

ONLINE CHAT

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1:53 p.m. December 14, 2007

moderator(P) Welcome. Last month Dr. Steve Kay wrote an informative and provocative commentary, "Why evolution matters," for the San Diego Union-Tribune. (It can be found [here](#).) Kay is here today to continue his discussion on evolution and its importance in modern biology.

moderator(P) As we wait for your questions, I would like to take a few minutes to tell you a little more about Kay. Dr. Kay is dean of UCSD's Division of Biological Sciences. A pioneer in the biology of circadian rhythms, he was formerly a professor of cell biology at The Scripps Research Institute, chair of its Department of Biochemistry and director of its Institute for Childhood and Neglected Diseases, where he was a faculty member from 1996 to September, 2007. Kay also holds an appointment as adjunct professor in UCSD's Department of Psychiatry. His discoveries have expanded our knowledge of the molecular components and mechanism of action of circadian clocks, ranging from understanding the mechanism of day length sensing in plants to daily behavioral controls in mammals. He has received several noteworthy academic awards, including a Keck Foundation Faculty Award and the Honma Prize for Life Sciences in 1999. His work was cited in Science magazine's "Breakthroughs of the Year" consecutively in 1997 and 1998 and again in 2002. Born in the United Kingdom, Kay received both his bachelor's degree and his Ph.D. in biochemistry from the University of Bristol. He was a member of the faculty of the biology department and the medical school at the University of Virginia and also held a faculty appointment at The Rockefeller University in New York.

barbara7(Q) Darwin posed tiny improvements requiring "countless generations of countless species." He puzzled that not one formation was charged with some of these billions of missing links. The late Steve Gould tried to fix the false hypothesis with his new giant leap idea. But Darwin wrote in Chapter 6 that no gaps were allowed - any life without a parent looked like a creation. Modern biology with DNA and genetics does not fill these countless gaps and does not require Darwins evolution to do very well. Please discuss.

dr_steve_kay(A) hi barbara, thanks for getting us going here. Darwin of course was referring to gaps in the fossil record - these gaps concerned him, particularly the lack of transitional forms. What we know today is that our DNA sequences are an even more powerful form of evidence for evolution and the pace at which evolution occurs, because we can look at changes at the DNA level amongst extant as well as some extinct, species

windar007_(Q) MACROevolution requires constructive mutations that add genetic material that will code for new structures - is this true? I say this because Coyne & Orr's book a few yrs back had a chapter on macroevolution that was "rather anticlimactic" (American Scientist v. 92, p. 560).

dr_steve_kay(A) beneficial mutations dont necessarily "add" genetic material - they produce changes in proteins, or the expression of genes that within the context of a network provide some adaptive advantage to the organism. hence micro and macro evolution ultimately have the same underlying mechanisms

windar007_(C) May I suggest that Dr. Kay please use the words "micro" & "macroevolution" so we all know what specifically being addressed? Thanks!

moderator(Q) This question was submitted via e-mail by Steven King: Q: Hello Dr. Kay just a quick question are you familiar with Dr. Kent Hovind and his thoughts of Evolution?....His website is : [Http//www.drdino.com](http://www.drdino.com)

dr_steve_kay(A) Here is my answer : I just took a quick look at Hovind's website, and I have to disagree with the position that the earth is young - a great deal of evidence, mostly from physicists and chemists point to the earth being about 4.5 billion years old.

lytnin88(Q) Dr Kay, I'm puzzled about how sexual reproduction of a species could have occurred, and still allow the species to reproduce as this method of reproduction was evolving.

dr_steve_kay(A) The evolution of sex is a vibrant field, many of the mechanisms are under investigations by scientists in my Division as well as at many universities that have evolutionary biology departments. There appear to be a wide array of mechanisms that allow sexual reproduction - it is present in microbes such as bacillus and yeast, as well as all the way up through mammals. A more recent view is that multiple mechanisms have evolved to allow sexual reproduction to occur - and the benefit we get from it, which is to generate variation in the progeny.

Retired_Catholic(Q) I'm curious about your thoughts on the statistics you cited on the portion of Americans that do not believe in evolution.

dr_steve_kay(A) I think that many americans may not believe in evolution because they find it confusing. I think that scientists need to do a better job at explaining to the public difficult concepts such as genetics.

lytnin88(Q) Dr Kay, what are your thoughts on abiogenesis, or how life came about from non-life?

dr_steve_kay(A) Scientists at UCSD, such as Stanley Miller and Leslie Orgel provided some of the first evidence for how the building blocks of cells - more complex chemicals such as amino acids and bases that make up RNA, could be formed from the primitive atmosphere. These building blocks were the first steps towards formation of life. Other scientists in San Diego have shown how the evolution of RNA can be modeled in a test tube - many people think that RNA was our first nucleic acid, that it preceded DNA in forming the earliest genetic code

windar007_(Q) OK, so why do you think the chapter by these 2 neo-Darwinists was "anticlimactic"?

dr_steve_kay(A) I didn't read that article, but I presume that they thought it was anticlimactic as it no longer portrayed a controversy

barbara7(Q) Thanks. I will go over your DNA response with my son, an orthopedic doctor. Living without killing each other off, we have alligators, eagles, elephants, monkeys, and man. I would expect many of the missing links between these big animals to still be thriving among us. Why don't we find them?

dr_steve_kay(A) we don't find them because most species that evolve are actually no longer with us. but we see the history of these organisms in two main places - the fossil record, and even more powerfully in our genetic makeup - our DNA sequences that we can compare among individuals as well as among different species

dgish(Q) Dr Kay I wonder if you have become aware of the book Genetic Entropy and the Mystery of the Gnome by the Cornell University geneticist Dr. John Sanford? On pages 138 and 139 he says "since we know that the bad mutations overwhelmingly outnumber the good, we can be certain that any such stretch of DNA must degenerate. The hordes of bad mutations will always drag the rare good mutations down with them. While we are waiting for a rare beneficial mutation, bad mutations are piling up throughout the region.....(we have reviewed compelling evidence that even when ignoring deleterious

mutations, mutation/selection cannot create a single gene--not within the human evolutionary time scale.

dgish(Q) Dr Kay, my previous question was not completed before it was submitted to you. When deleterious mutations are factored back in, we see that the mutation/selection cannot create a single gene EVER. this is overwhelming evidence against the Primary Axiom. In my opinion this constitutes what is essentially a formal proof that the Primary Axiom is false.

dr_steve_kay(A) dgish, i am not myself an expert on the exact mechanisms of genome evolution. but bear in mind that the vast majority of polymorphism we see in genomes, that is to say variations, are mostly "silent", thought not to have an effect on the organism under a particular circumstance. but then what happens is that environmental changes may occur that mean a particular genetic change now confers an advantage on an organism that leads to increased reproductive success and is maintained. seriously deleterious mutations of course dont last long - they generally lead to a substantial reduction in reproductive success.

hms-beagle(Q) Evolution is often met with such fierce opposition because of the perception that it absolutely invalidates any other sort of religious or spiritual belief system. As you said, it can be confusing and the majority of the public do not get a sufficiently in-depth explanation or experience any legitimate discourse on the topic. Are you in agreement with such scientists as Joan Roughgarden who believe that spiritual belief systems provide a metaphorical framework that evolution actually supports or do you think that the facts negate any sort of reconciliation of belief?

dr_steve_kay(A) I really like the points this question raises. As a scientist, I feel that my scientific understanding of nature must be based upon evidence and hypothesis. This is completely separate from any belief system I may adhere to as an individual. I have many colleagues who wholeheartedly adhere to evolution because they see all the evidence for its occurrence, but are also deeply spiritual. I think in many ways the "conflict" between "evolutionists" and "creationists" has been an unnecessary one, because they require different domains of thought.

wild_card(Q) Regarding the stats on Americans that do not believe in evolution, what is your response to those who reject it on the basis that it is said to censor other scientific theories, such as Intelligent Design?

dr_steve_kay(A) To put the record straight, Intelligent Design is not a credible scientific hypothesis, because it relies on the supernatural belief of a creator. My impression from reading some of the ID literature is that this is not a theory or hypothesis, it makes no

predictions, and it has no place in the science classroom because of this. It is therefore a false assertion that evolution "censors" ID. ID is not in the domain of science.

sd72(Q) Many people feel that if you believe in God, you must accept creationism. Do you see room for a belief in God and evolution? Or are the two mutually exclusive?

dr_steve_kay(A) Yes, as I said previously, one can hold beliefs in a religious system, as well as believe in evolution. I think some of the problem arises in how much one wants to take portions of the bible as literal vs. allegorical.

lytnin88(Q) In response to your answer to my question on abiogenesis, I'm surprised that you would cite Stanley Miller's research. His famous experiment that created amino acids in the lab has since been discredited.

dr_steve_kay(A) Some of the early experiments on abiogenesis have been refined, and made more relevant to current views of the early atmosphere, but I also pointed out that a lot of other work has been done and is ongoing in San Diego on how the first complex biomolecules were formed and evolved. In particular, we scientists experienced a breakthrough about ten years ago, thanks in part to scientists in this town, that RNA could act as an enzyme, as well as being part of the "genetic code".

dgish(Q) Relative to the transitional forms it should be noted that the fossils of complex invertebrates abruptly appear fully formed in the Cambrian with no trace of ancestors or transitional forms.

dr_steve_kay(A) I am not a paleontologist (I can barely spell it) but my understanding from my colleagues is that the Cambrian explosion didn't occur overnight - it was tens of millions of years that resulted in the appearance of a plethora of more complex life forms. But there are also many fossils that predate those found in the Burgess Shale and other sites in China. The fossil record will always be incomplete, but our views on life forms and their transitions are also supported by genetic evidence.

barbara7(Q) In Genesis 30:31-43 did Jacob use "intelligent design" to breed sheep with markings for his own benefit?

dr_steve_kay(A) I don't have the bible in front of me to look up that passage. But as you describe it, Jacob seems to have the rudiments of a good geneticist, - it is genetics in an evolutionary context that has produced all of our agricultural successes - the selection of

traits that are for a variety of reasons beneficial to man (if not always beneficial to the environment).

DaveG(Q) Is it possible to take a course of study in Intelligent Design (nee creationism) in the Biology department at USD? Univ. of Notre Dame? Georgetown U.? Catholic U.? I'm assuming it is not offered at UCSD.

dr_steve_kay(A) I am not aware of any courses in ID at UCSD, and its not a course that I would support, because it is about a belief system, rather than a scientific process of hypothesis refinement.

dgish(Q) Dr Kay, Michael Ruse an evolutionist and a philosopher of science professor now at Florida St Univ published the following statement in an article in a Canadian newspaper in which he said: "evolution is promoted by its practitioners as more than mere science. Evolution is promulgated as an ideology, a secular religion--a full fledged alternative to Christianity, with meaning and morality.....evolution is a religion."

dr_steve_kay(A) Understanding and accepting evolution does not equate with morality or religion any more than any other major scientific theory - be it quantum theory or relativity. I find myself more in awe of nature as I learn MORE about it, not less. My understanding of how life has evolved on this planet and generated such marvelous biodiversity inspires me to want to protect it better - to be a better steward of this planet. I hope others would feel the same.

dgish(Q) Can you tell us where the RNA came from that your friends suggest for the origin of life?

dr_steve_kay(A) from purines and pyrimidines (the bases that make up nucleic acids like DNA and RNA) that can form due to chemical reactions occurring that are consistent with views of the chemical resources available at the time life began.

wild_card(Q) How would you respond to legitimate scientists with legitimate degrees from secular universities being fired or denied tenure for refusing to accept or teach evolution because they wish to explore other options for the origins of life, a concept that is fundamentally the basis for scientific inquiry?

dr_steve_kay(A) I would expect faculty not to contaminate their scientific views with their personal belief systems - our students need to learn the plethora of science out there

by learning modern scientific methods and thoughts. My perusal of the news also turns out more teachers and professors being disciplined due to their stand on evolutionary science, rather than their opposition to it.

dgish(Q) If what Ruse says is true then evolution is as religious as creation. they are actually theories about history and theories about history cannot qualify as scientific theories. They are inferences based upon circumstantial evidence which depends upon events that took place in the unobservable past.

dr_steve_kay(A) Perhaps part of the issue here is what a "Theory" is in science, versus other disciplines. In science a "Theory" represents a large body of work and thought that proposes a truly remarkable breakthrough - it is what most scientists would love to participate in, but many of us never get that far. Gravity is a theory of Newton's, for example. The important part of scientific theory is it make specific predictions which can be tested. So "theory" has different meaning in different fields. This in my opinion is why ID is NOT theory, but a belief system.

Bohr(Q) Do you feel that the terms micro and macro evolution are simply a dodge, in the sense that creationists and ID'ers are simply looking for a way out when confronted by the evidence of evolution presented in species with much shorter life cycles (and hence generations), such as bacteria?

dr_steve_kay(A) Yes, i think that micro and macro evolution is used as a dodge. Evolutionary biologists use micro evolution - the study for example of how microbes can change in successive generations, to learn about detailed specific mechanisms that may contribute to the larger picture of how organisms evolve under natural conditions.

DaveG(Q) Is it, or could it be, possible to determine if a current species has changed (evolved? mutated?) enough to warrant being designated a new species? Has this been done with, say, fruit flies? Is there evidence that shows evolution happening?

dr_steve_kay(A) Yes, scientists do study speciation, the formation of new species, and what mechanisms lead to barriers in breeding between the newly formed species. In fact, the study of fruitflies that live on cactus in the deserts of Baja and Sonora, is one way in which scientists are investigating speciation

Bohr(Q) Has humanity slowed or stopped it's own evolution by taking natural selection out of the picture of day to day survival? (perhaps excluding the area of diseases and evolving viruses and bacteria such as MRSA)

dr_steve_kay(A) Its interesting to ponder how our own technological advances are affecting our survival and success as a species. Remember that it is populations that evolve, rather than a given individual. One thing that seems certain is that man has the ability to cause massive changes in the environment, and that those changes will have an effect on all species, including ourselves.

mayday(Q) I'm bothered by the phrase "believe in evolution", as though it is an article of faith. Nobody asks about belief in relativity or quantum theory.

dr_steve_kay(A) You are right, it is more accurate to type that they are convinced or adhere to the body of evidence, rather than "believe" in it.

hms-beagle(Q) fyi- definitely not within the biology dept but topics such as ID and creationism often get brought up and debated within the college core requirements such as the Humanities sequence for Revelle college students during discussion regarding the Bible and various philosophies- esp since most of the students taking these courses are also future scientists

dr_steve_kay(A) I think this is the right place for that debate - the humanities rather than our science classes.

hms-beagle(Q) Education, especially higher education, is becoming increasingly cross-disciplinary as time progresses; however, seeing as evolution vs. ID is comparing apples to oranges, do you think the controversy can be somewhat quieted by introducing thoughtful debate about the two into the classroom or is this an impossible task based on the pitfalls of passionate belief and human nature?

dr_steve_kay(A) I think the debate has been useful in helping people understand what the scientific process is, how do we arrive at theories and refine them through testing predictions. Take the PBS two hour documentary on this topic - it gave good examples of how scientists think, and therefore why we dont find ID suitable for science classes.

ABSOLUTEscience(Q) would you be willing to debate a creation scientist in a public setting??

dr_steve_kay(A) I thought I just did.

dr_steve_kay(P) I would like to thank everyone. Unfortunately I am out of time. I didnt get to answer a few questions due to typing speed, but I urge you all to attend our Evolution Matters lecture series at the Natural History Museum:
www.evolutionmatters.ucsd.edu Cheers, Steve.

moderator(P) I would like to thank Dr. Kay for having this discussion with us. Please do not forget our other chats. Check out our chat schedule (www.signonsandiego.com/chat) and visit us next week. Remember, if you don't have time to join a chat, just use the link and e-mail the moderator your question. Have a good weekend.

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