughly tested that biologists are no longer examining *whether* evolution has occurred and is continuing to occur. Similarly, biologists no longer debate many of the mechanisms responsible for evolution. As with any other field of science, scientists continue to study the *mechanisms* of how the process of evolution operates. As new technologies make possible previously unimaginable observations and allow for new kinds of experiments, scientists continue to

propose and examine the strength of evidence regarding the mechanisms for evolutionary change. But the existence of such questions neither reduces nor undermines the fact that evolution has occurred and continues to occur.

Nor do such questions diminish the strength of evolutionary science. Indeed, the strength of a theory rests in part on providing scientists with the basis to explain observed phenomena and to predict what they are likely to find when exploring new phenomena and observations. In this regard, evolution has been and continues to be one of the most productive theories known to modern science.

Even scientific theories that are firmly established continue to be tested and modified by scientists as new information and new technologies become available. For example, the theory of gravity has been substantiated by many observations on Earth. But theoretical scientists, using their understanding of the physical universe, continue to test the limits of the theory of gravity in more extreme situations, such as close to a neutron star or black hole. Someday, new phenomena may be discovered that will require that the theory be expanded or revised, just as the development of the theory of general relativity in the first part of the 20th century expanded knowledge about gravity.

With evolutionary theory, many new insights will emerge as research proceeds. For example, the links between genetic changes and alterations in an organism's form and function are being intensively investigated now that the tools and technologies to do so are available.

Some who oppose the teaching of evolution sometimes use quotations from prominent scientists out of context to claim that scientists do not support evolution. However, examination of the quotations reveals that the scientists are actually disputing some aspect of *how* evolution occurs, not *whether* evolution occurred.

What evidence is there that the universe is billions of years old?

This is an important question because evolution of the wide variety of organisms currently existing on Earth required a very long period of time. Several independent dating techniques indicate that the Earth is billions of years old. Measurements of the radioactive elements in materials from the Earth, the Moon, and meteorites provide ages for the Earth and the solar system. These measurements are consistent with each other and with the physical processes of radioactivity. Additional evidence for the ages of the solar system and the galaxy includes the record of crater formation on the planets and their moons, the ages of the oldest stars in the Milky Way, and the rate of expansion of the universe. Measurements of the radiation left over from the Big Bang also support the universe's great age.

What's wrong with teaching critical thinking or "controversies" with regard to evolution?

Nothing is wrong with teaching critical thinking. Students need to learn how to reexamine their ideas in light of observations and accepted scientific concepts. Scientific knowledge itself is the result of the critical thinking applied by generations of scientists to questions about the natural world. Scientific knowledge must be subjected to continued reexamination and skepticism for human knowledge to continue to advance.

But critical thinking does not mean that all criticisms are equally valid. Critical thinking has to be based on rules of reason and evidence. Discussion of critical thinking or controversies does not mean giving equal weight to ideas that lack essential supporting evidence. The ideas offered by intelligent design creationists are not the products of scientific reasoning. Discussing these ideas in science classes would not be appropriate given their lack of scientific support.

Recent calls to introduce "critical analysis" into science classes disguise a broader agenda. Other attempts to introduce creationist ideas into science employ such phrases as "teach the controversy" or "present arguments for and against evolution." Many such calls are directed specifically at attacking the teaching of evolution or other topics that some people consider as controversial. In this way, they are intended to introduce creationist ideas into science classes, even though scientists have thoroughly refuted these ideas. Indeed, the application of critical thinking to the science curriculum would argue against including these ideas in science classes because they do not meet scientific standards.

There is no scientific controversy about the basic facts of evolution. In this sense the intelligent design movement's call to "teach the controversy" is unwarranted. Of course, there remain many interesting questions about evolution, such as the evolutionary origin of sex or different mechanisms of speciation, and discussion of these questions is fully warranted in science classes. However, arguments that attempt to confuse students by suggesting that there are fundamental weaknesses in the science of evolution are unwarranted based on the overwhelming evidence that supports the theory. Creationist ideas lie outside of the realm of science, and introducing them in science courses has been ruled unconstitutional by the U.S. Supreme Court and other federal courts.

What are common ideas regarding creationism?

"Creationism" is a very broad term. In the most general sense, it refers to views that reject scientific explanations of certain features of the natural world (whether in biology, geology, or other sciences) and instead posit direct intervention (sometimes called "special creation") in these features by some transcendent being or power. Some creationists believe that the universe and Earth are only

several thousand years old, a position referred to as “young Earth” creationism. Creationism also includes the view that the complex features of organisms cannot be explained by natural processes but require the intervention of a nonnatural “intelligent designer.” The “Additional Readings” section following these questions contains several books that describe the various ways in which the word “creationism” is used.

Wouldn't it be “fair” to teach creationism along with evolution?

The goal of science education is to expose students to the best possible scholarship in each field of science. The science curriculum is thus the product of centuries of scientific investigation. Ideas need to become part of the base of accepted scientific knowledge before they are appropriately taught in schools. For example, the idea of continental drift to explain the movements and shapes of the continents was studied and debated for many years without becoming part of the basic science curriculum. As data accumulated, it became clearer that the surface of the Earth is composed of a series of massive plates, which are not bounded by the continents, that continually move in relation to each other. The theory of plate tectonics (which was proposed in the mid-1960s) grew from these data and offered a more complete explanation for the movement of continents. The new theory also predicted important phenomena, such as where earthquakes and volcanoes are likely to occur. When enough evidence had accumulated for the concept of plate tectonics to be accepted by the scientific community as fact, it became part of the earth sciences curriculum.

Scientists and science educators have concluded that evolution should be taught in science classes because it is the only tested, comprehensive scientific explanation for the nature of the biological world today that is supported by overwhelming evidence and widely accepted by the scientific community. The ideas supported by creationists, in contrast, are not supported by evidence and are not accepted by the scientific community.

Different religions hold very different views and teachings about the origins and diversity of life on Earth. Because creationism is based on specific sets of religious convictions, teaching it in science classes would mean imposing a particular religious view on students and thus is unconstitutional, according to several major rulings in federal district courts and the Supreme Court of the United States.

Does science disprove religion?

Science can neither prove nor disprove religion. Scientific advances have called some religious beliefs into question, such as the ideas that the Earth was created very recently, that the Sun goes around the Earth, and that mental illness is due to possession by spirits or demons. But many religious beliefs involve entities or ideas that currently are not within the domain of science. Thus, it would be false to assume that *all* religious beliefs can be challenged by scientific findings.

As science continues to advance, it will produce more complete and more accurate explanations for natural phenomena, including a deeper understanding of biological evolution. Both science and religion are weakened by claims that something not yet explained scientifically must be attributed to a supernatural deity. Theologians have pointed out that as scientific knowledge about phenomena that had been previously attributed to supernatural causes increases, a “god of the gaps” approach can undermine faith. Furthermore, it confuses the roles of science and religion by attributing explanations to one that belong in the domain of the other.

Many scientists have written eloquently about how their scientific studies have increased their awe and understanding of a creator (see the “Additional Readings” section). The study of science need not lessen or compromise faith.