Chapter 7
Science and Technology: Public Attitudes and Public Understanding

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HIGHLIGHTS

Interest in Science and Technology

- **Approximately 40 percent of Americans surveyed expressed a high level of interest in science discoveries and the use of new technologies.** This level of interest has been relatively stable for the past decade, indicating that science and technology have become an integral part of American culture. Individuals with more years of formal education and more courses in science and mathematics tend to indicate a high level of interest in science and technology. Comparatively, nearly 70 percent of Americans expressed a high level of interest in medical discoveries and 54 percent indicated that they were very interested in environmental issues, but only 25 percent reported a high level of interest in space exploration.

- **One in nine Americans thinks that he or she is very well informed about science and technology.** Americans with more years of formal education and more courses in science and mathematics are significantly more likely to view themselves as being very well informed than others, and men are significantly more likely to indicate that they are very well informed about science and technology, holding constant the level of formal education and the level of science and mathematics education.

Understanding Basic Scientific and Technical Concepts

- **There is a wide distribution in the level of understanding of scientific terms and concepts among American adults.** On a 10-point index, the mean score was 5.2 and a quarter of Americans earned a score of 7 or more. Individuals with more years of formal schooling and more courses in science and mathematics obtained significantly higher scores, demonstrating the pervasive effect of science and mathematics education throughout the adult years.

- **Only 23 percent of Americans understand the nature of scientific inquiry well enough to make informed judgments about the scientific basis of results reported in the media.** Through a combination of questions concerning the meaning of scientific study and the reasons for the use of control groups in experiments, a new measure of public understanding of the nature of scientific inquiry was developed. Individuals who had completed more years of formal schooling and more courses in science and mathematics were significantly more likely to understand the nature of scientific inquiry than other citizens.

- **One in 10 Americans is attentive to science and technology policy issues, a level that has remained stable for at least the past decade.** In complex modern societies, it is not possible for citizens to become, and remain, informed about the full range of public policy areas. Some degree of issue specialization is inherent in modern industrial societies. Approximately 50 percent of Americans indicate that they are interested in, and informed about, at least one public policy area, and, among those citizens who follow any public policy issues at all, it appears that most of these Americans follow two or three issues at any point in time.

Understanding Environmental Concepts

- **One in four Americans can explain some of the reasons for the thinning of the ozone layer.** One-third of American adults appear to understand some of the health and environmental consequences of a thinning of the ozone layer, but only 14 percent can identify the locations of the major thinning, or holes, in the ozone layer. Only 5 percent of Americans could provide a minimally acceptable scientific explanation of acid rain. Adults with more years of formal schooling and more science and mathematics courses were significantly more likely to display an understanding of these environmental concepts than other citizens. Individuals who are attentive to science and technology policy issues or environmental issues were also somewhat more likely to understand these concepts than citizens not attentive to those issues.

Understanding Basic Economic Concepts

- **The level of understanding of basic economic concepts varies widely among American adults, a general pattern similar to that found for the understanding of other scientific concepts.** On a 10-point index, the mean score was 5.1, and 22 percent of Americans earned a score of 7 or more on the index. Unlike the understanding of scientific concepts, the level of understanding of economic concepts was not as closely related to an individual's level of formal schooling. Men scored slightly higher on the index than women.

SOURCE OF SCIENTIFIC AND TECHNICAL INFORMATION

- **Americans receive most of their information about public policy issues from television news programs and newspapers.** When placed on a uniform metric of the number of uses or hours per year, the public consumption of television news programs and newspapers dwarfs all other information sources. In 1995, Americans watched an average of 409 hours of television news programs and read 199 newspapers in a 12-month period. During this same period, Americans watched 80 science shows on television. Individuals with cable or satellite television service watch twice as many science television shows as persons without this service.

- **A majority—55 percent—of Americans use a computer at home or at work.** Computer use has increased steadily in the past decade. In 1995, Americans used a computer at work for 320 hours and used a home computer for an additional 120 hours. A significantly higher proportion of college graduates use a computer than individuals with fewer years of schooling. Eighty-two percent of college graduates in the United States indicated that they used a computer at work or at home, compared with 59 percent of high school graduates and 17 percent of individuals who did not complete high school.

- **One in five Americans has a home computer that includes a modem, and 7 percent of adults reported in 1995 that they used an on-line computer service during the preceding year.** Fifteen percent of adults in the United States have a home computer with a CD-ROM reader, allowing for additional information acquisition opportunities. Nearly half the Americans with a graduate or professional degree have a home computer with a modem. Twenty-three percent of these individuals reported that they use an on-line computer service.

ATTITUDES TOWARD SCIENCE AND TECHNOLOGY POLICY ISSUES

- **Americans continue to hold the scientific community in high regard.** According to the most recent General Social Survey, approximately 40 percent of Americans are very confident in the leadership of the scientific community and the leadership of the medical community. These levels of national esteem have been stable for almost 2 decades and are far higher than the levels reported for the leadership of other major institutions in society.

- **More than 70 percent of Americans believe that the benefits of scientific research outweigh any present or potential drawbacks associated with scientific research.** This level of positive assessment of scientific research has been stable for nearly 2 decades. College graduates and citizens interested in science and technology policy issues are even more positive about the scientific research.

- **Despite their positive views of scientific research, Americans are deeply divided over the development and impact of several important technologies: nuclear power, genetic engineering, and those related to the space program.** Americans are evenly divided on the benefits and drawbacks of using nuclear power to generate electricity. This division has persisted for more than a decade. A similar division exists over the benefits and potential drawbacks of genetic engineering, but there is a clearer difference by level of education. College graduates hold a much more positive view of genetic modification research. In regard to the space program, the general public is evenly divided over the relative benefits and costs of the program. College graduates and those who are interested in space exploration are very positive about the space program.

Introduction

Chapter Background

While scientists and engineers have long recognized the growing global interdependence of the world, more and more people are experiencing the world as a global community. Science and technology have changed, and will continue to change production, communication, transportation, and education. One important aspect of scientific understanding is that it has no national borders; basic constructs, such as the atom or DNA, are the same in every nation. As global interdependence increases, it will become more necessary for a significant segment of citizens to understand these basic concepts from a public policy standpoint and for economic and cultural reasons.

In recent decades, economic and scientific interdependence has become more global. The number of public policy issues involving international trade has increased sharply in recent years, as reflected in the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT) debates, and will continue to grow. It is important for citizens to understand national and international economic policies and will be more so in the future.

Public policy concerns and economic concerns often intersect in such environmental issues as the thinning of the ozone layer. It is important to know how much citizens understand scientifically and economically about this kind of issue. It is also important to know what sources individuals use to obtain information about emerging scientific and technical issues.

Chapter Organization

This chapter begins with a discussion of the level of public interest in selected areas of science and technology and an examination of the changes in the patterns of public interest in these issues. Interest in an issue or subject acts as a filter for information and reflects the need to focus on a more limited range of issues and areas.

The second section of this chapter examines the level of public understanding of basic scientific concepts, including that of scientific inquiry. A second analysis examines the level of public understanding of basic economic concepts. A third, and related, analysis focuses on the public's understanding of scientific and technical concepts relevant to environmental issues.

The third section analyzes the sources of information used by citizens to improve and maintain their understanding of scientific and technical issues. For almost 2 decades, the *Science and Engineering Indicators* studies have tracked the use of relevant information sources. In 1995, more information on the use of traditional information sources, such as a public library, and on emerging technologies, such as computers and electronic networks, was added to this portion of the study.

The fourth section of this chapter assesses public attitudes toward select science and technology policy issues. Building on nearly 2 decades of *Science and Engineering Indicators* studies, this analysis looks at the pattern of public assessment of the costs and benefits of scientific research, the use of nuclear power to generate electricity, and the modification of genetic materials in plants and animals. The analysis also looks at the public's assessment of the costs and benefits of the space program.

The final section of the chapter summarizes the results described in this chapter, notes some of the major implications of these findings, and suggests areas in need of additional investigation.

Interest in Science and Technology

Citizens of modern industrial societies like the United States live in the midst of a wide array of science and technology. Most Americans live in homes that are cooled in the summers and heated in the winters to provide a comfortable living environment. The weather news is broadcast over television or radio or printed in newspapers, and it usually involves satellite information, if not images, that is only hours old. Numerous companies compete to provide the least expensive international telephone calls to countries around the world, and most Americans now use a computer at work or at home. Given this wide array of experiences, one might expect that all Americans would have a high level of interest in science and technology.

However, modern industrial societies are complex and diverse. Some people are more interested in law, painting, sports, or other occupations, and assign a relatively low priority to scientific and technical matters. Others use scientific technologies at work, but are more interested in the personal or human dimensions of the experiences rather than the scientific. In fact, for most individuals living in metropolitan areas in advanced industrial nations, the range of choices competing for an individual's time is large, while the time available is limited. Inevitably, these individuals must choose how to spend their time, what to spend their time on, and the level of participation in which they will engage.

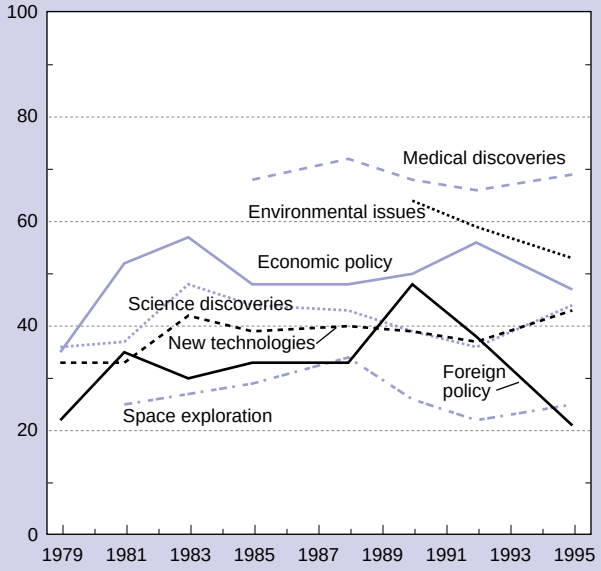
Interest in Science and Technology Issues

The level of interest in science and technology in the United States has remained relatively stable over the past 16 years, with approximately 40 percent of Americans expressing a high level of interest in science discoveries and new technologies.[1] (See figure 7-1 and appendix table

[1]Eleven of the 12 *Science and Engineering Indicators* published since 1972 have included a chapter on public attitudes toward and understanding of science and technology. The studies for the 1972, 1974, and 1976 *Indicators* were based on a block of 20 items inserted into an omnibus national personal interview survey conducted by Opinion Research Corporation of Princeton, New Jersey. The 1979 study was designed by Miller and Prewitt (1979) and analyzed by Miller, Prewitt,

Figure 7-1.
Public interest in select policy issues

Percentage reporting high level of interest



NOTE: Data are interpolated for years when survey was not conducted or questions were not asked.

See appendix table 7-1.

Science & Engineering Indicators – 1996

7-1.) Medical discoveries were of high interest to approximately two-thirds of Americans for the past decade. This level of interest remained high in 1995. The proportion of Americans indicating a high level of interest in environmental issues continued to decline in 1995, but over half—53 percent—of American adults still report that they are very interested in environmental issues. Approximately half of adults in the United States have reported a high level of public interest in issues about economic and business conditions during the past 15 years.

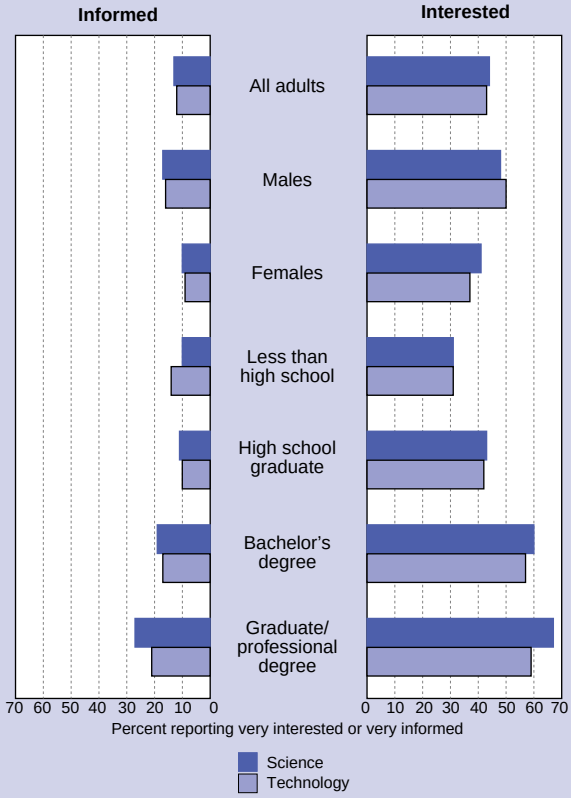
Individuals with higher levels of formal education and more high school and college coursework in science and mathematics were significantly more likely to report that they were very interested in science discoveries, new technologies, and space exploration than were other citizens. (See figure 7-2 and appendix table 7-2.) In contrast, individuals with higher levels of formal education were only slightly more likely to report a high level of interest in medical discoveries, nuclear power, or environmental issues.

In 1995, men were slightly more likely than women to report a high level of interest in science discoveries, the use of new technologies, nuclear power, and space exploration. Women were significantly more likely to express a high level of interest in medical discoveries than men and slightly more likely to have a high level of interest in environmental issues than men.

Knowledgeability of Science and Technology Issues

In contrast to the levels of interest reported above, only approximately one in nine Americans thinks of himself or herself as being well informed of science discoveries or the use of new technologies. (See figure 7-3 and appendix table 7-3.) While the next section of this chapter examines the level of understanding of basic scientif-

Figure 7-2.
Public interest in scientific and technological issues, by sex and level of education: 1995



See appendix tables 7-2 and 7-4.

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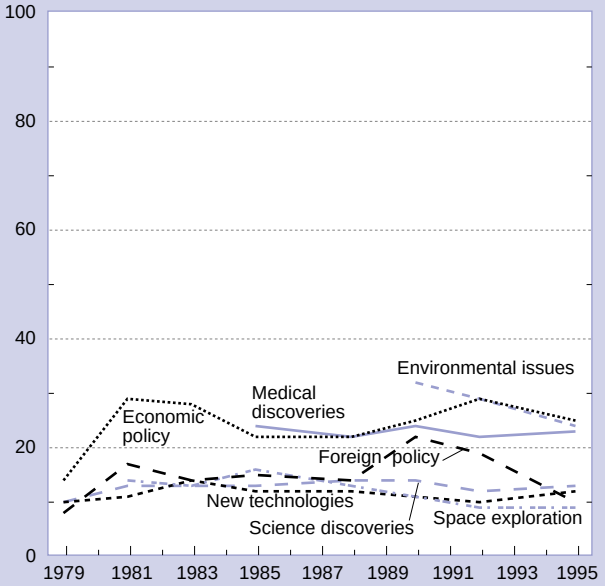
and Pearson (1980). The personal interviews were conducted by the Institute for Survey Research at Temple University. Additional national studies were performed for the 1982, 1985, 1987, 1991, and 1993 *Science and Engineering Indicators* reports, with the work being conducted by the Public Opinion Laboratory at Northern Illinois University, utilizing telephone interviews. The corresponding chapter for *Science and Engineering Indicators 1985* was based on a national telephone study conducted by the Public Opinion Laboratory for Professor George Gerbner of the Annenberg School of Communication at the University of Pennsylvania.

In 1995, the Chicago Academy of Sciences conducted a study that continued the core of attitude and knowledge items from previous *Science and Engineering Indicators* studies and included telephone interviews with a random-digit sample of 2,006 adults. The interviews were conducted by the Public Affairs Division of Market Facts, Incorporated.

The results can be found in the various *Science and Engineering Indicators* reports from 1972 to 1993. The data from these studies are available for secondary analysis from the International Center for the Advancement of Scientific Literacy at the Chicago Academy of Sciences and the Interuniversity Consortium for Political and Social Research (ICPSR) at the University of Michigan.

Figure 7-3.
Public informedness on select policy issues

Percent reporting that they are very well informed about issue



NOTE: Data are interpolated for years when survey was not conducted or questions were not asked.

See appendix table 7-3.

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ic concepts, it is important to understand how individuals assess their own knowledgeability on these subjects. In many cases—from deciding which cleaning product will be most effective to writing to a legislator on a current issue—it is the individual's self-assessment of his or her knowledge that will encourage or discourage a given behavior. Only 1 in 10 American adults thinks of himself or herself as being very well informed about space exploration, nuclear power, or foreign policy—concerns that may be distant from their daily lives.

Comparatively, approximately one in four American adults believes that he or she is very well informed about medical discoveries, environmental issues, and economic issues and business conditions. Medical and economic issues tend to affect daily life for more people than issues such as nuclear power or space exploration, thus it is not surprising that there is a more pervasive sense of being knowledgeable about these issues. Similarly, because individuals can see smog around major cities or heed ozone alerts, they may feel better informed about environmental issues than more distant topics.

The impact of formal education and coursework in science and mathematics on an individual's perception of his or her knowledge of scientific and technical issues is substantial. For example, in 1995 only 10 percent of individuals who did not graduate from high school believed that they were well informed about science discoveries, compared with 27 percent of graduate degree holders. (See appendix table 7-4.) In contrast, 25 percent of adults who did not complete high school felt very well informed about medical discoveries, compared with 34 percent of graduate degree holders. Since many of these adults with less formal education are older, they may have had frequent contact with health care providers and institutions. This personal experience may have fostered a sense of being well informed that compensates for their relatively lower level of formal education.

Attentiveness to Science and Technology Issues

Given the large number of issues on the public policy agenda at any point in time, it is impossible for any citizen to become and remain interested in and informed about the full range of public policy matters. In a pluralistic society such as the United States, citizens, including virtually all legislators, must choose which issues they wish to learn about and participate in policy discussions. This process of issue specialization is a fact of political life in modern industrial societies.

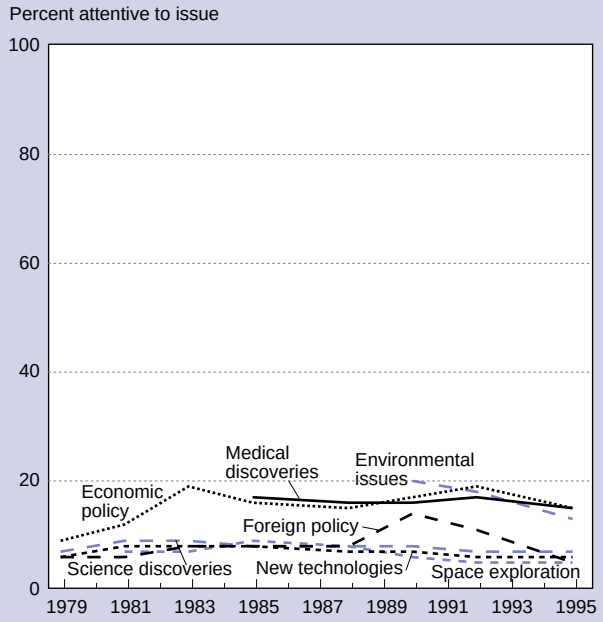
Citizens who display a high level of interest in an issue area, who believe that they are well informed about that issue, and who reveal at least a minimal pattern of information acquisition are classified as attentive to that issue.[2] A citizen with a high level of interest in an area, but who thinks of himself or herself as not being well informed about that issue area, is classified as a member of the interested public for that issue. Citizens without a high level of interest in an issue area are referred to as the residual public for that issue area. There is an attentive public for every major public policy area; the primary issues are its size and composition.

Since 1979, approximately 10 percent of American adults have been attentive to science and technology policy. (See figure 7-4 and appendix table 7-5.) This attentive public includes approximately 18 million American adults. Comparatively, 15 percent of Americans were attentive to economic issues and medical discoveries in 1995, while 13 percent were attentive to environmental issues. Only 5 percent of Americans were attentive to foreign policy or space exploration. The relative size of the primary attentive public related to science and technology has been stable for at least a decade, with the exception of a pattern of decline for environmental issues.

Attentiveness to science and technology policy is directly related to the number of years of formal schooling received by an individual and the number of science and mathematics courses completed in high school and college. (See figure 7-5 and appendix table 7-6.) Only 8 percent of high school graduates were attentive to science and technology policy, compared with 27 percent of graduate and professional degree holders. Similarly, only 6 percent of individuals with limited coursework in

[2]For a general discussion of the concept of issue attentiveness, see Almond (1950), Rosenau (1974), and Miller (1983).

Figure 7-4.
Public attentiveness to select policy issues

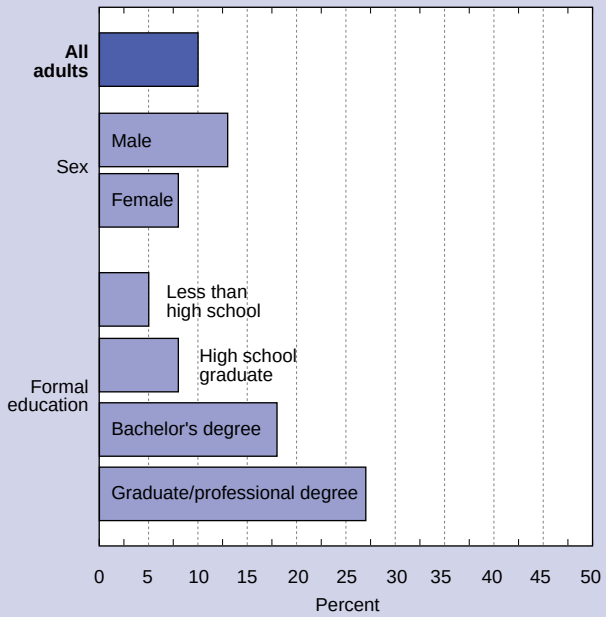


NOTE: Data are interpolated for years when survey was not conducted or questions were not asked.

See appendix table 7-5.

Science & Engineering Indicators – 1996

Figure 7-5.
Attentiveness to science and technology policy, by sex and level of education: 1995



See appendix table 7-6. *Science & Engineering Indicators – 1996*

science and mathematics were attentive to science and technology policy, compared with 19 percent of respondents with nine or more high school or college science or math courses. Men were significantly more likely to be attentive to science and technology policy than were women, holding constant educational differences.

As Almond (1950), Rosenau (1974), Miller (1983), and others have suggested, participation in the public policy process is dispute driven. When there is a high level of agreement between decisionmakers and policyleaders on an issue, policy is made and there is rarely any wider public debate about the issue. In some cases, however, there may be disagreement among the policyleaders themselves, or a disagreement between the decisionmakers and the policymakers. In these cases, policyleaders seek to alert attentive citizens to a given problem or issue and to persuade them to contact a legislator or executive branch officer about the issue.

Understanding Basic Scientific and Technical Concepts

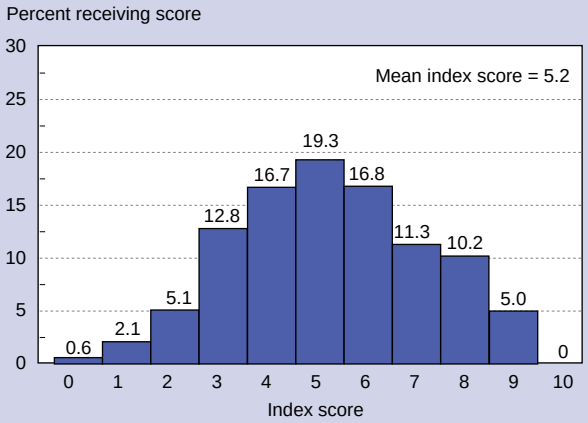
The essence of good communication is that all parties involved understand the same set of words, terms, and concepts in roughly the same way. Language has been a core component of the development of modern society and has become even more important in an increasingly scientific and electronic world. The extent to which the scientific community and political leaders can communicate about important science and technology policy issues or about new scientific or technological advances is limited by the ability of citizens to understand the words and ideas expressed. This section examines the level of public understanding of science and technology among American adults.

Understanding Basic Concepts

Understanding a basic set of scientific concepts is a prerequisite for reading about or listening to discussions concerning science and technology. It is important in reading news stories about new scientific findings or for understanding debates on public policy matters. While the range of scientific terms and concepts is vast, it is possible to identify a short set of basic concepts—the composition of matter, the nature of the universe, the basic processes that have shaped the planet, and the basic biology that supports life on the planet. If an individual understands these basic concepts, he or she can comprehend the wide array of science and technology material in books, magazines, and science television programs.

If a set of 10 items from the 1995 *Science and Engineering Indicators* study is considered, results show a wide range of understanding of these concepts, from 0 correct to 9 correct, with a mean of 5.2. (See figure 7-6.) Approximately 27 percent of American adults provided correct responses to 7 or more of the 10 items. This

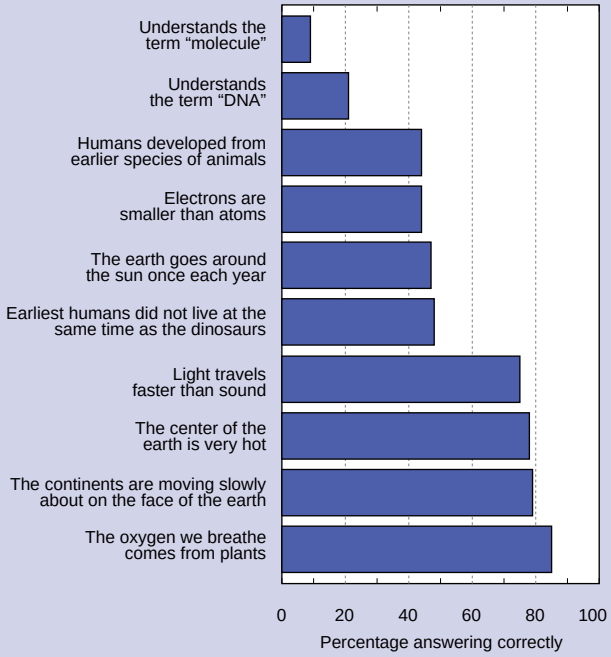
Figure 7-6.
Distribution of scores on the index *Vocabulary of Science Constructs:* 1995



SOURCES: J.D. Miller and L.K. Pifer, *Public Attitudes toward Science and Technology, 1979–1995, Integrated Codebook* (Chicago: International Center for the Advancement of Scientific Literacy, Chicago Academy of Sciences, 1995); and Science Resources Studies Division, National Science Foundation, unpublished tabulations.

Science & Engineering Indicators – 1996

Figure 7-7.
Knowledge about individual items on the index *Vocabulary of Science Constructs:* 1995



NOTE: See appendix table for exact wording of statements.

See appendix table 7-7.

Science & Engineering Indicators – 1996

scale is useful because two of the items were open-ended, requiring the respondent to provide a response rather than select among the alternatives as in a multiple choice or true-false question.

If the level of understanding on individual items is considered, fewer than 1 in 10 Americans can explain a molecule. A large portion of the population knows that a molecule is a small piece of matter, but is unable to relate it to an atom or a cell, which are also small pieces of matter. (See figure 7-7 and appendix table 7-7.) Despite the use and public discussion of DNA in widely publicized court trials and dramatic television shows, only one in five Americans can provide a minimally acceptable definition of DNA. And, despite substantial media attention to deep space probes and pictures from the Hubble telescope, only 49 percent of Americans know that the Earth rotates around the Sun once each year.

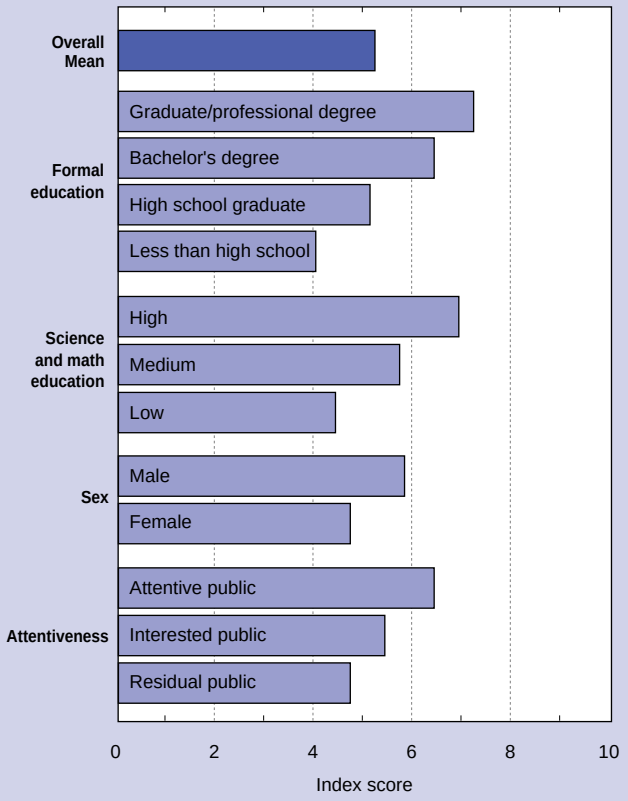
On the positive side, 85 percent of Americans recognize that oxygen comes from plants, and nearly 80 percent of them know that the center of the Earth is very hot and that portions of the Earth's crust—thought of in terms of continents—have been moving for millions of years and will continue to move. Despite this promising level of understanding of these basic biological and geological concepts, less than half of American adults agree that human beings evolved from earlier species and developed millions of years after the death of the dinosaurs. Many Americans appear to hold a mix of correct and incorrect scientific understandings that are not integrated into any broader level of systemic understanding.

The level of understanding of basic scientific terms and concepts is closely associated with the number of years of formal schooling completed and the number of science and mathematics courses taken. (See figure 7-8 and appendix table 7-8.) Those Americans who are attentive to science and technology policy issues displayed a higher level of understanding of these basic terms and concepts—a mean score of 6.4—than other citizens.

Understanding Scientific Inquiry

A second important dimension of public understanding concerns the level of understanding of the nature of scientific inquiry. The primary difficulty in measuring the public understanding of scientific inquiry is that science does not utilize a single uniform procedure. While some sciences rely heavily on experimental procedures, others, such as astronomy, depend primarily on observation, measurement, and model building and testing. Still other sciences, such as paleontology, depend on fossil discovery, classification, and the construction or integra-

Figure 7-8.
Score on index *Vocabulary of Science Constructs,* by education, sex, and attentiveness: 1995



See appendix table 7-8.

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tion of possible developmental sequences, in the context of understanding molecular biology and biological systems. Under the broad umbrella of scientific endeavor covered by the biomedical sciences, virtually all of these approaches are utilized to some degree.

What is central to all scientific endeavors, however, is the process of building theories or models that enhance our understanding of nature (Kuhn, 1962). Parallel to this process is a commitment that all theories be subject to logical or empirical falsification. Thus, the first level of conceptualization of science is an activity for the purpose of building and testing theory.[3]

At a second level, some individuals think of all scientific inquiry as a form of experimental investigation. To an extent, this may reflect a basic understanding of scientific ideas as being subject to testing. Popper's concept of falsification (Popper, 1959) is not widely known, and most people still think that scientists prove their theories or ideas as a mathematician might "prove" a theorem. In this context, a second important level of public understanding of scientific inquiry involves viewing science as the conduct of experimentation. The frequent media reporting on medical and pharmaceutical trials of new procedures and products reinforces this view.

At a third level, science is viewed as a combination of rigorous comparison and precise measurement. This view is largely devoid of any notion of theory building. Most often, this view lacks any understanding of experimentation as the use of random assignment and control groups and any appreciation of the purposes for those procedures. This view does see science as empirical in character and precise in its measurements, often resulting in a view of science as "testing," as against some standard. It is not a very sophisticated view, but most individuals holding this view would have greater confidence in a product that was "tested scientifically" than one that was not.

Below these levels of conceptualization, many individuals have some awareness of the word science, but generally have no cognitive substance behind the word. It may be associated with good or bad outcomes (medical miracles or weapons of mass destruction), but the work of scientists and the process of scientific inquiry are black boxes, at best. Generally, most individuals with this level of understanding have positive attitudes toward science, and expect it to cure virtually every disease and ailment and to solve any environmental problem. However, there is a wariness that appears to flow from recognizing the enormous power of science and technology and the individual's almost total lack of understanding of it.

In order to examine the level of public understanding of the nature of scientific inquiry, national surveys asking adults to define the meaning of scientific study have been conducted and reported in a series of *Science and*

[3]While there is broad consensus that theory building is the primary objective of science, this level of conceptualization is relatively rare in the public and not universal among graduates of science, engineering, or medical programs. The measurement of the understanding of scientific inquiry at this level is compounded by the dual meaning of theory in American English. In the usage employed in the preceding paragraph, we mean theory to refer to comprehensive sets of statements about the operation of various aspects of nature, or the development of models of natural processes. This usage would apply to generalizations or models in the biological, social, or physical sciences. At the same time, theory is often used in everyday language to refer to speculations or suppositions not yet supported by evidence. For example, it is common to hear a person dismiss a speculation by another person by saying that it is "only a theory," meaning that there is no evidence, or insufficient evidence, for that conclusion. Ironically, this is almost exactly the opposite meaning of the term as used in science.

This duality of meaning creates an interesting measurement problem. When a respondent is asked, for example, what it means to study something scientifically, and responds that it has to do with "making theories and things," it is not clear whether the individual means to use theory in a Kuhnian sense, or as an unsupported speculation. For this reason, it is important to ask these questions in an open-ended format and to probe the responses.

Engineering Indicators Public Attitudes and Understanding surveys. In the 1995 *Science and Engineering Indicators* study, each respondent was asked the same open-ended question as in previous studies as well as a new set of questions concerning the experimental evaluation of a drug.[4] Through each individual's response, a new typology of the understanding of scientific inquiry was constructed. Each respondent of the 1995 *Indicators* study was classified into one of the four following levels of understanding:

(1) Understands science as the development and testing of theory.

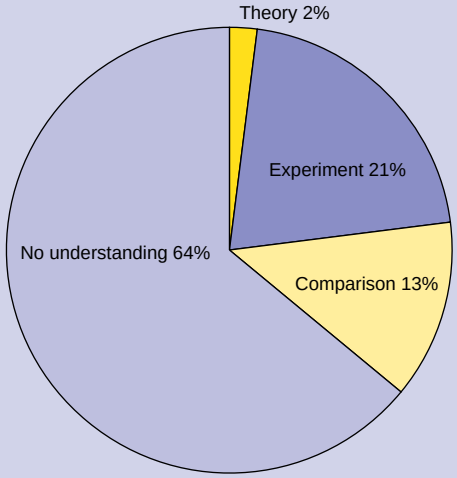
(2) Does not have the level of understanding in (1), but understands the concept of experimental study, including the meaning and use of a control group.

(3) Does not have the level of understanding in (1) or (2), but understands science to be based on careful and rigorous comparison, often involving precise measurement.

(4) Does not understand science at any of the above levels.

With this typology, the results from the 1995 study indicate that about 2 percent of American adults understand science in terms of theory construction and testing, and approximately 21 percent think of scientific inquiry in terms of experimentation. (See figure 7-9 and appendix table 7-9.) An additional 13 percent of respondents viewed science in general comparative terms, often coupled with a sense of precise measurement. Approximately two-thirds of American adults were unable to characterize scientific inquiry in even broad comparative terms. Many of these respondents simply said that they could not put the concept into words and others simply rephrased the question. From these results, it appears that only 23 percent of American adults understand scientific inquiry well enough to assess whether an actual or proposed study described in the media constitutes a scientific inquiry.

Figure 7-9.
Public understanding of the nature of scientific inquiry: 1995



NOTE: See appendix table for exact wording of statements.

See appendix table 7-9.

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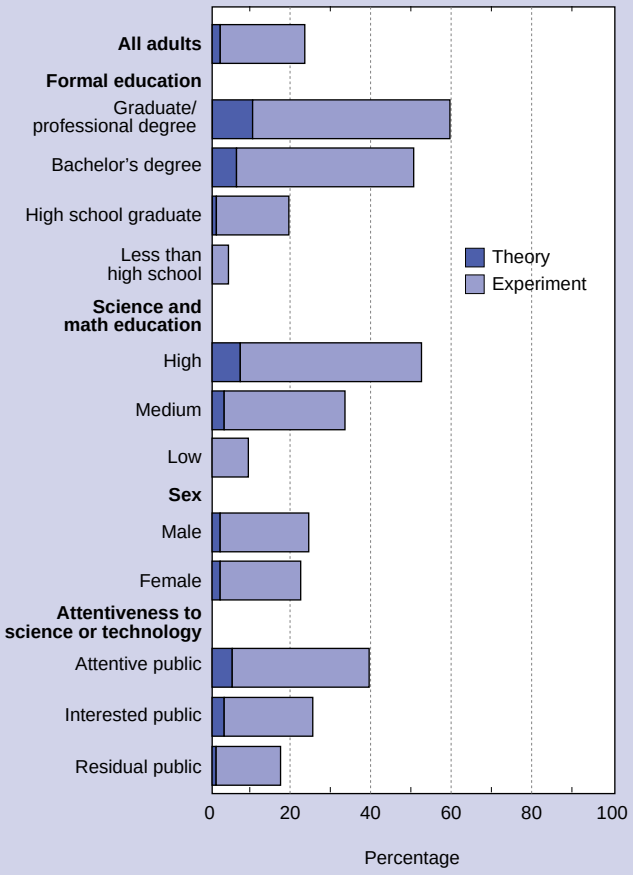
The number of years of formal schooling and the number of science and mathematics courses taken are closely associated with an individual's level of understanding of the nature of scientific inquiry. While fewer than 1 percent of respondents with less than a high school diploma were able to define the purpose of science as theory building or testing, 10 percent of graduate degree holders defined scientific inquiry in that manner. (See figure 7-10 and appendix table 7-9.) If responses that characterized science in terms of theory building or experimentation are combined, only 4 percent of Americans who had not completed high school were able to provide a minimally acceptable response, compared with 50 percent of those with baccalaureate degrees and 59 percent of those with graduate and professional degrees. Similarly, only 9 percent of individuals with a low level of formal science and mathematics coursework were able to provide an acceptable definition of scientific inquiry, compared with 52 percent of individuals with nine or more science and mathematics courses in high school and college. Clearly, education makes a difference in understanding the purpose of science and the nature of scientific inquiry.

[4]The question on the meaning of scientific study was, "When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms and I would like to ask you a few brief questions in that regard. First, some articles refer to the results of a scientific study. When you read or hear the term scientific study, do you have a clear understanding of what it means, a general sense of what it means, or little understanding of what it means? If clear understanding or general sense: In your own words, could you tell me what it means to study something scientifically?"

In addition, each respondent was asked the following question: "Now, please think of this situation. Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many experience lower blood pressure levels. The second scientist wants to give the drug to 500 people with high blood pressure, and not give the drug to another 500 people with high blood pressure, and see how many in both groups experience lower blood pressure levels. Which is the better way to test this drug? Why is it better to test the drug this way?"

As a part of the same interview, each respondent was asked a series of questions that included previously asked items about lucky numbers and whether or not astrology is very scientific, sort of scientific, or not at all scientific.

Figure 7-10.
Public understanding of the nature of scientific inquiry: 1995



See appendix table 7-9.

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Understanding Environmental Concepts

The preservation of a healthy environment and an ecologically sound planet has become an important issue in virtually all modern industrial nations. A majority of American adults indicate that they are very interested in issues pertaining to environmental pollution. Media coverage of environmental issues has increased over the past 2 decades, and the commercial demand for environmental books and materials has increased. This high level of awareness and concern justifies inquiring into the level of public understanding of environmental policy issues and concepts. (See *Public Understanding of Environmental Concepts in 20 Countries* and figure 7-11.)

The Thinning of the Ozone Layer

The thinning of the ozone layer and the appearance of a visible "hole" over the South Pole region has been the subject of extensive public policy discussions, media coverage, and national legislation and international treaties. The prohibition of the manufacture or use of chlorofluorocarbons in the United States, and many other nations, is perhaps the most visible result to date of this debate. Do Americans understand the reason for the thinning of the ozone layer? Do they know where it is primarily located? What do they think might be the consequences of a continued thinning of the ozone layer?

Recent *Science and Engineering Indicators* studies have probed the public's understanding of these issues. In 1995, 23 percent of Americans could provide a scientifically correct explanation of the role of chlorofluorocarbons in the thinning of the ozone layer, and 14 percent of adults were able to reasonably describe where the ozone layer is thinning. (See figure 7-12 and appendix tables 7-10 and 7-11.) A third of Americans were able to explain the present and potential health risks of the thinning of the ozone layer. In short, the overwhelming majority of Americans do not understand the reasons for the thinning of the ozone layer, the primary locations of major thinning, or the health consequences of this development.

As observed with other scientific and technical concepts, individuals with more years of formal schooling and more prior coursework in science and mathematics were more knowledgeable about the thinning of the ozone layer, its location, and its consequences. (See appendix table 7-10.) An analysis of these relationships found that the level of formal schooling accounted for approximately 30 percent of the variance in understanding the cause of the ozone hole and approximately 40 percent in understanding its location and consequences. Citizens who are attentive to science and technology policy issues and those who are attentive to environmental issues demonstrated a better understanding of the ozone issue than citizens not attentive to those issues. This pattern demonstrates the mutually reinforcing nature of attentiveness and knowledgeability.

The Acid Rain Issue

Although less prominent in the media in recent years, the issue of acid rain has been a concern for at least 2 decades. In the *Science and Engineering Indicators* studies, respondents were asked to explain the "primary cause of acid rain." The responses to this question illustrate the nature of the public's understanding of environmental issues. A third of Americans characterize acid rain as a form of pollution and can provide no additional information. (See figure 7-12 and appendix table 7-11.) They are opposed to pollution and acid rain, yet they have no understanding of the science involved in the issue. Approximately 2 percent offer a general description (it kills fish in lakes or hurts trees in the forest), but can provide no further explanation. Only 5 percent of Americans can explain that the burning of coal and other fossil fuels releases sulfuric dioxide into the air. Under certain weather conditions, this precipitates into rain and contains sulfuric acid. With the diminishing media cover-

Public Understanding of Environmental Concepts in 20 Countries

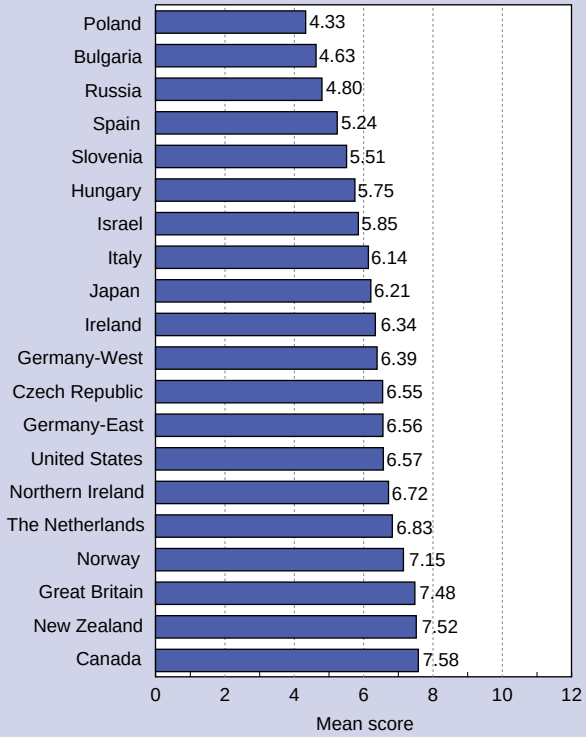
Americans ranked seventh among 20 nations in knowledge of the environment and science in 1993, according to the International Social Survey Program (ISSP), headquartered at the National Opinion Research Center (NORC) at the University of Chicago. (See figure 7-11.) A recent NORC report, "Environmental and Scientific Knowledge Around the World," found that Canadians earned the highest score on the 12-question quiz with an average score of 7.6. New Zealand, Britain, and Norway all have mean scores above 7.0. The United States had a mean score of 6.6 and ranked above the former West Germany and Japan, while Russia, Bulgaria, and Poland ranked lowest in the 20-nation comparison.

Setting aside the issue of ranking, these results suggest that the residents of major industrial nations throughout the world have a relatively low level of understanding of basic environmental concepts. The 12 questions included items concerning radiation, cancer, the greenhouse effect, species extinction, antibiotics, astrology, evolution, and air pollution.

In general, the levels of adult understanding of environmental and scientific concepts do not follow the patterns of student science achievement found by international comparative studies in recent decades. Japan and Israel, for example, have generally scored high in those studies, but rank 12th and 14th, respectively in the ISSP study. The disjuncture between adult and student patterns deserves more examination.

The study used self-administered questionnaires that were left at the home of each respondent by a survey representative and collected a few days later. In the United States, the knowledge items were administered as part of the General Social Survey (GSS) of the National Opinion Research Center at the University of Chicago. Both the GSS and the ISSP are sponsored, in part, by grants from the National Science Foundation.

Figure 7-11.
Mean score in index of environmental knowledge, by country: 1995



SOURCE: Smith, T.W. 1996. *Environmental and Scientific Knowledge around the World.* GSS Cross-national Report. No. 16. (Chicago: National Opinion Research Center).

Science & Engineering Indicators – 1996

age of the acid rain issue, the percentage of Americans able to provide a minimally correct scientific explanation has declined slightly from approximately 8 percent in 1992 to 5 percent in 1995.

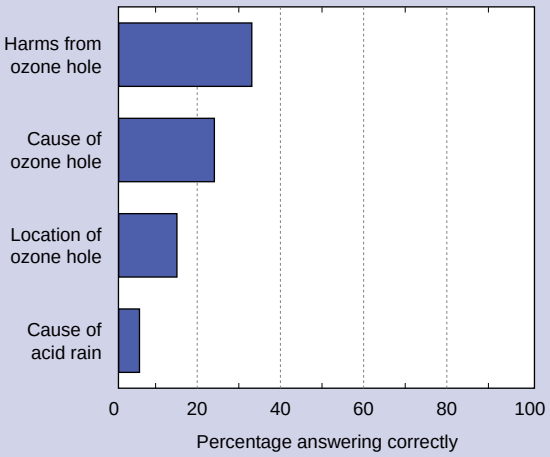
The proportion of adults able to explain acid rain was positively associated with the number of years of formal schooling and the number of science and mathematics courses completed, but the strength of the relationship was moderate at best.

Only approximately one in nine of those citizens attentive to environmental issues or science and technology policy issues was able to provide a minimally correct scientific explanation. (See appendix table 7-11.) While markedly better than nonattentive citizens, this level of knowledgeability reveals one of the biggest problems in attempting to mobilize citizens to participate in public policy debates—low levels of substantive understanding.

Understanding Basic Economic Concepts

The emergence of a global market economy in recent years has been reflected in a wide array of issues on the domestic political agendas of major industrial nations. In the United States, there have been spirited debates about the NAFTA and the GATT. Periodic international confrontations concerning trade problems have become commonplace. These events have received extensive

Figure 7-12.
Public understanding of selected environmental concepts: 1995

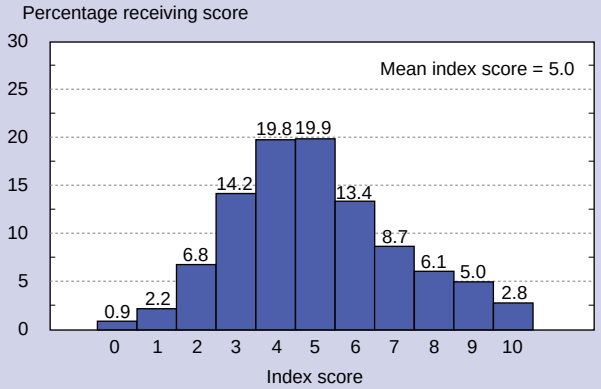


NOTE: See appendix table for exact wording of statements.

See appendix tables 7-10 and 7-11.

Science & Engineering Indicators – 1996

Figure 7-13.
Distribution of scores on the *Index of Economic Understanding:* 1995



See appendix table 7-12.

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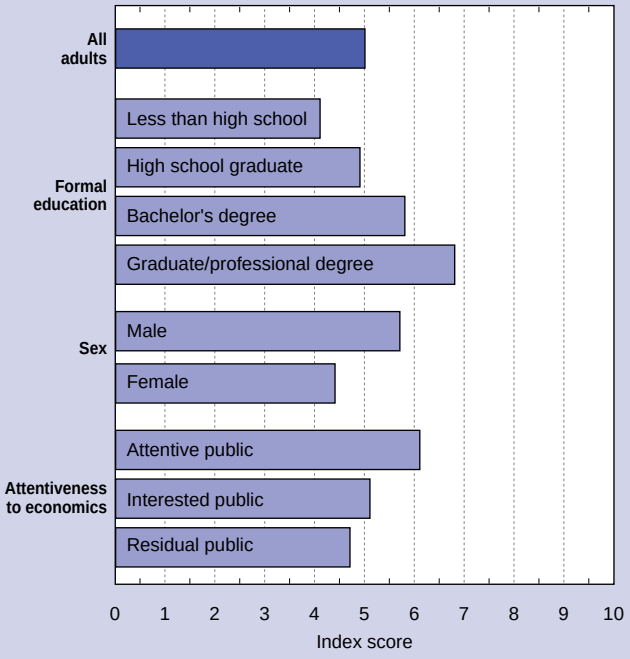
media coverage, but prior to the past 2 decades, the study of economics was limited to college students. Even today, only a portion of high school students study economics. How many Americans understand the basic terms and concepts associated with these economic issues?

With the use of a set of true-false and multiple-choice questions taken from the Test of Economic Literacy (Soper, 1978, 1979; Soper and Walstad, 1987; Walstad, 1987), the 1995 *Science and Engineering Indicators* Public Attitudes and Understanding study found substantial variation in the levels of economic understanding among Americans. Almost 80 percent of those surveyed recognized that tariffs benefit some groups at the expense of others and that a tightening of the money supply by the Federal Reserve Board would result in higher interest rates for consumers. (See appendix table 7-12.) Approximately 70 percent of Americans agreed that increasing investments in equipment, machinery, and other capital was one of the best ways to increase the productivity of labor. Sixty percent of those surveyed recognized that U.S. Treasury bonds were the safest investment of four choices, and 55 percent agreed that in a market economy the level of wages depends primarily on the level of output per worker. Slightly fewer than half of the respondents recognized that the majority of workers in the United States do not belong to unions. They also realized that increased tariffs on goods imported into the United States will not encourage the import of U.S. goods into other countries.

In recognition of the inherent limitations of closed-ended questions, the 1995 *Indicators* study asked respondents to provide an open-ended explanation of the meaning of "free trade." Approximately 20 percent of Americans were able to define free trade as involving the trade of goods and services between and among countries with no, or minimal, tariffs and other restrictions. An additional 10 percent recognized that free trade involved the encouragement of trade among nations, but could not provide additional information about the role of tariffs and duties in this process. Two-thirds of those surveyed could not provide a minimally acceptable open-ended explanation of free trade, although many of these same respondents did provide correct responses concerning international trade in a closed-ended question format. This pattern suggests that many respondents had a general sense of international trade and could make reasonable guesses when offered specific statements and choices, but were unable to translate this general understanding into an unstructured explanation.

For a summary measure of economic understanding, a 10-point index was constructed. Respondents received 1 point for each correct response to the seven closed-ended questions and 3 points for a correct open-ended definition of free trade. Respondents who provided a partial answer to the open-ended free trade question received 1 additional point. The mean score on this Index of Economic Understanding was 5.0 and the distribution was normal. (See figure 7-13 and appendix table 7-12.) Respondents with more years of formal schooling scored somewhat higher on the index, but the strength of this association was significantly lower than that found for the understanding of scientific terms and concepts. (See figure 7-14 and appendix table 7-12.) Citizens who are attentive to economic issues scored higher on the index than citizens not attentive to economic and business issues, but, again, the magnitude of this difference was smaller than the differences found in regard to scientific understanding.

Figure 7-14.
Score on the *Index of Economic Understanding,* by education, sex, and attentiveness: 1995



See appendix table 7-12.

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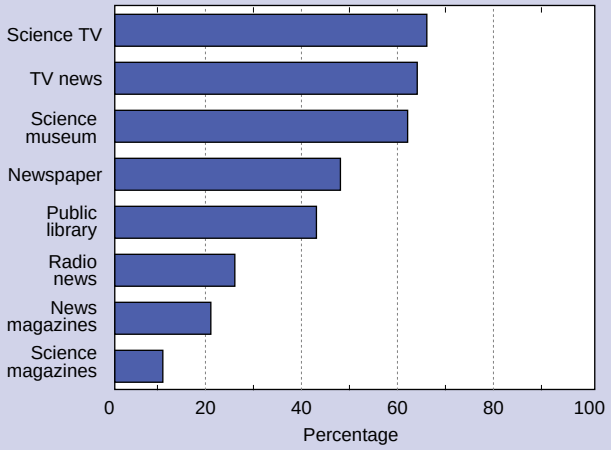
Figure 7-15.
Public use of selected information sources: 1995



NOTE: See appendix table for exact wording of statements.

See appendix table 7-13.

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Sources of Scientific and Technical Information

In recent decades, the number and variety of sources providing timely information about science and technology have increased markedly. Most major daily newspapers have at least one full-time science and technology writer and leading papers have staffs of three or four. Major weekly news magazines have sections on science or medicine, or both, and, more recently, sections on computers and networks. The number of popular science books continues to grow, and many reviewers report that the quality is increasing at the same time. In this context, it is interesting to examine which Americans are using which information sources to learn more about science and technology and to what effect.

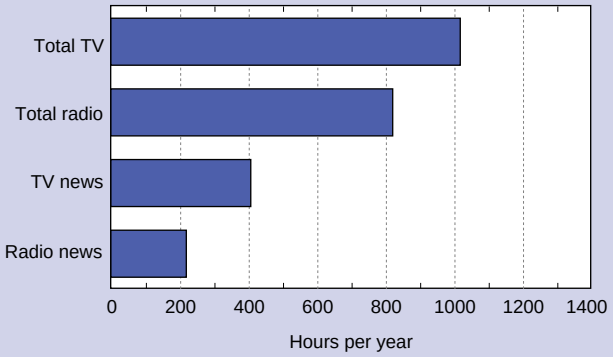
General Patterns of Information Acquisition

Trend data from *Science and Engineering Indicators* Public Attitudes and Understanding studies indicate that Americans utilize numerous sources and institutions for scientific and technical information; according to the 1995 study, television and newspapers remain primary sources. In 1995, 63 percent of adults in the United States reported that they watched a television news show for at least 1 hour on a typical day, and 47 percent indicated that they read a newspaper daily. (See figure 7-15 and appendix table 7-13.) One-quarter of Americans listen to 1 or more hours of radio news on a typical day, and 20 percent claim to read two weekly news magazines on a regular basis. Ten percent of respondents in the 1995 *Indicators* study reported that they read a science magazine on a regular basis. These same results show that nearly 70 percent of Americans use a public library at least once each year and that 43 percent claim to use a pubic library five or more times each year. (It is not possible to determine the extent to which materials related to science or technology were utilized.)

In broad terms, these indicators are threshold measures, reflecting the percentage of Americans who used various information sources more than some established minimum in a typical month or during the previous year. With the same data base, it is also possible to estimate the volume of use of these information sources and to place them all on the same metric—the number of uses or hours per year. If different information sources on the same metric are compared, it is possible to obtain a more useful picture of the patterns of scientific and technical information acquisition.

In the category of broadcast media, the results from the 1995 *Indicators* study show that Americans watch an average of 1,019 hours of television per year and that 408 of those hours are spent watching the news. (See figure 7-16 and appendix table 7-14.) Americans report that they watch an average of 81 science shows, or about 81 hours of science television per year. Since respondents in the 1995 *Indicators* study were asked the name of each show they claimed to watch regularly or periodically, this estimate of viewership is reasonably solid. The frequency of viewing science television shows is unrelated to the number of years of formal schooling or to the number of science and mathematics courses taken in high school and college. It is apparent, however, that

Figure 7-16.
Mean number of television and radio hours of use: 1995



See appendix table 7-14.

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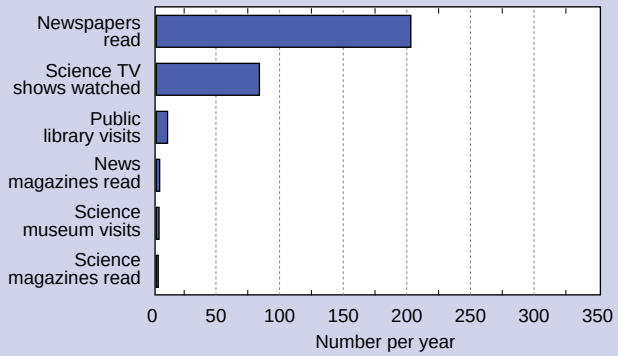
individuals who subscribe to a cable television service or have a satellite dish watch significantly more science television shows than individuals without cable or satellite services. In 1995, cable subscribers reported watching an average of 97 television shows, compared with 42 for individuals without cable or satellite service. Men were significantly more likely to watch science television shows than were women.

In the category of print media, newspaper reading is the dominant activity. In 1995, Americans reported reading an average of 200 newspapers during the previous 12 months. (See figure 7-17 and appendix table 7-14.) Comparatively, they read an average of 2.6 news magazines and 1.5 science magazines during the same 12-month period. The 1995 study also found that Americans used a public library 8.8 times during the year and borrowed 12.1 books and 1.5 videotapes. During the same 12-month period, Americans reported visiting a science museum, natural history museum, zoo, or aquarium an average of 2.1 times.

Figure 7-17.
Public use of selected information sources: 1995



See appendix table 7-14.

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The reading of newspapers, news magazines, and science magazines are all positively related to the number of years of formal schooling and the number of high school and college science and mathematics courses completed. (See appendix table 7-14.) The average college graduate reads approximately 231 newspapers, 4.3 news magazines, and 2.1 science magazines in a 12-month period, compared with non-high-school-graduates who read 170 newspapers and less than 1 news or science magazine during the same time period. From these data, it is also clear that high school and college science and mathematics courses stimulate a lasting interest in science and technology, as reflected in the patterns of reading science magazines and attending science museums. Men were significantly more likely to read a science magazine than were women.

Citizens attentive to science and technology policy issues displayed a high level of information consumption, using both broadcast and print sources. Those attentive to science policy reported slightly more hours viewing television news than other citizens, and they read significantly more newspapers. (See appendix table 7-14.) Science and technology policy attentives read significantly more news magazines and science magazines than other citizens and visited a public library more frequently. Citizens interested in science and technology policy were only slightly more likely to visit a science and technology museum than other Americans.

Use of New Information Technologies

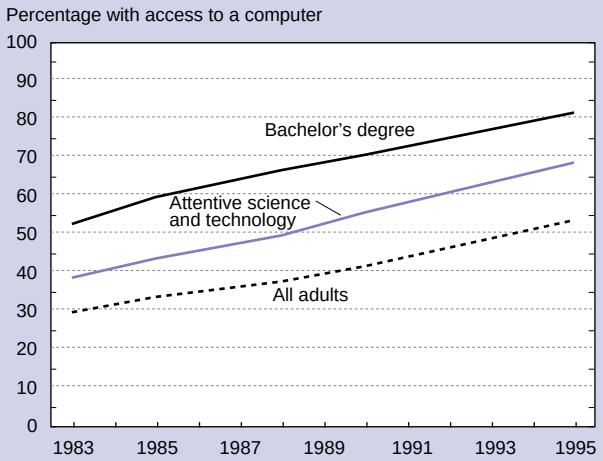
The 1990s may be characterized by the emergence of electronic media. Within the past decade, individual access to a computer has increased substantially and steadily. By 1995, a majority—54 percent—of Americans reported that they use a computer at work, at home, or at both. (See figure 7-18 and appendix table 7-15.) Eighty-two percent of college graduates in the United States indicated that they used a computer at work or at home, compared with 58 percent of high school graduates and 20 percent of individuals who did not complete high school. In 1995, almost 70 percent of those attentive to science and technology policy reported that they had regular access to a computer at work or at home.

Americans do a substantial amount of work on their computers. The average respondent in 1995 reported that he or she spent 319 hours a year using a work computer and 103 hours a year using a home computer.[5] (See appendix table 7-16.)

Approximately one in five Americans has a home computer with a modem, although only 7 percent report using an on-line or Internet service. Nearly half of Americans with a graduate or professional education indicated that they have a home computer with a modem, and 24 percent reported that they use an on-line

[5]The hours of computer use for individuals who work out of their home were counted as work hours.

Figure 7-18.
Percent of adults with access to a computer at work or at home



NOTE: Data are interpolated for years when survey was not conducted or questions were not asked.

See appendix table 7-15. *Science & Engineering Indicators – 1996*

computer service. Nearly 51 percent of those attentive to science and technology policy reported that they own a home computer and use it an average of 209 hours per year. Of this attentive public, nearly 40 percent has a home computer with a modem. These well-educated individuals would appear to be positioned to make extensive use of the Internet and its information resources.

Fourteen percent of Americans indicated that they have a home computer with a CD-ROM reader. This technology opens important information resources, ranging from larger reference works to collections of visual images with sound. The number of government agencies and private organizations that distribute information in this medium continues to grow rapidly. As with other electronic media, well-educated Americans are the most frequent users of this new technology.

Looking at the full range of information-use patterns, Americans use a wide array of sources to obtain new information, including information about science and technology. Americans with fewer years of formal education tend to rely on broadcast media, primarily television. Those who are college educated are frequent viewers of television news and science programs, but appear to rely more heavily on print media and, increasingly, electronic information sources. (See *Computer Access for the Next Generation*, figure 7-19, and appendix table 7-17.)

Looking Deeper

The studies of information acquisition referenced in this chapter describe the normal patterns in which Americans acquire information. It is also useful to know where Americans would go for additional information. In both 1990 and 1995, the *Science and Engineering Indicators* Public Attitudes and Understanding studies asked respondents where they would go to get additional information about the ozone hole. The studies went one step further and asked where respondents might go if they needed still more information. The three most frequently cited sources were the library, relevant magazines, and books or other printed materials. (See appendix table 7-18.) There was a sharp increase in the percentage of Americans citing a library between 1990 and 1995. In 1990, the selection of a library as a primary information source was strongly associated with the number of years of formal schooling, but this relationship all but disappeared by 1995. Compared with a library, the other information sources were relatively infrequent, each cited by 6 percent.

When asked where they would go for additional information, half of the respondents said they could not think of an additional place. The other half cited a wide array of books, magazines, and other resources, largely without pattern. These results reveal that, in searching for additional information, most Americans would turn first to their public library, but would not have a second source for information in mind if they were not able to find all that they wanted in the library.

Attitudes Toward Science and Technology Policy Issues

What do Americans think about science and technology? The answer, in short, is that they continue to hold science in high esteem and to make some distinctions in their assessment of various technologies.

One of the oldest indicators of the public attitude toward science and technology is the General Social Survey, which asks Americans to indicate whether they have a "great deal of confidence, only some confidence, or hardly any confidence at all" in the people running selected institutions. Approximately 40 percent of people asked expressed a great deal of confidence in the leadership of the scientific community, virtually the same confidence they revealed for the medical field. (See figure 7-20 and appendix table 7-19.) Comparatively, only one in four Americans expresses a great deal of confidence in leaders in education, organized religion, and major companies. In 1995, approximately 1 in 10 adults expressed a great deal of confidence in leaders in Congress, the Executive branch of the Federal Government, the press, television, and organized labor. The level of confidence in leaders in the scientific community has continued for the full 2 decades that this time series has been collected.

Perceptions of Benefits and Risks

When asked more directly about science and technology, Americans continue to give high marks to the scientific community. A four-item scale reflecting general attitudes toward science and technology, referred to as the Attitude Toward Organized Science Scale (ATOSS),

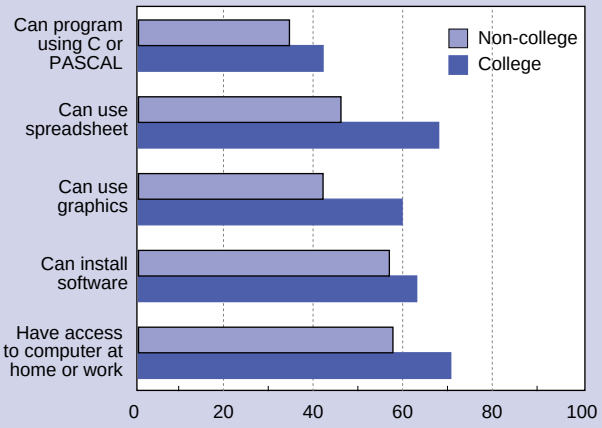
Computer Access for the Next Generation

Four years after high school, 62 percent of the high school class of 1990 reported that they use a computer at home, at work, or both. Among those students from the class of 1990 who were enrolled in a college or university 4 years after high school, fully 70 percent reported using a computer at home, work, or both. There was no difference in the extent of computer access for young men and young women in the class of 1990.

Focusing on those members of the class of 1990 who were attending college, these college students reported using a computer an average of 6 hours each week. Three-quarters of these college students indicated that they used their computer primarily for word processing. Only 24 percent reported that they used their computer for science or mathematics work. Sixty-two percent reported that they could install software on their computer, 67 percent said they could use a spreadsheet program, and 41 percent claimed that they were able to write programs in a computer language. (See figure 7-19 and appendix table 7-17.) Given the extent of computer use by this generation of college students, it is likely that they will expect to continue to use those tools in the workplace, accelerating the pace of computer utilization in American society.

Reflecting the national patterns reported in this chapter, 57 percent of high school graduates in the class of 1990 who did not attend college reported access to a computer at home or at work. Among this group, however, only 30 percent reported that they used a computer primarily for word processing. A quarter of this group reported using their computer primarily for business or financial record-keeping, and 22 percent indicated that they used a computer primarily for entertainment or games. A majority of this group reported that they could install software and use a graphics program on their computer. The magnitude of computer use among the non-college segment of the class of 1990 indicates the pervasive utilization of computers throughout American life.

Figure 7-19.
Computer access and use by high school class of 1990, by education level: 1995



NOTE: See appendix table for exact wording of statements.

See appendix table 7-17.

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shows a positive stable pattern over the past decade. (See figure 7-21 and appendix table 7-20.) Americans with college degrees tend to hold more positive views of science than individuals with fewer years of formal education. The attentive public for science and technology policy expresses a more positive attitude toward organized science than citizens not attentive to those issues.

When asked to weigh the benefits and risks of "scientific research," 72 percent of Americans indicated in 1995 that the benefits had exceeded any risks, and only 13 percent took an opposing view. (See figure 7-22 and appendix table 7-21.) This pattern has remained relatively stable since the series began in 1979. As found in the ATOSS results, well-educated Americans and citizens attentive to science and technology policy tend to hold the most positive views of the impact of science. In 1995, 90 percent of college graduates indicated that the benefits of scientific research outweighed any disadvantages, compared with 48 percent of Americans who did not finish high school. Eighty-five percent of the attentive public for science and technology policy concluded that the benefits of scientific research had outweighed any disadvantages.

Perceptions of Nuclear Power

In contrast to the strong positive attitudes of the public toward scientific research, Americans are divided over the issue of using nuclear power to generate electricity. Over the past several decades, Americans have indicated in four *Science and Engineering Indicators* Public Attitudes and Understanding studies that they are evenly divided on this question. In 1995, 43 percent said the benefits of nuclear power were greater than its consequences, while 42 percent took the opposite position; 14 percent remained uncertain. (See figure 7-23 and appendix table 7-22.)

Individuals with more years of formal schooling, males, and citizens attentive to science and technology policy were more favorable in their assessment of the benefits and consequences of nuclear power than other Americans, but the differences were modest. (See appendix table 7-22.) Half of those attentive to science policy thought that the benefits of nuclear power exceed-

ed any actual or potential dangers, but 40 percent of those attentive to science policy thought that the dangers were greater than the benefits.

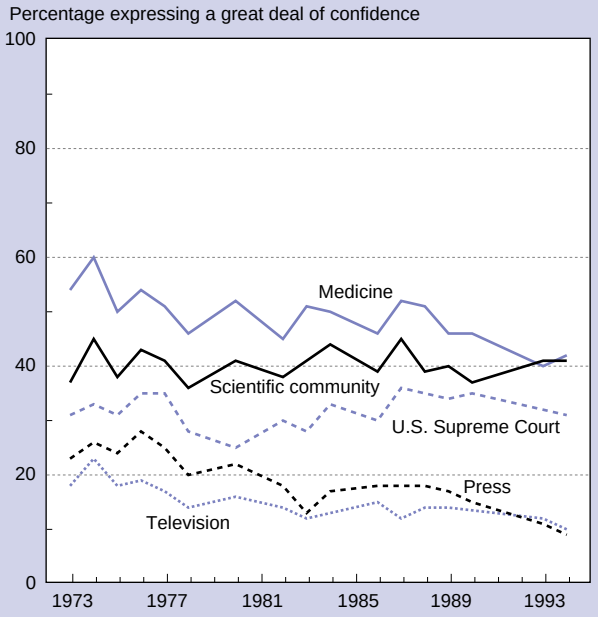
Perceptions of Genetic Engineering

Americans are also divided in their assessment of the benefits and dangers of genetic engineering. When asked in 1995 to weigh the relative benefits and dangers of genetic engineering, 43 percent of Americans thought that the benefits were greater, but 35 percent concluded that the actual or potential dangers were greater. (See figure 7-24 and appendix table 7-23.) Approximately one in five respondents was undecided on this issue. The distribution of views on this issue over the past decade shows that the number of citizens who see the benefits and costs as essentially equal, or who do not know enough about the issue to reach a conclusion, has nearly doubled since 1985. These patterns suggest that the change has been gradual and that short-term influences such as *Jurassic Park* or other movies or books have not had a major influence on this pattern.

Several patterns of change are evident in this assessment of various segments of the public. First, over the past decade, the proportion of college graduates with a positive assessment of genetic engineering has increased from 62 percent in 1985 to 65 percent in 1995. On the other hand, the proportion of college graduates believing that the actual or potential risks of genetic engineering outweigh its benefits dropped from 31 percent in 1985 to 20 percent in 1995. (See appendix table 7-23.) Virtually the opposite pattern prevailed among Americans who did not complete high school. The percentage of those believing the benefits outweigh the risks dropped from 48 to 29. The percentage of those believing the risks outweigh the benefits rose from 36 to 42.

Second, those attentive to science and technology policy and those attentive to medical research illustrate

Figure 7-20.
Public confidence in leadership of selected institutions



See appendix table 7-19.

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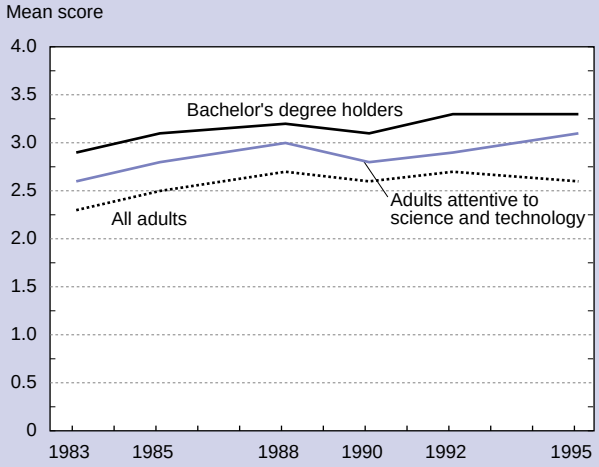
Figure 7-21.
Mean score on Attitudes Toward Organized Science Scale (ATOSS)

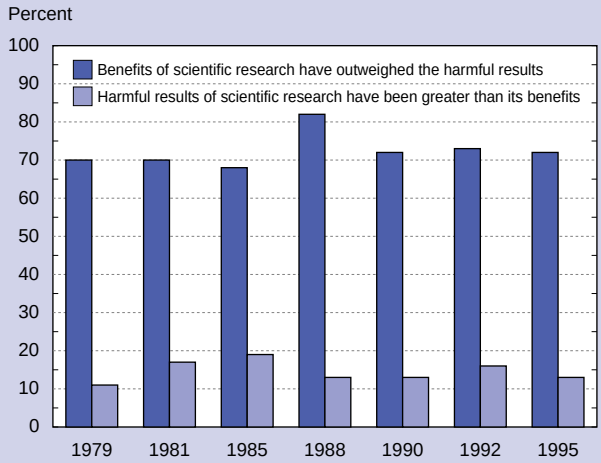


NOTE: Scale ranges from 0 (anti-science) to 4 (pro-science)

See appendix table 7-20.

Science & Engineering Indicators – 1996

Figure 7-22.
Public assessment of scientific research

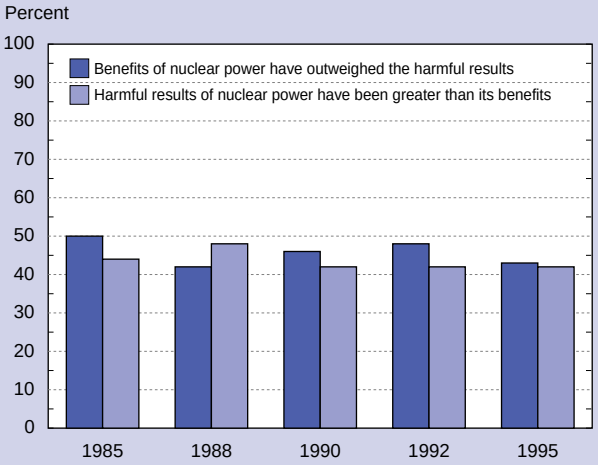


NOTES: Survey was only conducted in the years shown. Data reflect responses of people saying that benefits/harms exceed or strongly exceed harms/benefits.

See appendix table 7-21.

Science & Engineering Indicators – 1996

Figure 7-23.
Public assessment of nuclear power

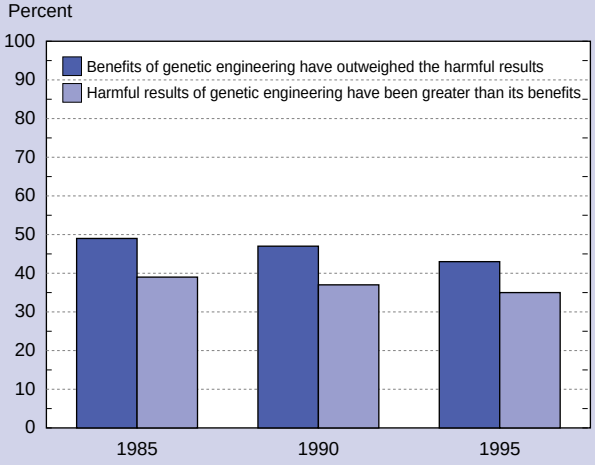


NOTES: Survey was only conducted in the years shown. Data reflect responses of people saying that benefits/harms exceed or strongly exceed harms/benefits.

See appendix table 7-22.

Science & Engineering Indicators – 1996

Figure 7-24.
Public assessment of genetic engineering



NOTES: Survey was only conducted in the years shown. Data reflect responses of people saying that benefits/harms exceed or strongly exceed harms/benefits.

See appendix table 7-23.

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another set of patterns. Between 1985 and 1995, more than 60 percent of the attentive public for science and technology policy held a positive view of the benefits and risks of genetic engineering, while the proportion of science policy attentives with a negative assessment dropped from 26 percent to 20 percent. This pattern suggests a generally positive outlook on genetic engineering among science policy attentives throughout the past decade. The attentive public for medical research reflects a very similar pattern for the past decade, in which the positive assessment increased from 53 percent to 55 percent and the negative assessment dropped from 35 percent to 27 percent.

Finally, there is a clear gender difference in attitudes surrounding genetic engineering. A large number of men have had a positive view of genetic engineering for the past decade, but American women have been almost equally divided on the issue. The proportion of men and women who assessed the benefits and risks as being equal, or too close to call, increased significantly during the past 10 years.

Perceptions of Space Exploration

For the space program, the issue has been the balance between benefits and costs, since it involves virtually no direct risks to the public at large. During the past decade, the public's assessment has shifted from a majority being supportive to being equally divided. (See figure 7-25 and appendix table 7-24.) These assessments provide a useful insight into the role of attentive publics for low-salience issues.

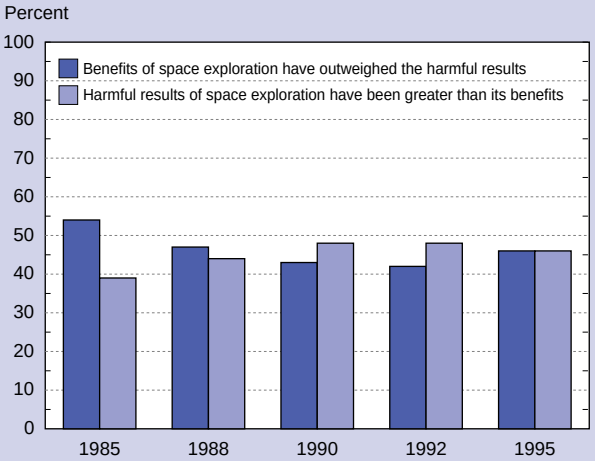
In 1985, immediately prior to the Challenger accident, 54 percent of Americans thought that the benefits of the space program outweighed its costs, but 66 percent of the attentive public for science and technology policy and 74 percent of the attentive public for space exploration believed that the benefits outweighed the costs and tended to hold strong feelings on this matter.

The explosion of the shuttle Challenger produced an immediate increase in support for the space program in all segments of the American public (Miller, 1987), but the grounding of the shuttle program for more than 2 years eroded a great deal of this new support. By the early 1990s, support had declined in both the general public and among the attentive public for science policy. In 1992, 82 percent of the attentive public for space exploration believed that the benefits of the space program were greater than the costs. Given the relatively low levels of interest in the space program, it has become less salient and less visible than other programs. Further, unlike nuclear power, with strong and organized pro-nuclear and anti-nuclear groups, there has never been a significant anti-space movement in the United States. Although public sentiment is evenly divided, the strong support of space policy leaders and those attentive to space exploration has sustained an active space program.

Summary

Science and technology are subjects of interest to a substantial minority of Americans—approximately 40 percent. Only 10 percent feel very well informed about science and technology, and studies show that only a small segment of the population has a strong grasp of

Figure 7-25.
Public assessment of space exploration



NOTES: Survey was only conducted in the years shown. Data reflect responses of people saying that benefits/harms exceed or strongly exceed harms/benefits.

See appendix table 7-24.

Science & Engineering Indicators – 1996

basic scientific ideas. More Americans demonstrate a moderate level of comprehension of scientific terms and concepts than an understanding of the purpose of science or the nature of scientific inquiry. Only 23 percent of Americans are able to provide a minimally acceptable explanation of the nature of scientific study or inquiry.

Public understanding of environmental terms and concepts was somewhat higher. A quarter of Americans could explain the factors involved in the thinning of the ozone layer, but only 5 percent could provide a scientific explanation of acid rain. Even among the attentive public for environmental issues, the level of understanding of some of these basic concepts was limited.

The public's understanding of basic economic concepts was similar in level and form to that of scientific concepts. Unlike the category of scientific terms and concepts, the overall level of economic understanding was unrelated to the level of formal schooling, suggesting that individuals learn economic concepts from their work experiences and from newspapers, magazines, and other sources.

An analysis of the sources of information used by Americans to obtain public policy information, including scientific and technical information, demonstrated again the continuing importance of newspapers and television news programs. When placed on a common metric of the number of uses or hours per year, these two sources dwarfed all other information sources. The results from the 1995 study indicated that Americans watch 81 science television shows per year and that the rate at which they view science programs is twice as high for cable subscribers or satellite dish owners than for other citizens.

Finally, this analysis found that the American people continue to hold the scientific community in high regard. The leadership of the scientific community and the medical community are the two most esteemed groups in the United States. An overwhelming majority of Americans continues to believe that the benefits of scientific research outweigh any potential risks, but there are some deep divisions concerning the benefits and potential risks of nuclear power and genetic engineering. The general public is also evenly divided over the benefits and costs of space exploration. In all of these areas, however, college-educated Americans and those attentive to the related policy issues continue to have strong positive views of those technologies and their programs.

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