THE GEOLOGICAL SOCIETY OF AMERICA®

GSA Position Statement

Adopted in May 2001;
Revised in October 2006, July 2009, and November 2012

Teaching Evolution

Position Statement. The Geological Society of America strongly supports the teaching of evolution and the directly related concept of deep time as part of science curricula at all levels of education. The evolution of life on Earth stands as one of the central concepts of modern science. During the past two centuries, research in geology, paleontology, and biology has produced an increasingly detailed, consistent, and robust picture of how life on Earth has evolved.

GSA opposes teaching creationism alongside evolution in any science classroom and rejects the characterization of evolution as scientifically controversial. Science, by definition, is a method of learning about the natural universe by asking questions in such a way that they can be answered empirically and verifiably. If a question cannot be framed so that the answer can be tested, and the test results can be reproduced by others, then it is not science. Creationism, whether presented as creation "science," intelligent design, or hydroplate theory, attempts to explain complicated phenomena of the natural world by invoking a creator or designer. Creationism is not science because it invokes supernatural phenomena that cannot be tested. It therefore has no place in a science curriculum. Because science is limited to explaining natural phenomena through the use of empirical evidence, it cannot provide religious explanations. Science teachers should not advocate any religious interpretations of nature and should be nonjudgmental about the personal beliefs of students.

Purpose. This document (1) summarizes GSA's views regarding the teaching of evolution; (2) defines evolution and discusses the physical and biological evidence for evolution; (3) describes the concepts of "intelligent design" and "creation science" and explains why they are not science; and (4) provides a communications tool for GSA member use.

Rationale

The rock record provides an abundance of fossils, and by the early 1800s, geologists were using physical relationships among rocks as evidence to establish the basis for the geologic time scale. They understood that the fossil record shows major changes in life forms over time. In 1859, Charles Darwin's *On the Origin of Species* described these changes in detail and showed that they indicate that all life on Earth is related through descent with modification and showed that these changes can be explained by natural selection operating on random variations in organisms—the process we now know as biological evolution. Since then, we have continued to uncover details of life's history, and biologists have elucidated the genetic and molecular basis for evolution. Evolution is not a static idea but a growing concept added to by scientific observation, testing, and debate. Scientific discoveries in these fields and related disciplines have progressively sharpened our understanding of evolution, which is now established as a well-tested fact. Evolution is accepted by the scientific community because all available evidence supports the central conclusions of evolutionary science: that life on Earth has evolved and species share common ancestors and genomes.

The discovery of radioactivity in the twentieth century and its use for measuring the ages of rocks has made it possible to quantify Earth's age and to estimate rates of many geologic processes. Many rocks over a billion years in age can now be dated with great precision. The ages of many rocks have been confirmed by repeated tests in multiple laboratories, often using different isotopic decay schemes. The results are consistent with the geological record, which includes the processes that uplift the land and cause the erosion and deposition of sediments. Geologists can now identify rocks that record hundreds of millions of years of sedimentation by the slow layer-by-layer accumulation of mud, the rhythmic rise and fall of tides on ancient continental margins, the growth of reefs, and the slow back-and-forth meandering of rivers in ancient valleys. Additionally, techniques that date more recent deposits have been repeatedly and accurately compared to known historical events.

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Studies of Earth's history, including the evolution of life on Earth, aid in the quest to understand how the Earth-life system functions and in the search for natural resources. The geologic record reveals how forms of life have responded to past environmental change, sometimes migrating, sometimes evolving, and sometimes going extinct. Understanding evolution has made possible many of the medical advances that save human lives and has furthered agricultural developments that feed the world. The short-term adaptive evolution demonstrated by the ability of viruses to evolve and adapt to new vaccines, or simply to new environmental conditions, is readily comparable to the longer-term evolution of more advanced species. Evolution has resulted in the presence of unique assemblages of life forms that change over time, the fossilized remains of which can be used to correlate rock units and thus allow geologists to accurately and efficiently locate valuable resources.

From before the time of Darwin, some people have objected to and challenged those findings of science that were considered to conflict with certain traditional religious beliefs about creation. Creationism, creation "science," hydroplate theory, and intelligent design have emerged from religious thought, and because they invoke supernatural phenomena, they cannot frame questions that can be tested scientifically. Therefore, by definition, the notions of creationism and its more recent forms are not science. The immensity of geologic time and the evolutionary origin of species are concepts that pervade modern geology, biology, and other sciences that support human life. These concepts must therefore be treated as central themes in science courses. Without an adequate knowledge of geologic time and the evolutionary origin of species, students will not understand the processes that shape the natural environment in which they live. As a result, they will lack the understanding that is essential for making wise decisions regarding the environment upon which our survival depends. Without an understanding of and appreciation for rigorous scientific methods, students will not be prepared for higher education in the sciences or to work in the many fields of science upon which our society depends for resources and technological innovation.

RECOMMENDATIONS

- The Geological Society of America encourages use of this position statement in any dialogue about teaching evolution in schools. GSA members may want also want to refer to the GSA publication *The Nature of Science and the Scientific Method* (http://www.geosociety.org/educate/NatureScience.pdf).

- Evolution and the directly related concept of deep time must be included as part of science curricula at all levels, from K–12 to all forms of higher education as well as post-graduate education.

- Creationism should not be included in science curricula and must not be taught alongside evolution in any science classroom.

ABOUT THE GEOLOGICAL SOCIETY OF AMERICA

The Geological Society of America, founded in 1888, is a scientific society with more than 25,000 members from academia, government, and industry in more than 100 countries. Through its meetings, publications, and programs, GSA enhances the professional growth of its members and promotes the geosciences in the service of humankind. GSA encourages cooperative research among earth, life, planetary, and social scientists, fosters public dialogue on geoscience issues, and supports all levels of earth science education. Inquiries about the GSA or this position statement should be directed to GSA's Director for Geoscience Policy, Kasey S. White, at +1-202-669-0466 or kwhite@geosociety.org.

Opportunities for GSA and its Members to Help Implement Recommendations

To facilitate implementation of the goals of this position statement, The Geological Society of America recommends that when discussing the importance of teaching evolution and geologic time with school boards, legislative committees, and other groups likely to include individuals with strong fundamental religious conviction, it may be necessary to assert that literal interpretations of creation stories do not constitute science. Nonetheless, at all times, we must respect the differing viewpoints and interests of others.

- The separation of science and religion that we advocate does not mean that science and religion are incompatible. Many scientists who study evolution are religious. Several major religions accept the importance of science and the theory of evolution. Some religious scholars find evolution fertile ground for the development of theological and spiritual understanding.
- Scientists do not and cannot claim to prove or disprove the existence of God or other major tenets of religious traditions.
- The core concepts of evolution are firmly established, but our understanding of evolution is itself changing. As with any field of active scientific research, there will be debate about unresolved issues at the frontiers of evolutionary science. Our understanding of the relationships between the evolution of species and the ecological systems that sustain them is progressing. Instead of weakening the case for evolution, scientific debate on these topics reveals how science advances. As those controversies are resolved, the answers enrich our understanding of evolutionary processes.
- Some arguments used to support the notion of an intelligent design focus on issues that are not well understood and claim that some action by a creator is needed to explain gaps in our understanding of particular natural processes. Scientists find that it is generally wiser to admit that the gap exists and to work to understand how to fill it. For example, Darwin had no way of explaining how traits were transmitted from generation to generation, but Gregor Mendel's later discovery of genes paved the way for one of the most robust pillars of modern evolutionary understanding.
- Our present ability and that of future generations to cope with mounting environmental, agricultural, and human health challenges will depend upon how effectively the scientific method can be mastered and how the vast body of scientific knowledge can be utilized. The science taught in our schools must be the best the scientific community can offer. Science must not be confused with religious claims, no matter how well intended the latter may be.