

You Say You Want an Evolution? A Role for Scientists in Science Education

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National Science Teachers Association
Society for Developmental Biology

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Abstract

We conducted a national survey of likely U.S. voters to examine acceptance of evolution, attitudes toward science and scientists, and opportunities for promoting science education. Most respondents accepted that life evolved, many accepted that it evolved through natural processes, and more favored teaching evolution than creationism or intelligent design in science classes. The majority ranked developing medicines and curing diseases as the most important contributions of science to society, and they found promoting understanding of evolutionary science's contribution to medicine to be a convincing reason to teach evolution. Respondents viewed scientists, teachers, and medical professionals favorably, and most were interested in hearing from these groups about science, including evolution. These data suggest that the scientific community has an important role to play in encouraging public support for science education.

You Say You Want an Evolution? A Role for Scientists in Science Education

Although evolution is firmly established as one of the most important, integrative, and robust concepts in science, teaching evolutionary science and related subjects (e.g., the origins of the universe, the age of the earth, plate tectonics) has been challenged in school districts across the United States. These challenges—whether introducing religious beliefs as “alternatives” to science, labeling evolution or the big bang as “theory, not fact,” or singling out scientific subjects for “critical analysis”—jeopardize science education. Recognizing the harm such actions pose to science education and, ultimately, to the foundation on which scientific advancement is based, 17 scientific societies, representing the physical, chemical, biological, and social sciences and science teachers communities, established an unprecedented coalition to explore opportunities for collective understanding and action. As part of this effort, we engaged a professional research firm to conduct a national survey of approximately 1,000 likely U.S. voters (1) that examined attitudes toward science and scientists, views on evolutionary science in the context of education, and means through which the scientific community can effectively bolster support for teaching evolution and related subjects.

Recent studies show that Americans’ views on evolutionary science have been relatively stable over the past several decades. Beginning in the 1980s, polls consistently found that between approximately 40% and 50% of the American public accepts human evolution (2-3), and 40% to 50% favors a Biblical creationist account of the origins of life (3). An analysis by the Pew Research Center shows that Americans’ views on evolutionary science vary with the phrasing of the question, however (3). For example, when people are asked to choose whether humans developed over millions of years either with or without guidance from God (a Gallup poll question), more select evolution with guidance (38%) than without guidance (13%). A Pew poll question shows a different pattern of results. Respondents were first asked, without reference to a supreme being, if they thought humans evolved or were created in their present form. Those who accepted evolution were then asked if they thought it occurred through natural processes or with guidance. When asked this way, 18% reported that evolution occurred with guidance and 25% accepted that it occurred through natural selection.

We anticipated that acceptance of evolutionary science would also be influenced by the distinction between human and non-human species (Fig. 1). We asked half of the respondents about their views on the evolution of “all living things” and found that 61% accepted that “all living things have evolved over time.” Of those, 36% thought all living things “evolved due to natural processes such as natural selection” and 25% thought “a supreme being guided the evolution of living things for the purpose of creating life in the form it exists today.” We asked the remaining respondents to consider human evolution and found that 53% accepted that “humans and other living things” evolved. This majority included 32% who accepted that humans and other living things evolved through natural processes and 21% who thought they had evolved with guidance. Compared to other surveys (3), we found weaker overall support for

creationism: 28% and 31% agreed with statements that “all living things” or “humans and other living things,” respectively, were created in their present form. Sixteen percent of respondents who were asked about the evolution of “humans and other living things” and 11% of those asked about the evolution of “all living things” did not know or would not disclose their views.

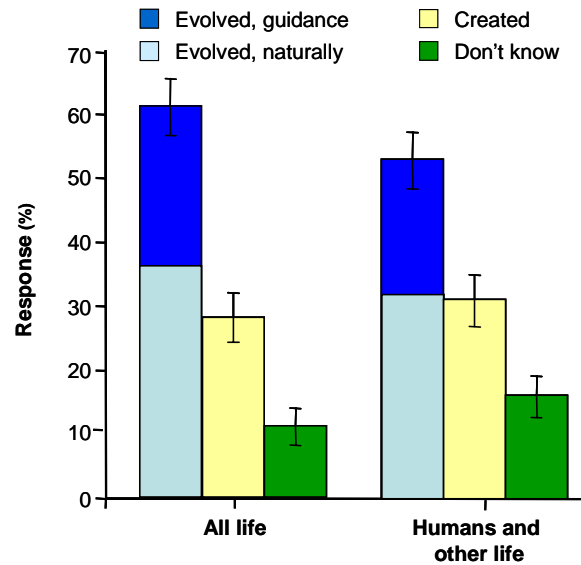


Figure 1. Acceptance of evolution. The percentage of respondents who accepted that all living things (left) or humans and other living things (right) evolved due to natural processes (light blue), evolved through guidance by a supreme being (dark blue), were created in their present form (yellow), or who did not know or refused to answer (green).

Although public opinion is often characterized as polarized, there is considerable uncertainty about what to teach in public school science classes, particularly with regard to including certain religious perspectives. Thirty-two percent of respondents in our study were unsure about teaching creationism and 41% were uncertain about teaching intelligent design. By comparison, 22% expressed uncertainty about teaching evolution. Consistent with other studies (5), however, more respondents favored teaching evolution (53%) than creationism (36%) or intelligent design (27%) in public school science classes. These data show that a majority of people favor—and even more may be open to—teaching evolution in science classes.

Why don't more Americans accept evolutionary science? A recent study shows that acceptance is negatively correlated with fundamentalist religious beliefs and politicization of science and positively correlated with genetics literacy (2). While we did not examine genetics literacy in particular, we did find a connection between respondents' views on evolution education and their answers to three scientific questions (Fig. 2). Although 69% of survey participants had some college education (27% were college graduates and 14% had attended graduate school), only 23% gave correct responses to all three of the following statements: the continents or land masses on which we live have been moving for millions of years and will continue to move in the future (79% correctly agreed); antibiotics kill viruses as well as bacteria (43% correctly

disagreed); the earliest humans lived at the same time as the dinosaurs (53% correctly disagreed). Respondents who answered all three questions correctly were much more likely to respond that humans and other living things evolved (78%) than that they were created in their present form (11%), and more favored teaching evolution (78%) than creationism (27%) or intelligent design (24%). In contrast, respondents who answered fewer than two questions correctly were less likely to accept that life evolved (36%) than to believe it was created in its present form (47%), and they were about as likely to favor teaching evolution (36%) as creationism (38%) and intelligent design (29%).

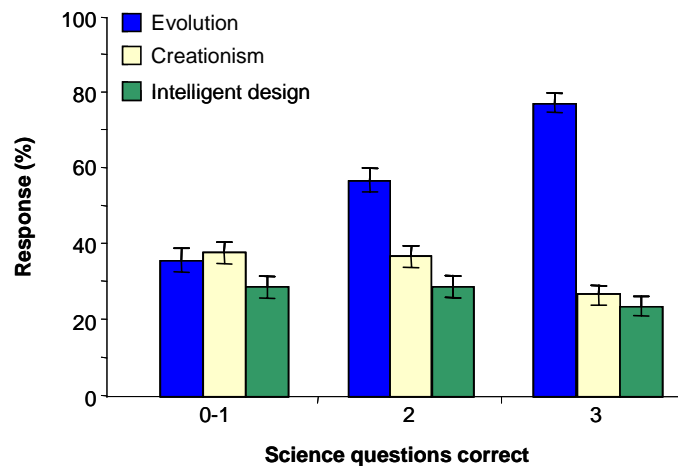


Figure 2. Relationship between scientific literacy and support for teaching evolution. The percentage of respondents who answered zero or one, two, or all three scientific literacy questions correctly who also favored teaching evolution (blue), creationism (yellow) or intelligent design (green) in public school science classes.

Studies show that the vast majority of Americans have a strong appreciation for the role of science in health, education, and competitiveness, and they especially value the contribution that scientific research makes to eliminating diseases (4). Within this sample, 63% of respondents ranked developing medicines and curing diseases as the most important contributions of science to society. Proponents of teaching evolution (65%), creationism (62%), or intelligent design (63%) were equally likely to view these contributions as science’s most important.

People also appear to value the relationship between evolutionary science and medicine. Among a sample of respondents, 61% thought that understanding the contribution that evolution makes to modern medical science, including to understanding and treating diseases such as avian influenza, was a convincing reason to teach evolution in science classes. This finding, together with Americans’ consistently strong support of medical research (4), suggests that making the connection between evolutionary biology and advancing other areas of medical research (e.g., understanding human gene function or the mechanisms by which antibiotic resistance develops) might be equally compelling. People may also appreciate the contributions that evolutionary science makes to other fields, including agriculture, forensics, and even software engineering, although we did not examine these in this study.

Teaching evolutionary science may also enhance science pedagogy, as it “offers educators a superb opportunity to illuminate the nature of science and to differentiate science from other forms of human endeavor and understanding” (6). The tools and techniques that scientists employ to study evolution—gathering evidence from various sources, making logical inferences, establishing and testing competing hypotheses—are the hallmarks of science and necessary for everyday decision-making. Data from this survey suggest that the public values these learning opportunities: a majority of respondents rated learning to draw conclusions from evidence (80%), to think critically (78%), and how science is conducted (63%) as very important purposes of public school science education. Communicating the value of learning science, including evolution, for developing analytical skills that are widely applicable beyond the classroom may strengthen public support for all types of science.

The scientific community—scientists, science teachers, and medical professionals—have a key role in communicating the importance of science education to the public. Sixty-nine percent of respondents had favorable feelings toward scientists and even more viewed medical researchers (72%) and doctors (76%) favorably. While fewer people (59%) rated public school science teachers highly, public school teachers in general were the most widely favored group (79%).

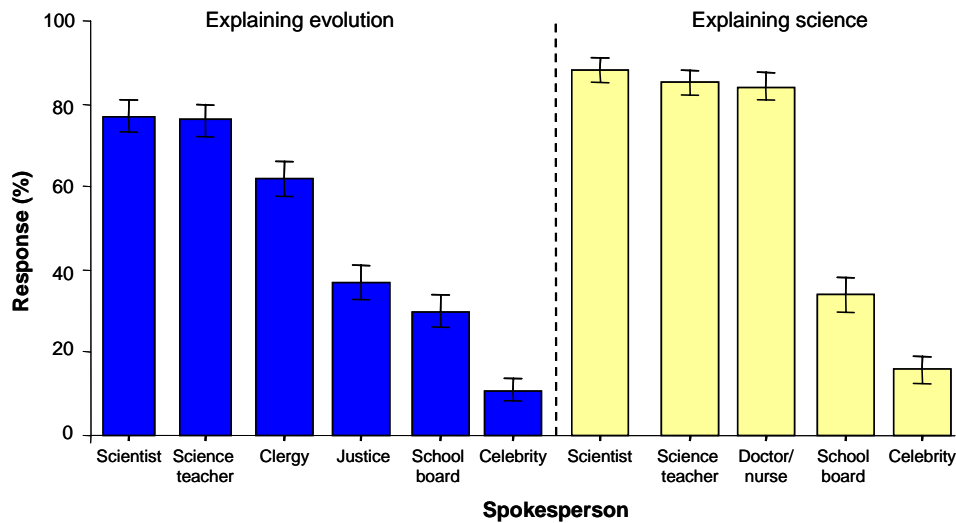


Figure 3. Public interest in spokespeople for science. The percentage of respondents who expressed interest in hearing science (right; yellow) or evolution, creationism, and intelligent design (left; blue) explained by various spokespeople. Respondents were not asked about their interest in hearing from a doctor or nurse about evolution, creationism, or intelligent design or from clergy or a Supreme Court Justice about science.

When it comes to scientific issues, the scientific community commands the attention of the public (Fig. 3). Among respondents presented with a list of people who might explain science to the public, 88% expressed interest in hearing from a scientist, and almost as many were

interested in hearing from a science teacher (85%) or a doctor or nurse (84%). On the topics of evolution, creationism, and intelligent design, most respondents expressed interest in hearing from scientists (77%), science teachers (76%), and clergy (62%). Fewer people were interested in hearing from Supreme Court Justices on evolution (37%), or from school board members and celebrities either on science (34% and 16%, respectively) and evolution (30% and 11%, respectively). These data indicate that Americans respect the expertise of science and education professionals and also look to clergy for guidance on scientific issues of potential relevance to religion. The value of encouraging each of these groups—including scientists who hold religious beliefs—to become involved in promoting quality science education cannot be overstated.

In communicating the value of science, scientists must emphasize the outcomes that matter to people—advancing medicine, improving health, fostering critical thinking—and they must do so clearly and understandably. Technical expositions on scientific topics will not get the attention of the public or policy makers who lack relevant expertise. If researchers can not communicate their findings in ways that are comprehensible, meaningful, and relevant to non-scientists, their message to the public—and their effectiveness as spokespeople for science—is lost (7). There are ample opportunities for scientists to develop and exercise their communication skills and, whether writing letters to local newspapers, speaking with school boards or community groups, or partnering with educators to design curricula, many scientific and professional societies have trained staff or other resources to help (Table 1).

There is a clear need for scientists to become involved in promoting science education. Challenges to teaching science undermine students' understanding of the scientific method, how scientific consensus develops, and the distinction between scientific and non-scientific explanations of natural phenomena. If our nation is to continue to develop the talent necessary to advance scientific and medical research, we must ensure that high standards in science education are maintained and that efforts to introduce non-science into science classes do not succeed. Failure to reach out effectively to a public that is supportive of science and open to information from the scientific community is not just a missed opportunity; it is a disservice to the scientific enterprise.

Table 1

Evolution Resources	Web Address
American Association for the Advancement of Science	http://www.aaas.org/news/press_room/evolution/
American Institute of Biological Sciences	http://www.actionbioscience.org/evolution/index.html
American Physiological Society	http://www.the-aps.org/pa/policy/bioissues/evolutionTeach.htm
American Society of Human Genetics	http://www.genednet.org/pages/k12_evolution.shtml
Federation of American Societies for Experimental Biology	www.evolution.faseb.org
Howard Hughes Medical Institute	http://www.hhmi.org/biointeractive/evolution/index.html
National Academies	http://nationalacademies.org/evolution/
National Center for Science Education	http://www.natcensci.ed.org/
PBS Evolution Website	http://www.pbs.org/wgbh/evolution/
Understanding Evolution (UC Museum of Paleontology)	http://evolution.berkeley.edu/

Acknowledgements

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References

1. Materials and methods are available in the survey methods section.
2. J.D. Miller, E.C. Scott, S. Okamoto, *Science* **313**, 765-766 (2006).
3. *Reading the Polls on Evolution and Creationism* (The Pew Research Center for the People and the Press, Washington, DC, 2005;
<http://peoplepress.org/commentary/display.php3?AnalysisID=118>).
4. *America Speaks* (Research!America, Alexandria, VA, 2007;
<http://www.researchamerica.org/publications/AmericaSpeaks/AmericaSpeaksV8.pdf>).
5. *Evolution, Creationism, Intelligent Design* (The Gallup Poll;
<http://www.gallupoll.com/content/default.aspx?ci=21814>).
6. National Academy of Sciences, *Teaching About Evolution and the Nature of Science* (National Academies Press, Washington, DC, 1998).
7. M.C. Nisbet, C. Mooney, *Science* **316**, 56 (2007).

Survey Methods

Survey Participants and Sampling Method

This survey was administered by telephone to approximately 1,000 American adults who were 18 years of age or older and who indicated that they were registered to vote, voted, or were eligible to vote in the 2004 Presidential election, and were almost certain to or would probably vote in the 2006 Congressional election.

Telephone numbers were generated by a random digit dial process, thereby allowing access to all listed and unlisted phones. The sample was stratified by state and weighted by demographic characteristics to reflect the population voting in the 2004 Presidential election. The survey was designed by Greenberg Quinlan Rosner Research with input from the Coalition of Scientific Societies and Mercury Public Affairs. Greenberg Quinlan Rosner Research administered the survey during August 17-24, 2006 and tabulated all of the results presented in this report.

Survey Questions and Data Analysis

The relevant wording and response options for each question presented in the analysis are described below. The data for each question are reported descriptively as percentages. Except where noted, all percentages are based on the total number of responses provided for each item. To minimize the length of the survey the sample was split such that every respondent did not answer every question. The size of the sampling error, therefore, varies with the sample size for and the percentage distribution of responses to a particular question. Since the conservative assumption of a 50% response for each item was made, the sampling error at the 95% confidence level for samples of size 250, 500, and 1000 is +/- 6.2%, 4.4%, and 3.1%, respectively.

Acceptance of evolution: To examine acceptance of evolution, we asked half of the respondents ($n = 500$) about their views on the evolution of “humans and other living things” and the other half about their views on the evolution of “all living things.” The two forms of the question were otherwise identical and are shown below with the differences underlined and in parentheses:

Some people think that humans and other living things (or all living things) have evolved over time. Others think that humans and other living things (or all living things) have existed in their present form since the beginning of time. Which comes closest to your view?

If respondents indicated that living things evolved over time, they were asked:

And do you think that humans and other living things (or all living things) have evolved due to natural processes such as natural selection, or do you think that a supreme being guided the evolution of living things for the purpose of creating humans and other life (or life) in the form it exists today?

Surveyors noted if respondents refused to answer or said they did not know.

Teaching evolution, creationism, and intelligent design: All participants were asked in separate questions whether they favor or oppose teaching evolution, creationism, and intelligent design in public school science classes. After each question they were asked if they strongly favor or oppose or somewhat favor or oppose teaching that topic. Respondents were told to indicate if they were not sure. Surveyors recorded this response as well as if they refused to answer or did not know what evolution, creationism, or intelligent design were.

Scientific knowledge: To gauge participants' understanding of basic science concepts, all respondents were asked to indicate whether they agreed or disagreed with three scientific statements. They were then asked whether they strongly or somewhat agreed or disagreed with or were unsure about each of those statements. The statements were as follows: the continents or land masses on which we live have been moving for millions of years and will continue to move in the future; antibiotics kill viruses as well as bacteria; the earliest humans lived at the same time as the dinosaurs. Responses were determined to be correct if participants strongly or somewhat agreed with true statements or strongly or somewhat disagreed with false statements. Surveyors recorded whether participants refused to answer, neither agreed nor disagreed, or did not know.

Contributions of science to society: All respondents were asked to indicate which of various contributions that science makes to society they thought were the most and second most important. The choices included: developing new medicines and curing diseases; developing new technologies and creating jobs; identifying the best ways to protect our environment and natural resources; developing new technologies to protect our national security; improving general quality of life. For each contribution, the percentage reported reflects the percentage of respondents who identified it as the first or second most important contribution.

Role of science education: Respondents were presented with a list of contributions that science education might make to a student's future and asked to indicate whether they thought each item was a very important, somewhat important, not too important, or not at all important purpose of a public school science education. Five hundred respondents were presented with the following statements: learn how to draw conclusions from evidence; learn how science is conducted; gain a broad knowledge of the natural and technological world; explore moral and ethical questions related to science and technology. The remaining 500 respondents were presented with these statements: to learn how to think critically; learn about the real world, such as how antibiotics work; prepare for college or a career; understand the origin and diversity of biological life on earth, including about evolution.

Contribution of evolution to medicine: To examine whether people valued the contribution that evolution makes to medicine, 250 respondents were asked to indicate whether they thought the statement below was a very convincing, a somewhat convincing, a little convincing, or not at all convincing reason to only teach evolution in public school science classes.

Evolution is the basis of modern medical science. Scientists are concerned that illnesses like the bird flu may change and become harder to treat, causing millions of people to get sick or die. Evolution helps us to understand this process and develop better medical responses. Rather than attacking the teaching of evolution, science students should be taught that evolution is critical to understanding medicine and the human body.

Responses of very or somewhat convincing were combined into a single percentage score.

Feelings about the scientific community: All respondents were asked to rate their feelings toward scientists, public school teachers, public school science teachers, doctors, and medical researchers. Ratings were on a 0-100 scale with zero meaning a very cold, unfavorable feeling, 100 meaning a very warm, favorable feeling, and 50 meaning not particularly warm or cold. For each person listed, the percentage of respondents who rated that person warmly was determined by calculating the percentage who rated them over 50%. While not reported in the main body of this report, the mean rating respondents gave to each group of people was also calculated and was as follows: scientists (72.5); public school teachers (74.0); public school science teachers (66.1); doctors (71.8); medical researchers (72.4).

Communicating scientific information: Half of the respondents (n = 500) were presented with a list of people who might get involved in explaining science to the public and asked to rate how interested they would be in hearing from each person about science. This list included a scientist, a science teacher, an elected school board member, a doctor or nurse, and a celebrity. The remaining respondents (n = 500) were asked how interested they would be in hearing from scientist, a science teacher, an elected school board member, a Supreme Court Justice, a member of the clergy, and a celebrity about evolution, creationism, or intelligent design. Both groups were asked to rate whether they were very interested, somewhat interested, not too interested, or not at all interested in hearing from these people. Responses of very or somewhat interested were combined into a single percentage score.

Educational attainment: All respondents were asked what the last year of schooling they had completed was.