Chapter 7
Science and Technology: Public Attitudes and Understanding

List of Sidebars

List of Tables

List of Figures

Highlights

Overview

Although Americans express strong support for science and technology (S&T), most are not very well informed about these subjects. The public's lack of knowledge about basic scientific facts and the scientific process can have far-reaching implications.

- Knowledge of basic scientific facts and concepts is necessary not only for an understanding of S&T-related issues but also for good citizenship. Knowing how science works—how ideas are investigated and either accepted or rejected—can help people evaluate the validity of various claims they encounter in daily life.
- Many in the scientific community are concerned that lack of knowledge about S&T may adversely affect the level of government support for research, the number of young people choosing S&T careers, and the public's resistance to miracle cures, get-rich-quick schemes, and other scams.

Information Sources

Television is still the main source of information about S&T, but the Internet is a strong competitor.

- In the United States and other countries, most adults pick up information about S&T primarily from watching television, including educational and nonfiction programs, newscasts and newsmagazines, and even entertainment programs.
- The Internet is having a major impact on how the public gets information about S&T. In 2004, the Internet was the second most popular source of news about S&T, up from fourth place in 2001.
- The number of households with broadband Internet connections has been growing rapidly. People with broadband are much more likely than those with dial-up connections to view the Internet as an important source of information.
- The Internet is the preferred source when people are seeking information about specific scientific issues. In 2004, 52% of National Science Foundation survey respondents named the Internet as the place they would go to learn more about a scientific issue such as global warming or biotechnology, up from 44% in 2001.

The media can affect the public's view of scientific issues.

- Television and other media sometimes miscommunicate science to the public by failing to distinguish between fantasy and reality and by failing to cite scientific evidence when it is needed.
- A study found that the movie *The Day After Tomorrow* influenced individuals' opinions about climate change.

Public Interest in S&T

Evidence about the public's interest in S&T is mixed.

- Surveys found that S&T ranked 10th of 14 categories of news followed most closely by the public in 2004.
- Very few Americans (about 10% of those surveyed) say they are not interested in S&T issues.
- S&T museums are much more popular in the United States than in other countries. The millions of people who visit science museums each year demonstrate interest in science without necessarily being interested in science-related news.

Public Knowledge About S&T

Most people do not think they are well informed about S&T. In fact, Americans generally know little about science, but they may be more knowledgeable than citizens of other countries.

- Many people throughout the world cannot answer simple, science-related questions. Nor do they have an understanding of the scientific process. However, U.S. adults may be somewhat more knowledgeable about science than their counterparts in other countries, especially Russia and China.
- Science knowledge in the United States is not improving. Survey respondents' ability to answer most questions about science has remained essentially unchanged since the 1990s, with one exception: more people now know that antibiotics do not kill viruses. This may be attributable to media coverage of drug-resistant bacteria, an important public health issue.
- Although the U.S. survey has not shown much change over time in the public's level of knowledge about science, the most recent Eurobarometer does show an increase. The change occurred in almost all countries surveyed; Belgium, Germany, Ireland, Luxembourg, and the Netherlands recorded double-digit increases between 1992 and 2005 in the percentage of correct responses to science literacy questions.
- There is considerable variation in science knowledge across countries in Europe.
- Less than half the American population accepts the theory of evolution. Whether and how the theory of evolution is taught in public schools remains one of the most contentious issues in science education.
- Belief in various forms of pseudoscience is common in both the United States and other countries.

Public Attitudes About Science-Related Issues

Most Americans have positive attitudes about the benefits of S&T, but some have reservations, including concerns about moral issues. Support for government funding of research is strong.

- Americans have more positive attitudes about the benefits of S&T than are found in Europe, Russia, and Japan. In recent surveys, 84% of Americans, compared with 52% of Europeans and 40% of Japanese, agreed that the benefits of scientific research outweigh any harmful results.
- A sizeable segment of the U.S. population has some reservations about S&T. For example, in 2004 surveys, more than half of the respondents agreed that "we depend too much on science and not enough on faith," that "scientific research these days doesn't pay enough attention to the moral values of society," and that "scientific research has created as many problems for society as it has solutions." However, agreement with the last two statements declined in recent years.
- In 2004, 83% of Americans surveyed agreed that "even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the federal government." Support is also strong in Europe and Asia.

Recent surveys on topics ranging from the environment to nanotechnology reveal a variety of perceptions and concerns.

- Attitudes toward environmental protection have been shifting in recent years. In 2005, 53% of survey respondents viewed environmental protection as more important than economic growth, and 36% held the opposite view. The percentage choosing the environment rose 6 percentage points between 2003 and 2005, after declining steadily from a peak of 69% in 2000 to an all-time low of 47% in 2003.
- Most Americans know little about genetically modified food and related issues. Although attitudes are divided, opposition to introducing genetically modified food into the U.S. food supply declined between 2001 and 2004. However, the vast majority of Americans (and others) believe that genetically modified food should be labeled.
- Opposition to medical research that uses stem cells from human embryos has declined. In 2004, 36% of those surveyed said they were opposed to this type of research, down from 51% in 2002.
- Most people have never heard of nanotechnology. Americans are somewhat concerned about the risks, but most believe the benefits will outweigh the risks. The biggest concern is loss of privacy from tiny new surveillance devices.

Most people have confidence in the scientific community and a high opinion of science as an occupation.

- Since 2002, more people have expressed confidence in the leadership of the scientific community than in any other profession except the military.
- Scientists share (with doctors) the top spot in the Harris poll of occupations having the most prestige; engineers are about in the middle of this ranking. Most Americans say they would be happy if their son or daughter chose a career in science.

Introduction

Chapter Overview

Most Americans probably do not think about scientific research and technological development on a daily basis. Yet most recognize and appreciate the related benefits. Most Americans also strongly endorse the government's investment in research, whether or not it leads to tangible improvements in health and safety or the economy or to new technologies that make life easier or more enjoyable.

In fact, with few exceptions, science and technology (S&T) enjoy a positive reputation throughout the world. Most people believe that S&T play a key role in raising their standard of living and improving their quality of life. People around the world have been quick to embrace inventions that make living and working conditions better and businesses more profitable, including the latest advancements in communication technologies, such as the Internet, cellular telephones, and increasingly sophisticated types of entertainment delivery systems. Moreover, emerging fields such as nanotechnology seem to be receiving the public's endorsement.

Despite their favorable attitudes, most people do not know a lot about S&T. Many do not seem to have a firm understanding of basic scientific facts and concepts, knowledge that is necessary not only for an understanding of S&T-related issues but also for good citizenship. Even more worrisome is a lack of familiarity with the scientific process. Both scientists and public policymakers are concerned that the public's lack of knowledge about S&T may result in

- Less government support for research[1]
- Fewer young people choosing S&T careers
- Greater public susceptibility to miracle cures, get-rich-quick schemes, and other scams (NIST 2002)

Chapter Organization

This chapter examines aspects of the public's attitudes toward and understanding of S&T. In addition to data collected in surveys sponsored by the National Science Foundation (NSF), the chapter contains extensive information from studies and surveys undertaken by other organizations that track trends in media consumption and changes in public opinion on policy issues related to S&T. (See sidebar, "Data Sources.") One of these sources is an international project designed to measure attitudes toward various technologies in Europe, Canada, and the United States. Preliminary data from the United States and Canada (Canadian Biotechnology Secretariat 2005) are included in this chapter. In addition, for the first time, this chapter includes coverage of similar surveys conducted in Russia and several Asian countries.

The chapter is in three parts. The first part focuses on S&T-related information and interest. It begins with a section on sources of news and information, including a detailed look at the role of the Internet. It then examines several measures of public interest in S&T. (Level of interest indicates both the visibility of the science and engineering community's work and the relative importance accorded S&T by society.) The first part also briefly discusses the public's perception of how well informed it is about science-related issues.

The second part of the chapter covers knowledge of S&T. It explores three indicators of scientific literacy: familiarity with scientific terms and concepts, understanding of the scientific method, and belief in pseudoscience.

The third part examines public attitudes about science-related issues. It includes data on public opinion about S&T in general, support for federal funding of scientific research, views on environmental issues, and public confidence in the science community. It also presents information on how the public perceives the pros and cons of various technologies such as stem cell research, genetic engineering (including genetically modified foods), and the emerging field of nanotechnology.

Data Comparability

The surveys that provided the data included in this chapter were sponsored and conducted by a variety of organizations, for different purposes, using different items in varying order and context. Therefore, their results are not directly comparable. This is particularly true for surveys done in other countries, where language and cultural differences add further complexities. (However, it should be noted that many items included in the NSF Survey of Public Attitudes Toward and Understanding of Science and Technology were replicated—to the greatest extent possible—in all countries covered in this chapter.) Thus, the findings presented in this chapter summarize broad patterns and trends emerging from these diverse sources. Readers will find the specific sources identified throughout the chapter and additional information in the sidebar, "Data Sources."

Information Sources, Interest, and Perceived Knowledge

People get news and information about S&T from a variety of sources. However, television is where most adults throughout the world find out about the latest S&T developments. Although the Internet is not the leading source of news for Americans, it is the only medium that has been gaining viewers in recent years, and it is now the first place people go to get information about specific S&T subjects (figure 7-1; appendix tables 7-1, 7-2, and 7-3).

Although most Americans claim to be at least moderately interested in S&T, few science-related news stories attract much public interest. In addition, few people feel well informed about new scientific discoveries and the use of new inventions and technologies.

This section takes a detailed look at the various sources of news and information about S&T in the United States and other countries, focusing on television as the longstanding

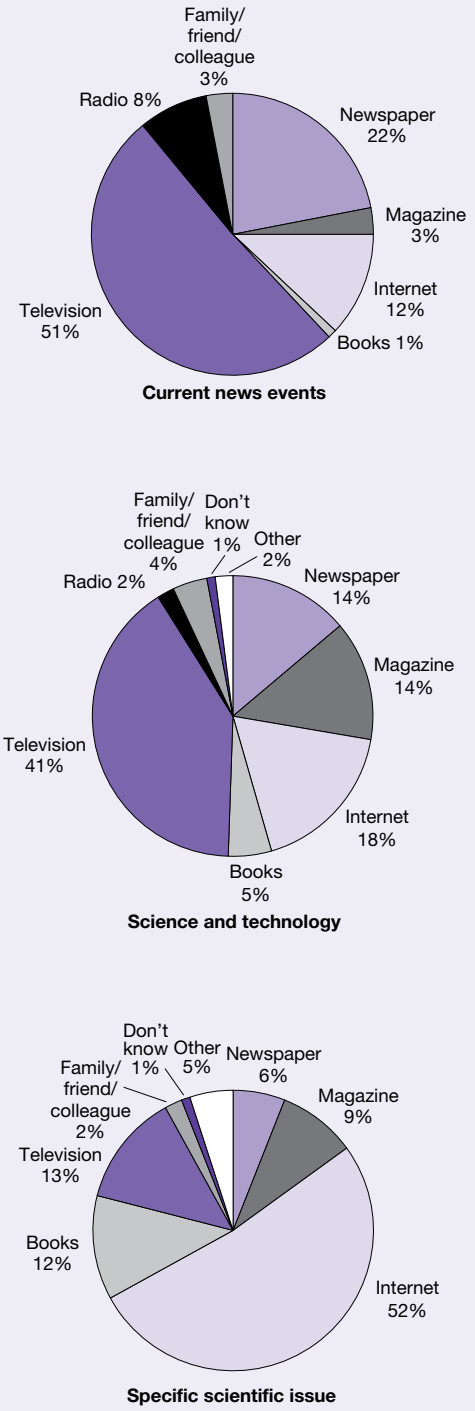
Data Sources

Data from the following surveys are included in this chapter:

Most recent year survey conducted	Sponsoring organization	Title*	Information used in the chapter	Type of survey	Number surveyed and standard error of estimates
2001	National Science Foundation	Survey of Public Attitudes Toward and Understanding of Science and Technology	Various knowledge and attitude items, including public support for basic research, belief in pseudoscience, and interest in science and technology	RDD	n=1,574 ± 2.47%
2004	National Science Foundation	Michigan Survey of Consumer Attitudes	A subset of items collected in the 2001 NSF survey	RDD	n=2,025 ± 2.49%
2005	European Commission	Eurobarometer 224/Wave 63.1: *Europeans, Science and Technology;* Eurobarometer 225/Wave 63.1: *Social Values, Science and Technology*	Various knowledge and attitude items, including public support for basic research and trust in scientists	Face-to-face interviews Multistage, random sampling	n=24,895 ± 1.9%–± 3.1%
2005	Canadian Biotechnology Secretariat	Canada-U.S. Survey on Biotechnology	Attitudes toward technology, including biotechnology and nanotechnology	RDD	Canada: n=2,000 ± 2.19%; United States n=1,200 ± 2.81%
2003	British Council, Russia	*Russian Public Opinion of the Knowledge Economy*	Various knowledge and attitude items	Paper questionnaires	n=2,107
2001	Chinese Ministry of Science and Technology	*China Science and Technology Indicators*	Various knowledge and attitude items	National in scope	n=8,350
2004	Food Policy Institute Rutgers–The State University of New Jersey	Americans and GM Food	Attitudes toward genetically modified food and mad cow disease	RDD	n=1,201 ± 3.0%
2005	The Gallup Organization	Various ongoing surveys	Public attitudes toward the environment, cloning, space exploration, belief in pseudoscience, and Internet use in China	RDD	n=1,000–1,100 ± 3.0%
2002	Harris Interactive	The Harris Poll	Prestige of various occupations, Internet use, and attitudes toward genetically modified food	RDD	n=2,415 ± 2.0%
2001	Japan National Institute of Science and Technology Policy	The 2001 Survey of Public Attitudes Toward and Understanding of Science & Technology in Japan	Various knowledge and attitude items	Face-to-face interviews Two-stage stratified random sampling	n=2,146
2004	Korea Science Foundation	Survey on Public Attitude of Science and Technology	Various knowledge and attitude items	Face-to-face interviews National, three-stage stratified random sampling	n=1,007 ± 3.1%
2000	Malaysian Science and Technology Information Centre	Public Awareness of Science and Technology	Various knowledge and attitude items	Face-to-face interviews Two stage sampling	n=5,000
2004	North Carolina State University	Public Perceptions About Nanotechnology	Attitudes toward nanotechnology	RDD	n=1,536 ± 2.5%
2004	Pew Initiative on Food and Biotechnology	Various ongoing surveys	Public attitudes toward food biotechnology	RDD	n=1,000 ± 3.1%
2004	Pew Research Center for the People and the Press	Various ongoing surveys	Media consumption and public attitudes toward technology	RDD	n=3,000 ± 3.0%
2005	Research!America	Various ongoing surveys	Public attitudes toward funding health and scientific research	RDD	n=800–1,000 ± 3.5%
2004	National Opinion Research Center	General Social Survey	Public confidence in various institutions and government funding of programs	Face-to-face interviews	n=877 ± 0.05%
2004	USC Annenberg School Center for the Digital Future	Surveying the Digital Future	Public attitudes toward the Internet and Internet use	RDD	n=2,009
2002	Virginia Commonwealth University Center for Public Policy	VCU Life Sciences Survey	Public attitudes toward scientific progress and moral values, stem cell research, and genetic testing	RDD	n=1,004 ± 3.0%

*For ongoing surveys, most recent year is shown.
RDD = random dialing computer-assisted interview survey. All RDD surveys listed above are national in scope.

Figure 7-1
Sources of information in United States: 2004



NOTES: Detail may not add to total because of rounding. Categories with <0.5% response not shown.

SOURCE: University of Michigan, Survey of Consumer Attitudes (2004). See appendix tables 7-1, 7-2, and 7-3.

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leading source and the Internet as a powerful competitor. The section also examines indicators of both the public's interest in S&T and how well informed people feel about S&T.

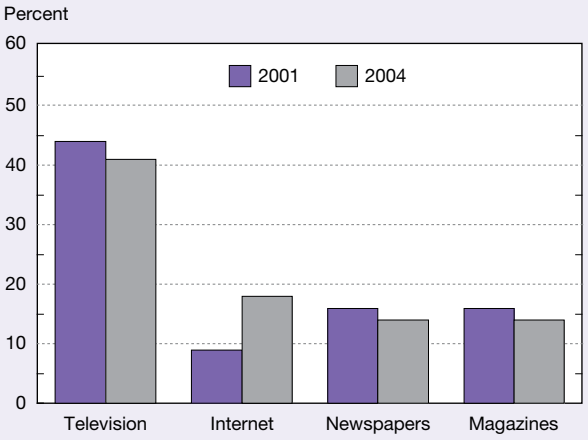
S&T Information Sources: Television Leads Worldwide

For decades now, television has been the top source of news and information in most U.S. households. (See sidebar, "Television and Other Forms of Popular Culture Influence What Adults Know and Think About Science.") The same holds true for other countries. However, the Internet has been gaining ground as a competing source of news and information for an increasing number of people throughout the world.

In the United States, in 2004, about half (51%) of those responding to an NSF-sponsored survey named television as their leading source of news about current events in general, about the same as the number (53%) recorded in 2001. In both years, newspapers and the Internet ranked second and third, respectively. However, the percentage of respondents naming newspapers as their main source of news about current events in general declined from 29% in 2001 to 22% in 2004. At the same time, those citing the Internet increased, from 7% to 12%. In fact, the Internet has been the only news medium to grow in popularity in recent years (Pew Research Center for the People and the Press 2004).

When survey respondents were asked about their leading source of news about S&T, television once again came in first, with 41% naming it in 2004. (The comparable statistic for 2001 was 44%.) The Internet was a distant second (18%), followed by newspapers (14%) and magazines (also 14%).[2] Between 2001 and 2004, the Internet went from being the fourth most popular source of news about S&T to being the second (figure 7-2).

Figure 7-2
Primary source of news about science and technology in United States: 2001 and 2004



SOURCES: National Science Foundation, Division of Science Resources Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (2001); and University of Michigan, Survey of Consumer Attitudes (2004).

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Television and Other Forms of Popular Culture Influence What Adults Know and Think About Science

Information about science is communicated to the U.S. public through several types of television programs. Educational and nonfiction shows promote science and aim to be both informative and entertaining. News programs, including national and local morning and nightly newscasts and newsmagazines, devote segments to science-related subjects and issues. In addition, entertainment programs occasionally include information about science. For example, a February 2005 episode of *The West Wing* featured storylines on stem cell research, Mad Cow Disease, and the field of economics.

A broad range of science-content programs is available on U.S. television, including Public Broadcasting Service (PBS) series (such as *Nova*) and programs for children. The vast majority of U.S. households now have cable or satellite television and therefore have access to the Discovery Channel and a growing array of options made possible by advances in digital technology. These include an increasing number of channels that devote considerable attention to science and technology and health (e.g., Discovery Health, the National Geographic Channel, the History Channel) and niche market channels (e.g., the Research Channel, the University Channel, NASA TV).

Table 7-1 is a comprehensive list of prime-time science programs on television in 2005. None of these 29 shows are on the broadcast networks (ABC, CBS, FOX, NBC, UPN, or WB) and only 3 are on PBS, the networks received by nearly all households.* The other 26 shows are all on the Science Channel, National Geographic, the History Channel, NASA TV, the Discovery Channel, Discovery Kids Network, or History International, where the number of viewers is far smaller than that of the broadcast networks. Therefore, most of the news and information the majority of adults receive about science comes from network news programs; network magazine

(continued on next page)

Table 7-1
Science programs on television: 2005

Program	Program type	Channel
Alan Alda in Scientific American Frontiers	Series science	PBS
Building the Ultimate	Limited series anthology, science	SCIENCE
Close Up	Series nature, science	NGC
Deep Sea Detectives	Series documentary, science	HISTORY
Destination Mars	Series documentary, science	SCIENCE
Discover Magazine	Series science	SCIENCE
DragonFlyTV	Series children, educational, science	PBS
Education File	Series educational, science	NASA
Gallery/History	Series science, history	NASA
ISS Mission Coverage	Series science	NASA
Living Wild	Series nature, science	NGC
Megascience	Series science	SCIENCE
MythBusters	Series documentary, science	DSC
Naked Science	Series documentary, science	NGC
National Geographic	Series anthology, nature, science	PBS
Nova	Series science, nature, anthology	PBS
Paleoworld	Series documentary, science	SCIENCE
Rough Science	Series science	SCIENCE
Science Wonders	Series science	SCIENCE
Solar Science	Series science	SCIENCE
Strange Days at Blake Holsey High	Series children, drama, science,	DCKIDS
Techknowledge	Series science	SCIENCE
The New Detectives: Case Studies in Forensic Science	Series crime, medical, science	DSC
The Planets	Limited series documentary, science	SCIENCE
This Week at NASA Education file	Series educational, science	NASA
Video File	Series news, science	NASA
Voyages	Series anthology, documentary, science	HISI
What the Ancients Knew	Limited series history, science	SCIENCE
Wild Tech	Series science	SCIENCE

DCKIDS = Discovery Kids Network; DSC = The Discovery Channel; HISI = History International; HISTORY = The History Channel; NASA = NASA TV; NGC = National Geographic Channel; PBS = Public Broadcasting Service; SCIENCE = The Science Channel

SOURCE: Rex Rivers, Land of Awes Information Services, Data Direct (Tribune Company), special tabulation.

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shows such as *60 Minutes, CBS Sunday Morning,*† and *20/20;* and the occasional network documentary.

Although television newsmagazines can be a leading source of news about science for the public, the regular audience for these shows has been declining since 1993. In that year, more than half (52%) of those surveyed by the Pew Research Center said they regularly watched "newsmagazine shows such as *60 Minutes, 20/20,* or *Dateline.*" In 2004, only 22% gave that response (Pew Research Center for the People and the Press 2004).

Local newscasts contain a relatively large number of segments about health and medicine and spend more time on the weather than any other topic. According to one report, "TV weathercasters are often the most visible representatives of science in U.S. households" (NIST 2002). They have educated the public about jet streams, fronts, barometric pressure, and environmental issues such as global climate change.

Television entertainment programs occasionally dispense information about science to the public. Because shows such as *CSI* (Crime Scene Investigation) reach relatively large audiences, many people may be educated or become aware of science and science-related issues by watching them. At the 2005 AAAS (American Association for the Advancement of Science) annual meeting, a symposium was devoted to "The CSI Effect: Forensic Science in the Public Imagination." According to the forensic scientists who participated in the event, *CSI* has sparked public interest in and respect for how science can be applied to catching criminals. In addition, universities have seen a significant increase in the numbers of students pursuing degrees in forensic sciences (Houck 2005).

Studies have also documented that young adults get much of their news from late night talk shows (Pew Research Center for the People and the Press 2004). Exposure to science takes place when these shows mention the latest scientific breakthroughs and science-related public policy issues (e.g., climate change), when scientists make occasional appearances to talk about their work, and when comedy segments revolve around science-related themes.

Entertainment television can also distort or mischaracterize science, cultivating among frequent viewers reservations about the impact of science on society, while displacing other activities (such as reading newspapers) that are valid ways of learning about science informally (Nisbet et al. 2002). For example, programs such as *Medium* that feature characters who claim to possess psychic abilities can foster or reinforce pseudoscientific beliefs (James Randi Educational Foundation 2005). Some scientists view such programs as harmful because "a misinformed public…is as worrisome as an uninformed public" (Chism 2002). In 2004, Showtime began running a series in which entertainers Penn and Teller debunk pseudoscientific beliefs. Topics covered have included mediums, alien abductions, and "even a relatively mainstream practice like feng shui" (Janzen 2004).

Other forms of popular culture, such as books and movies, also can affect what people know about science and shape their attitudes toward science-related issues. In a national survey, for example, about half of the respondents who had seen the movie *The Day After Tomorrow* said it made them more worried about global warming, although almost as many said it had had no effect on their view. However, national surveys taken before and after the movie's release did not find a significant shift in overall national opinion about global warming. One likely reason is that even very popular movies reach only a fraction of the population (Leiserowitz 2004).

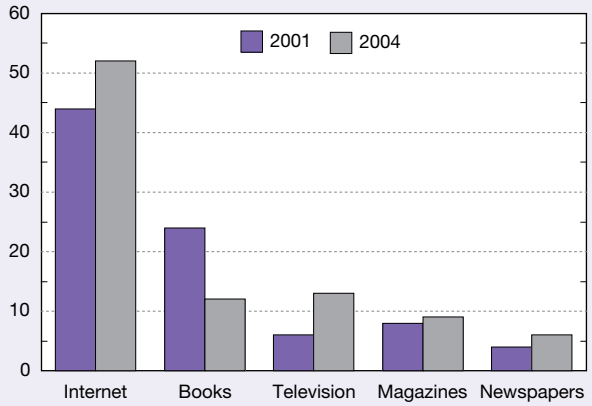
*A recent study found that CBS's coverage of biotechnology was three times as extensive as that of any other network (Kubey and Nucci 2004).

†The long-running series *Sunday Morning* almost always contains at least one segment aimed at informing the public about science. Recent topics have included nanotechnology and the controversy over the number of women who become scientists.

When people get information about science from television, they tend to do so inadvertently. That is, they pick up tidbits about science and science-related issues from watching the news or other programs that are not specifically about science (the exception would be viewers who purposefully seek out science programs such as Nova). In contrast, obtaining science information from the Internet is more likely to be purposive.[3] For example, the number of people naming the Internet as the place they would go to learn more about a scientific issue such as global warming or biotechnology rose from 44% in 2001 to 52% in 2004. Most of the gain apparently came at the expense of books. In 2001, nearly a quarter of those surveyed named books as their main source of information about a specific scientific issue. That percentage was cut in half (12%) in 2004, an indication that print materials, such as encyclopedias and other reference and technical books, are now taking a back seat to the Internet as research tools for the general public.[4] At the same time, the number naming television increased from 6% in 2001 to 13% in 2004. In both 2001 and 2004, magazines and newspapers were identified by less than 10% of those surveyed (figure 7-3).

One reason the Internet is supplanting traditional media such as print encyclopedias is that these sources are available on the Internet, where search engines have replaced thumbing through pages. For example, the *Encyclopedia Britannica* and *Encarta* are accessible online. Buying an online encyclopedia subscription has several advantages over visiting a library or purchasing the volumes. The online subscription is cheaper, more convenient, and less prone to obsolescence, and it requires no storage space. Current issues of major newspapers and newsmagazines are also available

Figure 7-3
Primary source of information about specific scientific issue: 2001 and 2004



SOURCES: National Science Foundation, Division of Science Resources Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (2001); and University of Michigan, Survey of Consumer Attitudes (2004).

Science and Engineering Indicators 2006

online. Arguably, it is easier to access the *New York Times* or *Washington Post* online than to read stories interspersed with page after page of advertisements.

According to the NSF survey data, people with more education and those with more income are less likely to rely on television as the chief source of both news in general and S&T information and more likely to use the Internet to get news and information. Also, men are more likely than women to rely on the Internet for news and S&T information. It is not surprising to find that reliance on the Internet is higher among these groups, given that they were the first to use the Internet extensively.

Television is also the leading source of news about S&T in other countries. For example, 60% of respondents to the 2001 Eurobarometer ranked television as either their first or second most important source of information on scientific developments, followed by the written press (37%), radio (27%), school or university (22%), scientific journals (20%), and the Internet (17%). In general, these preferences varied little across countries (European Commission 2001).

Similar statistics were also collected in Russia (Gokhberg and Shuvalova 2004). Once again, television was by far the leading source of news and information about S&T. (One reason television is such a dominant news source in Russia is that Internet access is relatively limited there, as in many other countries.)

In 2003, 87% of those surveyed in Russia named television as a source, compared with 82% in 1996. Newspapers and magazines also showed a gain between 1996 and 2003, from 45% to 50%. Radio ranked third (44% in 2003), followed by conversations with colleagues, friends, and family members (29%); advertising (17%); and scientific and popular science journals and books (13%). Only 6% named the Internet, and 2% named museums and S&T exhibitions. In 2003, 5% of Russians responded that they "have no concern about S&T news."

Statistics from several Asian countries show a similar pattern.[5] In Japan, 91% of those surveyed in 2001 said they obtained S&T information by watching television news. Newspaper articles ranked second, at 70%, followed by television documentary programs (53%), articles in magazines and weekly journals (35%), and conversations with friends and family (20%). Only 12% identified the Internet as a current method of obtaining S&T information, and only 2% said they read S&T magazines often. Another 16% said they read S&T magazines occasionally.

In South Korea, half of those surveyed in 2004 named television or radio as their leading means of gathering S&T information, followed by newspapers (21%), the Internet (13%), books and other publications (4%), and magazines (3%).[6]

Television is also the leading source of S&T information in China, with 83% of survey participants providing that response in 2001. Newspapers and magazines were second (52%), followed by "chatting with relatives or colleagues" (20%). Only 2% identified the Internet as a source of S&T information. Men, urban residents, and individuals with high levels of formal education were more likely than others to say they got information about S&T from books, newspapers, and magazines, and from the Internet. (See sidebar, "Internet Use Growing Rapidly in China.")

The Internet: An Increasingly Popular Source of S&T Information

According to an ongoing media consumption study, the Internet has established a foothold during the past decade as an important source of news, although "going online for the news has yet to become part of the daily routine for most Americans, in the same way as watching television news, reading the newspaper, or listening to radio news" (Pew Research Center for the People and the Press 2004).[7] In 2004, nearly three-quarters (73%) of survey respondents had a computer at home (Pew Research Center for the People and the Press 2004), up from about one-third (31%) a decade earlier (table 7-2).[8] According to NSF survey data, 70% of adults had access to the Internet at home in 2004, up from 59% in 2001. More men (74%) than women (66%) were online. In addition, 90% of college graduates had access to the Internet from home in 2004, compared with 65% of those with only a high school education and 29% of those who did not graduate from high school. Also, the higher the family income, the more likely a person was to be online in 2004.[9] (See appendix table 7-4 and sidebar, "Broadband Changes Everything.")

Trends in the Internet as a News Source

The number of people going online for news at least 3 days per week rose dramatically in the late 1990s, from 2% in 1995 to 23% in 2000, and has continued to increase during the early part of this decade, although at a much slower pace

Internet Use Growing Rapidly in China

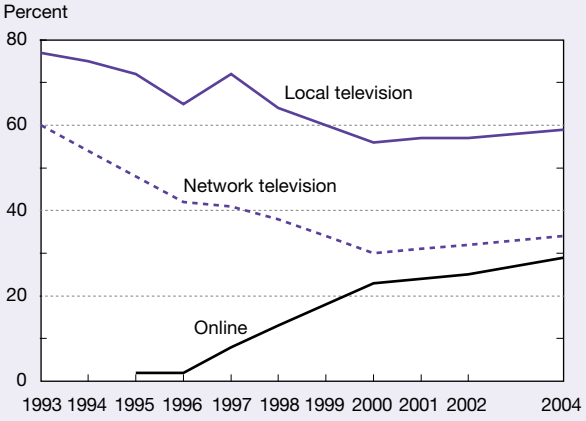
The Gallup Organization has been tracking computer and Internet use in China since 1997 (Burkholder 2005). The latest survey data show that both computer ownership and Internet use have increased substantially in that country in the past few years. By the end of 2004, 13% of Chinese households nationwide had a computer, up from 4% in 1999 and 2% in 1997. In China's 10 largest cities, 47% of households have at least one computer as of late 2004; in Beijing, the figure is 66%. About a quarter (24%) of survey respondents in late 2004 reported that they have regular access to a computer "either at home, at work, at school, or somewhere else"; among young adults (ages 18–24), the figure is 62%.

In addition, 12% of all Chinese citizens age 18 and older reported in 2004 that they have used the Internet, a major gain over the 2% figure recorded in 1999. In 1997, only 10% of Chinese adults had heard of the Internet. Not surprisingly, urban residents were far more likely than rural residents to report using the Internet (28% versus 2%, respectively). Internet use is especially common in the largest cities, such as Beijing (47%) and Shanghai (36%). Young adults (ages 18–24) in urban areas are far more likely to use the Internet than those age 40 and older (74% versus 5%, respectively).

About 7% of Chinese households had in-home broadband service in late 2004; the proportion is much higher in Beijing (38%) and Shanghai (32%). When asked what they used the computer for, the most frequent response was to access news (72%), followed by to obtain reference information (63%) and other general information such as sports and weather (59%).

(Pew Research Center for the People and the Press 2004). In 2004, 29% of those surveyed said that they went online for news at least 3 times per week (figure 7-4). In addition, online newspaper readership has been rising steadily since 2001 (Cole 2004).

Figure 7-4
Use of broadcast versus online news: 1993–2004



NOTE: Online news obtained at least 3 days per week.

SOURCE: Pew Research Center for the People and the Press, Biennial Media Consumption Survey (2004).

Science and Engineering Indicators 2006

Characteristics of Internet News Users

Internet news audiences tend to be younger, more affluent, and better educated than the population as a whole. They are also more likely to be male, although the gender gap has narrowed in recent years, as has the racial divide. Between 2002 and 2004, the proportion of African Americans going online for news at least 3 days per week increased from 15% to 25%. The increase was similar in the Hispanic community, from 22% in 2002 to 32% in 2004 (Pew Research Center for the People and the Press 2004).

Education has always been the most important determinant of online news use. At least half of college graduates use the Internet for news on a regular basis, compared with less than one-fifth of high school graduates and less than one-tenth of those who did not finish high school. Little growth has occurred in Internet news use among those without a college degree, regardless of age or sex (Pew Research Center for the People and the Press 2004).

Table 7-2
Ownership of home computers: Selected years, 1994–2004

Response	1994	1995	1998	2000	2002	2004
Yes	31	36	43	59	65	73
No	69	64	57	41	35	27

NOTES: Responses to: *Do you have any type of personal computer, including laptops, in your home?* Before 2002, question also said: *These do not include game machines such as Nintendo or Sega*. Before 2000, wording was: *Do you have any type of personal computer, including laptops, such as an IBM PC or a Macintosh, in your home?*

SOURCE: Pew Research Center for the People and the Press, NII/Entertainment Media Survey (March 2005).

Science and Engineering Indicators 2006

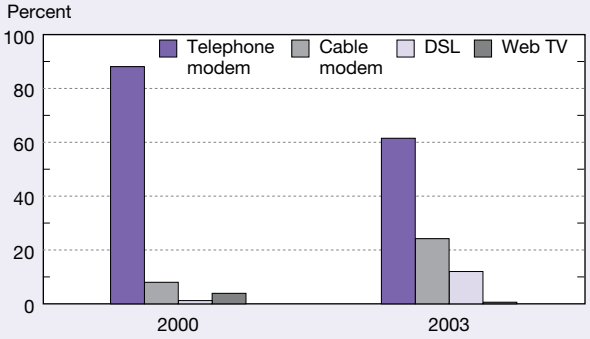
Broadband Changes Everything

The most notable finding of recent surveys on Internet use is the large gain in the number of households with broadband connections. In 2002, less than one-fourth (22%) of adults who went online had broadband. By late 2003, the proportion had grown to 37%. In mid-2004, the statistic was approaching one-half (44%) (Harris Interactive 2004c). Similarly, data from the Pew Research Center show that 49% of those surveyed in 2004 had a high-speed connection from home.

Another survey has been tracking Internet use since 2000 (Cole 2004). The survey has produced statistics documenting the increase in the number of households with broadband connections (figure 7-5).

According to one expert, "broadband changes everything" (Cole 2004). The differences between people with broadband and those with dial-up connections are greater than the differences between those with dial-up connections and those who do not use the Internet at all. How often people log on, how long they stay on, what they do online, and where they log on from are all related to whether or not they have a broadband connection. On average, broadband users are online 17.3 hours a week, compared with 10.6 hours for dial-up users. They do more of everything online, except seeking medical information and participating in distance learning. In particular, broadband users are more likely than telephone modem users to say that the Internet is a very important or extremely important source of information. For young people especially, online media usage is very high (Cole 2004).

Figure 7-5
Households with broadband versus other Internet connections: 2000 and 2003



SOURCE: J. Cole, *Surveying the Digital Future: Year Four: Ten Years, Ten Trends* (2004), http://www.digitalcenter.org/downloads/DigitalFutureReport-Year4-2004.pdf.

Science and Engineering Indicators 2006

Categories of News Sought Online

Weather has been the most popular category of news sought online since 2000, with more than three-fourths (76%) of those surveyed in 2004 saying that they sought that kind of information (table 7-3).[10] Science and health has been the second most popular category in every year of the survey except 1998 (when it led the other groups).[11] The types of science-related information sought online seem to be of a practical, personally relevant nature. People do not seem to be very curious about scientific research or policy-related issues.

In 1996, when data collection on Internet news began, technology was the most popular topic: 64% of those surveyed in 1996 said that they sought news about technology. However, as more people go online for news, technology has slipped in ranking: in 2004, it ranked fifth. Since the 2000 survey, the number of people going online for international and political news has grown. The 2000 and 2004 presidential elections, the events of September 11, 2001, and the subsequent wars in Afghanistan and Iraq generated increased interest in political and international news (Pew Research Center for the People and the Press 2004).

Internet users and nonusers have different news interests. In 2004, Internet users were more likely than nonusers to be interested in news about political figures and events in Washington, international affairs, S&T, and culture and the arts, and they were less likely than nonusers to be interested in news about weather, crime, health, local government, and religion. Among Internet users, 18% said they followed news about S&T very closely, compared with 13% of nonusers (table 7-4).

Public Interest in S&T

Most Americans say they are interested in S&T. When asked in a survey about their interest in S&T issues, very few adults admit to not being interested in these subjects. That was the usual pattern in NSF surveys conducted between 1979 and 2001. Similar surveys conducted in other countries indicate that the overall level of public interest in S&T is less than that in the United States. However, Americans may not be as interested in S&T as they claim. Indicators from other surveys point to relatively little interest in S&T topics and news.

Interest in S&T Around the World

Surveys conducted by NSF and other organizations consistently show that Americans are interested in issues related to S&T. In 2001, about 45% of NSF survey respondents said they were very interested in new scientific discoveries and the use of new inventions and technologies. About the same number said they were moderately interested in these subjects. Only about 10% were not interested at all.[12]

In Europe in 2005, 30% of survey respondents said they were very interested in new scientific discoveries and new inventions and technologies, about half (48%) said they

Table 7-3
Use of Internet as source of news: Selected years, 1996–2004
(Percent)

Type of news	1996	1998	2000	2002	2004
Weather	47	48	66	70	76
Science and health	58	64	63	60	58
International	45	41	45	55	54
Political	46	40	39	50	54
Technology	64	60	59	54	53
Business	53	58	53	48	46
Entertainment	50	45	44	44	46
Sports	46	39	42	47	45
Local	27	28	37	42	45

NOTE: Data reflect respondents who said they go online for news.

SOURCE: Pew Research Center for the People and the Press, Biennial Media Consumption Survey (2004).

Science and Engineering Indicators 2006

Table 7-4
News followed by American public, by Internet user status: 2004
(Percent)

Type of news	All respondents	Use Internet	Do not use Internet
Weather	53	49	60
Crime	32	29	36
Community	28	27	29
Health	26	23	31
Sports	25	25	23
Washington news	24	26	22
International affairs	24	26	19
Local government	22	20	24
Religion	20	17	26
Science/technology	16	18	13
Entertainment	15	14	15
Business/finance	14	15	13
Consumer news	13	12	14
Culture and arts	10	12	8

SOURCE: Pew Research Center for the People and the Press, Biennial Media Consumption Survey (2004).

Science and Engineering Indicators 2006

were moderately interested in these subjects, and one-fifth said they were not at all interested. There was considerable variation in interest across countries, and the overall level of interest was down somewhat from 1992, the last time these questions were asked. The reasons cited most often for disinterest in S&T were lack of understanding and lack of concern (European Commission 2005a).

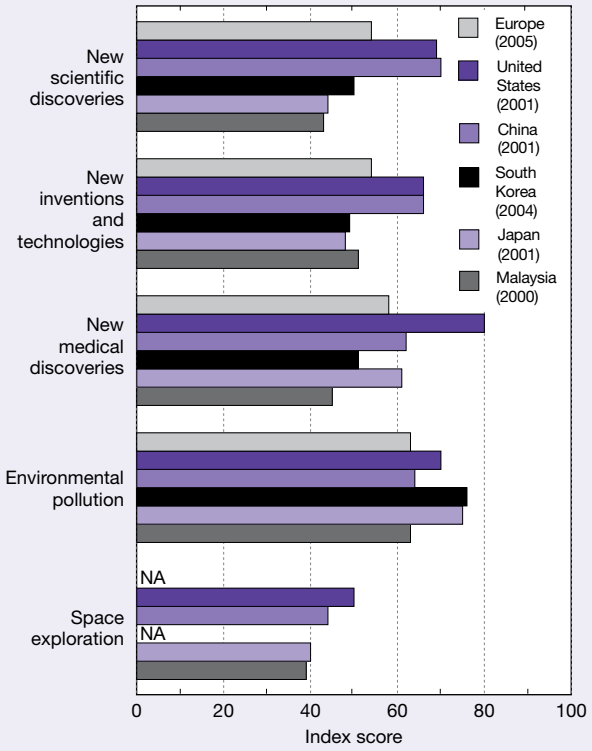
U.S. and European findings coincided in two areas: more men than women expressed an interest in S&T, and respondents were more interested in medicine and the environment than in S&T in general. However, the number of Europeans claiming to be very interested in new medical discoveries and environmental pollution declined significantly between 1992 and 2005 (European Commission 2005a).

Like Americans, Russians are more interested in "achievements in medicine" than in any other issue. In a group of 13 items in a 2003 survey of public interests, scientific discoveries and new inventions and technologies ranked seventh and ninth, respectively, after international affairs, the economy and business, environmental issues, education, and problems of age and life expectancy. However, interest in both issues increased between 1996 and 2003 (Gokhberg and Shuvalova 2004).

Citizens in several Asian countries seem to express less interest than Americans and Europeans in S&T (the Chinese are a notable exception). In 2001, the average levels of U.S. public interest in new scientific discoveries and the use of new inventions and technologies were, on a scale of 0–100, 69 and 66, respectively. The comparable numbers were much lower for Japan, South Korea, and Malaysia. However, the levels for China were about the same as those for the United States (figure 7-6; appendix table 7-5).

Interest in new medical discoveries seems to be much lower in Asian countries than in the West. In the United States in particular, nearly everyone is interested in new medical discoveries. Year after year, more people expressed interest in this subject than in any other. For example, in 2001, about two-thirds of the NSF survey respondents

Figure 7-6
Level of public interest in science and technology issues, by country/region: Most recent year



NA = not available

NOTES: Responses to: *There are a lot of issues in the news, and it is hard to keep up with every area. I'm going to read you a short list of issues, and for each one—as I read it—I would like you to tell me if you are very interested, moderately interested, or not at all interested.* "Don't know" responses not included. All responses converted to 0–100 scale, with 100 for very interested, 50 for moderately interested, and 0 for not interested. In China, values assigned were 100 for great interest, 67 for fair interest, 33 for not much interest, and 0 for not interested. In Malaysia, values assigned were 100 for interested, 67 for moderately interested, 33 for slightly interested, and 0 for not interested. Indices were obtained by adding all the values for each policy issue and computing average. Detail may not add to total because of rounding.

SOURCES: National Science Foundation, Division of Science Resources Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (2001); Chinese Ministry of Science and Technology, *China Science and Technology Indicators 2002* (2002); Korea Science Foundation, Survey on Public Attitude of Science & Technology 2004 (2004); National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, The 2001 Survey of Public Attitudes Toward and Understanding of Science & Technology in Japan (2002); Malaysian Science and Technology Information Centre, Ministry of Science, Technology and the Environment, *The Public Awareness of Science and Technology Malaysia 2000* (2001); and European Commission, Research Directorate-General, Eurobarometer 224/Wave 63.1: *Europeans, Science and Technology* (2005). See appendix table 7-5.

Science and Engineering Indicators 2006

reported they were "very interested" in new medical discoveries. (None of the other survey items, except local school issues, received such a high percentage of "very interested" responses.)[13] In the U.S. survey, new medical discoveries is the only item that has consistently produced interest index scores in the 80s. In contrast, it yielded much lower scores in the four Asian countries.

Interest in environmental pollution is high in most countries, including the United States, where the index score for this item was 70 in 2001. However, more recent data seem to indicate that interest may have waned during the first part of this decade (see "Environmental Issues" section in this chapter). In both South Korea and Japan, where pollution is an increasingly serious problem, environmental pollution issues attract more public interest than other S&T issues. China also had a relatively high index score for environmental issues. However, in Russia, interest in environmental issues declined between 1996 and 2003 (Gokhberg and Shuvalova 2004).

Despite all the newsworthy events taking place in space during the past few years, interest in issues related to space exploration is relatively low in all of the countries surveyed. The topic ranked at or near the bottom in the United States, Europe (in 2001), Russia, China, and Japan.

Attention to S&T News

Despite the American public's professed interest in S&T issues, there is reason to believe that interest may not be as strong as the NSF survey data indicate. Since 1986, the Pew Research Center for the People and the Press has maintained a news interest index. For a story to be included in the list of top news items, at least 1% of those surveyed had to say that they were following the story "very closely." Relatively few S&T-related stories have made the list. (See sidebar, "Few Science-Related News Stories Attract Public Interest.")

A Pew Research Center survey also shows that weather is by far the most popular type of news followed by most Americans.[14] The other types of news tracked most closely by Americans in 2004 were crime, community affairs, health, and sports.[15] S&T ranked tenth, lower than all other categories except entertainment, business and finance, consumer news, and culture and arts. Only 16% of those surveyed said that they followed news about S&T very closely. (See table 7-6.) However, S&T ranked higher (fifth) among college graduates, after weather, international affairs, national political news, and health. In contrast, the top categories among those who did not graduate from college were weather, crime, community, health, and sports.

Men and adults ages 30–64 were more likely than others to say that they followed S&T news very closely. The breakdown by race and ethnicity is similar to that for all respondents, with one exception: Asian Americans were disproportionately more likely than others to say that they followed S&T news very closely (Pew Research Center for the People and the Press 2004).

Visits to Museums, Zoos, and Libraries

Interest in news about S&T is only part of the story. The millions of people who visit science museums every year are also demonstrating interest in science without necessarily being interested in science news.

Surveys show that S&T museums are more popular in the United States than in other countries. In 2001, 30% of NSF survey respondents said they had visited such a museum in

Few Science-Related News Stories Attract Public Interest

For nearly two decades, the Pew Research Center for the People and the Press has been tracking news stories that attract public interest. Of the approximately 1,100 most closely followed news stories of 1986–2004, not many had anything to do with science and/or technology. And, of the few that did, most were about weather and other types of natural disasters (such as earthquakes) and health-related subjects—not about scientific breakthroughs and technological advances. It should be noted, however, that an engineering/technology story actually does top the list. In July 1986, 80% of those surveyed said they were closely following news about the explosion of the space shuttle Challenger, not a natural disaster, but a manmade one. Similarly, the loss of the space shuttle Columbia was one of the most closely followed news stories of 2003.

Table 7-5 lists the most closely followed S&T-related stories of 2000–2004 (Pew Research Center for the People and the Press 2005). Weather and health-related news dominate the list. In fact, hurricane news was the leading science-related news story in both 2002 and 2003.

In addition to the relatively small number of S&T news stories on the Pew list, interest in S&T news may have declined after 2001: only 4 stories were added to the list in 2002, 6 in 2003, and 4 in 2004 (3 of those occurred in late 2003), compared with 10 in 2000 and 12 in 2001.

Table 7-5
Science/technology-related news stories attracting most public interest: 2000–04

Subject	Public interest	Date question asked
Hurricane Isabel	47	Sep-03
Reports of anthrax in United States[a]	47	Nov-01
Space shuttle Columbia disaster	46	Feb-03
Firestone tire recall	42	Jan-01
Winter weather in Northeast and Midwest	42	Jan-01
Flu outbreak and shortage of vaccine	41	Dec-03
Reports of anthrax in United States[a]	41	Nov-01
SARS spread from Asia	39	May-03
Hurricanes in Louisiana and Gulf of Mexico	38	Oct-02
Cases of West Nile virus	34	Sep-02
Bush decision on stem cell research	1	Aug-01
Mad Cow Disease in Washington State	29	Jan-04
Federal ruling on Microsoft	28	Jun-00
SARS spread from Asia	28	Jun-03
Food and Drug Administration's decision on RU-486	26	Oct-00
Missing Los Alamos computer files	25	Jun-00
Outbreak of foot-mouth in Europe	22	Mar-01
Midwest floods	20	Apr-01
Droughts in United States	19	Apr-02
Landing of spacecraft on Mars	19	Jan-04
Reports on AIDS in Africa	19	Jul-00
Worldwide AIDS epidemic	19	Aug-01
Hackers attacking websites	18	Feb-00
Mad Cow Disease in Europe	18	Aug-01
AOL–Time Warner merger	17	Jan-00
Earthquake in Iran	16	Jan-04
Government's plan for Microsoft	16	May-00
Mapping human genetic code	16	Jul-00
Earthquake in India	15	Feb-01
Missile defense system	15	May-01
Oil spill off coast of Spain	15	Dec-02
Reports of cloned baby by religious cult	14	Jan-03
Court ruling in Microsoft case	13	Apr-00
Ricin found in Senate office building	12	Feb-04
Floods in Mozambique	10	Mar-00
United Nations' special session on HIV/AIDS	6	Jul-01

[a]Two separate surveys in November 2001 by the Pew Research Center asked about reports of anthrax.

NOTE: Data reflect respondents who said they followed story very closely.

SOURCE: Pew Research Center for the People and the Press, News Interest Index, Public Attentiveness to News Stories: 1986–2004 (2005).

Science and Engineering Indicators 2006

Table 7-6
News followed very closely by American public: Selected years, 1996–2004
(Percent)

Type of news	1996	1998	2000	2002	2004
Weather	NA	NA	NA	NA	53
Crime	41	36	30	30	32
Community	35	34	26	31	28
Health	34	34	29	26	26
Sports	26	27	27	25	25
Washington news	16	19	17	21	24
International affairs	16	16	14	21	24
Local government	24	23	20	22	22
Religion	17	18	21	19	20
Science and technology	20	22	18	17	16
Entertainment	15	16	15	14	15
Business and finance	13	17	14	15	14
Consumer news	14	15	12	12	13
Culture and arts	9	12	10	9	10

NA = not available

SOURCE: Pew Research Center for the People and the Press, Biennial Media Consumption Survey (2004).

Science and Engineering Indicators 2006

the last 12 months, compared with 16% of Europeans (in 2005), 13% of Japanese, 14% of Chinese, and 1% of Russians (2003).

Although the rate of S&T museum attendance in Europe seems to be about half that in the United States, the 2005 rate for Europe was about 50 percent higher than that recorded in 2001 (European Commission 2005a). When Europeans who had not visited an S&T museum were asked their reasons, about one-third said they "don't understand" S&T, and an approximately equal number said they "did not care" about S&T (European Commission 2005a). Within Europe, Sweden, Norway, Switzerland, Luxembourg, and Iceland have the highest rates of S&T museum attendance (appendix table 7-6).

S&T museums are not the only public attractions that are less popular in other countries than in the United States. More than half (58%) of Americans reported that they had visited a zoo or an aquarium during the past 12 months, compared with 43% of the Japanese respondents, 32% of Chinese, 27% of Europeans, and 9% of Russians.

Americans also go to libraries more often than the citizens of other countries and are more likely than Europeans (other than citizens of Iceland, Denmark, the Netherlands, Sweden, Switzerland, Norway, and Finland) to visit an art gallery. Finally, only 14% of the Americans surveyed said they had not visited any of the establishments included in the survey, compared with 4 of 10 Europeans (41%) and 7 of 10 Russians (71%) (European Commission 2005a; Gokhberg and Shuvalova 2004).

Feeling Well Informed About S&T Issues

Despite the public's expression of interest in S&T, few people feel well informed about these subjects. In 2004, only about 15% of NSF survey respondents described themselves as very well informed about new scientific discoveries and the use of new inventions and technologies. About one-third of those surveyed considered themselves poorly informed about these topics (appendix table 7-7).[16]

Among the issues included in the survey, Americans feel the most informed about local school issues and the economy and business conditions. In 2004, the index scores for these two topics (on a scale of 0–100) were 56 and 51, respectively. Five items (new medical discoveries, environmental pollution, military and defense policy, new scientific discoveries, and the use of new inventions and technologies) had index scores between 40 and 46. Space exploration had the second lowest index score (36) in 2004 (appendix table 7-8).

For 8 of the 10 issues included in the NSF survey, men were more likely than women to feel well informed. Among the science-related issues, the widest gender gap (14 points) was for space exploration; the gap for the use of new inventions and technologies, new scientific discoveries, and environmental pollution was 10, 5, and 3 points, respectively. In contrast, women were more likely than men to feel well informed about new medical discoveries (appendix table 7-9).

With few exceptions, the NSF survey data show a strong, positive relationship between education (both level of formal education and number of math and science courses completed) and feeling well informed about public policy issues. This is particularly true for four of the five science-related issues in the survey (the relationship between education and feeling well informed about new medical discoveries was not as strong as that for the other four issues). In contrast, the relationship between family income and feeling well informed about science-related public policy issues is either much weaker (than that for education) or nonexistent (appendix table 7-9).

Survey data from several Asian countries, Europe, and the United States indicate that, compared with the citizens of Japan, Malaysia, and South Korea, Americans and Europeans consistently feel better informed about science-related

issues, with one exception: environmental pollution. However, it is difficult to draw definitive conclusions from these data because the citizens of other countries may have different reference points for describing their level of knowledge.

Analysis of data from the United States, Europe, and four Asian countries (China, Japan, South Korea, and Malaysia) revealed similar relationships between interest in S&T and feeling informed. In all of these countries, the level of feeling informed about S&T is considerably lower than the level of professed interest in S&T issues, although the level of feeling informed about a specific issue is positively related to the level of interest in the same issue (Park 2005).

Public Knowledge About S&T

U.S. middle and high school students may not do as well in math and science as their counterparts in some other countries (see chapter 1, "Elementary and Secondary Education"). U.S. *adults,* however, seem to be slightly or somewhat more knowledgeable about science than their counterparts in other countries.

It is important to have some knowledge of basic scientific facts, concepts, and vocabulary. Those who possess such knowledge are able to follow science news and participate in public discourse on science-related issues. Having appreciation for the scientific process may be even more important. Knowing how science works, i.e., understanding how ideas are investigated and either accepted or rejected, is valuable not only in keeping up with important science-related issues and participating meaningfully in the political process, but also in evaluating and assessing the validity of various types of claims people encounter on a daily basis (including those that are pseudoscientific) (Maienschein 1999).

Surveys conducted in the United States and other countries reveal that most citizens do not have a firm grasp of basic scientific facts and concepts, nor do they have an understanding of the scientific process. In addition, belief in pseudoscience seems to be widespread, not only in the United States but in other countries as well. This section explores these three indicators of scientific literacy. (Scientific literacy is defined here as knowing basic facts and concepts about science and having an understanding of how science works.)[17]

Understanding Scientific Terms and Concepts

International Patterns and Trends

A substantial number of people throughout the world appear to be unable to answer simple, science-related questions (figure 7-7; appendix table 7-10). Many did not know the correct answers to several (mostly) true/false questions designed to test their basic knowledge of science.

U.S. data do not show much change over time in the public's level of knowledge about science. In contrast, the most recent European data do show an increase. Belgium, Germany, Ireland, Luxembourg, and the Netherlands recorded double-digit increases in the percentage of correct responses between 1992 and 2005, and most other European countries also recorded gains. There is considerable variation in science knowledge across countries in Europe.[18]

Knowledge scores were especially low in China and Russia. For example, in China, less than half the respondents answered "true" to the statements "the center of the Earth is very hot" and "the continents on which we live have been moving their location for millions of years and will continue to move in the future."[19] In contrast, substantial majorities of the respondents in most other countries answered these questions correctly (the question on the center of the earth was not asked in Russia).[20]

On two questions, U.S. survey participants did considerably better than their counterparts in other countries:

- More than 70% of Americans correctly answered "false" to the statement "all radioactivity is manmade." In the other countries, the percentage of correct responses was considerably lower.
- Only in the United States, Europe, and South Korea did a majority correctly answer true to the statement "it is the father's gene that decides whether the baby is a boy or a girl." The percentage of correct responses in other countries ranged from 46% for Malaysia to 22% for Russia. In addition, the number of Europeans who answered this question correctly increased significantly between 2001 and 2005.

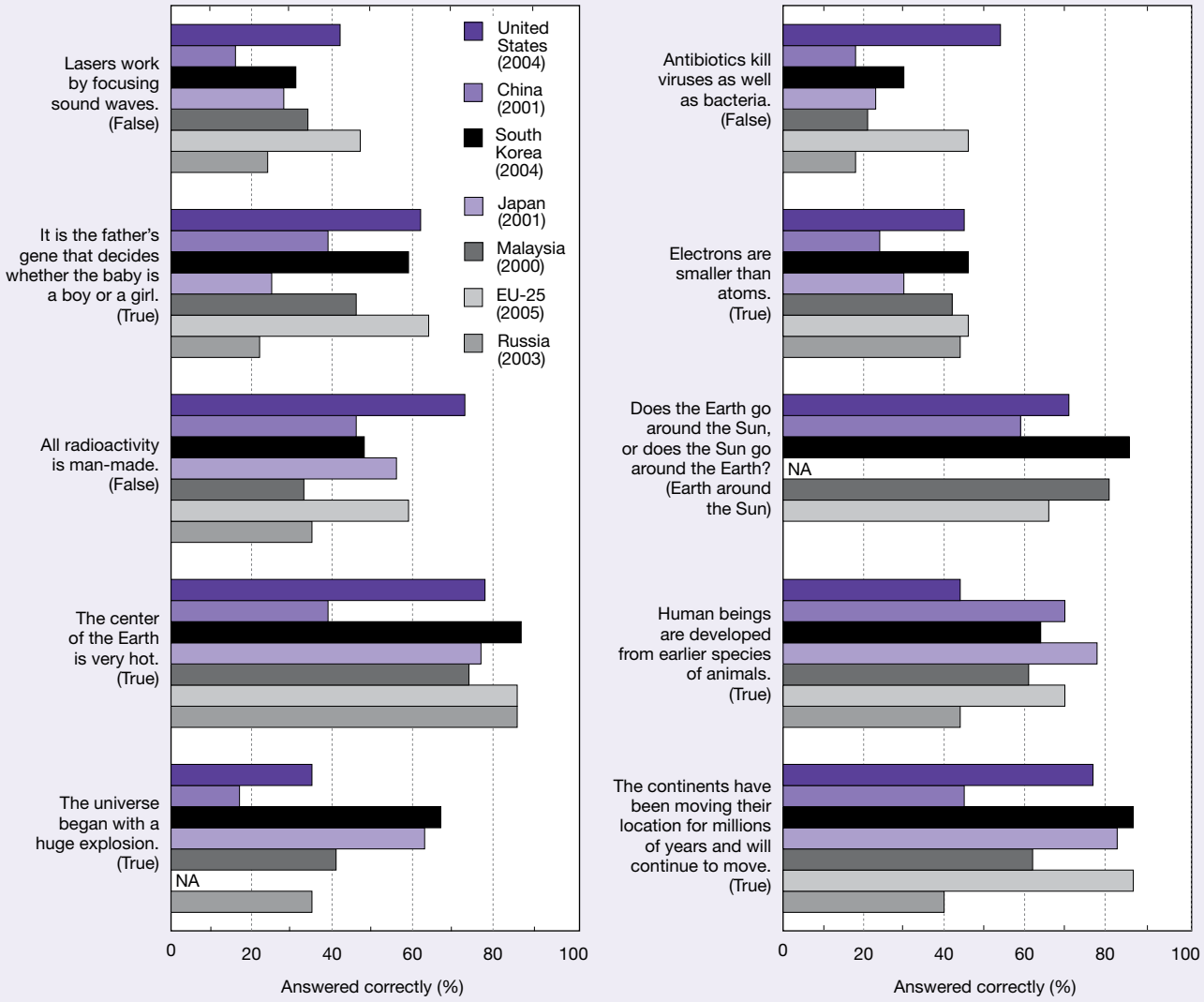
Less than half the respondents in each country knew that "lasers [do not] work by focusing sound waves." In contrast, most people seem to know that the Earth goes around the Sun (and not vice versa).

One question in particular shows a notable increase in the percentage of correct responses in both the United States and Europe: more people now know that antibiotics do not kill viruses. In 2001, for the first time, a majority (51%) of U.S. respondents answered this question correctly, up from 40% in 1995. In the United States, correct responses increased to 54% in 2004. In Europe, 46% of respondents answered the question correctly in 2005, compared with 40% in 2001 and only 27% in 1992.

The U.S. survey is the only one in which at least half the participants answered the question about antibiotics and viruses correctly. After Europe, the next highest percentage of correct responses was in South Korea (30%), followed by Japan (23%) and Malaysia (21%). Less than one in five Russian and Chinese respondents (18%) knew that antibiotics do not kill viruses.

The promising trend in knowledge about antibiotics and viruses in the United States and Europe suggests that a public health campaign to educate the public about the increasing resistance of bacteria to antibiotics has been working. This problem has been the subject of widespread media coverage, and when stories mention that the main culprit is the overprescribing of antibiotics, they typically note the fact that antibiotics are ineffective in killing viruses. In addition, parents of young children, especially those prone to ear infections,

Figure 7-7
Correct answers to specific science literacy questions, by country/region: Most recent year



EU = European Union; NA = not available

SOURCES: University of Michigan, Survey of Consumer Attitudes (2004); Chinese Ministry of Science and Technology, Public scientific literacy and attitudes towards S&T, *China Science and Technology Indicators 2002* (2002); Korea Science Foundation, Survey on Public Attitude of Science & Technology 2004 (2004); National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, The 2001 Survey of Public Attitudes Toward and Understanding of Science & Technology in Japan (2002); Malaysian Science and Technology Information Centre, Ministry of Science, Technology and the Environment, *The Public Awareness of Science and Technology Malaysia 2000* (2001); L. Gokhberg and O. Shuvalova, *Russian Public Opinion of the Knowledge Economy: Science, Innovation, Information Technology and Education as Drivers of Economic Growth and Quality of Life,* British Council, Russia (2004); and European Commission, Research Directorate-General, Eurobarometer 224/Wave 63.1: *Europeans, Science and Technology* (2005).

Science and Engineering Indicators 2006

have been warned by their pediatricians about this problem. However, the message still has not reached a large segment of the population throughout the world.

Americans apparently are also becoming more familiar with the terminology of genetics. In a 2001 NSF survey, 45% of respondents were able to define DNA. The percentage of correct responses to this survey question increased in the late 1990s, a trend that probably reflected heavy media coverage of DNA use in forensics and medical research. More recently, a 2003 Harris poll found that 60% of adults in the United States selected the correct answer when asked "what is DNA?" (the genetic code for living cells), and two-thirds chose the right answer when asked "what does DNA stand for?" (deoxyribonucleic acid) (kSERO Corporation, Inc. 2003). As mentioned earlier in the chapter, a popular television entertainment show such as *CSI* increases public understanding of DNA (see sidebar, "Television and Other Forms of Popular Culture Influence What Adults Know and Think about Science.")

In the United States, knowledge about science is positively related to level of formal schooling, income level, and number of science and math courses taken. In addition, younger respondents and those without minor children at home were more likely than others to have answered the questions correctly. Finally, men seem to be more knowledgeable about science than women: in 2004, men scored an average of 65%, compared with 55% for women (appendix tables 7-11 and 7-12).

Evolution and the "Big Bang"

Americans were less likely than residents of other countries to answer "true" to the following scientific knowledge questions: "human beings, as we know them today, developed from earlier species of animals" and "the universe began with a huge explosion." In the United States, 44% of the respondents in an NSF-sponsored survey answered "true" to the first question in 2004, about the same level recorded in every year (except one) that the question has been asked. In contrast, 78% of Japanese respondents answered "true," as did 70% of the Chinese and European respondents and more than 60% of the South Korean and Malaysian respondents. Only in Russia did less than half (44%) of respondents answer "true." Similarly, Americans were less likely than other survey respondents (except the Chinese) to answer "true" to the "big bang" question.

U.S. responses to questions about evolution and the big bang appear to reflect more than unfamiliarity with basic elements of science. The 2004 Michigan Survey of Consumer Attitudes administered two different versions of these questions to different groups of respondents. Some were asked questions that tested knowledge about the natural world ("human beings, as we know them today, developed from earlier species of animals" and "the universe began with a big explosion"). Others were asked questions that tested knowledge about what a scientific theory asserts or a group of scientists believes ("according to the theory of evolution, human beings, as we know them today, developed from earlier species of animals" and "according to astronomers, the universe began with a big explosion"). Respondents were much more likely to answer correctly if the question was framed as about scientific theories or beliefs rather than as about the natural world. When the question about evolution was prefaced by "according to the theory of evolution," 74% marked true; only 44% marked true when it was not. Similarly, 62% agreed with the prefaced question about the big bang, but only 35% agreed when the prefatory phrase was omitted. These differences probably indicate that many Americans hold religious beliefs that cause them to be skeptical of established scientific ideas, even when they have some basic familiarity with those ideas.

Surveys conducted by the Gallup Organization provide similar evidence. An ongoing Gallup survey, conducted most recently in 2004, found that only about a third of Americans agreed that Darwin's theory of evolution has been well supported by evidence (Newport 2004).[21] The same percentage agreed with the alternative statement that Darwin's theory was not supported by the evidence, and an additional 29% said they didn't know enough to say. Data from 2001 were similar. Those agreeing with the first statement were more likely than others to be men, well educated (65% of those with postgraduate education and 52% of those with a bachelor's degree), and live in the West (47%) or East (42%).

In response to another group of questions on evolution asked by Gallup in 2004, about half (51%) of those surveyed agreed with either of two statements compatible with evolution: that human beings developed over millions of years either with or without God's guidance in the process. However, 45% agreed with a third statement, that "God created human beings pretty much in their present form at one time within the last 10,000 years or so." These views on the origin of human beings have remained virtually unchanged (in six surveys) since the questions were first asked in 1982 (Newport 2004).

During most of the 20th century, probably the most contentious issue related to the teaching of science has been whether and how evolution is to be taught in U.S. public school classrooms.[22, 23] The controversy has continued in the new millennium, erupting in quite a few states, including Georgia and Pennsylvania, and making front-page headlines in major newspapers.[24] A survey conducted in 2005 revealed that Americans have been paying fairly close attention to newspaper and television news coverage about teaching alternatives to evolution (Nisbet and Nisbet 2005). Contention about this issue also surfaced in England in 2001 and in the Netherlands in 2005. (See sidebar, "More Than a Century After Darwin, Evolution Still Under Attack in Science Classrooms")

Understanding the Scientific Process

NSF has used three survey items to assess "public understanding of the nature of scientific inquiry," i.e., how well people understand aspects of the scientific process. Understanding how science works is a major indicator of scientific literacy. Based on their responses to the three inquiry items, many Americans appear not to have a firm grasp of the nature of the scientific process. The same is true of Europeans.

In 2001, both the NSF survey and the Eurobarometer asked respondents questions designed to test their knowledge of two important aspects of scientific literacy: how an experiment is conducted and their understanding of probability.[25] Only 43% of Americans and 37% of Europeans answered the experiment question correctly. Both groups did better with probability: 57% of Americans and 69% of Europeans answered that question correctly. In 2004, 46% of Americans answered the experiment question correctly, and 64% gave a correct answer to the probability questions (appendix table 7-13). NSF survey respondents were also asked to explain in their own words what it means to study something scientifically. In 2004, only 23% of respondents gave a response that indicated they knew what it meant.[26]

More Than a Century After Darwin, Evolution Still Under Attack in Science Classrooms

In 1999, the Kansas State Board of Education decided to delete evolution from the state's science standards. The action received widespread press coverage and sparked an outcry in the science community. Most of the public also disagreed with the decision, which was reversed after board members who had voted for the change were defeated in the next election.

Thus began another round of attacks on the teaching of evolution in public school classrooms. Similar eruptions have been occurring since the landmark 1925 Scopes "monkey" trial. Although Tennessee teacher John Scopes was convicted, science ended up being the true victor, according to the history books and thanks to the play *Inherit the Wind.* The next milestone occurred in 1987 when the Supreme Court struck down a Louisiana law that prohibited the teaching of evolution unless equal time was given to creationism.

The National Center for Science Education (NCSE) tracks attacks on the teaching of evolution in the United States and around the world. In general, the recent controversies have come from two directions: a push to introduce "intelligent design" in science classrooms as a viable alternative to evolution* and efforts to add evolution disclaimers to science textbooks. Recently, legislatures or school boards in about 20 states have considered allowing the teaching of alternatives to evolution in science classrooms. Controversies making national headlines include the following:

- In October 2004, the Dover, Pennsylvania, school district became the first in the nation to require that ninth-graders be told about intelligent design in biology class. The decision triggered a lawsuit. The parents of several students are suing the school board; the American Civil Liberties Union and Americans United for the Separation of Church and State are representing them. The trial is scheduled for September 2005.
- Six years after the initial controversy, Kansas is once again taking up the issue. This time, the state education board is considering adding intelligent design to its science standards. Representatives of the scientific community boycotted hearings on the subject, held in May 2005, because "participating in them would only strengthen the idea in some minds that there was a serious debate in science about the power of the theory of evolution" (Dean 2005). The final vote on the Kansas science standards is also scheduled for September 2005.
- In 2002, the school board in Cobb County, Georgia, decided that every biology textbook in the state would have a sticker declaring that "evolution is a theory, not a fact, regarding the origin of living things." A lawsuit was filed by parents of the students, and a trial was held in late 2004. In January 2005, the judge in the case ruled the evolution disclaimer unconstitutional and ordered the stickers removed. The school district is appealing the decision. Currently, Alabama is the only state requiring evolution disclaimer stickers on biology textbooks.

In addition to the way science is taught (or not taught) in classrooms,† battles over other issues have erupted in other places in recent years:

- In several cities, IMAX theaters have declined to screen films such as *Cosmic Voyage, Galapagos,* and *Volcanoes of the Deep Sea* because of community opposition to the films' treatment of evolution as fact (Dean 2005).
- Several science organizations protested the sale of a book promoting creationism, *Grand Canyon: A Different View at the Grand Canyon,* at the National Park Service bookstore. The National Park Service is reviewing the issue.
- The Smithsonian Institution screened the film *The Privileged Planet* in June 2005, but not before drawing criticism from a variety of science organizations because the authors of the book on which the film is based are affiliated with a pro-intelligent-design think tank. After the protests, the museum withdrew its cosponsorship and returned the organization's donation because it "determined that the content of the film is not consistent with the mission of the Smithsonian Institution's scientific research."
- In June 2005, the Park and Recreation Board of Tulsa, Oklahoma, voted to approve a display depicting the Biblical account of creation at the city's zoo. The decision was reversed a month later (NCSE 2005).

This kind of controversy is almost absent in other industrialized nations. However, that may be changing. For example, since 2002, the teaching of creationism at a small group of privately financed state schools in northeast England has triggered a considerable amount of debate in Parliament (Pincock 2005).

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*The theory of intelligent design holds that life is too complex to have happened by chance and that, therefore, some sort of intelligent designer must be responsible. Critics claim that this theory is simply a more sophisticated form of creationism (which the courts have said may not be taught in public schools). They argue that intelligent design theory has nothing to do with science because its assertions are not falsifiable: they cannot be tested or observed and cannot undergo experimentation. In contrast, "[evolution] has been directly observed in operation not only in the laboratory but also in the field. Where there is still room for argument and discussion is in the precise contributions of different mechanisms to evolutionary change. In this vibrant debate, intelligent design offers no meaningful contribution." According to Eugenie C. Scott, president of the National Center for Science Education, "There aren't any alternative scientific theories to evolution." In October 2002, the American Association for the Advancement of Science Board of Directors passed a resolution on intelligent design that "calls upon its members to assist those engaged in overseeing science education policy to understand the nature of science, the content of contemporary evolutionary theory and the inappropriateness of 'intelligent design theory' as a subject matter for science education."

†Although they are using teaching guides and textbooks that meet the approval of biologists, some teachers avoid mentioning evolution in their classrooms because their superintendents or principals discourage them from discussing it or because of opposition in the communities in which they teach. This approach can take the form of assigning the material on evolution to be read, but not discussing it in class (Dean 2005)

Although 39% of Americans surveyed in 2004 correctly answered all three questions about the nature of scientific inquiry, 61% did not.[27] This lack of understanding may explain why a substantial portion of the population believes in various forms of pseudoscience.

Belief in Pseudoscience

Although S&T are held in high esteem throughout the modern world, pseudoscientific beliefs continue to thrive. Such beliefs coexist alongside society's professed respect for science and the scientific process.

A recent study of 20 years of survey data collected by NSF concluded that "many Americans accept pseudoscientific beliefs," such as astrology, lucky numbers, the existence of unidentified flying objects (UFOs), extrasensory perception (ESP), and magnetic therapy (Losh et al. 2003). Such beliefs indicate a lack of understanding of how science works and how evidence is investigated and subsequently determined to be either valid or not. Scientists, educators, and others are concerned that people have not acquired the critical thinking skills they need to distinguish fact from fiction. The science community and those whose job it is to communicate information about science to the public have been particularly concerned about the public's susceptibility to unproven claims that could adversely affect their health, safety, and pocketbooks (NIST 2002). (See sidebar, "Sense About Science.")

Pseudoscience has been defined as "claims presented so that they appear [to be] scientific even though they lack supporting evidence and plausibility" (Shermer 1997, p. 33).[28] In contrast, science is "a set of methods designed to describe and interpret observed and inferred phenomena, past or present, and aimed at building a testable body of knowledge open to rejection or confirmation" (Shermer 1997, p. 17).

Belief in pseudoscience increased significantly during the 1990s and into the early part of this decade (Newport and Strausberg 2001) and then fell somewhat between 2001 and 2005 (figure 7-8). The largest declines were in the number of people who believe in ESP, clairvoyance, ghosts, mentally communicating with the dead, and channeling. Nevertheless, about three-fourths of Americans hold at least one pseudoscientific belief; i.e., they believed in at least 1 of the 10 survey items (similar to the percentage recorded in 2001).[29] In addition, 22% believed in five or more of the items, 32% believed in four, and 57% believed in two. However, only 1% believed in all 10 (Moore 2005b).

Belief in pseudoscience is widespread. For example, at least a quarter of the U.S. population believes in astrology, i.e., that the position of the stars and planets can affect people's lives. Although two-thirds (66%) of those queried in 2004 said that astrology is "not at all scientific," about one-third considered it at least "sort of scientific" (appendix table 7-14).[30]

Belief in astrology may be more prevalent in Europe. In 2001, 53% of Europeans surveyed thought astrology is "rather scientific" and only a minority (39%) said it is not at all scientific. In the 2005 survey, Europeans were asked whether or not they considered certain subjects to be scientific, using a 5-point scale (with higher values indicating that a subject is more scientific). About 4 out of 10 (41%) of those surveyed gave responses of 4 or 5 for astrology, the same as the score for economics. However, when the survey used the word "horoscopes" instead of astrology, only 13% gave a response of 4 or 5. Disciplines most likely to be considered scientific by Europeans were medicine (89%), physics (83%), biology (75%), mathematics (72%), astronomy (70%), and psychology (53%). History (34%) and homeopathy (33%) were at the bottom of the list (European Commission 2005a). Comparable U.S. data on the various disciplines do not exist.

Europeans were more likely than Americans to agree that "some numbers are particularly lucky for some people." The percentages in Europe were 37% (2005) and 32% (2001).[31]

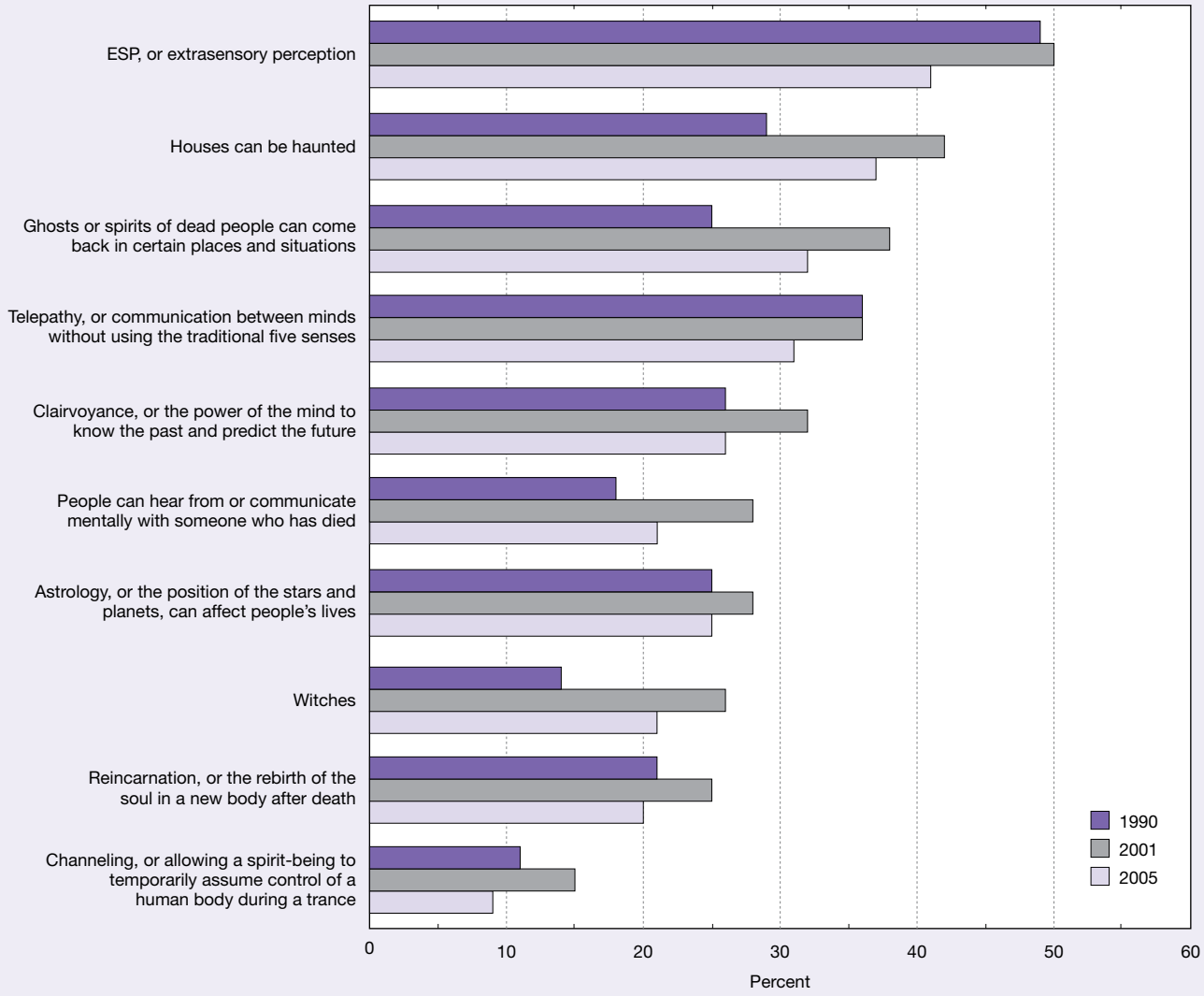
In the United States, skepticism about astrology is strongly related to level of education: in 2004, 81% of college graduates said that astrology is "not at all scientific," compared with 51% of those with less than a high school education and 62% of those who had completed high school but not college. In Europe, however, respondents with college degrees were just as likely as others to claim that astrology is scientific.

In the United States, belief in astrology is also related to level of income (which, in turn, is related to education). Those in higher income brackets were less likely than others to say that astrology is either very or sort of scientific.

Sense About Science

A new group, Sense About Science, was recently formed in the United Kingdom. Its goal is to help scientists and their institutions educate the press and the public about the importance of peer review. Recent scares—such as the possibility that radiation from mobile phones poses health risks, that the MMR (measles, mumps, and rubella) vaccine can cause autism, and that acrylamide in fried foods can cause cancer—could be put into perspective if the press and the public understood how the scientific process is used to distinguish between claims that are valid and those that are not. A poll commissioned in 2004 by the Science Media Centre and the journal *Nature* and conducted by the London-based market-research company MORI revealed that almost three-fourths of the UK public does not know what peer review is. Sense About Science plans to work with research and educational bodies to encourage teaching about peer review in schools and universities (Sense About Science 2004).

Figure 7-8
Belief in paranormal phenomena: 1990, 2001, and 2005



SOURCE: D.W. Moore, Three in four Americans believe in paranormal, *Gallup Poll News Service* (16 June 2005), http://www.gallup.com/poll/content/default.aspx?ci=16915.

Science and Engineering Indicators 2006

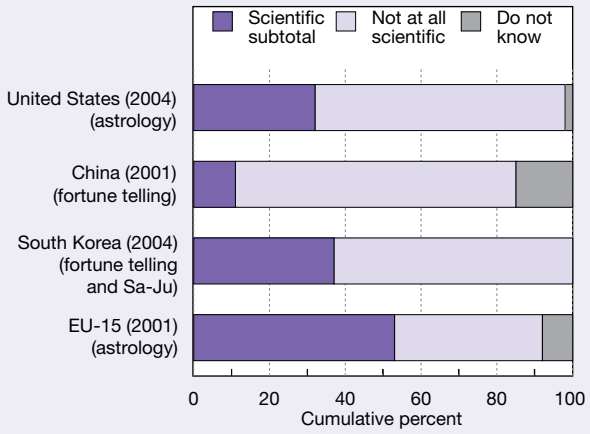
Like astrology in the United States and Europe, fortune telling is common in China and South Korea. However, only 1% of Chinese survey respondents said fortune telling is very scientific and 10% thought it is "a bit" scientific. In contrast, 74% answered either "not at all scientific" or "not very scientific." A similar item on a South Korean survey showed a larger percentage (37%) of respondents answering either "very scientific" or "sort of scientific" (figure 7-9; appendix table 7-15).

Surveys conducted by NSF and other organizations suggest that at least half of the U.S. public believes in the existence of ESP (CBS News 2002), and a sizable minority believes in UFOs and that aliens have landed on Earth. In the 2001 NSF survey, 60% of respondents agreed that "some people possess psychic powers or ESP," and 30% agreed that "some of the unidentified flying objects that have been reported are really space vehicles from other civilizations." Similarly, one-third of the Chinese respondents (33%) believed in the existence of aliens.

Public Attitudes About Science-Related Issues

Attitudes toward science in the United States are considerably more favorable than those in Europe and Japan, although similar to those in other Asian countries such as China and South Korea. Despite some disparity in attitudes toward science, Americans and the citizens of other countries strongly support government funding of basic research. Recently, the public has grappled with controversial developments such as

Figure 7-9
Public assessment of astrology or fortune telling, by country/region: 2001 or 2004



EU = European Union

NOTES: Responses to: *Would you say that astrology is very scientific, sort of scientific, or not at all scientific?* For United States, China, and South Korea, "scientific subtotal" is a sum of "very scientific" and "sort of scientific."

SOURCES: University of Michigan, Survey of Consumer Attitudes (2004); Chinese Ministry of Science and Technology, *China Science and Technology Indicators 2002* (2002); Korea Science Foundation, Survey on Public Attitude of Science & Technology 2004 (2004); European Commission, Research Directorate-General, Eurobarometer 55.2: *Europeans, Science and Technology* (2001).

Science and Engineering Indicators 2006

cloning and embryonic stem cell research (the vast majority of Americans oppose cloning, but attitudes about embryonic stem cell research are mixed). Genetically modified foods continue to generate public concern around the world, especially in Europe. In addition, scientists have been keeping a watchful eye on public opinion regarding the emerging field of nanotechnology, which some fear may prompt unwarranted or excessive concerns about safety (Cobb and Macoubrie 2004). Regardless of their attitudes about these and other science-related issues, Americans' confidence in the science community has remained high for several decades.

This section takes an in-depth look at public attitudes about S&T in general, high-profile issues that have tended to generate controversy, and science as a profession. It presents survey data from a variety of sources in the United States and other countries.

S&T in General

In general, Americans have highly favorable attitudes about S&T. In the Virginia Commonwealth University (VCU) 2004 Life Sciences Survey, 90% of respondents agreed that developments in science have helped make society better, and 92% agreed that "scientific research is essential for improving the quality of human lives." These two statistics were higher in 2004 than they have ever been (VCU Center for Public Policy 2004).

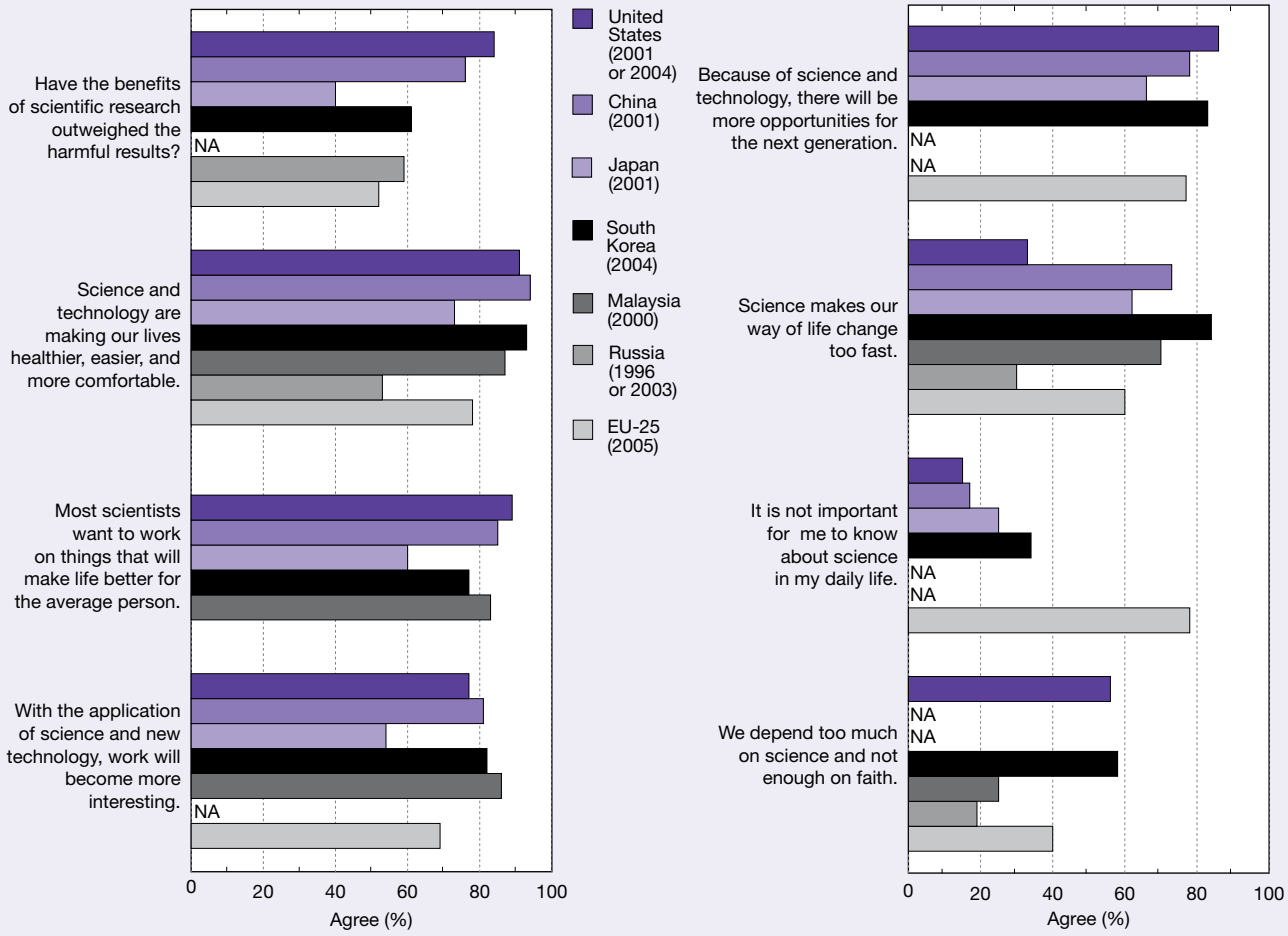
Attitudes toward S&T are also highly favorable in Europe. Nearly 9 out of 10 of those surveyed agreed that "developments in S&T have improved the quality of life for [their] generation," and nearly 8 out of 10 said that S&T "will improve the quality of life of future generations" (European Commission 2005b).

Americans seem to have more positive attitudes about the benefits of S&T than are found in Europe, Russia, and Japan; however, attitudes in China and South Korea are similar to those in the United States, if not more favorable (figure 7-10; appendix table 7-16). These attitudes are reflected in levels of agreement with various statements in surveys conducted most recently in 2004 (United States and South Korea), 2001 (China, Europe, and Japan), 2000 (Malaysia), or 2003 (Russia):

- **"Science and technology are making our lives healthier, easier, and more comfortable."** Among Americans surveyed, 91% of Americans agreed with the statement. The Chinese and South Korean statistics were similar to the U.S. findings, but lower percentages were recorded in Japan and Europe. In Russia, only half of those surveyed agreed with the statement.
- **"With the application of science and new technology, work will become more interesting."** About three-fourths of Americans agreed with the statement in 2004, as did somewhat greater proportions of Malaysians, South Koreans, and Chinese. Once again, the level of agreement was lower in Europe and considerably lower in Japan.
- **"Because of science and technology, there will be more opportunities for the next generation."** Among Americans, 86% agreed. Percentages for the other surveys ranged from 83% (South Korea) to 66% (Japan).
- **"The benefits of scientific research outweigh the harmful results."**[32] In the United States, 84% of survey respondents agreed with the statement in 2004.[33] The level of agreement was also high in China and South Korea but was lower in Europe, where only about half agreed. In the United States, 13% of respondents disagreed with the statement, about the same percentage recorded for Europe.[34] Among Russians surveyed in 2003, 59% agreed that the benefits of scientific research outweigh the harmful results, a larger proportion than found in Europe or in Japan (40% in 2001). The Russian percentage was, however, lower than it had been in some past years (e.g., 73% in 1999, 70% in 1997), although about the same as it was in 1996 (57%).

Despite Americans' highly favorable views about the benefits of S&T, a sizeable segment of the population has some reservations. In the 2004 VCU Life Sciences Survey, 61% of respondents agreed that "scientific research these days doesn't pay enough attention to the moral values of society." However, that percentage has been declining steadily and dropped 12 percentage points between 2001 and 2004. Agreement that "scientific research has created as many problems for society as it has solutions" also declined, from

Figure 7-10
Attitudes toward science and technology, by country/region: Most recent year



EU = European Union; NA = not available

NOTES: U.S. responses to "Most scientists want to work on things…" are from 2001 survey. U.S. responses for other questions are from 2004 survey. Russian responses to "Science and technology are making our lives healthier…" and "We depend too much…" are from 1996 survey. Responses to "Have the benefits…" and "Science makes our way of life change…" are from 2003.

SOURCES: National Science Foundation, Division of Science Resources Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (2001); University of Michigan, Survey of Consumer Attitudes (2004); Chinese Ministry of Science and Technology, *China Science and Technology Indicators 2002* (2002); Korea Science Foundation, Survey on Public Attitude of Science & Technology 2004 (2004); National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, The 2001 Survey of Public Attitudes Toward and Understanding of Science & Technology in Japan (2002); Malaysian Science and Technology Information Centre, Ministry of Science, Technology and the Environment, *The Public Awareness of Science and Technology Malaysia 2000* (2001); L. Gokhberg and O. Shuvalova, *Russian Public Opinion of the Knowledge Economy: Science, Innovation, Information Technology and Education as Drivers of Economic Growth and Quality of Life,* British Council, Russia (2004); and European Commission, Research Directorate-General, Eurobarometer 224/Wave 63.1: *Europeans, Science and Technology* (2005).

Science and Engineering Indicators 2006

59% in 2002 to 51% in 2004. In the 2004 Life Sciences Survey, those who said that "religious beliefs provide…guidance in [their] day-to-day living" were considerably more likely than others to support both statements (VCU Center for Public Policy 2004).

Findings from the NSF survey and other surveys also reveal some reservations about S&T in the United States and other countries. For example, Americans were more likely than the citizens of most other countries to agree with the statement "we depend too much on science and not enough on faith." In the United States, 56% of respondents agreed in 2004. The percentage of agreement was similar in South Korea and Malaysia but considerably lower in Europe and Russia.

Another survey item revealed less reservation about science in the United States than in other countries. One-third of Americans agreed that "science makes our way of life change too fast." Although the Russian response was similar, surveys in other countries all recorded much higher levels of agreement.

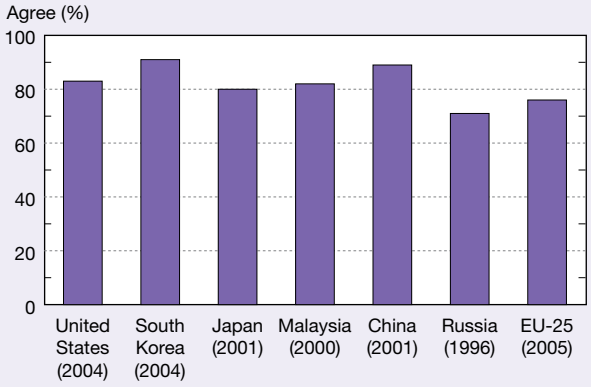
Government Funding of Scientific Research

All indicators point to widespread public support for government funding of basic research in the United States and elsewhere. This has been the case since at least the mid-1980s.

In 2004, 83% of NSF survey respondents agreed with the following statement: "Even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the federal government."[35] The stability of this measure of public support for basic research is noteworthy. The level of agreement has been around 80% since 1985. In addition, a consistently small percentage of respondents have held the opposite view. In 2004, 17% disagreed with the statement; only 2% strongly disagreed with it (appendix table 7-18).

The level of agreement about the desirability of government funding for research is similarly high in other world regions. Among Europeans surveyed, 76% favor government investment in basic research, and the level of agreement was similar or even higher in South Korea (91%), China (90%), Malaysia (82%), and Japan (80%)[36] (figure 7-11; appendix table 7-19).

Figure 7-11
Support for government funding of basic research, by country/region: Most recent year



EU = European Union

NOTE: Responses to: *Even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the Federal Government. Do you strongly agree, agree, disagree, or strongly disagree?*

SOURCES: University of Michigan, Survey of Consumer Attitudes (2004); Chinese Ministry of Science and Technology, *China Science and Technology Indicators 2002* (2002); Korea Science Foundation, Survey on Public Attitude of Science & Technology 2004 (2004); National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology, The 2001 Survey of Public Attitudes Toward and Understanding of Science & Technology in Japan (2002); Malaysian Science and Technology Information Centre (MASTIC), Ministry of Science, Technology and the Environment, *The Public Awareness of Science and Technology Malaysia 2000* (2001); L. Gokhberg and O. Shuvalova, *Russian Public Opinion of the Knowledge Economy: Science, Innovation, Information Technology and Education as Drivers of Economic Growth and Quality of Life,* British Council, Russia (2004); and European Commission, Research Directorate-General, Eurobarometer 224/Wave 63.1: *Europeans, Science and Technology (*2005). See appendix table 7-19.

Science and Engineering Indicators 2006

Although there is strong evidence that the American public supports the government's investment in basic research, few Americans can name the two agencies that provide most of the federal funds for this type of research. In a recent survey, only 5% identified the National Institutes of Health (NIH) as the "government agency that funds most of the medical research paid for by taxpayers in this country,"[37] and only 3% named NSF as "the government agency that funds most of the basic research and education programming in the sciences, mathematics, and engineering in this country." In the same survey, 68% could name the Food and Drug Administration (FDA) as the "government agency that conducts the review and approval of new drugs and devices before they can be put on the market in this country," and 32% were able to name the Centers for Disease Control and Prevention (CDC) as the "government agency whose primary mission is disease prevention and health promotion in this country" (Research!America 2005). Between 2001 and 2004, the number of people who could name NIH, NSF, or the FDA remained about the same, but the number who could identify the CDC increased from 24% to 32%.

In 2004, 13% of General Social Survey (GSS) respondents thought the government was spending too much on scientific research; 40% thought the government was not spending enough—an increase over the 34–37% levels recorded between 1988 and 2002.[38] In another survey, 57% thought it was very important "in terms of job creation and incomes" for the government to invest in scientific research, and an additional 36% thought it was somewhat important (Research!America 2005).

To put the response on scientific research in perspective, it helps to look at the percentage who thought the government was not spending enough in other program areas: improving health care (79%) and education (74%), reducing pollution (64%), improving national defense (39%), and exploring space (15%). The percentage favoring increased spending went up in all categories (except improving education) between 2002 and 2004 (appendix table 7-20).

The loss of the Columbia space shuttle in early 2003 apparently had little, if any, impact on public support for the U.S. space program. Public attitudes about manned space flight were strikingly similar to those recorded in 1986 after the loss of the space shuttle Challenger.[39]

Support for increased government spending on research is more common in Europe than in the United States. When asked about the statement "my government should spend more money on scientific research and less on other things," 57% of Eurobarometer respondents agreed. Italy, Spain, France, and Turkey had the highest rates of agreement, and the Netherlands, Finland, and Malta the lowest (European Commission 2005a).

Environmental Issues

Concern about the quality of the environment has not changed much since 2002, according to the Gallup Organization's Earth Day survey, conducted in March of each year.

In 2005, 35% of those surveyed said they "worried a great deal" about the quality of the environment, 30% said they worried "a fair amount," and 34% had little or no worry. However, the percentage of Americans who said they worried a great deal or a fair amount was lower in 2005 (and the 2 previous years) than in 2001 (Saad 2005).

Environment Compared With Other Concerns

The environment also ranks fairly low, in terms of worry, among various problems facing the country. Among 12 problems included in the survey in 2005, the quality of the environment ranked 9th. More people said they worried a great deal about the availability and affordability of health care (60%), Social Security (48%), crime and violence (46%), drug use (42%), the possibility of future terrorist attacks in the United States (41%), the availability and affordability of energy (39%), the economy (38%), and hunger and homelessness (37%) (Blizzard 2005).

Only 1% of those surveyed in 2005 named the environment when asked "what do you think is the most important problem facing this country today?"[40] Although the environment does not register as a serious current problem, the public considers it one of the most important problems the country will face in 25 years. But even by that long-term measure, concern about the environment has declined. Until 2002, the environment was the most frequently mentioned problem in response to the 25-year outlook question. Since 2002, more people have named other problems. Nearly a quarter (23%) of those surveyed in 2005 chose Social Security, followed by the economy in general, at a distant 9%. Only 6% named the environment (the same percentage chose health care), down from 14% and 11% in 2000 and 2001, respectively (Saad 2005).

Global Warming

Although Americans seem to accept climate change, or global warming, as a real phenomenon, most do not seem to have a great deal of concern about it.[41] In addition, in 2005, only 16% of Americans said they understood the issue of global warming "very well," about half (54%) understood it "fairly well," and the rest answered either "not very well" (24%) or "not at all" (6%). These percentages are almost identical to those recorded in each of the four previous annual surveys (Saad 2005).

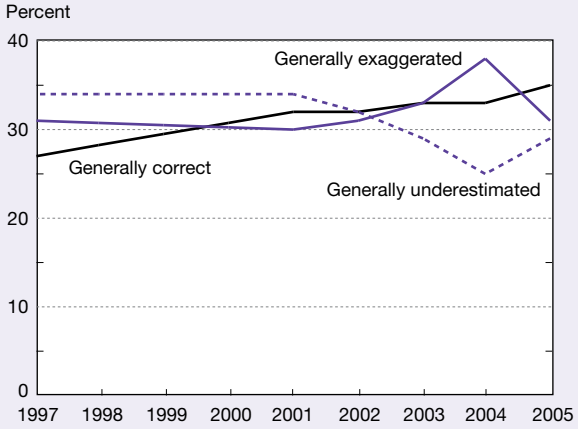
In 2005, 31% of those surveyed said that news reports on global warming generally exaggerated the problem, down from 38% of those surveyed the previous year. The number who believe that the press has been underestimating the problem was 35% in 2005, about the same as the percentages in the two previous survey cycles (but up from 27% in 1997). In 2005, 29% thought that news coverage of global warming was generally correct (the same percentage as 2003 but up from 25% in 2004) (Saad 2004, 2005a) (figure 7-12).

Whatever their view about the seriousness of global warming, more than half (54%) of Americans surveyed in 2005 think its effects have already begun, and others expect to see effects within a few years (5%) or within their lifetime (10%). Only 9% said the potential effects of global warming would never happen. Once again, these percentages changed little between 2001 and 2005. In addition, most Americans (61%) believe that human activities, more than natural causes, are responsible for increases in the Earth's temperature over the last century.

In 2005, 42% of Americans thought that the United States should agree to abide by the provisions of the Kyoto agreement on global warming; 23% said it should not, and 35% had no opinion. These statistics were virtually unchanged from the previous year (Moore 2004).

Although Americans seem to be aware of the issue and believe press reports, they are less concerned about global warming than other environmental hazards. On a list of 10 types of environmental issues, "damage to Earth's ozone layer" and the " 'greenhouse effect' or global warming" ranked eighth and ninth, respectively, in 2004 (table 7-7). In addition, after increasing from 24% in 1997 to 40% in 2000, the number of people who worry a great deal about global warming declined to 26% in 2004. In fact, 9 of the 10 items on the list had similar declines between 2000 and 2004, with "maintenance of the nation's supply of fresh water for household needs" the only exception. Figure 7-13 shows the decline in the public's worry about four environmental problems (global warming, air pollution, acid rain, and damage to the ozone layer) from 2000 to 2004 (Saad 2004).

Figure 7-12
Perceptions about news coverage of global warming: 1997–2005



NOTE: Responses to: *Thinking about what is said in the news, in your view is the seriousness of global warming generally exaggerated, generally correct, or is it generally underestimated?*

SOURCE: L. Saad, Public's environmental outlook grows more negative, *Gallup Poll News Service* (21 April 2005), http://www.gallup.com/poll/content/?ci=15961&pg=1.

Science and Engineering Indicators 2006

Table 7-7
Environmental concerns of American public: Selected years, 1997–2004
(Percent)

Issue	1997	1999	2000	2001	2002	2003	2004
Pollution of drinking water	NA	68	72	64	57	54	53
Pollution of rivers, lakes, and reservoirs	NA	61	66	58	53	51	48
Contamination of soil and water by toxic waste	NA	63	64	58	53	51	48
Maintenance of nation's supply of fresh water for household needs	NA	NA	42	35	50	49	47
Air pollution	42	52	59	48	45	42	39
Damage to Earth's ozone layer	33	44	49	47	38	35	33
Loss of tropical rain forests	NA	49	51	44	38	39	35
Extinction of plant and animal species	NA	NA	45	43	35	34	36
Greenhouse effect or global warming	24	34	40	33	29	28	26
Acid rain	NA	29	34	28	25	24	20

NA = not available

NOTE: Data reflect respondents who said they worry a great deal about issue.

SOURCE: L. Saad, Global warming on public's back burner, *Gallup Poll News Service* (20 April 2004), http://www.gallup.com/poll/content/?ci=11398&pg=1.

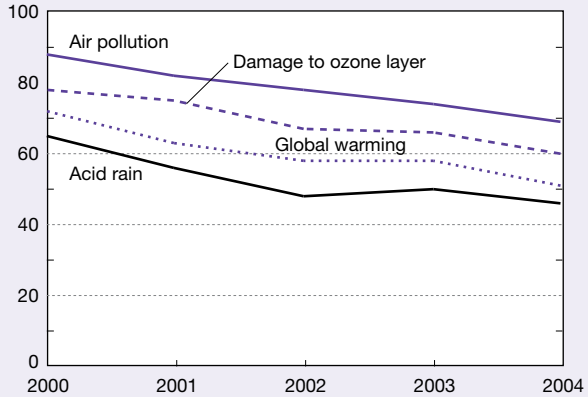
Science and Engineering Indicators 2006

Trust in Institutions

Americans place the most trust in local and national environmental organizations to protect the quality of the environment. However, the level of trust in national environmental groups in 2005 was down from that recorded in 2000 (Carlson 2005b).

About a quarter of those surveyed said they trusted national and local environmental organizations "a great deal." The comparable numbers for federal environmental agencies like the EPA and state environmental agencies were 22% and 16%, respectively. Politicians and private industry fared less well, with the percentage of "great deal" responses ranging from 15% for the Democratic Party and small businesses to 7% for large corporations. (The U.S. Congress [11%] and the Republican Party [7%] fell in between those groups.)

Figure 7-13
Worry about environmental problems: 2000–04
Percent



NOTES: Responses to: *I'm going to read you a list of environmental problems. As I read each one, please tell me if you personally worry about this problem a great deal, a fair amount, only a little, or not at all.* Percentages represent those who said either a "great deal" or "fair amount."

SOURCE: L. Saad, Global warming on public's back burner, *Gallup Poll News Service* (20 April 2004), http://www.gallup.com/poll/content/?ci=11398&pg=1.

Science and Engineering Indicators 2006

Government Environmental Policy

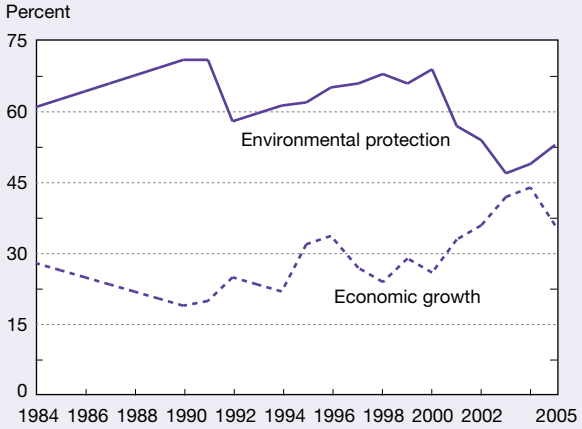
In 2005, a majority of Americans (58%) chose the "too little" response to the question, "do you think the U.S. government is doing too much, too little, or about the right amount in terms of protecting the environment?" Only 5% said "too much." These numbers resulted in the highest ratio of "too little" to "too much" since 1992, when 68% said the government was doing too little. That percentage fell continuously after 1992 until it reached a low point of 51% in 2003 (Dunlap 2005).

When survey respondents were asked in 2005 to choose between two statements about tradeoffs between environmental protection and economic growth, "protection of the environment should be given priority, even at the risk of curbing economic growth" or "economic growth should be given priority, even if the environment suffers to some extent," 53% chose the former, and 36% the latter. The percentage choosing the environment rose 6 percentage points between 2003 and 2005, after declining steadily from a peak of 69% in 2000 to an all-time low of 47% in 2003 (Carlson 2005a). Similarly, the percentage favoring economic growth over the environment in 2005 was the lowest it has been since 2002 (Carlson 2005a) (figure 7-14).[42]

In 2005, about half of the respondents (53%) opposed opening up the Alaskan Arctic Wildlife Refuge for oil exploration; 42% were in favor of it, up from 35% in 2002. Polls on this subject often produce inconsistent results, because of question wording and the general public's unfamiliarity with the issue (Moore 2005a).

In 2005, a slight majority (54%) of Americans favored using nuclear energy to provide electricity, about the same

Figure 7-14
Public priorities for environmental protection versus economic growth: 1984–2005



NOTE: Responses to: *With which one of these statements about the environment and the economy do you most agree—protection of the environment should be given priority, even at the risk of curbing economic growth (or) economic growth should be given priority, even if the environment suffers to some extent?*

SOURCE: D.K. Carlson, Public priorities: environment vs. economic growth. *Gallup Poll News Service* (12 April 2005), http://www.gallup.com/poll/content?ci=15820&pg=1.

Science and Engineering Indicators 2006

as the percentage recorded a year earlier, but a slight increase over the 2001 level. However, most Americans (63%) were opposed to the construction of a nuclear energy facility where they live. Men were more likely than women to favor nuclear energy and the construction of a plant in their community (Carlson 2005c).

Attitudes Toward Technology

Americans welcome new consumer products that are based on the latest technologies. Nowhere is that more obvious than in the burgeoning market for an array of devices that enhance and expand audio and video communication capabilities. About three-fourths of the population had a home computer and/or a digital video disc (DVD) player in 2004, and nearly as many (68%) had a cell phone. In addition, almost 15% of those surveyed in 2004 said they owned a personal digital assistant (PDA) and/or had a digital video recorder (DVR) or TiVo (a digital video recording set-top device for home televisions). As mentioned earlier in this chapter, the number of households with broadband Internet connections has grown tremendously in recent years, and the vast majority of Americans also subscribe to cable or have satellite service (Pew Research Center for the People and the Press 2004). Table 7-8 shows Americans' increasing acquisition of high-technology products between 1996 and 2004.[43]

An overwhelming number of Americans have favorable views of new technological developments in general. In response to the question, "on the whole, have developments in new technology helped make society better or not," 88% answered "better," a statistic that has been roughly the same since 2001, the first year the question was asked (VCU Center for Public Policy 2004).

Surveys conducted in the United States and Canada in 2005 show that respondents share a positive view of technology in general (69% and 65%, respectively), but differ somewhat in their perception of some specific technologies (Canadian Biotechnology Secretariat 2005). In both countries, men hold a more favorable view than women, and the level of agreement rises with respondents' income level; this is true for technology in general and for most specific technology fields. The

Table 7-8
Americans' acquisition of high-technology products: Selected years, 1996–2004
(Percent)

Variable	1996	1998	2000	2002	2004
Use a computer	58[a]	61	68	71	73
Have home computer	36	43	59	65	73
Go online	1	36	54	62	66
Subscribe to cable	69	67	67	66	64
Subscribe to satellite	NA	NA	NA	NA	25
Have a…					
VCR	85[b]	NA	NA	NA	92
DVD player	NA	NA	16	44	76
Cell phone	24[a]	NA	53	64	68
Palm Pilot	NA	NA	5	11	14
DVR/TiVo	NA	NA	NA	3	13

NA = not available

[a]June 1995.
[b]February 1994.

SOURCE: Pew Research Center for the People and the Press, Biennial Media Consumption Survey (2004).

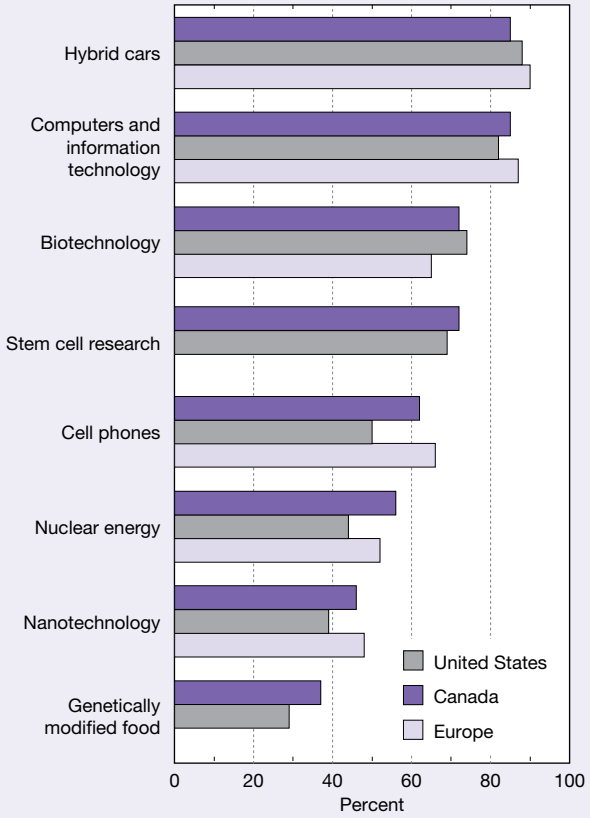
Science and Engineering Indicators 2006

same surveys also revealed considerable public support for research in the relatively new fields of biotechnology and nanotechnology, as well as confidence in the scientists who conduct the research. (See sidebar, "Americans and Canadians Share Optimistic Attitudes Toward Science and Those Who Practice It.")

Large majorities in the United States, Canada, and Europe believe that certain technologies, such as hybrid cars and computers and information technology, will "improve our way of life in the next 20 years,"[44] with not much difference between the three surveys. On the other hand, successively smaller percentages of respondents in all three (but fewer in Canada than in the United States and Europe) hold that view of cell phones, nuclear energy, and nanotechnology (figure 7-15). In addition, 40% of Americans and 52% of Canadians viewed genetically modified food as likely to "make things worse," and 28% of Americans and 39% of Canadians thought the same of nuclear energy.

In 2005, 72% of Americans thought that biotechnology would "improve our way of life in the next 20 years." This was a considerable gain over the 51% who expressed that view in 2000. In addition, the proportion who thought that biotechnology would "make things worse" in the next 20 years fell from 29% in 2000 to 13% in 2005. The pattern was similar in Europe, where the proportion of survey respondents who were optimistic about biotechnology increased from 38% in 1999 to 65% in 2005, while the proportion who were pessimistic dropped from 31% to 19% (figure 7-16).

Figure 7-15
Impact of new technologies in United States, Canada, and Europe: 2005



NOTES: Responses to: *I am going to read you a list of areas in which new technologies are currently developing. For each of these areas, do you think it will improve our way of life in the next twenty years, it will have no effect, or it will make things worse?* (In Europe, the question was worded: *For each of these, do you think it will have a positive, a negative, or no effect on our way of life in the next 20 years?*) Data are percent of responders who believe things will improve or have a positive effect.

SOURCE: Canadian Biotechnology Secretariat, Canada-U.S. Survey on Biotechnology (2005); and European Commission, Research Directorate-General, Eurobarometer 224/Wave 63.1: *Social Values, Science and Technology* (2005).

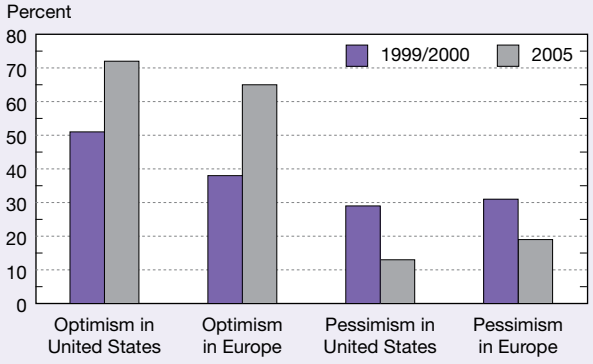
Science and Engineering Indicators 2006

Biotechnology and Medical Research

The introduction of new technologies based on genetic engineering has generated controversy during the past decade. From a nationwide recall of taco shells containing genetically modified corn not approved for human consumption to scientists promising to clone humans in the not-too-distant future, people around the world have been trying to determine whether the potential benefits of biotechnology outweigh the risks.

Most people admit to being ill informed about biotechnology. In 2003, 2004, and 2005, only 1 out of 10 Americans

Figure 7-16
Attitudes toward biotechnology in United States and Europe: 1999/2000 and 2005



NOTES: Responses to: *Science and technology change the way we live. I am going to read out a list of areas in which new technologies are currently developing. For each of these areas, do you think it will improve our way of life in the next 20 years, will have no effect, or will make things worse?* (In 2005, the question in Europe was worded: *For each of these, do you think it will have a positive, a negative or no effect on our way of life in the next 20 years?*) Percentages are for respondents who said that biotechnology will improve our way of life in the next 20 years (optimism) and for those who said that biotechnology will make things worse (pessimism). European surveys conducted in 1999 (EU-15) and 2005 (EU-25); U.S. surveys conducted in 2000 and 2005.

SOURCES: T.A. Ten Eyck, G. Gaskell, and J. Jackson, Seeds, food and trade wars: Public opinion and policy responses in the US and Europe, *Journal of Commercial Biotechnology* 10:258–67 (2004), Canadian Biotechnology Secretariat, Canada-U.S. Survey on Biotechnology (2005); and European Commission, Research Directorate-General, Eurobarometer 224/Wave 63.1: *Social Values, Science and Technology* (2005).

Science and Engineering Indicators 2006

Americans and Canadians Share Optimistic Attitudes Toward Science and Those Who Practice It

In early 2005, the Canadian Biotechnology Secretariat conducted surveys in both Canada and the United States to see how the public views research in the relatively new frontiers of biotechnology and nanotechnology. The results indicate that the citizens of both countries have considerable confidence in the scientific community and its work. For example, only about 15% of those surveyed in both countries seem to have apprehensions about research in the two fields. However, although trust in the scientific community was high, government authorities in both countries did not fare as well.

The views of Americans and Canadians were very similar, but American attitudes were somewhat more favorable. For example, Americans were more likely than Canadians to strongly agree with the following statements:

- "If the best available scientific evidence says that a particular use of biotechnology—or nanotechnology—is safe, it should be allowed."
- "Biotechnology research represents the next frontier of human endeavor, a frontier that will lead to significant quality of life benefits for all." (However, when "nanotechnology" replaced "biotechnology" in this statement, American and Canadian opinions converged.)

Approximately equal (and relatively small) percentages of respondents in the two countries (12% in the United States and 16% in Canada) disagreed with the first statement. About 15% of respondents in both countries disagreed with the second statement, with regard to both biotechnology and nanotechnology.

Roughly equal numbers of Americans and Canadians (about 9 out of 10), agreed that "although there may be some unknown risks, technologies like biotechnology—and nanotechnology—are an inevitable part of the future, so all we can do is make sure that [their] uses are as safe as possible."

Americans and Canadians also hold similar views about whether decisions concerning biotechnology and nanotechnology should be based on moral and ethical considerations or mainly on scientific evidence of risk and benefit. In both countries, more respondents chose scientific evidence over moral and ethical considerations, but the margin was not large: 16 percentage points in Canada and 19 in the United States.*

In addition to optimism about biotechnology and nanotechnology, Americans and Canadians seem to have a great deal of confidence in the people responsible for research. A considerable majority (about 70%) of respondents in both countries believe that decisions about biotechnology and nanotechnology should be based mainly on the views and advice of experts, not on the views of the average citizen. Canadians have slightly less confidence than Americans in the experts.†

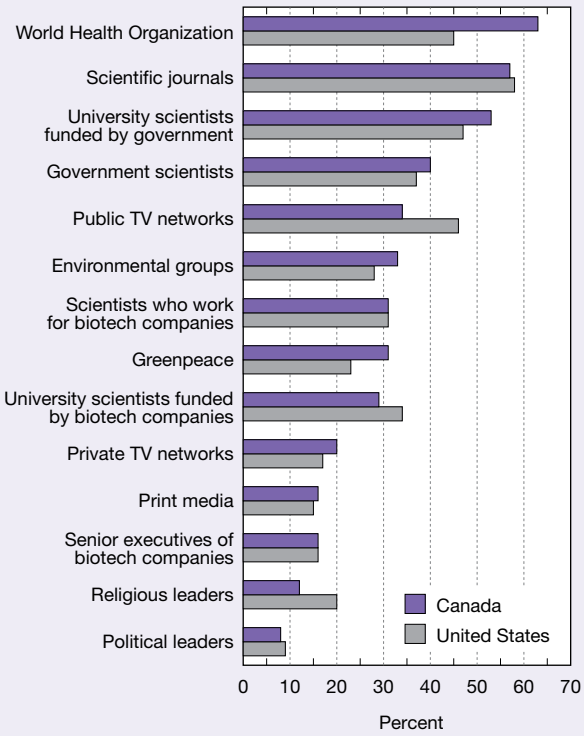
Americans were more likely than Canadians to choose the statement, "I believe that biotechnology research has been carried out in consideration of my interests, values, and beliefs" (57% versus 49%) instead of the alternative, "I believe that these types of technologies have not been developed in consideration of my interests, values, and beliefs." However, about half of those in both countries chose the first response when nanotechnology was substituted for biotechnology in the question.

A clear majority in both countries (55%–58%) said they trusted those in authority to ensure that biotechnology or nanotechnology research will follow strict ethical guidelines. However, 40% said they did not trust those in authority to do so. Moreover, 55% of Americans and 65% of Canadians said that their governments did not do enough to study and monitor the impact of biotechnology and nanotechnology products.

Both Americans and Canadians were asked to rate their trust in various institutions that could provide information about biotechnology‡ (figure 7-17). Near or at the top of the list in both countries were scientific journals and university scientists funded by the government. The

(continued on next page)

Figure 7-17
Credibility of sources of information on biotechnology: 2005



NOTES: Responses to: *For each of the following, if you were to hear information from them regarding biotechnology, how much would you trust that information to be credible, using a scale of 1–5, where 1 is not at all credible and 5 is extremely credible?* Percentages represent those who said 4 or 5.

SOURCE: Canadian Biotechnology Secretariat, Canada-U.S. Survey on Biotechnology (2005).

Science and Engineering Indicators 2006

(continued from previous page)

World Health Organization and government scientists were also in the top five. Scientists who work for biotechnology companies held a middle ranking in both countries. Among the least trusted were political leaders, senior executives of biotechnology companies, the print media, and private television networks. Although there were more similarities than differences in the level of trust accorded the various institutions in the two countries, there were a few exceptions:

- Canadians have more trust than Americans in the World Health Organization.
- Canadians are more likely than Americans to trust environmental groups and Greenpeace.
- University scientists funded by biotechnology companies enjoy more trust in the United States than in Canada.
- Americans are more likely than Canadians to trust religious leaders and public television.

*A majority of Europeans (53%) said that decisions about S&T should be based primarily on an analysis of the risks and benefits involved. However, one-third of those surveyed thought that such decisions should be based on the moral and ethical issues involved (European Commission 2005b).

†In Europe, two-thirds of those surveyed said that decisions about science and technology should be based primarily on the advice of experts; in contrast, about a quarter of the respondents said that such decisions should be based on "the general public's views of risks and benefits" (European Commission 2005b).

‡The question was: *For each of the following, if you were to hear information from them regarding biotechnology, how much would you trust that information to be credible, using a scale of 1–5 where 1 is not at all credible and 5 is extremely credible.*

described themselves as being "very familiar" with biotechnology. In 2005, 56% thought they were somewhat familiar with it, 25% described themselves as "not very familiar," and 9% said "not at all familiar." Canadians were slightly less likely than Americans to consider themselves familiar with biotechnology (Canadian Biotechnology Secretariat 2005).[45]

When asked whether they have a positive, neutral, or negative reaction to the word biotechnology, Americans and Canadians had similar reactions. In the United States, 38% of those surveyed in 2005 said they had a positive reaction. The comparable numbers for 2004 and 2003 were 41% and 36%, respectively. The percentages were similar for Canada (Canadian Biotechnology Secretariat 2005).

In 2005, 19% of Americans said that they strongly supported "the use of products and processes that involve biotechnology." About half (52%) chose the "support" category. The remainder said they opposed biotechnology (16%) or strongly opposed it (6%). These numbers did not change between 2003 and 2005. In contrast, the number of Canadians saying they supported biotechnology increased from 51% in 2003 to 67% in 2005, and the number opposing it dropped from 37% to 28% during the same period, causing the Canadian numbers to more closely resemble those for the United States in 2005 (Canadian Biotechnology Secretariat 2005).

Americans and Canadians also held similar views of biotechnology's potential in the field of medicine. In 2005, more than 8 out of 10 respondents in each country agreed that biotechnology would be one of the most important sources of health treatments and cures in the 21st century (Canadian Biotechnology Secretariat 2005).

Americans find genetic modification of plants far more acceptable than genetic modification of animals. When asked to rate on a 10-point scale how "comfortable" they are with genetic modification of different types of life forms, respondents were most comfortable with the modification of plants (5.94 average rating), followed by microbes (4.14), animals used for food (3.73), insects (3.56), and animals used for other purposes (2.29). The survey participants were least comfortable with the genetic modification of humans (1.35). When asked specifically about genetic modification of animals, more than half (57%) of those surveyed said they opposed it; only one-third (32%) favored it. These percentages remained virtually unchanged between 2003 and 2004 (Pew Initiative on Food and Biotechnology 2004).

From a list of several possible uses for biotechnology, survey participants were most likely to support "to produce more affordable pharmaceutical drugs by using plants." More than half (54%) of those surveyed said this was a very good reason to use biotechnology. Nearly as many (52%) supported "to produce less expensive food to reduce hunger around the world" (Pew Initiative on Food and Biotechnology 2004).

Genetically Modified Food

Issues that people perceive as a possible threat to their health and safety—and that of their children—are bound to draw attention and generate controversy (see sidebar, "Are Americans Afraid of Getting Mad Cow Disease?). The persistent public concern about genetically modified (GM) food, in the United States and elsewhere in the world, is a clear example.

The first products genetically altered using biotechnology started appearing on store shelves about a decade ago. Since then, concern about their safety has stirred worldwide controversy. For example, in 2003, the European Union voted to require labeling on foods containing GM ingredients. The promised benefits of GM food—increased productivity, longer shelf life, and reduced reliance on chemical pesticides—have been offset by perceived health and environmental risks and a perceived assault on consumers' right to choose what they eat.[46]

Several major surveys that measure public opinion on GM food have been undertaken in the United States in recent years. Their findings, which are similar, are summarized below.

Are Americans Afraid of Getting Mad Cow Disease?

Most Americans have not changed their beef-eating habits because of Mad Cow Disease. In a survey conducted in January 2004, about one-fifth of those queried said they had reduced their beef consumption, and 4% said they had stopped eating beef altogether (Hallman, Schilling, and Turvey 2004).

The survey also showed that about 9 out of 10 Americans had heard of Mad Cow Disease, and nearly that many were aware of the case discovered in the United States in December 2003. However, the level of knowledge about the disease was not high. For example, only a little more than half (56%) correctly answered false to the statement, "cooking beef thoroughly will reduce the chance of getting sick from beef contaminated with mad cow disease."

About two-thirds of those surveyed thought that the nation's beef supply was safe; a somewhat higher percentage thought the beef in their local stores was safe. In addition, most expressed confidence in the government and farmers for the way they handled the case discovered in December 2003. On a scale of 1–10, with 10 the highest level of confidence, the median score for both the government and farmers was 8.

Few respondents (6%) claimed to be very worried about getting the disease. However, 7 out of 10 thought it likely that another case of it would be found in the United States.

Awareness and Knowledge

Not only are most Americans unfamiliar with GM food issues, their level of awareness has declined and their level of knowledge has not increased in recent years. In a recent survey, only 32% of respondents reported that they heard some or a great deal about genetically modified foods in 2004, a 12-point decline since 2001.[47] The public is largely dependent on the media to inform them about GM food, and when the subject receives little press coverage, their level of awareness declines (Pew Initiative on Food and Biotechnology 2004).[48]

Most people admit to not knowing much about GM food. The majority of survey respondents in the United States and Canada said they had read, seen, or heard only a little or nothing about issues involving GM food, and nearly half (47%) of Americans and more than half (59%) of Canadians said they had never discussed GM food with anyone before the survey interview (Canadian Biotechnology Secretariat 2005).

In addition, most Americans were unaware that GM ingredients have been in the food supply for some time. Only about half (48%) knew that GM food was currently available on their grocery store shelves, and only about a third (31%) said they had consumed it.[49] When asked to rate their own knowledge of GM food, about half (48%) chose the "very little" category. Another 16% said that they knew "nothing at all." Thirty percent claimed to know "a fair amount" and 5% thought they knew a great deal about GM food (Hallman et al. 2004).

In 2004, survey respondents were also asked a dozen quiz-type questions designed to test their knowledge of textbook genetics and basic facts about GM food. More than half of the respondents (58%) answered less than half of the questions correctly, and only three respondents (less than 1%) answered every question correctly.[50] Respondents' self-reported level of knowledge about GM food was only moderately related to their performance on the quiz (Hallman et al. 2004).

Attitudes

"Approval and disapproval of GM products has not changed much over the past three years" (Hallman et al. 2004). As stated earlier, Americans are more disapproving of animal-based than plant-based genetic modification. In a Food Policy Institute survey, 27% said they approved of the use of genetic modification to create plant-based food products, and 16% said the same about animal-based GM food products; 23% disapproved of plant-based GM food products, and 43% disapproved of animal-based GM products (Hallman et al. 2004).

In Europe, the most recent Eurobarometer revealed "a large diversity in public opinion at the national level on the use of genetically modified organisms for meat products or crops" (European Commission 2005b).[51]

Perceived Benefits and Risks

In judging the extent to which GM food might benefit society, on a scale of 1 to 5, 41% of Americans chose 3 (moderate benefit). About a third (31%) assigned higher scores (substantial benefits), and about a quarter (26%) gave lower scores. Almost equal numbers of Americans gave the exact same scores in response to the opposite question about how much risk GM food might pose for society. Canadians were less likely than Americans to believe in the benefits of GM foods and more likely to assign risk to them. Americans were also more likely than Canadians to think that GM food is morally and ethically acceptable. For example, 43% of Americans gave a rating of 5 (29%) or 4 (14%) in response to this question, compared with 32% of Canadians (Canadian Biotechnology Secretariat 2005).

In the most recent Pew Initiative survey, 30% of respondents agreed that GM foods are "basically safe" and 27% thought they were "basically unsafe." However, opposition to "introducing genetically modified foods into the U.S. food supply" declined from 58% in 2001 to 47% in 2004. Attitudes about the safety of GM food improved considerably when the survey participants were told that they were already consuming foods developed through biotechnology (Pew Initiative on Food and Biotechnology 2004).

In another survey conducted in 2004, 43% of Americans thought that the risks of GM foods outweighed the benefits

(38% took the opposite view), a slight decline from the 48%-to-38% split recorded in 2000 (Harris Interactive 2004b). Survey respondents recognized both advantages and disadvantages. On the plus side, 71% of respondents in 2004 (up from 66% in 2000) believed that agricultural production would increase because of GM plants and crops, and 47% (up from 42% in 2000) believed that GM crops "will make food less expensive than it would be otherwise." On the negative side, a majority (54%) in 2004 thought GM crops "will upset the balance of nature and upset the environment" (Harris Interactive 2004b).[52]

Government Regulation

Along with health and environmental concerns, labeling of GM food products is a related biotechnology issue that has received considerable attention in recent years. However, Americans appear to know very little about this topic. In 2004, most survey respondents (68%) did not know that the federal government does not require food labels to specify that a product contains GM ingredients. In addition, 88% did not know that GM crops are not tested for human safety, and 77% did not know that they are not tested for environmental safety (Hallman et al. 2004).[53]

A recent survey found a high level of confidence in the government's ability to properly regulate GM food, with three-fifths (61%) of those surveyed assigning scores of 5 or 4 (on a 5-point scale) in describing their level of confidence in the safety and regulatory approval systems of the U.S. government. Only 3% assigned a score of less than 3. Canadians expressed slightly less confidence in their government regulatory approval system (Canadian Biotechnology Secretariat 2005).

In another survey conducted in 2004, 8% of Americans who reported hearing about regulations for GM foods thought there is "too much" regulation, 19% said there is the right amount, and 40% said there is "too little." (down 5 percentage points from 2003). Among those surveyed, 85% thought regulators should ensure that GM foods are safe before they come to market, and 81% believed the FDA should approve the safety of GM foods before they come to market, even if there would be "substantial delays" (Pew Initiative on Food and Biotechnology 2004).

Labeling

Nine out of 10 Americans support the labeling of GM food and GM ingredients in processed foods (Pew Initiative on Food and Biotechnology 2004). Although the same overwhelming support for labeling was found in a 2002 survey, only half of the respondents (53%) said they would actually take the time to look for foods labeled as not being genetically modified, and less than half (45%) said they were willing to pay more for foods that had not been genetically modified (Hallman et al. 2002).

Public Trust in Scientists and Others

In the United States, scientists are considered more trustworthy than any other group involved in biotechnology issues such as GM foods. In a recent survey, scientists received more votes of confidence than medical professionals, consumer advocacy organizations, environmental organizations, universities, and farmers. Ranked lowest in trustworthiness were the federal government, media sources, industry, and (in last place) grocery stores. However, because scientists are likely to be employed by groups on the list, these data have been interpreted to indicate that survey respondents probably distinguish between scientists and the organizations that may employ them (Lang 2004) and seem to deem scientists more trustworthy than the organizations (Hallman, Hebden, and Cuite, 2004).

Another recent survey also revealed confidence in the scientists involved in biotechnology research. When asked how confident they were that GM food research is in safe hands, two-thirds of respondents in both the United States and Canada assigned a rating of 4 or 5 (on a 5-point scale, 5 being the highest rating) (Canadian Biotechnology Secretariat 2005). (For more about the views of Americans and Canadians on biotechnology research, see sidebar "Americans and Canadians Share Optimistic Attitudes Toward Science and Those Who Practice It.")[54]

Human Cloning and Stem Cell Research

Americans overwhelmingly oppose human cloning but are more divided on the subject of medical research that uses stem cells from human embryos. Support for the latter has fluctuated, but in 2004, 53% of the public expressed support for embryonic stem cell research, whereas 36% were opposed.

Human Cloning

All recent U.S. surveys that measure public opinion on human cloning have yielded similar findings: about 4 out of 5 Americans say they are opposed, and most of those say they are strongly opposed. In one survey, 66% of respondents said they were strongly opposed to human cloning, 17% were somewhat opposed, and only 13% said they favored it (VCU Center for Public Policy 2004). In another survey, 77% answered "no" to the question, "do you think that research into reproductive cloning should be allowed." In contrast, 66% said that they thought therapeutic cloning should be allowed (Research!America 2005).

Opposition to human cloning seems to be based on moral objections, not safety concerns. Moreover, public opinion on this subject has held steadfast. In annual surveys conducted between 2001 and 2004, about 9 out of 10 respondents said that cloning humans was morally wrong (Lyons 2004a).

Cloning animals evoked a lesser degree of moral objection. In 2004, 64% of those surveyed found it morally objectionable, compared with 32% who did not. Like the statistics for human cloning, these numbers have held fairly constant since 2001 (Lyons 2004a).

People may have difficulty differentiating between human reproductive cloning and human therapeutic cloning.[55] (Therapeutic cloning refers to the use of cloning technology in medical research to develop new treatments for diseases.) In 2004, only 8% of respondents described themselves as

having a "very clear" understanding of the difference between human reproductive cloning and human therapeutic cloning; 26% were "somewhat clear," 34% were "not very clear," and 30% were "not at all clear." These statistics were almost identical to those in the previous year's survey. (VCU Center for Public Policy 2004).

Opposition to therapeutic cloning is not quite as strong as opposition to human cloning in general: 38% of respondents in the 2004 VCU survey were strongly opposed to therapeutic cloning, 18% were somewhat opposed, 16% strongly favored it, and 26% somewhat favored it. College graduates were somewhat less opposed than others.

According to the most recent Eurobarometer, "Europeans seem somewhat prepared to accept cloning animals and cloning human stem cells from embryos (in exceptional circumstances or under strict control) for the sake of human health." About a third (31%) of those surveyed answered "never" when asked if they approve "cloning animals such as monkeys or pigs for research into human diseases. Opposition was highest in Switzerland, Luxembourg, and the United Kingdom, and lowest in Spain, Belgium, Hungary, and Estonia. Less than a fourth (22%) of respondents gave the "never" response when asked about "cloning human stem cells from embryos to make cells and organs that can be transplanted into people with diseases." However, a majority (59%) of Europeans are opposed to "cloning human beings so that couples can have a baby even when one partner has a genetic disease." The highest levels of opposition were in Switzerland, Luxembourg, Iceland, and France (European Commission 2005b).

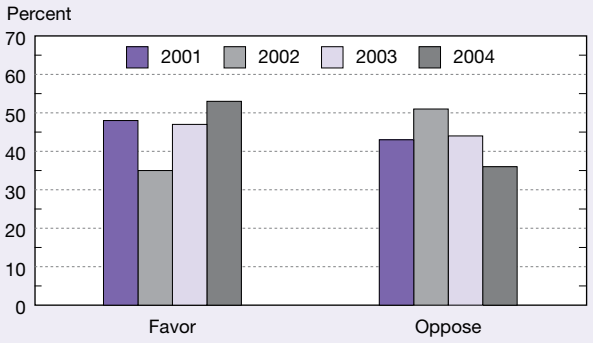
Stem Cell Research

Controversy over the federal government's role in funding embryonic stem cell research became a 2004 presidential campaign issue. In addition, several states have begun (or are considering) funding such research on their own. Four states—California, Connecticut, Illinois, and New Jersey—have allocated taxpayer funds. By far, the largest initiative is in California, where voters in 2004 approved spending $3 billion to establish the California Institute of Regenerative Medicine. California plans to spend $300 million annually during the next decade to support stem cell research.

Public opinion on stem cell research is more evenly divided than that on human cloning. However, the most recent data show an increase in public support for embryonic stem cell research between 2002 and 2004:

- After falling from 48% in 2001 to 35% in 2002, the percentage of survey respondents favoring medical research that uses stem cells from human embryos rose to 47% in 2003 and 53% in 2004 (figure 7-18). The percentage strongly favoring this type of research showed a similar pattern, doubling from 12% in 2002 to 24% in 2004. At the same time, opposition declined from 51% in 2002 to 36% in 2004, and strong opposition declined from 29% to 22% (VCU Center for Public Policy 2004).

Figure 7-18
Public attitudes toward stem cell research: 2001–04



NOTE: Responses to: *On the whole, how much do you favor or oppose medical research that uses stem cells from human embryos?*

SOURCE: Virginia Commonwealth University (VCU), Center for Public Policy, Public Opinion on Science and Biotechnology: Increasing opposition to cloning, but greater support for embryonic stem cell research, VCU Life Sciences Survey (2004).

Science and Engineering Indicators 2006

- The percentage of respondents who said that "conducting stem cell research [is more important than] not destroying the potential life of human embryos involved in this research" increased from 43% in March 2002 to 52% in August 2004 to 56% in December 2004 (Pew Research Center for the People and the Press 2005).[56]

Other surveys have explored various dimensions of Americans' opinion about embryonic stem cell research, including morality, government restrictions on funding, correlations with religious beliefs and political conservatism, and comparative views of men and women.[57] These surveys show:

- The percentage of respondents who believe that embryonic stem cell research is morally acceptable increased from 52% in 2002 to 60% in 2005. Among those surveyed, 11% thought there should be no restrictions on this type of research, 42% thought current restrictions should be eased, 24% chose "keep current restrictions," and 19% were opposed to all funding (Saad 2005).
- Religious beliefs play a major role in shaping opinions on this issue. In 2004, 77% of survey respondents who said that religion was not important to them favored stem cell research, compared with 38% of those who said that religion provides a great deal of guidance for them (VCU Center for Public Policy 2004).[58]
- Those who identified themselves as political conservatives were more likely than others to oppose stem cell research. For example, 44% of self-defined conservatives thought that conducting stem cell research was more important than reservations about destroying the potential life of human embryos, compared with 61% of moderates, and 77% of liberals (Pew Research Center for the People and the Press 2005).

- Finally, men were more likely than women (47% versus 39%) to say that conducting stem cell research was more important than reservations about destroying the potential life of human embryos. Support for this type of research also varied by age, education, and income, with younger adults, those with more formal education, and those with higher family incomes more likely than others to indicate support for stem cell research (Pew Research Center for the People and the Press 2005).

Surveys in the United States and Canada found that attitudes about stem cell research were remarkably similar in the two countries. (See sidebar, "Americans' and Canadians' Attitudes Toward Stem Cell Research Are Not That Different.")

Nanotechnology

Nanotechnology refers to the emerging technology of making extremely small components measured in nanometers (a nanometer is one-billionth of a meter). Though a relatively new area of research, nanotechnology is already having a major impact in many fields, including medicine, electronics, and chemistry, and it is already an important driver of innovation in manufacturing.

The science and policy communities are paying close attention to public reaction to nanotechnology-related issues. The media have recently begun to report on possible dangers and risks (e.g., that nanoparticles may be detrimental to human health), focusing attention on the adequacy of government regulation and oversight of this emerging field. Scientists fear that, as happened in Europe and elsewhere when GM foods were introduced, public opinion about nanotechnology could turn negative, potentially slowing research (Brown 2004).

Several surveys designed to gauge public opinion about nanotechnology have been undertaken recently. Findings from these surveys, summarized below, indicate that most of the public has never heard of nanotechnology, most think the benefits outweigh the risks, and views about government funding of nanotechnology research are mixed.

Awareness

In one recent study, more than half of Americans surveyed said they were not very familiar (23%) or not at all familiar (35%) with nanotechnology. A similar percentage (59%) said they had not read, seen, or heard about issues involving nanotechnology research, and 73% said they had never discussed nanotechnology research with anyone. Responses were similar in Canada (Canadian Biotechnology Secretariat 2005).

In another survey, more than 80% of those polled said they had heard "little" or "nothing" about nanotechnology (Cobb and Macoubrie 2004). In a third study, about a quarter of the respondents said they had never heard of nanotechnology—even after the interviewer provided an explanation. Only 16% said they felt somewhat informed about nanotechnology and its economic impact (Scheufele 2005). In addition, 80% of Americans were unable to name a single leading nanotechnology company (Small Times 2004).

Perceived Benefits and Risks

Although nanotechnology may have numerous unknown social, economic, and environmental consequences, and although most Americans do not know much about it (Cobb and Macoubrie 2004), the majority hold generally positive views of it. When asked to rate nanotechnology's potential benefit to society on a scale of 1 to 5 (where 1 is no benefit and 5 is substantial benefit), nearly 9 out of 10 respondents (87%) assigned scores of 5 (32%), 4 (18%), or 3 (37%). Scores were even higher when respondents were asked about nanotechnology's economic benefits. More than 8 out of 10 assigned scores of 5 (42%) or 4 (42%). Canadians' responses to these questions were similar (Canadian Biotechnology Secretariat 2005).[59]

When given a list of five options specifying benefits from nanotechnology, a majority (57%) of survey respondents selected "new and better ways to detect and treat human diseases" as the most important, followed by "new and better ways to clean up the environment" (16%), "increased national

Americans' and Canadians' Attitudes Toward Stem Cell Research Are Not That Different

According to a study conducted in early 2005, Canadians are more likely than Americans to approve of embryonic stem cell research, but the difference is not large. Canadians also expressed slightly more confidence in their country's safety and regulatory approval systems governing stem cell research and in the scientists responsible for conducting such research. (Canadian Biotechnology Secretariat 2005). However, Americans were more likely than Canadians to think they were very or somewhat familiar with the issue; say they had read, seen, or heard about issues involving stem cell research; and say they had discussed the subject with others.

Survey respondents in the United States and Canada had almost identical assessments of the benefits and risks of stem cell research: they thought the benefits are greater than the risks. On a scale of 1 (none) to 5 (substantial), two-thirds of respondents in both countries assigned scores of 4 or 5 for benefits, and only about one-fifth assigned 4 or 5 for risks. In both countries, more respondents scored risk as 3 (moderate) than any other score: 32% of U.S. respondents and 39% of Canadians. About half of the respondents in each country scored stem cell research as 4 or 5 for moral acceptability; 18% of Americans and 13% of Canadians deemed it "morally questionable" or "morally unacceptable."

security and defense capabilities" (12%), and ways to "improve human physical and metal abilities" (11%). Only 4% chose "cheaper, longer-lasting consumer products" as the most important benefit (Cobb and Macoubrie 2004).

When Americans and Canadians were asked to rate the risk nanotechnology may "pose for our society" on a scale of 1 (lowest) to 5 (highest), about half (49%) of the American respondents chose 3, only 14% picked 4 or 5, and about 30% chose 1 or 2. The Canadian response was almost identical (Canadian Biotechnology Secretariat 2005).

In choosing which of five potential risks was the most important to avoid, more respondents (32%) picked "losing personal privacy to tiny new surveillance devices" than any other choice. Other respondents chose "a nanotechnology inspired arms race" (24%), "breathing nano-sized particles that accumulate in your body" (19%), "economic disruption caused by the loss of traditional jobs" (14%), and "uncontrollable spread of self-replicating nano-robots" (12%) (Cobb and Macoubrie 2004).[60]

Ethics and Morality

In general, although many Americans are unfamiliar with nanotechnology, most Americans believe it to be morally and ethically acceptable. On a scale of 1 to 5, 36% of those surveyed scored it 5 and 18% scored it 4, the highest levels of moral and ethical acceptability. Only 8% had the greatest reservations, scoring it 1 or 2. Canadians were somewhat more likely than Americans to question nanotechnology's moral and ethical acceptability (Canadian Biotechnology Secretariat 2005).

Government Regulation

Most Americans and Canadians also expressed confidence in the ability of their country's safety and regulatory approval systems to monitor developments in nanotechnology. About 7 out of 10 survey participants in both countries gave their governments scores of 4 or 5 (the highest levels of confidence), and another quarter of each group were moderately confident in their country's safety and regulatory approval systems (Canadian Biotechnology Secretariat 2005).

Survey participants in the United States and Canada were asked to choose one of five statements that best captured their views about nanotechnology. In the United States, 43% chose "I approve of nanotechnology, as long as the usual levels of government regulation and control are in place," compared with 35% of Canadians. The percentages were essentially reversed for the statement "I approve of nanotechnology if it is more tightly controlled and regulated," selected by 35% of Americans and 44% of Canadians. Less than 15% in each country chose "I do not approve of nanotechnology except under very special circumstances," and only 5% of Americans and 4% of Canadians said they did "not approve of nanotechnology under any circumstances" (Canadian Biotechnology Secretariat 2005).

Confidence in Scientists and Others

Both Americans and Canadians also have a high level of confidence in the scientists who are involved in nanotechnology research. Eight out of 10 (79%) of the respondents in each country indicated that nanotechnology "is in safe hands" by assigning the scientists scores of 4 and 5; another 16% in each country gave them a score of 3 (Canadian Biotechnology Secretariat 2005).

However, most Americans seem to be distrustful of business leaders in the nanotechnology industry and their ability and willingness to minimize potential risks to humans. Six out of 10 (60%) of those surveyed said they had "not much trust" in nanotechnology business leaders, less than 5% said they had "a lot" of trust, and 35% said they had "some" trust. The respondents who were less trusting were also more likely to think nanotechnology's risks were greater than its benefits (Cobb and Macoubrie 2004).

Government Funding of Research

Various surveys have produced mixed findings about public support for government funding of nanotechnology research, as summarized below:

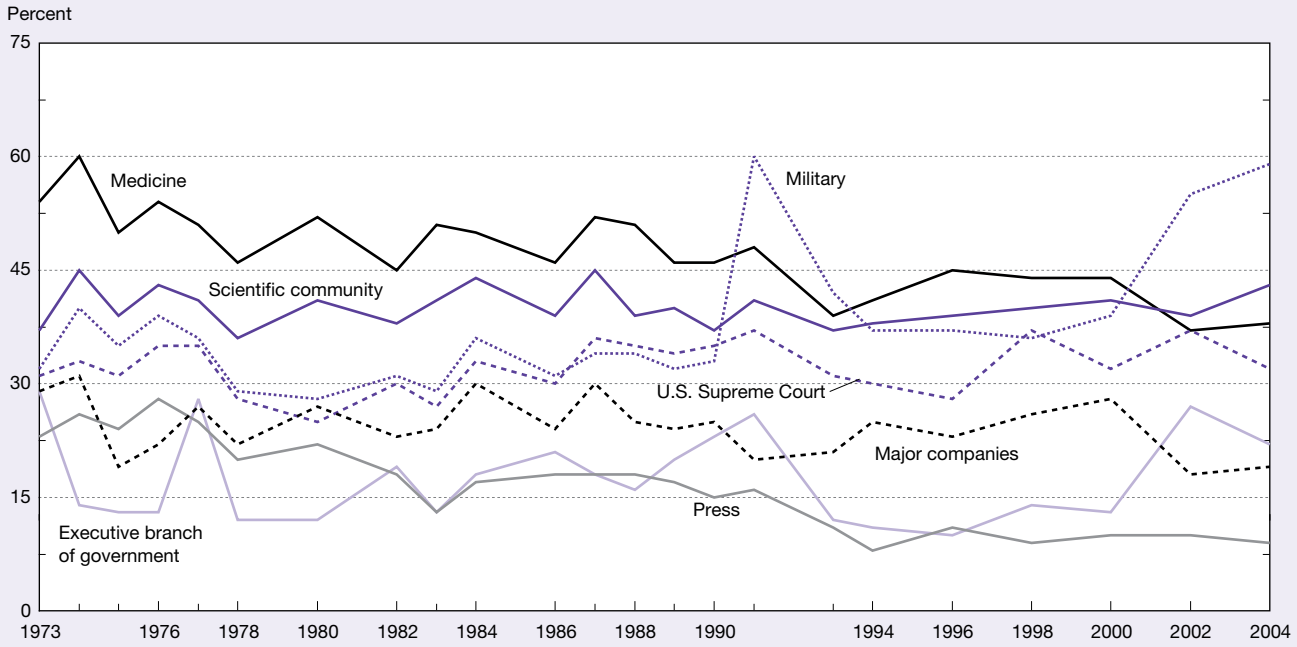
- In one survey, 42% favored increased funding for nanotechnology research, and 58% opposed it (Scheufele 2005).[61]
- In another survey, 31% of Americans and 38% of Canadians said their government should be "actively involved" in nanotechnology research, about 45% in each country said "moderately involved," and 20% of Americans and 14% of Canadians said "not involved" (Canadian Biotechnology Secretariat 2005).
- A third survey found that 60% of respondents agreed the government should increase current funding levels for nanotechnology research; 60% also agreed it is very important for state governments to get involved in nanoscience research funding (GolinHarris 2004).

Confidence in the Leadership of the Science Community

Since 2002, more people have expressed confidence in the leadership of the scientific community than in any other profession except the military. Public confidence in the leadership of various professional communities has been tracked for nearly three decades. Participants in the General Social Survey (GSS) are asked whether they have a "great deal of confidence, only some confidence, or hardly any confidence at all" in the leadership of various professional communities (Davis, Smith, and Marsden 2005). In 2004, 43% said they had a great deal of confidence in the leadership of the scientific community, marking the second time in the history of the survey (the first was in 2002) that greater confidence was expressed in science than in medicine (figure 7-19; appendix table 7-21).[62]

In 2002 and 2004, the science community might have topped the GSS confidence rankings had events not prompted

Figure 7-19
Public expressing confidence in leadership, by institution type: 1973–2004



SOURCE: J.A. Davis, T.W. Smith, and P.V. Marsden, *General Social Survey 1972–2004 Cumulative Codebook,* University of Chicago, National Opinion Research Center (2005).

Science and Engineering Indicators 2006

public focus on the military. In 2000, only 39% of the respondents said they had a great deal of confidence in the military; the number rose to 55% in 2002 and 59% in 2004. The events of September 11, 2001, and the subsequent wars in Afghanistan and Iraq are likely contributors to the increase in public confidence in the military. A similar trend was seen in the early 1990s, when confidence in the military rose from 33% in 1990 to 60% in 1991 (at the time of the Gulf War); confidence in the military then dropped to 42% in 1993.

Most of the institutions measured in the GSS saw an increase in the public's confidence in their leadership between 2002 and 2004. This was particularly true for banks and financial institutions and organized religion. Exceptions were the U.S. Supreme Court (which saw a drop in confidence from 37% to 32% between 2002 and 2004), and the executive branch of the federal government (27% in 2004, after an unprecedented increase for that institution from 13% in 2000 to 27% in 2002).

The science community has ranked second or third in the GSS public confidence survey in every year since 1973. Although the vote of confidence for the science community has fluctuated somewhat over the years, it has hovered around 40%. In contrast, the medical profession, which has ranked first in most years, has seen its vote of confidence, once as high as 60% (in 1974), gradually erode. Public confidence in the medical profession was 37% in 2002 (a low) and 38% in 2004; it ranked third in both years.

The public's confidence in the leadership of the press (9% in 2004) and television (10%) was the lowest of all institutions. These ratings have changed little in the past 10 years.

Europeans also express a lot of confidence in scientists. When asked if scientists who work at universities or in industry (doing research or developing new products) have a positive or a negative effect on society, the overwhelming majority of respondents (more than 8 out of 10) said they had a positive effect (European Commission 2005b).[63] However, about three-fifths of Europeans agreed with the following statements: "Because of their knowledge, scientists have a power that makes them dangerous" and "Scientists put too little effort into informing the public about their work" (European Commission 2005a).

Science Occupations

Most people do not encounter scientists in their daily lives. When asked if they personally knew any scientists, 82% of Americans surveyed said no (Research!America 2005).[64] In the United States and several Asian countries, surveys asked participants whether they agreed with the statement "most scientists want to work on things that will make life better for the average person." In the United States, 89% agreed with the statement in 2001, as did 85% of Chinese and 83% of Malaysian respondents. The level of agreement was lower in South Korea (77%) and Japan (60%).

Perceptions of science occupations can be assessed by examining the prestige that the public associates with them. In an August 2004 Harris poll (Harris Interactive 2004a), doctors and scientists received the highest prestige rankings out of 22 occupations. In fact, these were the only occupations seen by more than half of adults (52%) as having very great prestige. However, the 2004 number for scientists was down from that recorded in 2003 (57%), when scientist led all other occupations for the first time, with doctor ranking second at 52%. In 2004, fireman and teacher tied for third (48%), followed by military officer (47%), nurse (44%), police officer (40%), priest/minister/clergyman (32%), and member of Congress (31%) (table 7-9).

The engineering profession generally falls in the middle of the prestige rankings. In 2004, engineering ranked 10th among the 22 occupations in the survey, with 29% of the public saying it had very great prestige—about the same level as 2003, but down from 34% in 2002 and 36% in 2001.

Some notable changes have taken place during the 27 years of Harris Interactive polls about the prestige of different professions and occupations. Among the 11 occupations included in the survey since it began in 1977, only teachers saw an improvement in their rating, from 29% in 1977 to 48% in 2004. In contrast, the rating for scientists fell 14 points, from 66% to 52%, and ratings for doctors and lawyers fell 9 and 18 points, respectively.

The public's perception of science occupations can be measured in other ways. When asked how they would feel if their son or daughter wanted to become a scientist, 80% of Americans responding to the 2001 NSF survey said they would be happy with that decision (18% said they would not care and 2% said they would be unhappy). Responses were the same for both sons and daughters.[65] In contrast, in South Korea, only 54% of those surveyed in 2004 said they would feel happy if their son wanted a career in science; 57% said the same about a daughter. In Russia, only 32% of those surveyed in 2003 said they would want their son or daughter to become a researcher (down from 41% in 1995). In contrast, the Chinese rated science second highest (after medicine) as the occupation they would most like for their children (figure 7-20).

Table 7-9
Prestige of various occupations: Selected years, 1977–2004
(Percent)

Occupation	1977	1982	1992	1997	1998	2000	2001	2002	2003	2004
Scientist	66	59	57	51	55	56	53	51	57	52
Doctor	61	55	50	52	61	61	61	50	52	52
Teacher	29	28	41	49	53	53	54	47	49	48
Military officer	NA	22	32	29	34	42	40	47	46	47
Police officer	NA	NA	34	36	41	38	37	40	42	40
Priest/minister/clergyman	41	42	38	45	46	45	43	36	38	32
Member of Congress	NA	NA	24	23	25	33	24	27	30	31
Engineer	34	30	37	32	34	32	36	34	28	29
Athlete	26	20	18	21	20	21	22	21	17	21
Architect	NA	NA	NA	NA	26	26	28	27	24	20
Business executive	18	16	19	16	18	15	12	18	18	19
Lawyer	36	30	25	19	23	21	18	15	17	17
Entertainer	18	16	17	18	19	21	20	19	17	16
Union leader	NA	NA	12	14	16	16	17	14	15	16
Banker	17	17	17	15	18	15	16	15	14	15
Journalist	17	16	15	15	15	16	18	19	15	14
Accountant	NA	13	14	18	17	14	15	13	15	10

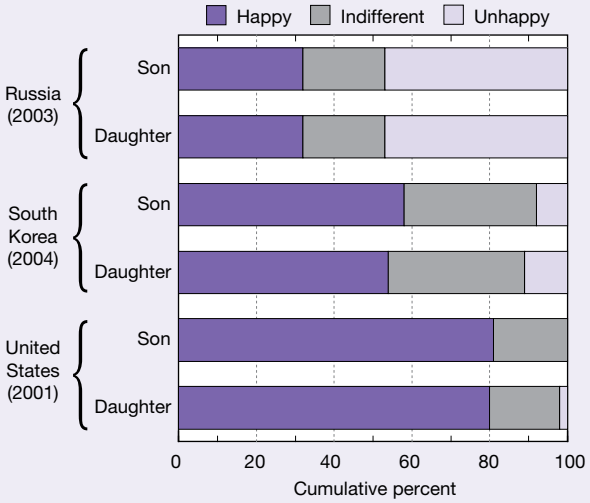
NA = not available

NOTE: Data based on "very great prestige" responses to: *I am going to read off a number of different occupations. For each, would you tell me if you feel it is an occupation of very great prestige, considerable prestige, some prestige, or hardly any prestige at all?*

SOURCE: Doctors, scientists, firemen, teachers and military officers top list as "most prestigious occupations," *The Harris Poll* 65, Harris Interactive (15 September 2004).

Science and Engineering Indicators 2006

Figure 7-20
Attitude toward science career for son or daughter: 2001, 2003, or 2004



NOTES: Responses to: *If you had a daughter, how would you feel if she wanted to be a scientist—would you feel happy, unhappy, or would you not care one way or the other?* and: *If you had a son, how would you feel if he wanted to be a scientist—would you feel happy, unhappy, or would you not care one way or the other?* Russian question slightly different: *Do you want your son/daughter to become a researcher?* Some respondents did not provide information about highest level of education. Detail may not add to total because of rounding.

SOURCES: National Science Foundation, Division of Science Resources Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (2001); South Korea Science Foundation, Survey on Public Attitude of Science & Technology 2004 (2004); and L. Gokhberg and O. Shuvalova, *Russian Public Opinion of the Knowledge Economy: Science, Innovation, Information Technology and Education,* British Council, Russia (2004).

Science and Engineering Indicators 2006

Conclusion

Americans and the citizens of other countries continue to get most of their information about the latest developments in S&T from watching television. However, the Internet has made inroads and is the leading source of information on specific scientific issues. Although Americans continue to rely most heavily on other, traditional sources of news and information, the Internet is the only news medium with an expanding audience.

Most Americans recognize and appreciate the benefits of S&T. The public is also highly supportive of the government's role in funding basic research. By most measures, American attitudes about S&T are considerably more positive than those in Europe and Japan, but about the same as those in South Korea and Malaysia.

In the United States and other countries, however, residents do not know much about S&T. In addition, their level of knowledge and understanding of scientific terms and concepts has not changed appreciably in the past few years. Perhaps more importantly, most Americans do not understand the scientific process and therefore may lack a valuable tool for assessing the validity of various claims they encounter in daily life. On a related note, evidence suggests that belief in pseudoscience is relatively widespread.

Although Americans generally have very positive attitudes about S&T and high regard for scientists, some harbor reservations about S&T, and many (70% of those surveyed) believe that scientific research does not pay enough attention to moral values. Although Americans are overwhelmingly supportive of medical applications of biotechnology, they are strongly opposed to human cloning. They are more evenly divided about genetically modified food and embryonic stem cell research. Support for the latter, however, has increased recently. Researchers are just beginning to track public attitudes toward and understanding of the emerging field of nanotechnology.

Notes

1. A recent unpublished analysis of the results of nearly 200 surveys conducted in 40 countries between 1988 and 2003 concluded that, other things being equal, the more people know about science, the more likely they are to have favorable attitudes toward it (Allum et al. 2005).

2. In a recent survey, 67% of respondents said that they "would like to see more information in newspapers, magazines, or on television about scientific and medical research," 25% said "about the same amount," and 5% said "less information" (Research!America 2005).

3. However, with increasing fragmentation of television audiences, it seems likely that exposures to science-relevant information from both media are increasingly intentional, even if those exposures are not always for a specific purpose.

4. In a survey on Americans' attitudes toward genetically modified food, most (88%) said that they had never looked for information about the subject. However, when "asked to speculate where they would turn for information about genetically modified food if they were so inclined…57% said they would search the Internet for information;…10% said they would go to the library for information" (Hallman et al. 2004).

5. In this chapter, all data for Asia (unless otherwise specified) were collected by the following: the Chinese Ministry of Science and Technology; the Korea Science Foundation; the Malaysian Science and Technology Information Centre (MASTIC) of the Ministry of Science, Technology and the Environment; and the National Institute of Science and Technology Policy of the Ministry of Education, Culture, Sports, Science and Technology in Japan. For more information, see sidebar, "Data Sources."

6. Among Asians surveyed, South Koreans were most likely to say information on the Internet is reliable and accurate, and Japanese citizens were least likely to say that (Cole 2004).

7. For example, when people were queried about their news habits on a typical day ("yesterday"), only about a quarter (24%) said they got news online, whereas 60%

watched the news on television, 42% read a daily newspaper, and 40% listened to the news on a radio. In addition, the survey revealed that people spend far less time per day obtaining news online than getting news from other sources (Pew Research Center for the People and the Press 2004).

8. In the Pew Research Center survey, 8% of those with a home computer did not have access to the Internet.

9. A study of data collected with the NSF surveys revealed that the most important predictor of home computer ownership was labor force participation (Losh 2004).

10. In the Pew Research Center survey, those respondents who reported that they go online for news were then asked if they looked for particular types of news online.

11. According to Harris Interactive polls, the most popular categories of online news are weather (sought by 60% of respondents in 2004), national news (56%), international news (44%), and local news (36%). (S&T was not among the choices given the respondents.) The Harris polls also found that the number of people who went online often or very often to obtain information about health or diseases rose from 15 to 21% between December 2003 and December 2004 (Harris Interactive 2004d).

Another survey conducted in 2004 found that 58% of respondents had used the Internet to look for information on specific diseases, 33% had looked for information on nutrition, and 32% had looked up information on prescription drugs. In 2004, most Americans thought that health information on the Internet was either strongly helpful (31%) or somewhat helpful (38%) and either very useful (23%) or somewhat useful (42%). Only 19% thought it was harmful, and 21% thought it was not useful (Research!America 2005).

12. Other surveys had similar findings (VCU Center for Public Policy 2004). When asked about their interest in scientific discoveries, only 10% of respondents said they were "not much interested," and only 5% said they were "not at all" interested; 42% said they had "a lot" of interest, and 42% reported "some" interest. (These numbers have changed little since 2001.)

13. The VCU surveys also show a high level of interest in new medical discoveries (VCU Center for Public Policy 2004). In the 2004 survey, 46% of respondents answered "a lot" when asked how much they were personally interested in new medical discoveries; 44% answered "some"; 7%, "not much"; and 2%, "not at all." (These numbers also have shown little variation since 2001.)

14. The Pew Research Center question was: "Now I'm going to read you a list of different types of news. Please tell me how closely you follow this type of news either in the newspaper, on television, or on radio…very closely, somewhat closely, not very closely, or not at all closely?" Note that the question did not include online news consumption.

15. Although the number of Americans who follow hard news—especially international news—has increased in recent years, interest in most news topics has remained stable (Pew Research Center for the People and the Press 2004).

16. An examination of the NSF data revealed a positive relationship between feeling well informed about S&T and providing correct answers to science literacy questions; however, the relationship was statistically weak (Losh et al. 2003).

17. Researchers have concluded that fewer than one-fifth of Americans meet a minimal standard of civic scientific literacy (Miller, Pardo, and Niwa 1997).

18. In Europe, residents of Sweden, the Czech Republic, Finland, the Netherlands, Norway, Denmark, and Slovenia have the highest rates of scientific knowledge, and Portugal, Malta, Latvia, Bulgaria, Cyprus and Turkey the lowest. Also, in Europe, men, persons between the ages of 15 and 54, those with more years of formal schooling, and those who do not attend religious services are more likely than others to provide correct responses to questions designed to test their knowledge of science (European Commission 2005a).

19. In China, only 1.4% of the population possessed basic scientific literacy in 2001. The percentage was higher among men (1.7%) and urban residents (3.1%) (Chinese Ministry of Science and Technology 2002).

20. In its own international comparison of scientific literacy, Japan ranked itself 10th of 14 countries included in the report (National Institute of Science and Technology Policy 2002).

21. A recent analysis of public opinion concerning evolution suggests that "many members of the public underestimate the scientific evidence in support of evolution and overestimate the evidence supporting intelligent design" (Nisbet and Nisbet 2005).

22. The cover of the November 2004 issue of *National Geographic Magazine* asked *"Was Darwin Wrong?"* The 33-page article concluded that "[t]he evidence for evolution is overwhelming."

23. The National Science Board issued a statement on the subject in August 1999 (National Science Board 1999).

24. In a 2005 CBS/*New York Times* poll, 57% of those surveyed favored teaching creationism along with evolution in public schools, down from 65% 4 months earlier. In the same 2005 poll, 35% favored teaching creationism instead of evolution in public schools, down from 37% in the previous survey. About half of those surveyed in both 2004 and 2005 opposed teaching creationism instead of evolution.

25. The question pertaining to experimental evaluation was: "Now, please think of this situation. Two scientists want to know if a certain drug is effective in treating 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?"

The text of the probability question in 2004 was: "Now think about this situation. A doctor tells a couple that their 'genetic makeup' means that they've got one in four chances

of having a child with an inherited illness. Does this mean that if their first child has the illness, the next three will not? Does this mean that each of the couple's children will have the same risk of suffering from the illness?"

26. Correct explanations of scientific study include responses describing it as theory testing, experimentation, or rigorous, systematic comparison.

27. Similar to questions about scientific facts and concepts, younger respondents, those with more formal education and higher incomes, and those without minor children at home were more likely than others to give correct responses to questions about the scientific process (appendix table 7-13).

28. According to one group studying such phenomena, pseudoscientific topics include yogi flying, therapeutic touch, astrology, fire walking, voodoo magical thinking, alternative medicine, channeling, Carlos hoax, psychic hotlines and detectives, near-death experiences, unidentified flying objects and alien abductions, the Bermuda Triangle, homeopathy, faith healing, and reincarnation (Committee for the Scientific Investigation of Claims of the Paranormal 2003).

29. Those 10 items were extrasensory perception (ESP), that houses can be haunted, ghosts/that spirits of dead people can come back in certain places/situations, telepathy/communication between minds without using traditional senses, clairvoyance/the power of the mind to know the past and predict the future, astrology/that the position of the stars and planets can affect people's lives, that people can communicate mentally with someone who has died, witches, reincarnation/the rebirth of the soul in a new body after death, and channeling/allowing a "spirit-being" to temporarily assume control of a body.

30. In the 2001 NSF survey, 56% of those surveyed agreed that astrology is "not at all scientific," 9% said it is "very scientific," and 31% thought it "sort of scientific." The difference between the 2001 and 2004 data may be attributable to differences in questionnaire design in the 2 years.

31. Countries with the highest levels of agreement were Italy, Latvia, the Czech Republic, Ireland, and Austria. The "least convinced" were in the Netherlands, Luxembourg, and Finland (European Commission 2005a).

32. The question wording was: "Have the benefits of scientific research outweighed the harmful results?"

33. In the United States, agreement with this statement is positively related to education and level of family income (appendix table 7-17).

34. Norway had the highest level of agreement with this statement (74%), followed by Poland (65%), Hungary (63%), Lithuania (63%), and Portugal (60%). The Netherlands (39%) and Slovenia (40%) had the lowest agreement rates, and Finland had the highest disagreement rate (30%) (European Commission 2005a).

35. Another survey found similar (79%) support for government funding of scientific research in 2004 (Research! America 2005).

36. In addition, 83% of Europeans agreed that "basic scientific research is essential for the development of new technologies" (European Commission 2001).

37. According to an annual survey commissioned by the Association of American Medical Colleges, 41% of congressional staff surveyed said that they did not know how and where the NIH budget supports medical research. In another survey of voters conducted by the same organization, 40% said they had never heard of NIH; 31% said they had a favorable opinion of the agency. Many voters (47%) and congressional staffers (35%) erroneously believed that most medical research is carried out by private industry (McInturff and Harrington 2004).

38. In Russia, 76% of those surveyed in 2003 thought that "funds allocated by the government for support of scientific research" were not sufficient, up from 65% recorded in 1997. In 2003, 9% said that such funds were "fairly sufficient," 1% said "more than sufficient," and 14% said they did not know (Gokhberg and Shuvalova 2004).

39. According to a survey conducted in mid-2005, about three-fourths of Americans favor continuing the manned space shuttle program. Surprisingly, support for the shuttle program was even greater immediately after the loss of the Challenger in 1986 (80%) and the Columbia in 2003 (82%). Although a large majority of Americans support the program, and most give NASA's overall performance high marks, support for space exploration declines when respondents are reminded of the expense. In 2005, 58% of those surveyed opposed allocating government funds for a manned trip to Mars, slightly higher than the percentages recorded in 1999 and 1969 (Newport 2005).

40. In recent years, few survey respondents (less than 5%) have mentioned the environment when asked to name the most important problem facing the country today. The story was quite different in the 1970s, after the first Earth Day celebration, when significantly higher percentages of survey participants mentioned the environment (Saad 2005).

41. The Gallup researchers concluded that the "global warming disaster movie—*The Day After Tomorrow*—[which] was the No. 6 top-grossing movie of the year…doesn't appear to have stirred up a great deal of alarm among Americans about global warming" (Saad 2005).

42. In Europe, 89% of those surveyed agreed that "we have a duty to protect nature, even if this means limiting human progress." About half (51%) agreed that "exploiting nature may be unavoidable if humankind is to progress," and 43% agreed that "we have a right to exploit nature for the sake of human well being" (European Commission 2005b).

43. In Europe, half of those surveyed agreed that "many high-tech products are just gadgets," indicating "negative opinion on technological developments linked to the economy." At least 60% of the citizens of Sweden, Norway, Germany, Cyprus, and Luxembourg agreed with the statement (European Commission 2005a).

44. In Europe, the 2005 question was worded "for each of these, do you think it will have a positive, a negative or no effect on our way of life in the next 20 years?"

45. In another series of surveys in the United States, almost half of those queried had heard or read "nothing at all" about genetic engineering or biotechnology; a little over a quarter had heard or read "not much." In addition, nearly two-thirds of those surveyed in 2004 reported that they had never discussed biotechnology, genetic engineering, or genetic modification with anyone (Hallman et al. 2004).

46. Fears that have prompted consumers' concerns include the possible development of food allergies resulting from unknown gene combinations, increased resistance to antibiotics through ingestion of food with antibiotic-resistant genes, and potential toxicity from foods modified to produce pesticides.

47. In a 2005 survey, 12% of Americans described themselves as being very familiar with GM food, 54% said they were somewhat familiar with it, 21% said not very, and 13% said that they were not at all familiar with it; statistics for Canadians were similar (Canadian Biotechnology Secretariat 2005).

48. In January 2001, shortly after widespread media coverage of the Starlink incident (the discovery of unapproved GM corn in the food supply), 44% of those surveyed said they had heard some or a great deal about GM foods. Subsequently, without a similar story making frontpage headlines in more recent years, the level of awareness fell. In 2004, only 32% said they had heard some or a great deal about GM foods (Pew Initiative on Food and Biotechnology 2004). In addition, most Americans were unable to recall news stories about GM food (Hallman et al. 2004).

49. Those who claimed to be aware that GM foods were available in their supermarkets were asked to estimate how many years the products have been available to consumers. The median guess—10 years—was accurate. However, many were confused about which products contained GM ingredients (Hallman et al 2004).

50. For most of the questions, about half of the respondents chose the "unsure" option. For example, 40% of respondents correctly answered "false" to the statement "ordinary tomatoes do not contain genes while GM tomatoes do." However, 51% said they were unsure.

51. More than half (54%) of Europeans surveyed answered "never" in response to a question asking if they approve "growing meat from cell cultures so that we don't have to slaughter farm animals." However, fewer respondents gave the same response to two other items: "developing genetically modified crops to increase the variety of regionally grown foods" (37%) and "developing genetically modified bacteria that could clean up the environment after environmental catastrophes" (19%) (European Commission 2005b).

52. In the Pew Initiative study, those who felt positively toward GM food cited higher yields, food lasting longer, and benefits to developing countries as the major advantages. Those who were concerned were more likely to say that it was wrong to tamper with nature and were more likely to worry about long-term effects on health (Pew Initiative on Food and Biotechnology 2004).

53. In another survey conducted in 2004, 83% of respondents said they knew "not too much" or "nothing at all" about the federal regulation of GM foods. These numbers were virtually unchanged from the previous years (Pew Initiative on Food and Biotechnology 2004).

54. The 2005 Eurobarometer asked several questions about public perceptions of the relationship between policymakers and the field of science. About three-fourths of Europeans surveyed believed that politicians should rely more on the advice of expert scientists. Only about a third agreed that "research conducted by industry is well controlled and regulated" and that "there should be no limit to what science is allowed to investigate on." In addition, half of those surveyed agreed with two different statements: "if a new technology poses a risk that is not fully understood, the development of this technology should be stopped even if it offers clear benefits"; and "if we attach too much importance to risks that are not yet fully understood, we will miss out on technological progress" (European Commission 2005a).

55. The questions used in the Gallup surveys did not differentiate between reproductive and therapeutic cloning (Lyons 2004a). According to the author, the results of an earlier (2002) survey (that asked about both reproductive and other types of cloning) "strongly suggest that respondents are thinking about cloning that results in the creation of a human being when they are simply asked for their views on 'human cloning.' The 2002 poll found higher support for more limited types of cloning, including 59% for cloning organs to be used in medical transplants and 51% for cloning human cells from adults to use in medical research."

56. In the same survey, the percentage of respondents who said they had heard a lot about the issue of stem cell research increased from 27% in March 2002 to 47% in December 2004. Those who said they had heard a lot were more likely than others to say they supported stem cell research (Pew Research Center for the People and the Press 2005).

57. Other surveys provide comparisons with Canadian and British public opinion on embryonic stem cell research. In 2004, 54% of Americans said that embryonic stem cell research was morally acceptable, compared with 61% of Canadians and 57% of the residents of Great Britain. In all three countries, those who said that religion was very important in their daily lives were less likely to believe that stem cell research was morally acceptable than were those who said religion was "fairly important" or "not very important" in their daily lives (Lyons 2004b). For more comparisons between Americans and Canadians on this issue, see sidebar

"Americans' and Canadians' Attitudes Toward Stem Cell Research Are Not That Different."

58. An analysis of the VCU data found that religion might act as a "perceptual screen" on this issue. According to the analysis, for most Americans, the more they reported hearing, reading, or seeing about the issue, the greater their support for embryonic stem cell research. However, among highly religious Americans, regardless of how much more they reported hearing, reading, or seeing about stem cell research, their opinions remained relatively unchanged, which suggests that very religious people may only pay attention to arguments about the issue that confirm their initial reservations (Nisbet 2005).

59. In another survey, about the same number of respondents said that nanotechnology would produce more benefits than risks (40%) and that risks and benefits would be about equal (38%). Only 22% predicted that risks would outweigh benefits (Cobb and Macoubrie 2004). Another researcher found that survey respondents who were aware of nanotechnology held significantly more optimistic views of its potential benefits than those who were not aware of it, but no relationship between factual knowledge about nanotechnology and optimism about its benefits (Scheufele 2005.).

60. The "nano-robot" response is a scenario from *Prey,* a novel by Michael Crichton.

61. Those who were aware of nanotechnology were more likely than others to express support for it. However, factual knowledge about nanotechnology does not seem to have a significant effect on attitudes toward nanotechnology in general, support for increased funding, or risk/benefit perceptions. Nearly half (49%) of the respondents who were aware of nanotechnology said they supported increased financial support for research, compared with only 22% of the unaware group (Scheufele 2005).

62. In China and South Korea, scientists are accorded the highest level of prestige, and medical doctors are ranked second in both countries. In Russia, scientists ranked eighth in terms of the most respected occupations, after lawyer, businessman, politician, programmer, skilled worker, doctor, and teacher. Engineering ranked fourteenth, lower than journalist, artist/actor/writer, tradesman, farmer, and soldier.

63. When the Eurobarometer survey asked "for each of these different people and groups involved in science and technology, do you think that what they do has a positive or a negative effect on society," the following percentages of positive responses were obtained: scientists in university (88%), television and radio reporting on science and technology (86%), consumer organizations testing new products (86%), scientists in industry doing research (85%), newspapers and magazines reporting on science and technology (83%), industry developing new products (81%), environmental groups campaigning on issues related to science and technology (80%), citizens who get involved in debates about science and technology (78%), public authorities assessing the risks that may come from new technologies (78%), animal rights groups campaigning about the treatment of animals (77%), the European Commission regulating science and technology for all European Union countries (75%), and public authorities regulating science and technology (73%) (European Commission 2005b).

64. The 18% who said they did know a scientist were then asked what fields those scientists worked in. Biotechnology/medical/pharmaceutical got the highest number of responses (22%), followed by biology/anatomy/genetics/microbiology (14%), chemistry (11%), physics/nuclear physics (11%), environmental science (5%), and engineering/rocket science (5%); 31% responded "other fields" (Research!America 2005).

65. In Europe, three-fourths of those surveyed agreed that "girls and young women should be further encouraged to take up studies and careers in science"; only 7% held the opposite viewpoint. The highest rates of agreement were in Malta, Ireland, Portugal, Sweden, Cyprus, Poland, Iceland, and Norway, and the lowest were in Latvia and the Czech Republic (European Commission 2005b).

Glossary

Pseudoscience: "Claims presented so that they appear [to be] scientific even though they lack supporting evidence and plausibility" (Shermer 1997, p. 33).

Science: "A set of methods designed to describe and interpret observed and inferred phenomena, past or present, and aimed at building a testable body of knowledge open to rejection or confirmation" (Shermer 1997, p. 17).

Scientific literacy: Knowing basic facts and concepts about science and having an understanding of how science works.

Therapeutic cloning: Use of cloning technology in medical research to develop new treatments for diseases; differentiated from human reproductive cloning.

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