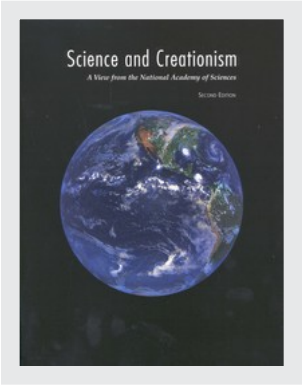


Science and Creationism: A View from the National Academy of Sciences, Second Edition (1999)

DETAILS

48 pages | 8.5 x 11 | PAPERBACK

ISBN 978-0-309-06406-4 | DOI 10.17226/6024

CONTRIBUTORS

Steering Committee on Science and Creationism, National Academy of Sciences

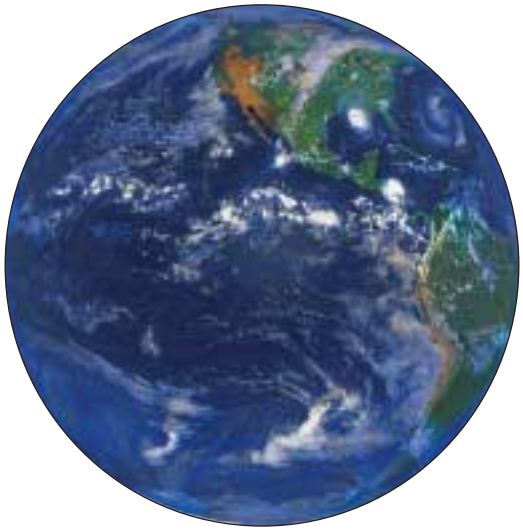
SUGGESTED CITATION

National Academy of Sciences. 1999. *Science and Creationism: A View from the National Academy of Sciences, Second Edition*. Washington, DC: The National Academies Press. https://doi.org/10.17226/6024.

Science and Creationism

A View from the National Academy of Sciences

SECOND EDITION



THE NATIONAL ACADEMIES

National Academy of Sciences • National Academy of Engineering • Institute of Medicine • National Research Council

NATIONAL ACADEMY PRESS Washington, DC 1999

Contents

Preface

In his preface to the original 1984 version of this document, Frank Press, my predecessor as president of the National Academy of Sciences, called attention to a pair of illustrations similar to the ones on the front and back of this booklet. The first is a photograph of Earth from space—the one on this booklet was taken by the GOES 7 satellite in 1992 as it passed over Earth and captured in graphic detail Hurricane Andrew. The second shows a map of the world prepared during the 7th century by the scholar Isidore of Seville. As Press pointed out, both illustrations reflect the efforts of humans to understand the natural world. "How then," he wrote, "can the two views be so different? The answer lies at the very heart of the nature of this system of study we call science."

Since those words were written, the mapping of Earth has provided further powerful examples of how science and science-based technologies progress. Beginning in the early 1990s, a network of satellites has allowed anyone with a hand-held receiver to know his or her position on Earth to within a few feet. This Global Positioning System* (GPS) now is being used to locate vessels lost at sea, study plate tectonics, trace open routes through crowded city streets, and survey Earth's surface. Yet the technology originated with a purely scientific objective—the desire to build extremely accurate clocks to test Einstein's theory of relativity.

Emphasis on explanation

The tremendous success of science in explaining natural phenomena and fostering technological innovation arises from its focus on explanations that can be inferred from confirmable data. Scientists seek to relate one natural phenomenon to another and to recognize the causes and effects of phenomena. In this way, they have developed explanations for the changing of the seasons, the movements of the sun and stars, the structure of matter, the shaping of mountains and valleys, the changes in the positions of continents over time, the history of life on Earth, and many other natural occurrences. By the same means, scientists have also deciphered which substances in our environment are harmful to humans and which are not, developed cures for diseases, and generated the knowledge needed to produce innumerable labor-saving devices.

The concept of biological evolution is one of the most important ideas ever generated by the application of scientific methods to the natural world. The evolution of all the organisms that live on Earth today from ancestors that lived in the past is at the core of genetics, biochemistry, neurobiology, physiology, ecology, and other biological disciplines. It helps to explain the emergence of new infectious diseases, the development of antibiotic resistance in bacteria, the agricultural relationships among wild and domestic plants and animals, the composition of Earth's atmosphere, the molecular machinery of the cell, the similarities between human beings and other

primates, and countless other features of the biological and physical world. As the great geneticist and evolutionist Theodosius Dobzhansky wrote in 1973, "Nothing in biology makes sense except in the light of evolution."

Nevertheless, the teaching of evolution in our schools remains controversial. Some object to it on the grounds that evolution contradicts the accounts of origins given in the first two chapters of Genesis. Some wish to see "creation science"—which posits that scientific evidence exists to prove that the universe and living things were specially created in their present form—taught together with evolution as two alternative scientific theories.

Scientists have considered the hypotheses proposed by creation science and have rejected them because of a lack of evidence. Furthermore, the claims of creation science do not refer to natural causes and cannot be subject to meaningful tests, so they do not qualify as scientific hypotheses. In 1987 the U.S. Supreme Court ruled that creationism is religion, not science, and cannot be advocated in public school classrooms. And most major religious groups have concluded that the concept of evolution is not at odds with their descriptions of creation and human origins.

This new edition of *Science and Creationism: A View from the National Academy of Sciences* is a companion volume to a publication released in 1998 by the Academy, *Teaching About Evolution and the Nature of Science*. That longer document is addressed to the teachers, educators, and policymakers who design, deliver, and oversee classroom instruction in biology. It summarizes the overwhelming observational evidence for evolution and explains how science differs from other human endeavors. It also suggests effective ways of teaching the subject and offers sample teaching exercises, curriculum guides, and "dialogues" among fictional teachers discussing the difficulties of presenting evolution in the classroom.

This new edition of *Science and Creationism* has a somewhat different purpose. It, too, summarizes key aspects of several of the most important lines of the evidence supporting evolution. But it also describes some of the positions taken by advocates of creation science and presents an analysis of these claims. As such, this document lays out for a broader audience the case against presenting religious concepts in science classes. Both this document, and the earlier *Teaching About Evolution and the Nature of Science*, are freely available online at the Academy website (www.nap.edu).

Scientists, like many others, are touched with awe at the order and complexity of nature. Indeed, many scientists are deeply religious. But science and religion occupy two separate realms of human experience. Demanding that they be combined detracts from the glory of each.

Bruce Alberts
President
National Academy of Sciences

---

*"The Global Positioning System: The Role of Atomic Clocks." Part of the series *Beyond Discovery: The Path from Research to Human Benefit* by the National Academy of Sciences (Washington, D.C.: National Academy Press, 1997). This document is also available at www2.nas.edu/bsi.

Introduction

Science is a particular way of knowing about the world. In science, explanations are limited to those based on observations and experiments that can be substantiated by other scientists. Explanations that cannot be based on empirical evidence are not a part of science.

In the quest for understanding, science involves a great deal of careful observation that eventually produces an elaborate written description of the natural world. Scientists communicate their findings and conclusions to other scientists through publications, talks at conferences, hallway conversations, and many other means. Other scientists then test those ideas and build on preexisting work. In this way, the accuracy and sophistication of descriptions of the natural world tend to increase with time, as subsequent generations of scientists correct and extend the work done by their predecessors.

Progress in science consists of the development of better explanations for the causes of natural phenomena. Scientists never can be sure that a given explanation is complete and final. Some of the hypotheses advanced by scientists turn out to be incorrect when tested by further observations or experiments. Yet many scientific explanations have been so thoroughly tested and confirmed that they are held with great confidence.

The theory of evolution is one of these well-established explanations. An enormous amount of scientific investigation since the mid-19th century has converted early ideas about evolution proposed by Darwin and others into a strong and well-supported theory. Today, evolution is an extremely active field of research, with an abundance of new discoveries that are continually increasing our understanding of how evolution occurs.

This booklet considers the science that supports the theory of evolution, focusing on three categories of scientific evidence:

- Evidence for the origins of the universe, Earth, and life
- Evidence for biological evolution, including findings from paleontology, comparative anatomy, biogeography, embryology, and molecular biology
- Evidence for human evolution

At the end of each of these sections, the positions held by advocates of "creation science" are briefly presented and analyzed as well.

The theory of evolution has become the central unifying concept of biology and is a critical component of many related scientific disciplines. In contrast, the claims

of creation science lack empirical support and cannot be meaningfully tested. These observations lead to two fundamental conclusions: the teaching of evolution should be an integral part of science instruction, and creation science is in fact not science and should not be presented as such in science classes.

Terms Used in Describing the Nature of Science*

Fact: In science, an observation that has been repeatedly confirmed and for all practical purposes is accepted as "true." Truth in science, however, is never final, and what is accepted as a fact today may be modified or even discarded tomorrow.

Hypothetico-deductive methodology

Hypothesis: A tentative statement about the natural world leading to deductions that can be tested. If the deductions are verified, it becomes more probable that the hypothesis is correct. If the deductions are incorrect, the original hypothesis can be abandoned or modified. Hypotheses can be used to build more complex inferences and explanations.

Law: A descriptive generalization about how some aspect of the natural world behaves under stated circumstances.

Theory: In science, a well-substantiated explanation of some aspect of the natural world that can incorporate facts, laws, inferences, and tested hypotheses.

The contention that evolution should be taught as a "theory, not as a fact" confuses the common use of these words with the scientific use. In science, theories do not turn into facts through the accumulation of evidence. Rather, theories are the end points of science. They are understandings that develop from extensive observation, experimentation, and creative reflection. They incorporate a large body of scientific facts, laws, tested hypotheses, and logical inferences. In this sense, evolution is one of the strongest and most useful scientific theories we have.

*Adapted from *Teaching About Evolution and the Nature of Science* by the National Academy of Sciences (Washington, D.C.: National Academy Press, 1998).