

**American Astronomical Society  
Statement on the Teaching of Evolution  
September, 2005**

The American Astronomical Society supports teaching evolution in our nation's K-12 science classes. Evolution is a valid scientific theory for the origin of species that has been repeatedly tested and verified through observation, formulation of testable statements to explain those observations, and controlled experiments or additional observations to find out whether these ideas are right or wrong. A scientific theory is not speculation or a guess -- scientific theories are unifying concepts that explain the physical universe.

Astronomical observations show that the Universe is many billions of years old (see the AAS publication, *An Ancient Universe*, cited below), that nuclear reactions in stars have produced the chemical elements over time, and recent observations show that gravity has led to the formation of many planets in our Galaxy. The early history of the solar system is being explored by astronomical observation and by direct visits to solar system objects. Fossils, radiological measurements, and changes in DNA trace the growth of the tree of life on Earth. The theory of evolution, like the theories of gravity, plate tectonics, and Big Bang cosmology, explains, unifies, and predicts natural phenomena. Scientific theories provide a proven framework for improving our understanding of the world.

In recent years, advocates of "Intelligent Design," have proposed teaching "Intelligent Design" as a valid alternative theory for the history of life. Although scientists have vigorous discussions on interpretations for some aspects of evolution, there is widespread agreement on the power of natural selection to shape the emergence of new species. Even if there were no such agreement, "Intelligent Design" fails to meet the basic definition of a scientific idea: its proponents do not present *testable* hypotheses and do not provide evidence for their views that can be verified or duplicated by subsequent researchers.

Since "Intelligent Design" is not science, it does not belong in the science curriculum of the nation's primary and secondary schools.

The AAS supports the positions taken by the National Academy of Sciences, the American Association for the Advancement of Science, the National Science Teachers' Association, the American Geophysical Union, the American Chemical Society, and the American Association of Physics Teachers on the teaching of evolution. The AAS also supports the National Science Education Standards: they emphasize the importance of scientific methods as well as articulating well-established scientific theories.

For further information on evolution and the process of science, please refer to the websites and publications listed below.

## Reviews and Critiques

*The Privileged Planet*, by Guillermo Gonzales and Jay W. Richards, Reviewed by William H. Jefferies, The University of Texas at Austin. The review is available at [http://www.ncseweb.org/resources/articles/784\\_review\\_of\\_emthe\\_privileged\\_p\\_6\\_7\\_2005.asp](http://www.ncseweb.org/resources/articles/784_review_of_emthe_privileged_p_6_7_2005.asp).

*Devolution: Why intelligent design isn't.*, by H. Allen Orr, *The New Yorker*, 30 May 2005.

## The New York Times series of articles on evolution, August 21-23, 2005

*Politicized Scholars Put Evolution on the Defensive*, By Jodi Wilgoren

The Discovery Institute is the ideological and strategic backbone behind the eruption of skirmishes over science in school districts and state capitals across the country.

URL: <http://www.nytimes.com/2005/08/21/national/21evolve.html>.

*In Explaining Life's Complexity, Darwinists and Doubters Clash*. By Kenneth Chang. Proponents of intelligent design say biological marvels point to the hand of a higher being, but mainstream scientists say such an explanation is unscientific.

URL: <http://www.nytimes.com/2005/08/22/national/22design.html>.

*Scientists Speak Up on Mix of God and Science*, By Cornelia Dean

Disdain for religion is far from universal among scientists, and some are beginning to speak out about their faith.

URL: <http://www.nytimes.com/2005/08/23/national/23believers.html>.

## Editorials and Opinion Pieces

*Why "intelligent design" doesn't deserve to be taught with evolution*, by Verlyn Klinkenborg, New York Times, 23 August, 2005

<http://www.nytimes.com/2005/08/23/opinion/23tue3.html?n=Top%2fOpinion%2fEditorials%20and%20Op%2dEd%2fEditorials>.

*Show Me the Science*, By Daniel C. Dennett, New York Times, 28 August, 2005.

[http://www.nytimes.com/2005/08/28/opinion/28dennett.html?incamp=article\\_popular](http://www.nytimes.com/2005/08/28/opinion/28dennett.html?incamp=article_popular).

## Books

*The Ancient Universe: How Astronomers Know the Vast Scale of Cosmic Time*. Published by the American Astronomical Society. It is also available as a PDF on the Society's webpages at

<http://www.aas.org/education/publications/AncientUniverseWeb.pdf>.

*Evolution vs. Creationism: An Introduction* by Eugenie C. Scott (2004)

*Science and Creationism: A View from the National Academy of Sciences* by National Academy Of Sciences (2<sup>nd</sup> ed, 1999)

*The Logic of Scientific Discovery* by Karl Popper (15<sup>th</sup> ed. 2002)

*The Structure of Scientific Revolutions* by Thomas S. Kuhn (3<sup>rd</sup> Ed. 1996)

## Professional Science Societies

[www.aas.org](http://www.aas.org) American Astronomical Society

[www.aaas.org](http://www.aaas.org) American Association for the Advancement of Science

[www.agu.org](http://www.agu.org) American Geophysical Union

[www.nas.edu](http://www.nas.edu) National Academy of Sciences

[www.nsta.org](http://www.nsta.org) National Science Teachers Association

[www.acs.org](http://www.acs.org) American Chemical Society

[www.aapt.org](http://www.aapt.org) American Association of Physics Teachers

## Science Education and Science Literacy

National Science Education Standards, National Research Council.

URL <http://www.nap.edu/books/0309053269/html/index.html>

Project 2061, American Association for the Advancement of Science.

URL <http://www.project2061.org/research/goals.htm>.

National Center for Science Education. URL [www.natcensci.org](http://www.natcensci.org).

# A Resource Guide for Responding to Challenges to Evolution and the Age of the Universe

By Andrew Fraknoi (*Foothill College and the Astronomical Society of the Pacific*)

Fundamentalist religious thinkers (from a number of religions) have sought to deny the evidence from geology, astronomy, and evolutionary biology about the age and gradual development of the universe, the Earth, and its life-forms. (Recent creationist tactics have involved attacking the Big Bang theory and radioactive dating, for example.) Some groups have worked hard to get their own brand of “creation science” or “intelligent design” into the public schools and to undermine the teaching of *evolution*, one of the most fundamental and best-established ideas in modern science. The literature examining this controversy is enormous; the list below is merely a representative sampling.

## Books

- Berra, T. *Evolution and the Myth of Creationism: A Basic Guide to the Facts in the Evolution Debate*. 1990, Stanford U. Press.
- Futuyma, Douglas *Science on Trial: The Case for Evolution*. 1983, Pantheon. A leading evolutionary biologist explains the case for evolution that the creationists seek to deny.
- Godfrey, L., ed. *Scientists Confront Creationism*. 1982, Norton. A useful collection of articles.
- Kitcher, Philip *Abusing Science: The Case Against Creationism*. 1982, MIT Press. A philosopher takes a critical look at the claims against evolution and illuminates the issues involved.
- McGowan, Chris *In the Beginning: A Scientist Shows Why the Creationists are Wrong*. 1984, Prometheus Books. A Canadian zoologist examines and refutes creationist arguments.
- Pigliucci, Massimo *Denying Evolution: Creationism, Scientism, and the Nature of Science*. 2002, Sinauer Associates. A biologist gives the history of, explains, and refutes the various “brands” of creationism.
- Ruse, Michael, ed. *But Is It Science?* 1996, Prometheus. A collection of articles about the creationism/evolution controversy, by scientists, philosophers, etc.
- Ruse, Michael *The Evolution Wars*. 2000, Rutgers U. Press. A history of the creationist-evolution controversy.
- Scott, E. & Eldredge, N. *Evolution vs. Creationism : An Introduction*. 2005, U. of California Press. A detailed analysis with good answers by the scientist who heads the national effort to maintain science in the classroom when it comes to evolution.
- Strahler, Arthur *Science and Earth History: The Evolution / Creation Controversy*. 1987, Prometheus Books. A discussion from the geologist’s point of view, with lots of information about dating the Earth’s rocks.
- Tuomey, C. *God's Own Scientists: Creationists in a Secular World*. 1994, Rutgers U. Press. An anthropologist examines the culture of creationism as if he were looking at far-away tribe.
- Wilson, David, ed. *Did the Devil Make Darwin Do It? Modern Perspectives on the Creation-Evolution Controversy*. 1983, Iowa State U. Press. Interesting collection of essays, by historians, scientists, and educators, laying out the history of the controversy and the perspectives of the sciences.

## Articles

- Abell, G. "The Ages of the Earth and the Universe" in Godfrey, Laurie, ed. *Scientists Confront Creationism*. 1983, Norton.
- Asimov, I. "The Threat of Creationism" in the *New York Times Magazine*, June 14, 1981, p. 90.
- Bobrowski, M. "Teaching Evolutionary Processes to Skeptical Students" in *Physics Teacher*, Dec. 2000, p. 565. Includes a list of creationist arguments and science teacher responses. Nice summary of issues.
- Bobrowski, M. "Dealing with Disbelieving Students on Issues of Evolutionary Processes and Long Time Scales" in *Astronomy Education Review*, vol. 4, issue 1. <http://aer.noao.edu>
- Brush, S. "Finding the Age of the Earth by Physics or by Faith?" in *Journal of Geological Education*, 1982, vol. 30, pp. 34-58.
- Coyne, J. "The Faith That Dare Not Speak its Name: The Case Against Intelligent Design" in *The New Republic*, Aug. 22/29, 2005 issue (vol. 233, issue 4727/8, p. 21.) Superb layperson's introduction to the history/politics of intelligent design and a refutation of its arguments (by a biologist.)
- Dutch, S. "A Critique of Creationist Cosmology" in *Journal of Geological Education*, 1982, vol. 30, p. 27.
- Edis, T. "Darwin in Mind: Intelligent Design Meets Artificial Intelligence" in *Skeptical Inquirer*, Mar/ Apr. 2001, p. 35. An analysis of the latest "guise" of creationism, "Intelligent Design Theory." (On the web at: <http://www.csicop.org/si/2001-03/intelligent-design.html> )
- Rusk, J. "Answers to Creationism" in *The Planetarian (Journal of the International Planetarium Society)*, Sep. 1988, vol. 17, No. 3.
- Scott, E. "Antievolution and Creationism in the U.S." *Annual Reviews of Anthropology*, 1997, vol. 26, p. 263. A leading pro-evolution educator summarizes the issues.
- Wilson, M. "Geology Confronts Creationism: An Undergraduate Science Curriculum" in *Skeptical Inquirer*, Jan/Feb. 2002, p. 52. A course for geology majors.

## Web Sites:

- An Ancient Universe: How Astronomers Know the Vast Scale of Cosmic Time: <http://www.aas.org/education/ancientuniverse.html> (A booklet for teachers, school board members and the public refuting creationist claims of a young universe, and explaining how we know that the cosmos is 10-14 billion years old. Produced by the Astronomy Education Board of the American Astronomical Society.)
- National Center for Science Education: <http://www.ncseweb.org/> NCSE is the key organization working to oppose the efforts of creationists and to assist educators who want to present the evolutionary perspective. Their site is full of excellent information and links, with particular attention to current events and the political struggles to prevent creationism from taking root.
- Science and Creationism* is a short booklet from the National Academy of Sciences, with a fine summary of the scientific perspective on evolution: <http://bob.nap.edu/html/creationism/>
- Creation Watch: A special web site from the Committee for the Scientific Investigation of Claims of the Paranormal with great resources for those who want to respond to intelligent design and other forms of creationism: <http://www.csicop.org/creationwatch/>

Talk.Origins Archive: <http://www.talkorigins.org> contains articles, essays, and discussion about all aspects of the creation/evolution controversy. For an interesting example of how creationists tried to use some recent astronomical results to argue for a young universe, see: <http://www.talkorigins.org/faqs/supernova/snrfab.html>

The Age of the Earth: <http://www.talkorigins.org/faqs/faq-age-of-earth.html> This useful page from the Talk.Origins site describes how we measure the age of our planet and then dissects some of the common creationist arguments for a younger Earth.

Questions and Answers about Creationism/Evolution: <http://www.vuletic.com/hume/cefec/> A nicely organized summary of creationist arguments and scientific responses.

Supernovae, Supernova Remnants, and Young Earth Creationism by Dave Moore: <http://www.talkorigins.org/faqs/supernova/> (Discusses how some creationists misuse arguments about exploding stars.)

No Answers in Genesis: <http://home.austarnet.com.au/stear/default.htm> is a site run by Australian skeptics that takes on creationist claims aggressively.

Changing Speed of Light Analysis: <http://www.talkorigins.org/faqs/c-decay.html> Addresses the creationist idea that the age of the universe could be a lot less than astronomers think if the speed of light has been getting a lot slower with time, so that light from distant objects wouldn't have had to leave them so long ago. A more technical site is:

<http://homepage.mac.com/cygnusx1/cdecay/>