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Questions and Answers About God, Evolution, and the Big Bang — What the Creationists Don't Want You to Know

Who are you, and what's your agenda?

Hi! My name is Ben Crowell, and I teach physics and astronomy at Fullerton College, a community college in Southern California. I have a Ph.D. in physics from Yale University, which admittedly qualifies me better to deal with the Big Bang than with evolution. The title of the pamphlet shows that I have a definite point of view, but you don't have to trust everything I say — there are references at the end of this pamphlet to more information from people with various perspectives.

Does believing in the Big Bang and Evolution require you to be an atheist?

No. Here's what the Episcopal Church says about so-called "creation science:"

Whereas, ... several states have recently passed so-called "balanced treatment" laws requiring the teaching of "Creation-science" whenever evolutionary models are taught; and ...

Whereas, the terms "Creationism" and "Creation-science" ... in these laws do not refer simply to the affirmation that God created the Earth and Heavens and everything in them, but specify certain methods and timing of the creative acts, and impose limits on these acts which are neither scriptural nor accepted by many Christians; and

Whereas, the dogma of "Creationism" and "Creation-science" ... has been discredited by scientific and theological studies and rejected in the statements of many church leaders; ...

[T]he ... Convention affirms the glorious ability of God to create in any manner, whether men understand it or not, and in this affirmation reject the limited insight and rigid dogmatism of the "Creationist" movement...

Here is a 1996 quote from Pope John Paul II:

Today, almost half a century after the publication of [Pius XII's] Encyclical, fresh knowledge has led to the recognition that evolution is more than a hypothesis. It is indeed remarkable that this theory has been progressively accepted by researchers, following a series of discoveries in various fields of knowledge. The convergence, neither sought nor fabricated, of the results of work that was conducted independently is in itself a significant argument in favor of this theory.

The Catholic Church also officially supports the Big Bang theory because it agrees with their theological position that time itself began at creation. By the

way, when I refer to “creationists” in this pamphlet, I mean people who don’t believe in standard science. The Pope certainly believes the universe was created by God, but he is not a “creationist” in this sense.

Shouldn’t creationism and evolution get equal time in the classroom?

A favorite strategy of creationists is to imply that there are only two alternatives: scientific atheism or their version of creationism. This allows them to paint educators as prejudiced for devoting 100% of class time to 50% of the possible explanations, and also lets them reason that if they can make you doubt evolution, then the only alternative is creationism. The problem is that creationism isn’t one theory but many. Young-earth creationists (YECs) put the earth’s age at 6000 years, but old-earth creationists (OECs) say it’s billions, in agreement with standard science. Intelligent-design creationists (IDCs) tend not to commit themselves on the age issue at all. Prominent creationist Michael Behe believes that humans and apes are descended from a common ancestor, although most of his compatriots disagree. An antievolution video called “Forbidden Archaeology” used to be a favorite of Christian fundamentalist creationists, until they found out that it had been produced by the Hare Krishnas, who say that creation happens over and over again in a cycle stretching over millions of years.

Doesn’t creationism deserve to be evaluated on scientific grounds?

Some versions have been. In fact, various types of creationism were assumed in western science until the 19th century. Geologists, for instance, used to try to explain all the earth’s geological features in terms of Noah’s Flood. In a famous series of debates in England, Geological Society members Adam Sedgwick and Charles Lyell carefully sifted the evidence, and in 1829 Sedgwick ended up giving up on the Flood theory, writing “I think, one great negative conclusion now incontestably established [is] that the vast masses of diluvial gravel, scattered almost over the surface of the earth, do not belong to one violent and transitory period.” A few thousand years simply is not enough time, for example, to explain the amount of sediment at the bottoms of rivers. Thus, YEC has been given a fair shake and proven incorrect.

When faced with this type of difficulty, creationists often respond by making their claims more vague and harder to check. IDCs are the champions at this kind of strategic fuzziness. They claim, for example, that a peacock’s plumage is impossible to explain in terms of evolution, but that it is a perfectly reasonable thing for a whimsical God to create. The problem with this “theory” is that it is immune to contrary evidence. Any living form that seems functional

Further Reading

Pro-Evolution

A thorough critique of creationism is given in **Tower of Babel: The Evidence Against the New Creationism**, by Robert T. Pennock, MIT Press, 1999. For a creationist rebuttal to Pennock by a well known OEC, see

http://www.arn.org/docs/behe/mb_godofscience.htm .

Young-Earth Creationism

The most prominent organization advocating YEC is the Institute for Creation Research,

<http://www.icr.org> .

For links to criticisms of YEC, see

<http://www.lightandmatter.com/evolution/index.html#yec> .

Old-Earth Creationism and Intelligent-Design Creationism

You wouldn’t know it from their misleading home page, but Access Research Network,

<http://www.arn.org> ,

is run entirely by OEC and IDC creationists, as you will soon find out if you dig a little deeper into their web site.

An atypical but well known OEC book is **Darwin’s Black Box: The Biochemical Challenge to Evolution**, by Michael Behe, The Free Press, 1996. For links to evolutionist reviews of this book, see

<http://www.lightandmatter.com/evolution/index.html#behe> .

The most influential exposition of IDC is **Darwin on Trial** by Phillip Johnson, Regnery Gateway, 1991. Responses are linked to at

<http://www.lightandmatter.com/evolution/index.html#johnson> ,

or see Stephen Jay Gould’s review in the July 1992 Scientific American.

How to Obtain and Produce this Pamphlet

This pamphlet is available on-line at <http://www.lightandmatter.com/evolution>. It is designed to be printed on both sides of 8.5”x11” paper and folded in half. Print the first sheet, then print onto the back of that sheet. Then do the same for the front and back of the second sheet.

Evolution is just a theory. Why teach it as fact?

There are at least three misconceptions betrayed by the commonly heard refrain that “evolution is just a theory.” First, the word “theory” doesn’t just mean “what some person thinks;” the word is generally used in science to mean a powerful, rigorous framework that is based on a large body of evidence, has made many predictions that have been verified, and has withstood vigorous and skeptical examination. Evolution is a “theory” in the same sense as Newton’s “theory” of gravity and Einstein’s “theory” of relativity.

Second, the word “theory” implies knowledge that is not the final word but rather is subject to revision, and to many people this implies that a “theory” is not trustworthy. Actually, a general feature of science is that it only seeks provisional truth, not absolute truth. Typically, however, once a school of thought has climbed to the level of “theoryhood,” it is unlikely to be overturned completely, since it could only have reached that stage by dealing successfully with a great many phenomena. What usually happens instead is that a theory that was developed within a certain range of circumstances is found to be less accurate under other conditions. For instance, one of the most basic statements of chemical theory is that one element doesn’t change into another — lead doesn’t turn into gold. In the 20th century it was discovered that elements could be transmuted, but only via nuclear reactions that take place under conditions of extreme temperature, not in ordinary chemical reactions. This doesn’t make it any less foolish to try to turn lead into gold in a test tube.

Finally, many people feel that the theory of evolution can never be firmly established because it describes so many events that no human has seen. All public-school biology textbooks in Alabama must have a disclaimer pasted in the front that reads in part, “No one was present when life first appeared on earth. Therefore, any statement about life’s origins should be considered as theory, not fact.” Vast portions of modern science, however, deal with phenomena that are not directly accessible to the senses. Atoms are invisible, but we accept their existence as a matter of course. (Four hundred years ago, “atomism” was thought by many people to conflict with religion.) Nobody has ever been below the earth’s crust, but we know quite a bit about the earth’s interior from such techniques as seismology, measurements of the earth’s gravitational field, the study of volcanoes, and knowledge of the mechanisms by which heat is conducted outward to the surface.

to our minds is used as evidence that God designed it for a purpose; anything that seems nonfunctional is interpreted by saying that God is whimsical, or that God’s mind is too complex for us to fathom.

What’s the evidence that the universe is billions of years old?

To believe in a YEC-style 6000 year old earth, you’d have to ignore evidence from nearly every corner of the sciences. The original evidence for an old earth came from geological processes like river sedimentation, but even stronger evidence is available today from continental drift and radioactive decay rates. Essentially all the earth’s helium, for instance, comes from the radioactive decay of heavy elements with half-lives of millions of years; if the earth was only thousands of years old, then virtually none of these atoms would have decayed yet. In biology, the great age of the earth is demonstrated by rates of change of DNA. Historical linguistics shows that many modern languages evolved from a smaller number of parent languages, and the rate at which languages change is too slow to allow this linguistic evolution to have occurred within 6000 years. There is also a great deal of astronomical evidence. Measurements of the rate of cratering in our solar system show that the moon must be billions of years old. The ages of star clusters can be determined based on models of how the structure of a star changes as it uses up its hydrogen fuel.

What’s the evidence for the Big Bang?

For one thing, we look in the sky and see it! The universe is permeated with microwave radiation that has been traveling through space ever since the universe cooled to the point where it was transparent. The detailed spectrum and anisotropy (lumpiness) of the radiation have been measured precisely by the Cosmic Microwave Background Explorer (COBE) satellite, and the agreement with theory is so good that scientists can even relate its features to quantities like the speed of sound waves traveling through the Big Bang fireball.

We also currently observe that the universe is expanding. Not only does this suggest that in the past everything must have been closer together, but it can even be proven mathematically from Einstein’s general theory of relativity that the current expanding state of the universe traces back to a time when what is now the entire observable universe was smaller than a single atom.

The Big Bang theory makes a variety of predictions that have been borne out by observations. For example, it predicts that hydrogen and helium would be the only elements created in appreciable quantities in the early universe, and indeed we observe that the oldest stars contain only very small amounts of heavier elements.

What's the evidence for evolution?

Creationists often claim that evolution is not a very important part of biology, but nothing could be further from the truth. You will have a hard time finding a biologist who will disagree with Theodosius Dobzhansky's statement that "Nothing in biology makes sense without evolution."

Evolution is easily observed in the laboratory, for instance when bacteria evolve resistance to a particular antibiotic. The fossil record shows, for example, how birds evolved from dinosaurs. The hypothesis that present-day forms evolved from a common ancestor or ancestors is corroborated by DNA studies, which show that humans have 98.5% of their DNA in common with chimpanzees — in terms of DNA, we are even quite similar to mushrooms!

Evolution makes many definite predictions that have been borne out by observation. For instance, evolution predicts that many sophisticated body parts in animals must have evolved from previous structures that worked differently or had different purposes, sometimes resulting in clumsy or maladaptive traits. One example is the vertebrate eye's maladaptive blind spot, where the optic nerve passes through the retina. Squids, on the other hand, have eyes in which the nerve endings connect on the back of the retina, so they have no blind spot. Such evolutionary accidents make perfect sense in terms of evolution, but are difficult to reconcile with the idea of intelligent design.

What if evolution works within species, but doesn't change one species to another?

This compromise approach to evolution is spreading more and more into the popular consciousness now that traditional creationism has suffered so many embarrassing defeats. The problem is that it is disproved by the fossil evidence, which for example displays sequences showing how horses and rhinos evolved from a common ancestor. The plant species *Tragopogon mirus* and *Tragopogon miscellus* evolved from a common ancestor in the 20th century as a result of a kind of chromosomal change. Species are usually defined as populations that cannot reproduce with other populations, but the definition doesn't even apply to many single-celled organisms that only reproduce asexually.

It's also a little depressing to consider the story of life obtained by superimposing this within-species concept of evolution onto the fundamentalist Christian world-view that motivated it. We have to imagine that God simultaneously created a great variety of species — trilobites, dinosaurs, humans — but then decided to drive nearly all of them extinct, with no mechanism for creating new species to replace them. The logical consequence of this extinction-with-

out-replacement picture would seem to be the end of all life at some point in the future.

How could any phenomenon as complex as life arise by chance?

Darwin was not the first biologist to suggest that species changed over long periods of time. His two new fundamental ideas were that (1) the changes arose through random genetic variation, and (2) changes that enhanced the organism's ability to survive and reproduce would be preserved, while maladaptive changes would be eliminated by natural selection. Creationists often consider only the first point, about the randomness of natural variation, but not the second point, about the systematic action of natural selection. They make statements such as, "the development of a complex organism like *Homo sapiens* via random chance would be like a whirlwind blowing through a junkyard and spontaneously assembling a jumbo jet out of the scrap metal." The flaw in this type of reasoning is that it ignores the systematic winnowing effect of the second half of Darwin's theory.

What about the evidence against evolution?

Creationists have made countless stabs at evolution, and it would be impossible to address them all here. In conversations with sincere evolution-doubters, however, I commonly hear a couple of arguments that are simply wrong and should long since have been put to bed.

The first is that evolution contradicts the second law of thermodynamics, which states that the entropy of a closed system always increases. Entropy is a measure of randomness, and since life is a highly ordered state of matter, it is indeed likely that the earth's biosphere has a lower entropy now than the earth's surface before life began. This is not a contradiction to the second law of thermodynamics, however, since the earth receives energy continuously from the sun, and therefore is not a closed system.

Another bogus piece of evidence that won't seem to go away is the so-called "Paluxy man-tracks." These are two overlapping sets of fossilized footprints, which some creationists have claimed are those of a human and a dinosaur. This would be inconsistent with normal science, which separates humans and dinosaurs by tens of millions of years. But the putative human prints are 40-55 cm (16-20 inches) long. Furthermore, careful examination has shown that many of them have saurian characteristics, while some others are crude forgeries carved into the rock!