Chapter 7
Science and Technology: Public Attitudes and Understanding

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Highlights

Interest, Information Sources, and Involvement

Four out of five Americans say they are interested in "new scientific discoveries."

- ♦ Other science and technology (S&T) related issues also interest many Americans; these include new medical discoveries, environmental pollution, and new inventions and technologies.
- ♦ A survey of the United States and 10 European countries, including the 5 largest, suggests that interest in S&T in the United States is somewhat higher than in Europe.

The Internet has surpassed television as Americans' primary source for information about S&T.

- ♦ About 4 in 10 Americans cited the Internet as their primary source of S&T information in 2012 compared with about one-third in 2010. The percentage of Americans saying they relied on television as their primary source of S&T information dropped between 2010 and 2012.
- ♦ Most of those who used the Internet for S&T information said they used online editions of newspapers.

A majority of Americans said they had visited a zoo or aquarium, natural history museum, or S&T museum in 2012.

- ♦ Reported attendance at informal science and cultural institutions in 2012 was down slightly from 2008. The primary drop was for zoos and aquariums.
- ♦ Attendance at informal science institutions was associated with higher education and income.

Public Knowledge about S&T

Americans correctly answered 5.8 out of 9 factual knowledge questions in 2012, a score similar to those in recent years.

- ♦ A survey experiment showed that 48% of respondents said they thought it was true that "human beings, as we know them today, developed from earlier species of animals," but 72% gave this response when the same statement was prefaced by "according to the theory of evolution." Similarly, 39% of respondents said that "the universe began with a huge explosion," but 60% gave this response when the statement was prefaced by "according to astronomers."
- ♦ Levels of factual knowledge in the United States are comparable to those in Europe and are generally higher than levels in countries in other parts of the world.
- ♦ Americans with more formal education do better on science knowledge questions.
- ♦ Men do better on questions focused on the physical sciences, but there are few differences between men and women in terms of responses to questions focused on the biological sciences.

Most Americans could correctly answer two multiple-choice questions dealing with probability in the context of medical treatment and the best way to conduct a drug trial but had difficulty providing a rationale for the use of a control group or describing what makes something scientific.

- ♦ Americans performed better than the average for residents of 10 European countries on a similar multiple-choice measure of probability, although the residents of several individual countries had better scores than U.S. residents.

Fewer Americans rejected astrology in 2012 than in recent years.

- ♦ In 2012, slightly more than half of Americans said that astrology was "not at all scientific," whereas nearly two-thirds gave this response in 2010. The comparable percentage has not been this low since 1983.

Public Attitudes about S&T in General

Most Americans continue to say that the benefits of science outweigh the potential harms and that the federal government should fund research that "advances the frontiers of knowledge."

- ♦ As in past years, about 4 in 10 Americans said the government was spending "too little on research." In 2012, about half of respondents said government spending on scientific research was "about right," and about 1 in 10 said there was too much research spending.
- ♦ Americans are most likely to say that education has remained the area in which the government spends too little money. Majorities have also consistently said that they believe health, "alternative energy," and environmental improvement and protection receive too little funding. The only area in which majorities say government spends "too much" is on "assistance to other countries."

Americans are more likely to have a "great deal of confidence" in leaders of both the scientific community and the medical community than in leaders of any group except the military.

- ♦ The scientific and medical communities are also among the most highly regarded groups in most other countries surveyed.

Americans hold positive views about both scientists and engineers. Attitudes are similar to those expressed about scientists in 1983 and 2001.

- Less than half of Americans say they have an "excellent" or "good" understanding of what scientists and engineers do at work. Americans say they have a better understanding of engineers' work than scientists' work.
- Many Americans say they think that "scientific work" and "engineering work" are "dangerous," although scientific work is seen as more dangerous than engineering work.
- Most Americans see scientists and engineers as "dedicated people who work for the good of humanity."

Americans see many traditional research fields, as well as a range of applied fields, as "scientific."

- Only about half of Americans see the social science fields of economics and sociology as scientific. More Americans see applied activities such as computer programming, farming, and firefighting as scientific.

Public Attitudes about Specific S&T-Related Issues

Americans are about as concerned about the overall environment as respondents in many other developed countries.

- In 2010, about one-third of Americans said they worried about "the quality of the environment." Responses to this question have been similar in recent years.

Americans remain divided on views about climate change and hold views that are different from those of citizens of other countries.

- A majority of Americans worried "a great deal" or a "fair amount" about climate change in 2013.
- About 3 in 10 Americans say that "dealing with global warming" should be a priority for the president and Congress. In recent years, dealing with climate issues has been near the bottom of Americans' list of potential priorities.
- Many of the other countries surveyed show more concern than the United States about climate change.
- Americans are more likely than residents of other countries to say they believe that any apparent change in temperatures is the result of natural rather than man-made causes.

Americans' support for oil and nuclear energy has rebounded or stabilized following declines associated with major accidents.

- About two-thirds of Americans supported "allowing more offshore oil and gas drilling" in 2012. Less than half of Americans supported drilling in a survey conducted in 2010, shortly after the *Deepwater Horizon* oil spill in the Gulf of Mexico.
- Most Americans continue to express support for nuclear energy as "one of the ways to provide electricity," although support remains lower than before the 2011 nuclear accident in Fukushima, Japan.
- Americans are more supportive of nuclear energy than residents of most other countries.

Americans are less concerned about "modifying the genes of certain crops" than residents of most other countries surveyed, although most still see potential danger.

- In 2010, about one-quarter of U.S. respondents said that modification could be "very" or "extremely dangerous." Belgium was the only country where residents saw less danger.

Most Americans see using stem cells from human embryos in medical research as "morally acceptable."

- In 2013, 6 in 10 of Americans saw using stem cells from human embryos as acceptable. This percentage has stayed relatively stable since 2005.

Introduction

Chapter Overview

Science and technology (S&T) is central to American life. Whether at home, work, school, or out in our communities, S&T affects our daily activities and how we interact in a host of different ways. Many Americans work in jobs in which they innovate using S&T, whereas others use these innovations to produce the goods and services that improve and reshape our lives. S&T gives us new opportunities to get healthy and stay healthy. It affects what and how we eat while providing technologies that keep us entertained and connected. S&T also gives us things to talk about, whether as part of political discussions or simply because so much about S&T can be interesting and important to how the world works. Such conversations are common because S&T is integral to American society. This centrality means that Americans' attitudes and understanding about S&T matter a great deal.

Sometimes S&T debates involve potential risks to health or the environment or changes to what it takes for individuals or companies to succeed. Societies can do a better job addressing potential concerns when these concerns are well understood, even if some concerns turn out to be unfounded. Americans' ability to deal with potential risks may affect what kinds of S&T development occurs within the country as well as whether we can take advantage of the S&T that already exists. Individuals may also choose where to focus their careers based on both their personal interests as well as where they feel they can make a meaningful impact.

Given the centrality of S&T to life in the United States, this chapter presents indicators about interest in S&T news, where people encounter S&T in the media, trend data regarding knowledge of S&T, and indicators of people's attitudes about S&T-related issues. To put U.S. data in context, the chapter examines trend indicators for past years and comparative indicators for other countries.

Chapter Organization

This chapter is divided into four main sections. The first includes indicators of the public's interest in S&T news, sources of information, and involvement in informal S&T activities. The second section reports indicators of public knowledge, including trend measures of factual knowledge of S&T and people's understanding of the scientific process. This second section also includes the way individuals respond to knowledge questions. The third and fourth sections of the chapter describe public attitudes toward S&T. The third section presents data on attitudes about S&T in general, including support for government funding of basic research, confidence in the leadership of the scientific community, and perceptions of scientists and engineers. Also included is a focus on the degree to which the public views various fields and activities as "scientific." The fourth section addresses attitudes on public issues in which S&T plays an important role, such as the environment, climate change, energy, nuclear power, and the use of animals in scientific research. It also includes indicators of public opinion about several emerging lines of research and new technologies, including nanotechnology, genetically modified (GM) food, stem cell research, and cloning.

A Note about Data and Terminology

This chapter emphasizes trends over time, patterns of variation within the U.S. population, and international patterns. It reviews recent survey data from national samples with sound, representative sampling designs. The emphasis in the text is on the trends and patterns in the data.

Like all survey data, the data in this chapter are subject to numerous sources of error and random variation that should be kept in mind when interpreting the findings. Caution is especially warranted for data from surveys that omit significant portions of the target population, have low response rates, or have topics that are particularly sensitive to subtle differences in question wording (see sidebars "U.S. Survey Data Sources" and "International Survey Data Sources"). Also, although many of the international comparisons involve identical questions asked in different countries, these comparisons can be affected by language and cultural differences that cause survey respondents to interpret questions differently. International comparisons therefore require careful consideration.

S&T questions asked in the biennial General Social Survey (GSS) are a major source of data for this chapter. The GSS is a high-quality, nationally representative data source on attitudes and behavior of the U.S. population. Questions about S&T information, knowledge, and attitudes have been included in the GSS since 2006 and have formed the basis of this chapter in *Science and Engineering Indicators* since 2008. The GSS collects data primarily through in-person interviews. Comparable survey data collected between 1982 and 2004 used telephone interviewing; prior to 1982, these data were collected via in-person interviews. Changes in data collection methods over these years, particularly prior to 2006, may affect comparisons over time.

Another important limitation is that recent, high-quality, relevant data are not always available. In some cases, there are large gaps between data collections or only a small number of questions on any given topic. This challenge is particularly acute when it comes to international data. There is a substantial amount of survey work on S&T in Europe, but these data are not collected as regularly as data from the GSS. Asian data are collected even less frequently. Data from Africa and South America are also limited. In general, the current chapter focuses on surveys that have become public after the preparation of the 2012 *Indicators* report. Earlier data can be found in past editions of *Indicators*. In addition, Bauer, Shukla, and Allum (2012) summarize survey data up to 2006 from a range of countries and regions.

U.S. Survey Data Sources

Sponsoring organization	Title	Years used	Information used	Data collection method	Respondents (*n*); margin of error of general population estimates
National Science Foundation (NSF)	Survey of Public Attitudes Toward and Understanding of Science and Technology (1979–2001); University of Michigan Survey of Consumer Attitudes (2004)	1979–2001, 2004	Information sources; interest; visits to informal science institutions; general attitudes; attitudes toward government spending, science/mathematics education, and animal research	Telephone interviews	*n* = 1,574–2,041; ± 2.5%–3.0%
National Opinion Research Center (NORC) at the University of Chicago	General Social Survey (GSS)	1973–2012	Attitudes toward government spending, confidence in institutional leaders	Face-to-face interviews, supplemented by telephone interviews	Government spending (2000–12): *n* = 1,372–4,510; ± 2.8%–3.9% Confidence in institutional leaders (1973–2012): *n* = 876–2,223; ± 2.5%–4.4%
NORC at the University of Chicago	GSS environment module	1993–94, 2000, 2010	Attitudes toward environment	Face-to-face interviews, supplemented by telephone interviews	*n* = 1,276–1,557; ± 2.5%–3.3%
NORC at the University of Chicago	GSS Science and Technology (S&T) module	2006, 2008, 2010, 2012	Information sources; interest; visits to informal science institutions; science knowledge; general attitudes; attitudes toward government spending, science/mathematics education, animal research, and nanotechnology	Face-to-face interviews, supplemented by telephone interviews	*n* = 1,864–2,256; ± 2.5%–3.3%
National Survey of American Public Opinion on Climate Change	American Belief in Climate Change	2012	Attitudes toward climate change	Telephone interviews	*n* = 726; ± 4.0%
Gallup	Various ongoing surveys	1982–2013	Federal priorities; attitudes toward environmental protection, climate change, nuclear energy, alternative energy, animal research, stem cell research, and quality of science/mathematics education in U.S. public schools	Telephone interviews	*n* = ~ 1,000; ± 3.0%–4.0%
GfK Roper/ Bisconti Research	U.S. Public Opinion Survey	1983–2013	Attitudes toward nuclear energy	Telephone interviews	*n* = ~ 1,000; ± 3.0%
Harris Interactive	The Harris Poll	1977–2009	Views on occupational prestige	Telephone interviews	*n* = ~ 1,000 (~ 500 asked about each occupation)
Pew Initiative on Food and Biotechnology, The Pew Charitable Trusts	Poll on consumer attitudes toward genetically modified foods and genetic engineering	2001–06	Attitudes toward genetically modified foods	Telephone interviews	*n* = 1,000; ± 3.1%
Pew Internet & American Life Project, Pew Research Center	Pew Internet & American Life Survey	2006, 2012	Information sources, interest, involvement, Internet use, library use	Telephone interviews	2006: *n* = 2,000; ± 3.0% 2012: *n* = 2,252; ± 2.3%
Pew Research Center	Biennial News Consumption Survey	1994–2012	Information sources, interest, credibility of information sources, top stories, time spent following the news	Telephone interviews	1994, 1998–2012: *n* = 3,000–3,667; ± 2.0%–2.5% 1996: *n* = 1,751; ± 3.0%
Pew Research Center	General Public Science Survey	2009	Public's beliefs about S&T-related issues and benefits of science to well-being of society	Telephone interviews	*n* = 2,001; ± 2.5%
Pew Research Center	Media surveys (various)	1985–2012	Attitudes toward news media, media believability	Telephone interviews	*n* = ~ 1,000–1,505; ± 3.4%–4.0%
Pew Research Center	Political surveys (various)	2008–13	Information sources; Internet use; attitudes toward national policy on environment, climate change, and energy; attitudes toward government spending for scientific research	Telephone interviews	*n* = ~ 1,000–2,250; ± 2.5%–3.5%
Thomson Reuters	National Survey of Healthcare Consumers: Genetically Engineered Food	2010	Attitudes toward genetically modified foods	Telephone interviews	*n* = 3,025; ± 1.8%
Virginia Commonwealth University (VCU)	VCU Life Sciences Survey	2001–08, 2010	Attitudes toward animal research, stem cell research, and cloning technology	Telephone interviews	*n* = ~ 1,000; ± 3.0%–3.8%

U.S. Survey Data Sources—continued

Sponsoring organization	Title	Years used	Information used	Data collection method	Respondents (*n*); margin of error of general population estimates
Yale Project on Climate Change Communication and the George Mason University Center for Climate Change Communication	Climate Change in the American Mind	2008–12	Attitudes toward climate change	Online (probability-based sample)	*n* = ~ 1,000; ± 4.0%

NOTES: All surveys are national in scope and based on probability sampling methods. Statistics on the number of respondents and the margin of error are as reported by the sponsoring organization. When a margin of error is not cited, none was given by the sponsor.

International Survey Data Sources

Sponsoring organization	Title	Years used	Information used	Data collection method	Respondents (*n*); margin of error of general population estimates
BBVA Foundation (Fundación BBVA)	BBVA Foundation International Study on Scientific Culture	2011	Media use, various knowledge and attitudes items	Face-to-face interviews	*n* = 1,500 for each of 15 countries; ± 2.6%
British Council, Russia	Survey of Public Attitudes Toward Science and Technology in Russia	2003	Various knowledge items	Paper questionnaires	*n* = 2,107
Chinese Association for Science and Technology, China Research Institute for Science Popularization	Chinese National Survey of Public Scientific Literacy	2007, 2010	Interest, various knowledge and attitude items, information sources, visits to informal science institutions, views on occupational prestige	Face-to-face interviews	2007: *n* = 10,059 2010: *n* = 68,416
European Commission	Special Eurobarometer 52.2: *The Europeans and Biotechnology* (1999)	1999	Attitudes toward nuclear energy	Face-to-face interviews	(EU total) *n* = 16,082; (Germany) 2,000; (UK) 1,300; (Luxembourg) 600; (12 other countries) ~ 1,000
	Special Eurobarometer 224/ Wave 63.1: *Europeans, Science and Technology* (2005)	2005	Views on academic fields, visits to informal science institutions		(EU total) *n* = 26,403; (Germany) 1,507; (UK) 1,307; (Slovakia) 1,241; (19 other countries) ~ 1,000; (3 other countries) ~ 500
	Special Eurobarometer 224/ Wave 64.3: *Europeans and Biotechnology in 2005: Patterns and Trends* (2006)	2005	Various knowledge items		(EU total) *n* = ~ 25,000; (each member country/state) ~ 1,000
	Special Eurobarometer 300/ Wave 69.2: *Europeans' Attitudes Towards Climate Change* (2008)	2008	Attitudes toward climate change		(EU total) *n* = ~ 26,661; (Germany) 1,534; (UK) 1,306; (22 other countries) ~ 1,000; (3 other countries) ~ 500
	Special Eurobarometer 340/ Wave 73.1: *Science and Technology Report* (2010)	2010	Attitudes toward science and technology, animal research		(EU total) *n* = ~ 26,671; (Germany) 1,531; (UK) 1,311; (22 other countries) ~ 1,000; (3 other countries) ~ 500
	Special Eurobarometer 341/ Wave 73.1: *Biotechnology* (2010)	2010	Attitudes toward cloning and nuclear energy		(EU total) *n* = ~ 26,676; (Germany) 1,531; (UK) 1,316; (22 other countries) ~ 1,000; (3 other countries) ~ 500
	Special Eurobarometer 365/ Wave 75.2: *Attitudes of European Citizens Toward the Environment*	2011	Attitudes toward the environment		(EU total) *n* = ~ 26,825; (Germany) 1,588; (UK) 1,317; (22 other countries) ~ 1,000; (3 other countries) ~ 500

International Survey Data Sources—continued

Sponsoring organization	Title	Years used	Information used	Data collection method	Respondents (*n*); margin of error of general population estimates
Gallup	Global Gallup Reports	2007–08, 2010	Attitudes toward climate change	Face-to-face interviews Telephone interviews	2007–08: (Total) *n* = 206,193; ± 1.0%–6.0% (United States and 127 other countries) ~ 2,000 in most countries 2010: (Total) *n* = ~ 111,000; ± 1.7%–5.7% (United States and 110 other countries) ~ 1,000 each
India National Council of Applied Economic Research	National Science Survey	2004	Various knowledge items, visits to informal science institutions, information sources	Face-to-face interviews	*n* = 30,255
International Social Survey Programme	Environment Module	1993, 2000, 2010	Various environment and science items	Face-to-face interviews Paper questionnaires	1993: (Total) *n* = 28,301; (United States) 1,430; (22 other countries) 767–1,931 2000: (Total) *n* = 31,042; (United States) 1,276; (37 other countries) 527–1,609 2010: (Total) *n* = 45,199; (United States) 2,044; (31 other countries) 527–1,609
Japanese Cabinet Office	A Public Opinion Poll on Science, Technology, and Society (except 1998, when it is "…Science and Technology in the Future")	1990, 1995, 1998, 2004, 2007, 2010	Interest	Face-to-face interviews	1990, 1995, 1998, 2004, 2010: *n* = ~ 1,900–2,200 2007: *n* = 1,667
Japan National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology	Survey of Public Attitudes Toward and Understanding of Science and Technology in Japan	2001, 2011	Interest, various knowledge and attitude items, information sources, visits to informal science institutions	Face-to-face interviews	2001: *n* = 2,146 2011 (July): *n* =1,010 2011 (Dec.): *n* =1,208
Korea Foundation for the Advancement of Science and Creativity (formerly Korea Science Foundation)	Survey of Public Attitudes Toward and Understanding of Science and Technology	2004, 2008, 2010	Interest, various knowledge and attitude items, information sources, funding, visits to informal science institutions	Face-to-face interviews	*n* = 1,000; ± 3.0%–3.1%
Malaysian Science and Technology Information Center, Ministry of Science, Technology and Innovation	Survey of the Public's Awareness of Science and Technology: Malaysia	2008	Interest, awareness, various knowledge and attitude items, information sources, visits to informal science institutions	Face-to-face interviews	*n* = 18,447; ± 1.0%
Ministry of Science and Technology of Brazil	Public Perceptions of Science and Technology	2010	Attitudes toward government spending	Face-to-face interviews	*n* = ~ 2,000; ± 2.2%
Pew Global Attitudes Project, Pew Research Center	Global Attitudes Survey	2010	Climate change concerns	(Varies by country) Face-to-face interviews Telephone interviews	(United States) *n* = 1,002; ± 4.0% (21 other countries) *n* = 700–3,262; ± 2.5%–5.0%

EU = European Union; UK = United Kingdom.

NOTES: All surveys are national in scope and based on probability sampling methods. Statistics on the number of respondents and margin of error are as reported by the sponsoring organization. When a margin of error is not cited, none was given by the sponsor.

Throughout this chapter, the terminology used in the text reflects the wording in corresponding survey questions. In general, survey questions asking respondents about their primary sources of information, interest in issues in the news, and general attitudes use the phrase "science and technology." Thus, *S&T* is used when discussing these data. Survey questions asking respondents about their confidence in institutional leaders, the prestige of occupations, and their views on different disciplines use terms such as "scientific community," "scientists," "researchers," and "engineers," so *S&E* is used when examining issues related to occupations, careers, and fields of research. Although science and engineering are distinct fields, national survey data that make this distinction are scarce. The term *Americans*, as well as equivalent terms for other countries, is meant to refer to U.S. residents included in a national survey. However, not all respondents were citizens of the countries in which they were surveyed.

Interest, Information Sources, and Involvement

Americans' understanding and attitudes about topics such as S&T depend, in part, on how much exposure they get to such content throughout their life, as well as how much attention they pay to such content (Slater, Hayes, and Ford 2007). Exposure and attention to S&T can make residents more informed, shape attitudes, and help them make decisions that are better for themselves, their families, and their communities. Media use can also spur interest in S&T issues and foster a desire to seek out and consider new information.

This section reviews overall expressed interest in media reports about S&T, the sources of material about S&T that are available to the public, and the type of S&T-related content the public uses. It concludes with indicators of behavioral involvement in S&T through visits to museums and other cultural institutions.

Public Interest in S&T

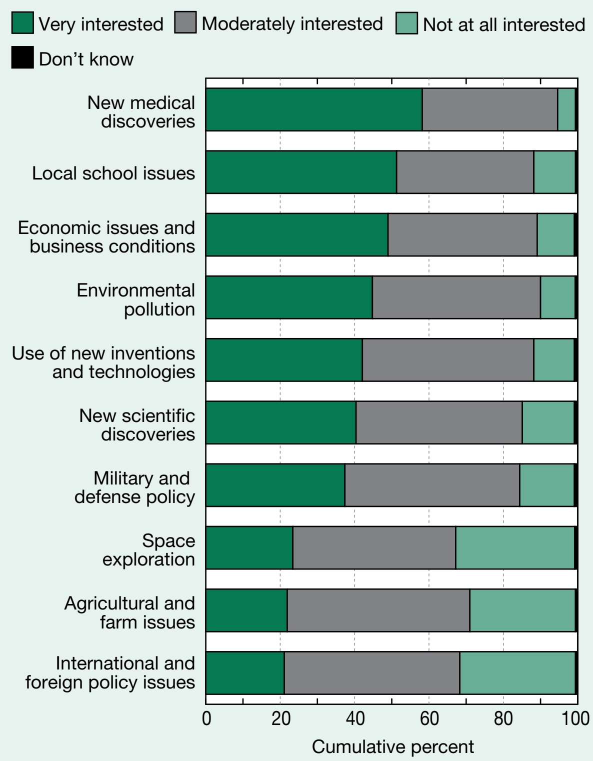
U.S. Patterns and Trends

Most Americans say they are interested in science news, although several other subjects draw more interest. Less than half of Americans (40%) in 2012 said that they were "very interested" in news about "new scientific discoveries," which is about the same as the percentage who expressed high levels of interest in news about "military and defense policy" (37%) and the "use of new inventions and technologies" (42%). Interest in other issues that touch on S&T ranged from a high of 58% for "new medical discoveries" to a low of 23% for "space exploration." "Environmental pollution" issues (45%) were also popular (figure 7-1; appendix tables 7-1 and 7-2).[1]

Current findings for science news are within their historical range. For 2012, the percentage of Americans who said they find news about scientific discovery "very" interesting stayed stable from 2010, but the percentage saying they are "not at all interested" in scientific discovery climbed from 8% in 2010 to 14%. Between 1981 and 2012, the percentage of uninterested respondents has ranged between 17% (1981) and 8% (2001), whereas the percentage of "very interested" respondents has ranged between 37% (1981) and 49% (1997). The topic of medical discoveries has consistently stayed at the top of the list alongside nonscience issues such as local school issues and economic issues. Space exploration has remained near the bottom alongside nonscience subjects such as international affairs (figure 7-2; appendix tables 7-1 and 7-2).

Also, although most Americans may say they have an interest in S&T, Pew Research data show that the percentage of Americans who actually followed news about "Science and Technology" "very closely" was just 16% in 2012 and has stayed between 13% and 18% since 2000. The 2012 percentage is down from highs of 20% and 22% in 1996 and 1998, respectively. Weather is the most common subject respondents say they follow "very closely" (52%). About the same percentage of people paid close attention to S&T as paid close attention

Figure 7-1
Public interest in selected issues: 2012



NOTE: 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 I would like you to tell me if you are very interested, moderately interested, or not at all interested.*

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix table 7-1.

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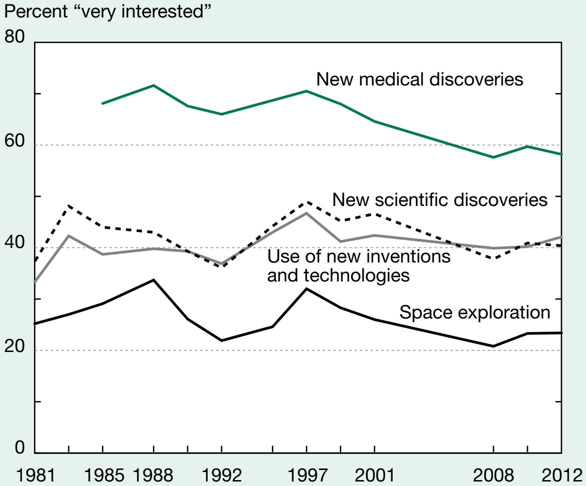
Figure 7-2
Public interest in selected science-related issues: 1981–2012



NOTE: 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 I would like you to tell me if you are very interested, moderately interested, or not at all interested.*

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1981–2001); University of Chicago, National Opinion Research Center, General Social Survey (2008–12). See appendix table 7-1.

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to politics, business and finance, and international affairs. Although some issues have stayed relatively stable, most issues have seen at least small declines in the percentage of Americans who say they follow that topic closely. One of the largest declines has been in the percentage of Americans interested in health news (Pew Research Center 2012a) (table 7-1).

International Comparisons

Americans generally report higher levels of interest in S&T issues than do residents of many European countries. A survey conducted by the BBVA Foundation in the United States and 10 European countries—including the 5 largest (France, Germany, Italy, Spain, and the United Kingdom) and 5 others (Austria, the Czech Republic, Denmark, the Netherlands, and Poland)—asked respondents to use a 0-to-10–point scale to rate their interest in six issues. These included three S&T-related issues ("scientific issues," "environmental issues," and "health issues") and three non-S&T issues ("economic issues," "international issues," and "political issues"). For scientific issues, the United States had an average interest level of 6.0, which was greater than the 10-country European average of 5.6. The Netherlands had the highest score (6.4), and several countries were in the same general range as the United States. The U.S. average for interest in environmental issues (6.9) tied the Netherlands, the highest of the included European countries, but was only a little higher than the overall average of 6.6. For health issues, the U.S. average of 7.8 was just below

Table 7-1
News followed "very closely" by American public: 1996–2012
(Percent)

Type of news	1996	1998	2000	2002	2004	2006	2008	2012
Weather	NA	NA	NA	NA	53	50	48	52
Crime	41	36	30	30	32	29	28	28
Community	35	34	26	31	28	26	22	26
Sports	26	27	27	25	25	23	20	26
Health news	34	34	29	26	26	24	20	23
Local government	24	23	20	22	22	20	20	21
Politics/Washington news	16	19	17	21	24	17	21	17
Science and technology	20	22	18	17	16	15	13	16
Business and finance	13	17	14	15	14	14	16	15
International affairs	16	16	14	21	24	17	16	14
Entertainment	15	16	15	14	15	12	10	11
Education	NA	NA	NA	NA	NA	NA	23	NA
Environment	NA	NA	NA	NA	NA	NA	21	NA
Religion	17	18	21	19	20	16	17	NA
Consumer news	14	15	12	12	13	12	13	NA
Culture and arts	9	12	10	9	10	9	11	NA
Celebrity news	NA	NA	NA	NA	NA	NA	7	NA
Travel	NA	NA	NA	NA	NA	NA	6	NA

NA = not available, question not asked.

NOTE: Data reflect respondents who said they followed a type of news "very closely."

SOURCES: Pew Research Center for the People and the Press, *Audience Segments in a Changing News Environment: Key News Audiences Now Blend Online and Traditional Sources* (17 August 2008), p. 39; Biennial News Consumption Survey (30 April–1 June 2008), http://www.people-press.org/reports/pdf/444.pdf, accessed 21 September 2009; Biennial News Consumption Survey (9 May–3 June 2012), http://www.people-press.org/files/legacy-questionnaires/News%20Consumption%20topline%20for%20release.pdf, accessed 25 January 2013.

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that of Spain (7.9%), which had the highest average of the European countries. The overall European average for health issues was quite high at 7.4. The U.S. averages for non-S&T issues were also relatively high (BBVA Foundation 2012b).[2]

A separate 2010 all-European survey found that 30% of respondents across 27 European nations reported being "very interested" in new scientific discoveries and technological developments, 49% were "moderately interested," and 20% were "not interested." Thus, again, expressed interest in S&T appears lower in the European Union (EU) than in the United States, where 40% of Americans in 2010 reported being "very interested" in S&T. However, several European countries—the Netherlands (48%), the United Kingdom (43%), Sweden (43%), Luxembourg (42%), France (41%), and Hungary (41%)—had percentages similar to the U.S. percentage (European Commission 2010a).[3]

A majority of residents of China, Japan, and Korea report interest in science and technology, although the varied questions and survey structures used make direct comparisons with the United States unwise. In 2010, 72% of Chinese respondents said they were "interested" in "new scientific discoveries," and 68% said they were interested in "new inventions and technologies" (CRISP 2010). Interest in both topics appears to be up from a 2007 survey (NSB 2010). In Japan, the percentage saying they were interested in "science and technology" climbed from 63% in January of 2010 to 76% in July of 2011, before and after the major earthquake that damaged the nuclear energy plant in Fukushima. It dropped back to 65% in December of 2011. Japanese interest in S&T was in the mid-50% range from 1990 to 2004 (NISTEP 2012). In Korea, a 2010 survey found that 51% of respondents said they had an interest in "new inventions and technologies," and 49% had an interest in "new scientific discoveries" (KOFAC 2011). Korean interest in scientific discovery was up from 24% in a 2008 survey (NSB 2012). Respondents in China and Korea were asked about both S&T and non-S&T topics, whereas the Japanese surveys addressed only S&T topics.

The 2011 BBVA Foundation survey, as well as the 2010 Chinese survey, reported two novel indicators of science interest and involvement: how much people discussed science and whether they knew someone who was a scientist. Interpersonal discussion and contact with opinion leaders within one's social network influence views about S&T issues (Hwang and Southwell 2007; Nisbet and Kotcher 2009). About 36% of Americans said that S&T issues were "part of [their] conversations with family members, friends, or work colleagues" "very often" or "quite often." The 10-country European average was 27%, although countries such as Denmark (50%), the United Kingdom (38%), and the Netherlands (37%) had scores at or above the U.S. level. The percentage of Americans who said they are "personally acquainted with someone who is a scientist" (44%) was close to the 10-country European average of 40% but lower than those of a number of countries, including the Netherlands (74%), Denmark (67%), the United Kingdom (55%), and Germany (53%). In total, 1 in 5 Americans (20%) reported having a friend who was a scientist. This was about the same as the 10-country European average (22%) but once again was less than the scores for the Netherlands (34%), Denmark (30%), and the United Kingdom (28%) (BBVA Foundation 2012a). In China, 43% of respondents said that "conversations with people" were a main source of S&T information. Further, 61% said they had "often" or "sometimes" engaged in talk about S&T with "relatives, friends, and colleagues," and 14% said they had been involved in "discussions or hearings" related to S&T.

Availability of S&T News in the Media

Americans' knowledge and attitudes about S&T, particularly in areas of emerging knowledge, partially depend on the availability of S&T news. Media coverage often sets the public agenda (Soroka 2002) and frames the debate related to scientific issues (Nisbet and Scheufele 2009). A range of social processes associated with journalism, science, and public decision making determine which issues get attention from journalists at particular periods of time (Nisbet and Huge 2006). For example, natural or human disasters may increase the likelihood that relevant S&T issues are covered by the news while decreasing the likelihood that unrelated issues are covered. Quantity and prominence of coverage may also affect topical knowledge within society (Barabas and Jerit 2009). Other research suggests that different types of media have different effects on attitudes, with newspaper and Internet use being associated with more favorable attitudes than television (e.g., Dudo et al. 2011). Given the potential impact of media use, indicators that address how much and what kinds of S&T news coverage are available in the media can be important for understanding the development of views about S&T.

The Project for Excellence in Journalism (PEJ 2012) conducted an extensive content analysis of media coverage between January 2007 and May 2012 using 52 outlets in the following media sectors: print, Internet, network television, cable television, and radio. Each week, stories were classified into 1 of 26 broad topic areas, including S&T, the environment, and "health and medicine."[4]

Special tabulations of PEJ data show that S&T coverage made up a small percentage of the total amount of news in the traditional media—less than 2% annually—between 2007 and 2012. News coverage of the environment made up a similarly small percentage of the news, dropping to 1.0% of all coverage in 2011 and 1.2% in the first part of 2012. Coverage of health and medicine consistently made up a greater percentage of the news, ranging from 3.1% in 2011 to 8.9% in 2009 (table 7-2).[5]

Many issues that dominated coverage in previous years remained prominent in 2011 and early 2012. For S&T, "cyberspace" issues have been near the top of the media agenda since 2009 (NSB 2010, 2012). The National Aeronautics and Space Administration (NASA) led coverage in 2011 with

Table 7-2
Traditional media coverage of science and technology, by topic area: 2007–12
(Percent)

Year	Number of stories	Science and technology	Environment	Health and medicine
2007	70,737	1.3	1.6	3.6
2008	69,942	1.1	1.3	2.7
2009	68,717	1.8	1.5	8.9
2010	52,613	1.5	1.6	5.0
2011	48,555	1.4	1.0	3.1
2012 (January–May)	20,452	1.2	1.2	4.1

NOTES: Data reflect the percentage of news stories in each topic area that are based on content analysis of coverage by media outlets in five sectors: print, Internet, network television, cable television, and radio. Data for 2012 reflect only the first 5 months of the year; data were not collected after May 2012.

SOURCE: Project for Excellence in Journalism, News Coverage Index, special tabulations (21 March 2011, 10 December 2012), received via e-mail. For methodology, see http://www.journalism.org/commentary_backgrounder/new_media_index_methodology, accessed 18 January 2013.

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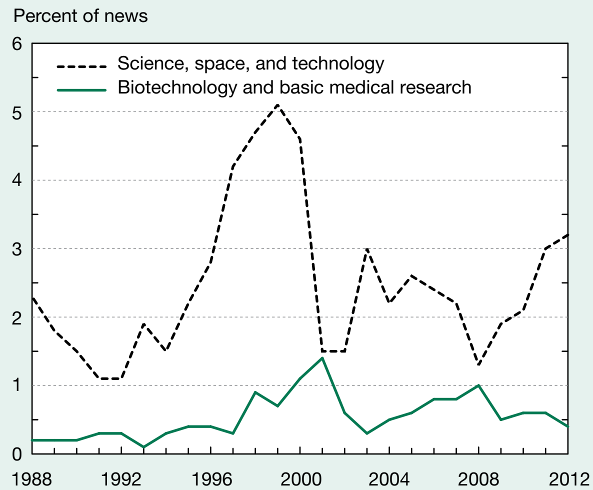
the final launch of the Space Shuttle *Atlantis* and the end of the shuttle program. (table 7-3) (NSB 2012). The most prominent environmental issue in the news has varied over recent years. The energy debate and global warming/climate change, as well as the oil spill in the Gulf of Mexico, have all received prominent coverage in recent years (NSB 2012).

News programming on the three major broadcast networks (ABC, CBS, and NBC) shows a similar pattern. The Tyndall Report has tracked the content of the three major broadcast networks for more than 20 years. Tyndall tabulates the amount of airtime devoted to different topics using 18 different categories (Tyndall Report 2013). Two categories with large science, engineering, and technology components are “science, space, and technology” and “biotechnology and basic medical research.”[6] Neither category has ever occupied a large percentage of the approximately 15,000 minutes of annual nightly weekday newscast coverage on the networks. The airtime devoted to “science, space, and technology” averaged about 2% of broadcast news between 2000 and 2012. Time devoted to “biotechnology and basic medical research” was even lower, almost always 1% or less of broadcast news (figure 7-3).

The leading stories in these two science-related categories on nightly news broadcasts in 2011 were the death of Apple chief executive officer and technology innovator Steve Jobs and the end of NASA’s Space Shuttle program. In 2012, the social networking site Facebook’s initial public offering of stock led technology coverage. NASA stayed in the news with its *Curiosity* rover mission to Mars as well as additional coverage of the end of the space shuttle program. In the category of “biotechnology and basic medical research,” cancer research garnered the most coverage in both 2011 and 2012 (table 7-4). Since 2006, cancer research has received more attention than other medical research topics (NSB 2008, 2010, 2012).

The PEJ also tracked new media and social media—a segment of the Internet that continues to grow at high rates around the world (Pew Research Global Attitudes Project 2012)—between January 2009 and June 2012. The New Media Index focused specifically on the five main topics linked to by blog and Twitter posts from Monday to Friday of each week.[7] Discussion of specific technology companies (e.g., Apple, Google, Samsung, Facebook, and Twitter) dominated both blogs and Twitter. In 2012, technology companies remained among the most common topics of discussion on blogs, but other subjects dominated Twitter (table 7-5). The one environmental issue that made the top five list multiple times was “global warming.”

Figure 7-3
Network nightly news coverage of science and technology: 1988–2012



NOTES: Data reflect the percentage of approximately 15,000 total annual minutes of weekday nightly newscasts on ABC, CBS, and NBC that were spent on science, space, and technology and on biotechnology and basic medical research. Excluded from science, space, and technology are stories on forensic science and media content. Excluded from biotechnology and basic medical research are stories on clinical research and medical technology.

SOURCE: Tyndall Report, special tabulations (21 March 2011, 12 January 2013, 22 January 2013).

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Entertainment television can also shape views. However, one recent study showed that, between 2000 and 2008, scientists represented just 1% of characters on prime-time network shows. Of these scientists, 7 out of 10 were men and almost 9 of 10 were white. Medical professionals were 8% of the characters. Generic "professionals" were the most common type of character (21%). In general, about 8 of 10 scientists were coded as being "good" (Dudo et al. 2011).[8]

Table 7-3
Leading traditional media story lines on science and technology, by topic area: 2011 and 2012
(Percent of news in each topic area)

Topic area/leading story line	2011
Science, space, and technology (*n* = 693 stories)	
NASA/shuttle missions	26.2
Cyberspace issues	13.2
Apple news	7.2
Supreme Court actions	3.4
Facebook/Zuckerberg news	2.4
Texting and driving/multitasking	1.9
Gabrielle Giffords shooting	1.7
Google news	1.2
Iran	1.1
Economy	0.9
Japan earthquake/tsunami (March 2011)	0.9
Nobel prizes	0.8
Pollution/emissions/going green	0.8
Education system/debate	0.8
Environment (*n* = 467 stories)	
Energy debate	28.0
Japan earthquake/tsunami (March 2011)	14.1
Pollution/emissions/going green	13.3
Global warming	7.1
Solyndra scandal	6.8
Gas/oil prices	5.5
BP oil spill in the Gulf of Mexico	5.2
Economy	2.1
2012 presidential election	1.4
District of Columbia–area earthquake	0.6
Health and medicine (*n* = 1,499 stories)	
Health care reform debate	42.8
2012 presidential election	2.9
Economy	2.7
Gabrielle Giffords shooting	1.8
Cigarette warning labels	1.4
World AIDS Day 2011	1.2
Japan earthquake/tsunami (March 2011)	1.1
Education system/debate	1.0
Stem cell controversy	1.0
Avastin® loses FDA approval	0.9
Listeria-tainted melons	0.8
WHO cell phone study (June 2011)	0.8
Heart disease research	0.8
Dr. Oz and apple juice	0.8
HPV cervical cancer vaccine	0.6
German *E. coli* outbreak	0.5

Topic area/leading story line	January–May 2012
Science, space, and technology (*n* = 255 stories)	
Cyberspace issues	12.7
Online piracy legislation	12.6
Facebook/Zuckerberg news	7.8
NASA/shuttle missions	7.3
SpaceX rocket launch	4.5
Google news	4.2
Kony 2012 viral video	3.9
Apple news	3.1
Texting and driving/multitasking	2.2
Education system/debate	1.8
Japan earthquake/tsunami (March 2011)	0.8
New Year celebrations	0.8
Economy	0.6
Environment (*n* = 244 stories)	
Energy debate	30.4
Keystone oil pipeline	13.1
Gas/oil prices	11.0
Global warming	10.3
Pollution/emissions/going green	6.9
Nuclear policy	3.7
BP oil spill in the Gulf of Mexico	2.3
Japan earthquake/tsunami (March 2011)	1.9
Solyndra scandal	1.4
2012 presidential election	1.2
Economy	1.2
Supreme Court actions	0.8
Health and medicine (*n* = 839 stories)	
Health care reform debate	60.3
2012 presidential election	3.7
Autism research	1.5
Heart disease research	1.2
Truvada™—promising HIV/AIDS medication	1.0
Flesh-eating bacteria	0.9
Bloomberg big soda ban	0.9
Education system/debate	0.9
U.S. airline industry	0.8
Stem cell controversy	0.6
Trayvon Martin shooting	0.6

FDA = Food and Drug Administration; HPV = human papillomavirus; NASA = National Aeronautics and Space Administration; WHO = World Health Organization.

NOTES: Data reflect story lines with the greatest percentage of news in each topic area based on content analysis of coverage by media outlets in five sectors: print, Internet, network television, cable television, and radio. Data for 2012 reflect only the first 5 months of the year; data were not collected after May 2012.

SOURCE: Project for Excellence in Journalism, News Coverage Index, special tabulations (10 December 2012). For methodology, see http://www.journalism.org/commentary_backgrounder/new_media_index_methodology, accessed 18 January 2013.

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S&T Information Sources

U.S. Patterns and Trends

The media environment has changed repeatedly over the last century. The available data show clear trends in what sources Americans say they use to get news about current events and S&T, as well as where they would look for new S&T information. Overall, Pew Research reports that Americans said they spent 67 minutes with the news per day in 2012, similar to previous years. The main difference was a clear shift toward online sources (Pew Research Center 2012a).

For news about current events, television remains the primary source of information for 43% of Americans. Substantial percentages also reported in 2012 that most of their current event news comes from the Internet (33%) or newspapers (13%) (figure 7-4). The percentage of Americans getting information about current events from the Internet has increased steadily since about 2001, and the percentage using newspapers for current events has declined. Television use declined for several years but has held steady at current levels since about 2008 (figure 7-5; appendix table 7-3).

For news specifically about S&T, Americans are now more likely to rely on the Internet than on television. In 2012, 42% of Americans cited the Internet as their primary source of S&T information, up from 35% in 2010. The percentage citing the Internet as their primary source of S&T information has also grown steadily since 2001. Conversely, reliance on television has dropped; about 32% of Americans reported that television was their primary source of S&T news in 2012, down from 39% in 2008. Some 7% said they get their S&T information from newspapers, and another 8% said they get their S&T information from magazines (figure 7-5; appendix table 7-4).

Table 7-4
Leading nightly news story lines on science and technology, by topic area: 2011 and 2012
(Annual minutes of coverage)

Topic area/leading story line	2011
Science, space, and technology	
Computer CEO Steve Jobs of Apple dies at age 56	68
NASA Space Shuttle program discontinued	62
Cellular telephone/computer combination: smartphones	27
Cellular telephone radiation safety worries	20
Computer networks targeted by coordinated hackers	15
Cellular telephone billing abuses, surcharges	14
NASA research satellite falls out of orbit	14
Internet online commerce volume increases	13
Immigrant quotas on work visas for high-technology jobs	11
Computer flat-screen tablet technology innovation	10
NASA *Apollo* manned moon missions remembered	9
International Space Station program	9
Inventions/innovations in technology surveyed	9
Asteroids/astronomy: rock to pass close to Earth	8
Internet used for social networking: Facebook grows	8
Mars astronomy: search for signs of life	8
NASA Space Shuttle *Challenger* disaster 25th anniversary	8
Air safety: in-cabin cellular telephone use risks	8
Internet BlackBerry e-mail service is addictive	7
Science and mathematics education in schools	5
Space transportation to use privatized rockets	5
Flash mobs assemble via instant message networks	5
Telecommunications billing consumer fraud: crammed surcharges	5
Biotechnology and basic medical research	
War on cancer research efforts	59
Spinal cord injuries and paralysis research	16

Topic area/leading story line	2012
Science, space, and technology	
Internet social network Facebook launches IPO	69
Mars astronomy: NASA *Curiosity* rover mission	34
NASA Space Shuttle program ends as a museum piece	31
Solar astronomy: storms, flares, Northern Lights	22
Computer networks targeted by coordinated hackers	18
Space transportation uses privatized rockets	16
Cellular telephone/computer combination: smartphones	14
Computer flat-screen tablet technology innovation	10
Computer manufacturer Apple posts record profits	10
Science and mathematics education in schools	9
International Space Station program	9
NASA manned space flights from the 1960s	9
Teenage girl is a science achiever despite homelessness	9
Internet search engine Google monitors browsing	9
Highway safety: drivers' cell phone use dangers	8
Internet online commerce volume increases	8
Physicists build supercollider, search for particle	7
High school science fair competitions held for students	7
Solar eclipses visible in western states, Australia	7
Internet copyright piracy crackdown proposed	6
Internet social network photographs from Instagram	6
NASA *Apollo* manned moon missions remembered	6
Telemarketing abuses: automated robocalls increase	6
Venus astronomy: transit visible across the face of the sun	6
NASA Space Shuttle astronaut Sally Ride dies at age 61	6
Computer systems are vulnerable to viruses, worms	5
NASA *Apollo* astronaut Neil Armstrong dies at age 82	5
Air safety: in-cabin use of electronic devices	5
Asteroids/astronomy: rock passes close to Earth	5
Digital surveillance spycams are miniaturized	5
Biotechnology and basic medical research	
War on cancer research efforts	28
Bone marrow stem cell transplants save lives	9
Spinal cord injuries and paralysis research	5

CEO = chief executive officer; IPO = initial public offering; NASA = National Aeronautics and Space Administration.

NOTES: Data reflect annual minutes of story coverage on these topics by major networks ABC, CBS, and NBC, out of approximately 15,000 total annual minutes on weekday nightly newscasts. Story lines receiving at least 5 minutes of coverage in 2011 or 2012 are shown. Excluded from science, space, and technology are stories on forensic science and media content. Excluded from biotechnology and basic medical research are stories on clinical research and medical technology.

SOURCE: Tyndall Report, special tabulations (12 January 2013, 22 January 2013).

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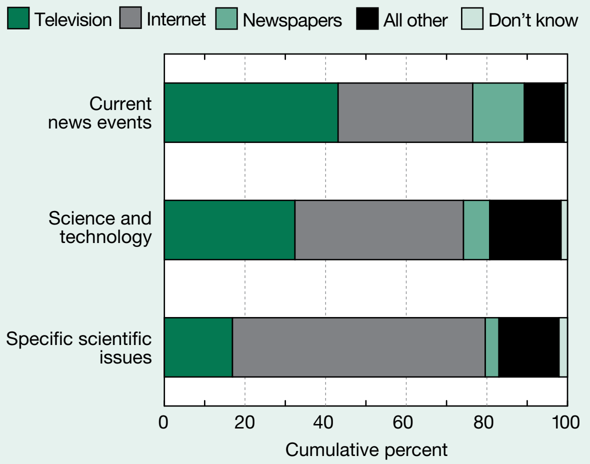
In 2012, the GSS also included questions aimed at unpacking what people mean when they say they go online for S&T information and whether people are using traditional media sources' online content. These analyses point to the importance of newspapers' online presence. Of the 42% who said they go online for S&T news, 63% indicated they used online newspapers. Of the 7% who said newspapers were the primary source of S&T information, about one-sixth (16%) said they used an online edition. Combined, this means that 33% got S&T news from newspapers, with 27% getting their newspaper online and 6% getting it in traditional form. It also means that newspaper content is described as a primary S&T source by about the same percentage of people who said television was their primary source of S&T information (32%). Another 11% said their online source was magazines. This represents about 5% of all respondents and means that about 13% of all S&T media use was from magazines. All other potential online sources—which might include blogs and other forms of social media—were chosen by less than 10% of respondents who indicated they went online for S&T news. The data do not address attention to individual issues.

Figure 7-4
Primary source of information about current news events, science and technology, and specific scientific issues: 2012



NOTE: "All other" includes radio, magazines, books, government agencies, family, and friends/colleagues.

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix tables 7-3–7-5.

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Since at least 2001, the Internet has also been the most common resource that respondents say they would use to seek out information about specific scientific issues. In 2012, the highest ever percentage of Americans (63%) said they would go online to find information about a specific S&T issue. Another 17% said they would turn to television and just 3% said they would use newspapers (figure 7-5; appendix table 7-5).

Generally, newspaper reliance is more common for relatively older respondents, and Internet reliance is more common for relatively younger and higher earning respondents. Television use is also somewhat less common for younger respondents, although the pattern is not nearly as pronounced. Those with lower incomes and lower levels of

Table 7-5
Most-discussed subjects in the new media: 2011 and 2012

Subject	2011[a] Weeks in top 5 (*n*)	2011[a] Weeks in top 5 (%)	Subject	2012[b] Weeks in top 5 (*n*)	2012[b] Weeks in top 5 (%)
Blogs			Blogs		
Apple	20	40	Apple	16	70
2012 presidential election	13	26	Google	11	48
Google	12	24	Search engine optimization	10	43
California budget	6	12	2012 presidential election	6	26
Samsung	5	10	Application programming interfaces (tie)	4	17
			Samsung Galaxy (tie)	4	17
Twitter					
Facebook	19	38	Twitter		
Google	19	38	One Direction (music)	16	70
Twitter	18	36	Justin Bieber (music)	10	43
Apple	16	32	Super Junior (music)	10	43
Justin Bieber (music)	11	22	@The90sLife	4	17
			Lady Gaga (music) (tie)	3	13
			Trayvon Martin shooting (tie)	3	13

[a] Blogs and Twitter content analysis for 2011 is based on 50 weeks in the year.
[b] Blogs and Twitter content analysis for 2012 is based on the first 23 weeks in the year.

NOTES: Data reflect the number and percentage of weeks a subject appeared in the Project for Excellence in Journalism's (PEJ's) New Media Index. PEJ stopped regularly producing the New Media Index in June 2012.

SOURCE: PEJ New Media Index, special tabulations (January–February 2013), http://www.journalism.org/news_index/100, accessed 8 February 2013.

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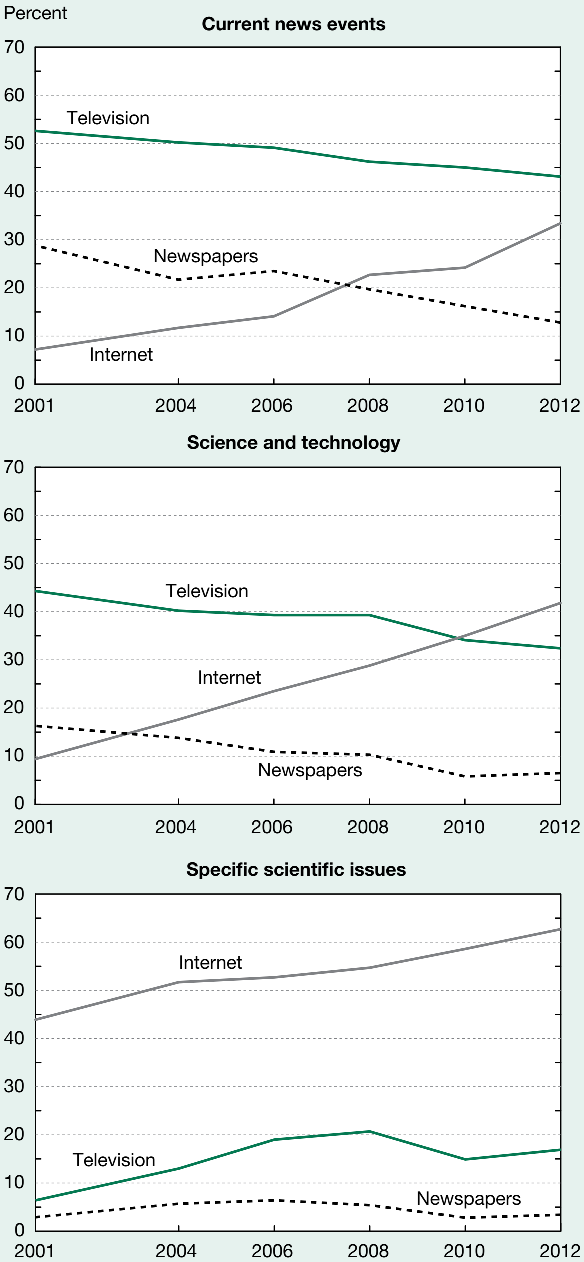
education are more likely to say they get their news, including S&T-related news, from television, whereas those with more education and income get their news from newspapers, television, and the Internet (appendix tables 7-3–7-5).

Figure 7-5
Primary source of information about current news events, science and technology, and specific scientific issues: 2001–12



SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (2001); University of Michigan, Survey of Consumer Attitudes (2004); University of Chicago, National Opinion Research Center, General Social Survey (2006–12). See appendix tables 7-3–7-5.

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Blending traditional and online news sources was also addressed in the context of S&T for the 2012 *Indicators* report based on 2010 GSS data. That survey asked half of the sample a question with response options that distinguished between online and print-format sources for newspapers and magazines. Overall, there was a clear pattern of increasing reliance on online sources for increasingly specific content (NSB 2012). More recent information on what other online sources people may use for S&T information and the degree to which people encounter S&T information as a byproduct of attention to other issues is not available.[9]

Another important aspect to understanding media use is to recognize that people make choices about what media to use based partially on the degree to which they trust that source. Both Pew Research and Gallup data suggest that Americans trust the media less than they did in previous years (Morales 2012; Pew Research Center 2011a, 2012b). Evidence about how Americans judge the credibility of S&T-specific media is, however, scant. A 2006 Pew Internet & American Life Project study of how Americans acquire science information indicates that Internet users who seek science information online do not always assume that the information they find there is accurate. The vast majority reported that they checked information by comparing it to other information they found online, comparing it to offline sources (e.g., science journals, encyclopedia) or by looking up the original source of the information (Horrigan 2006; NSB 2008).

International Comparisons

The 2011 BBVA Foundation survey found that residents of all countries made similar uses of television, newspapers, the Internet, and radio to acquire S&T content. The survey found that 47% of Americans watched television programs addressing S&T topics "very" or "quite" often. The average of the 10 European countries surveyed was 41% but residents of two countries—the United Kingdom (54%) and Denmark (54%)—watched more S&T television than Americans. About one-third (34%) of Americans said they read news items about S&T "very" or "quite" often in newspapers. This was similar to the 10-country European average of 32%. Residents of the Netherlands were the most likely to say they often read S&T news in newspapers (52%), although Denmark (48%) and the United Kingdom (43%) also had relatively high S&T readership. About 32% of Americans said they often read S&T news online, which was a percentage comparable to those of the largest European countries and substantially above the 10-country European average of 24% (BBVA Foundation 2012a). Although these data, compared with the GSS information on media use, may suggest a less prominent role for the Internet, this may reflect a difference in the questions on the two surveys. Whereas the GSS asks people for their primary source of information, the BBVA Foundation survey asked about overall use for each channel.

Outside of Europe and North America, research has also suggested that television is the leading source of S&T

information; newspapers are generally second, and relatively fewer survey respondents cite the Internet as an important source of S&T information. This was true in countries such as Malaysia (MASTIC 2010) and India (Shukla 2005). A 2010 Chinese survey allowed respondents to choose up to three sources of information. About 88% of Chinese indicated that television was a primary source of their S&T information, 59% said newspapers, and 27% said the Internet (CRISP 2010). However, in more widely connected South Korea, a 2010 survey found that more respondents named the Internet (23%) as their primary source of S&T information than newspapers (12%). About 57% said television was their primary source of S&T information. A separate set of measures show that 30% said they "almost never" get S&T information from television. About 53% said they rarely get S&T information from newspapers, and 56% said they rarely get S&T information from the Internet (KOFAC 2011).

Americans and Europeans also appear to differentiate the degree to which they trust scientific information provided by various sources. The 2011 BBVA Foundation survey of 10 European countries and the United States asked respondents to score a range of different groups on an 11-point scale, where "0" meant they did "not trust it at all" and "10" meant they trusted it a "great deal." The results suggest substantial agreement over who should be trusted as an information source. In the United States, professional medical associations were the most trusted, with a mean score of 7.6, but universities (7.4), science museums (7.2), and government (7.2) were also highly trusted. In Europe, universities were the most trusted information sources, with a mean score of 7.2, but medical associations (7.0) and science museums (6.9) were also highly regarded. The score for government was about a point lower in Europe (6.1) than in the United States (7.2) but varied widely across countries. The news media was the least trusted source in both the United States (4.8) and Europe (5.1), but again scores varied widely in Europe. Consumer organizations and environmental organizations had midrange scores in both the United States (6.1 and 6.2, respectively) and in the European countries surveyed (both 6.3) (BBVA Foundation 2012b).

Although the media received relatively low trust scores on the BBVA Foundation S&T survey, a 2011 U.S. survey by Pew Research suggested the media was among the most trusted sources of general information (Pew Research Center 2011a). This difference may reflect the comparison groups involved in the two studies. The Pew Research study asked about the trustworthiness of information from the media versus various actors typically involved in political decision making, and the BBVA study asked about actors from a broader range of sources. The Pew Research study also focused on general media trust, whereas the BBVA Foundation study focused specifically on science.

Involvement

U.S. Patterns and Trends

U.S. residents may also come in contact with S&T through America's rich and diverse informal science and cultural institutions. Many of these institutions actively try to broaden and deepen Americans' intellectual and emotional engagement with science (Bell, Lewenstein, Shouse, and Feder 2009).[10] By offering visitors the flexibility to pursue individual curiosity, such institutions provide exposure to S&T that is well-suited to helping people develop their interests and improve their knowledge, and such institutions can sometimes even change patrons' attitudes.

The 2012 GSS shows that reported attendance at informal science and cultural institutions was down slightly from 2008, although the changes were all quite small.[11] Zoos and aquariums were the most popular type of informal science institutions with 47% of Americans saying they had visited such an organization in the previous year. This represents a drop from 52% in 2008 and 58% in 2001. The Association for Zoos and Aquariums' member surveys have also consistently shown that about half of Americans visit a zoo or aquarium in any given year, but their numbers suggest that attendance stayed relatively stable between 2008 and 2011 at about 175 million visitors and then climbed to 181 million in 2012.[12] According to the GSS, natural history museums (28%) and science and technology museums (25%) continued to attract about the same percentage of people in 2012 as they did in 2008, although these percentages are also down from 2001. In total, 58% of Americans said they had visited at least one of these three types of cultural institutions in the 12 months prior to the 2012 survey, down from 61% in 2008 and 66% in 2001.[13]

The public library remains a widely used resource in communities across America, with 60% of respondents saying that they had visited a library in the previous 12 months. This number was down from 2008 (64%) and 2001 (75%). The percentage visiting art museums (33%)—the other cultural institution in the survey—stayed essentially unchanged from 2008 (34%) and the earlier 2001 survey (32%) (table 7-6; appendix table 7-6).

Americans with more years of formal education are more likely than others to engage in these informal science activities. Those in higher income brackets are more likely to have visited a zoo or aquarium, a natural history or S&T museum, or an art museum but are just as likely as those in the lowest income bracket to have visited a public library. In general, visits to informal science institutions are less common among Americans who are 45 or older (appendix table 7-7).

A 2012 Pew Research study focused on libraries found similar results. It found that 53% of Americans aged 16 or older said they had visited a library in the "past year" and that women (59%) and residents aged 16–17 (62%) were most likely to have done so. Almost everyone (91%) agreed that libraries are "very" or "somewhat" important to their "community as a whole." Many also said they used the library for activities such as researching a "topic of interest" (54%), using a "research database" (46%), and attending a "class, program or lecture for adults" (21%) (Pew Internet & American Life Project 2013).

International Comparisons

The available data—some of which are relatively dated—suggest that Americans are particularly active in the degree to which they make use of a range of informal science and cultural institutions.

China and Japan are the only countries where zoo and aquarium attendance is similar to that in the United States, and China also has similar levels of S&T and natural history museum attendance. Chinese attendance at these types of institutions also appears to be growing, with average attendance up about 8% from 2007 across the five types of cultural institutions measured (NSB 2012) (table 7-6).

The 2011 BBVA Foundation survey of 10 European countries and the United States asked slightly different questions and found that attendance varies greatly between countries. About 32% of Americans said they had visited an S&T museum or exhibition in the previous 12 months. This was higher than the 10-country European average of 25% but similar to the rate of attendance by residents of several specific countries such as Germany (35%), the Netherlands (32%), Denmark (29%), Austria (29%), and France (29%). Also, about 12% of Americans said they had attended a "conference or talk on science or technology topics." This was about the same as the European average (12%) but substantially lower than for countries such as the Netherlands (25%) and Denmark (27%). Americans were, however, nearly twice as likely as those in the 10 European countries surveyed to have made a "virtual visit to a science and technology museum via the Internet." About 20% of Americans said they had made such a "visit" in the previous 12 months, whereas the 10-country European average was 8%, and the highest percentage for an individual country was for Denmark (12%) (BBVA Foundation 2012a). As noted previously, the BBVA Foundation also found that both Americans and Europeans in the 10 countries surveyed see science information from museums as more trustworthy than information from many other groups (BBVA Foundation 2012b).

Table 7-6
Visits to informal science and other cultural institutions, by country/region: Most recent year
(Percent)

Institution	United States (2012)	Brazil (2010)	China (2010)	EU (2005)	India (2004)	Japan (2001)	Malaysia (2008)	South Korea (2010)
Zoo/aquarium[a]	47	22	58	27	35	43	30	28
Natural history museum	28	NA	22	NA	NA	19	NA	NA
Science/technology museum[b]	25	8	27	16	12	12	11	9
Public library[c]	60	29	50	34	27	46	NA	27
Art museum[d]	33	14	27	23	22	34	30	27

NA = not available, question not asked.

EU = European Union; data are not available for Bulgaria and Romania.

[a] "Zoo" for Brazil, India, and Malaysia; "Zoo, aquarium, botanical garden" for China.
[b] "Science museums or technology museums or science centers" for EU; "Science parks" for India; "National Science Centre" for Malaysia; "Science museum or exhibition" for South Korea.
[c] "Library" for Brazil and India.
[d] "Art gallery or exhibition hall" for China; "Museum" for India and Malaysia; "Museum/art gallery" for South Korea.

NOTES: Responses to (United States, Japan) *I am going to read you a short list of places and ask you to tell me how many times you visited each type of place during the last year, that is, the last 12 months* (percentage includes those who visited each institution one or more times); (Brazil, China, EU) *Which of the following have you visited in the last 12 months?* (multiple answers possible); (India) *How frequently did you visit the following during the last 12 months?* (percentage includes those who visited each institution one or more times); (Malaysia, South Korea) *In the past year, how many times did you visit the following places?* (percentage includes those who visited each institution one or more times).

SOURCES: United States—University of Chicago, National Opinion Research Center, General Social Survey (2012); Brazil—Ministry of Science and Technology of Brazil, Public Perceptions of Science and Technology (2010); China—Chinese Association for Science and Technology/China Research Institute for Science Popularization, Chinese National Survey of Public Scientific Literacy (2010); EU—European Commission, Eurobarometer 224/Wave 63.1: Europeans, Science and Technology (2005); India—National Council of Applied Economic Research, National Science Survey (2004); Japan—National Institute of Science and Technology Policy/Ministry of Education, Culture, Sports, Science and Technology, Survey of Public Attitudes Toward and Understanding of Science and Technology in Japan (2001); Malaysia—Malaysian Science and Technology Information Center/Ministry of Science, Technology and Innovation, Survey of the Public's Awareness of Science and Technology: Malaysia (2008); South Korea—Korea Foundation for the Advancement of Science and Creativity, Survey of Public Understanding of Science and Technology (2010). See appendix table 7-6 for U.S. trends.

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Public Knowledge about S&T

Science and Engineering Indicators has been assessing Americans' knowledge about science and technology since 1979. Initial questions focused on the proper design of a scientific study and views about whether pseudoscientific belief systems, such as astrology, could be considered scientific. Questions focused on an understanding of probability and an understanding of basic constructs were added in the late 1980s and early 1990s (Miller 2004). These later questions remain the core of the available data on trends in adult Americans' knowledge of science.

Researchers have questioned both the degree to which scientific literacy has a substantial impact on how people make decisions in their public and private lives (see, for example, NSB 2012:7-27; Bauer, Allum, and Miller 2007) and whether a short battery of questions can assess scientific literacy. Despite the limitations of these indicators, evidence suggests that knowledge about science, as measured by the GSS, has a small but meaningful impact on attitudes and behaviors (Allum et al. 2008). In addition, adult responses to an expanded list of knowledge questions drawn from tests given to students nationwide indicate that people who "answered the additional factual questions accurately also tended to provide correct answers to the trend factual knowledge questions" included in the GSS (NSB 2010:7-20). This finding suggests that the trend questions used in this report represent a reasonable indicator of basic science knowledge. At the same time, in light of the limitations of using a small number of questions largely keyed to knowledge taught in school, generalizations about Americans' knowledge of science should be made cautiously. Toumey et al. (2010) recommended additional research aimed at developing a measure of S&T literacy focused on how people actually use S&T knowledge. Similar challenges confront attempts to study health literacy (Berkman, Davis, and McCormack 2010) and political literacy (Delli Carpini and Keeter 1996). More generally, in developing measures for what is often termed *scientific literacy* across nations, the Organisation for Economic Co-operation and Development (OECD 2003) emphasizes that scientific literacy is a matter of degree and that people cannot be classified as either literate or not literate. The OECD noted that literacy had several components:

> Current thinking about the desired outcomes of science education for all citizens emphasizes the development of a general understanding of important concepts and explanatory frameworks of science, of the methods by which science derives evidence to support claims for its knowledge, and of the strengths and limitations of science in the real world. It values the ability to apply this understanding to real situations involving science in which claims need to be assessed and decisions made…
>
> Scientific literacy is the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity. (OECD 2003:132–33)

The degree to which respondents demonstrate an understanding of basic scientific terms, concepts, and facts; an ability to comprehend how S&T generates and assesses evidence; and a capacity to distinguish science from pseudoscience are widely used indicators of basic scientific literacy.

The 2012 GSS continues to show that many Americans provide multiple incorrect answers to basic questions about scientific facts and do not apply appropriate reasoning strategies to questions about selected scientific issues. Residents of other countries, including highly developed ones, appear to perform no better, on balance, when asked similar questions.

Understanding Scientific Terms and Concepts

U.S. Patterns and Trends

A primary indicator of public understanding of science in the United States comes from a nine-question index of factual knowledge questions included in the GSS. In 2012, Americans were able to correctly answer an average of 5.8 of the 9 items (65%), which is slightly up from 2010 (5.6 of 9 items, or 63%) (appendix table 7-8).

The public's level of factual knowledge about science has not changed much over the past two decades (figure 7-6). Since 2001, the average number of correct answers to a series of nine questions for which fully comparable data have been collected has ranged from 5.6 to 5.8 correct responses, although scores for individual questions have varied somewhat over time (appendix tables 7-8 and 7-9). Pew Research used several of the same questions in a 2013 survey and received nearly identical results (Pew Research Center 2013a).

Factual knowledge of science is strongly related to people's level of formal schooling and the number of science and mathematics courses completed. For example, those who had not completed high school answered 45% of the nine questions correctly, and those who had completed a bachelor's degree answered 78% of the questions correctly. The average percentage correct rose to 83% among those who had taken three or more science and mathematics courses in college (figure 7-7). Respondents aged 65 or older are less likely than younger Americans to answer the factual science questions correctly (appendix table 7-8). Younger generations have had more formal education, on average, than Americans coming into adulthood some 50 years ago; these long-term societal changes make it difficult to know whether the association between age and factual knowledge is due primarily to aging processes, cohort differences in education, or other factors. Analyses of surveys conducted between 1979 and 2006 concluded that public understanding of science has increased over time and by generation, even after controlling for formal education levels (Losh 2010, 2012).

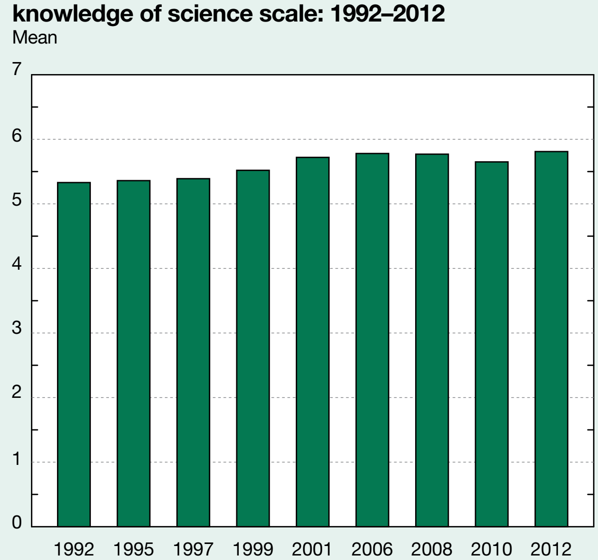
Factual knowledge about science is also associated with sex of the respondent. On average, men tend to answer more factual science knowledge questions correctly (70% correct) than do women (60% correct) (figure 7-7). However, this pattern depends on the science domain referenced in the question. Men typically score higher than women on questions in the physical sciences but not on questions in the biological sciences. Women tend to score at least equally as high as men on the biological science questions and often a bit higher (table 7-7; appendix table 7-10).

Evolution and the Big Bang

The GSS survey includes two additional true-or-false science questions that are not included in the index calculation because Americans' responses appear to reflect factors beyond unfamiliarity with basic elements of science. One of these questions addresses evolution, and the other addresses the origins of the universe. To better understand Americans' responses, the 2012 GSS replicated an experiment first conducted in 2004 (NSB 2006). Half of the survey respondents were randomly assigned to receive questions focused on information 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"). The other half were asked the questions with a preface that focused on conclusions that the scientific community has drawn about the natural world ("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").

In 2012, respondents were much more likely to answer both questions correctly if the questions were framed as being about scientific theories or ideas rather than about natural world facts. For evolution, 48% of Americans answered "true" when presented with the statement that human beings evolved from earlier species with no preface, whereas 72% of those who received the preface said "true," a 24 percentage point difference.[14] These results replicate the pattern from 2004, when the percentage answering "true" went from 42% to 74%, a 32 percentage point difference (NSB 2008). For the big bang question, the pattern was very similar: in 2012, 39% of Americans answered "true" when presented with the statement about the origin of the universe without the preface, whereas 60% of those who heard the statement with the preface answered "true." This represents a 21 percentage point difference. The 2004 experiment found that including the preface increased the percentage who answered correctly

Figure 7-6
Mean number of correct answers to trend factual knowledge of science scale: 1992–2012



NOTES: Mean number of correct answers to the nine questions that are included in the trend factual knowledge of science scale; see appendix table 7-8 for explanation, list of questions, and percentage of questions answered correctly. See appendix tables 7-9 and 7-10 for responses to individual questions.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1992–2001); University of Chicago, National Opinion Research Center, General Social Survey (2006–12).

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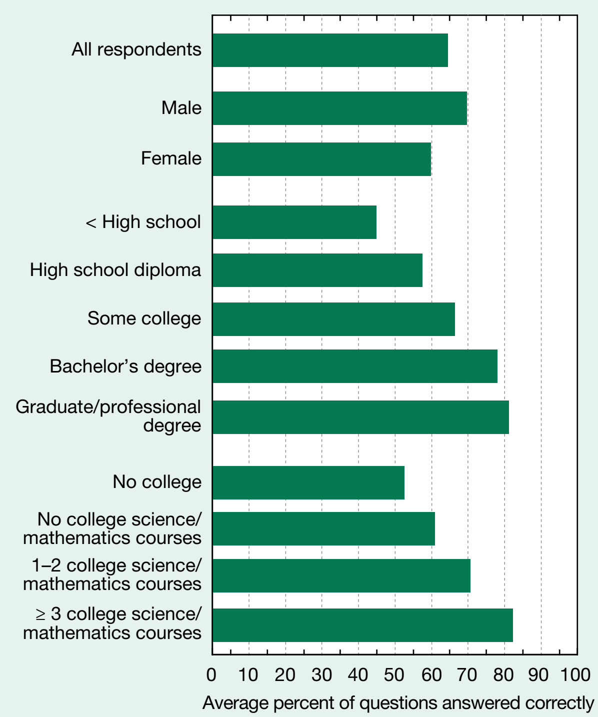
Figure 7-7
Correct answers to trend factual knowledge of science scale, by respondent characteristic: 2012



NOTES: Data reflect the average percentage of nine questions answered correctly. "Don't know" responses and refusals to respond are counted as incorrect. See appendix table 7-8 for explanation, list of questions, and additional respondent characteristics. See appendix tables 7-9 and 7-10 for responses to individual questions.

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012).

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from 33% to 62%, a 29 percentage point difference (NSB 2008). Residents of other countries have been more likely than Americans to answer “true” to the evolution question.[15]

International Comparisons

Researchers in a range of countries have asked adults in their countries identical or substantially similar questions to test their factual knowledge of science in past years. Knowledge scores for individual items vary from country to country, and no country consistently outperforms the others. For the physical science and biological science questions, knowledge scores are relatively low in China, Russia, and Malaysia. Compared with scores in the United States and the EU overall, scores in Japan are also relatively low for several questions (table 7-8).[16]

Science knowledge scores have also varied across Europe, with northern European countries, led by Sweden, scoring the highest on a set of 13 questions. For a smaller set of four questions, administered in 12 European countries in 1992 and 2005, each country performed better in 2005. In contrast, U.S. data on science knowledge did not show upward trends over the same period. In Europe, as in the United States, men, younger adults, and more highly educated people tend to score higher on these questions (NSB 2008).

The 2011 BBVA Foundation survey of 10 European countries and the United States included a set of 22 knowledge questions that were mostly different from those that have traditionally been included in *Indicators*. On average, the United States—with a mean score of 14.3 correct answers—performed similarly to many of the European countries surveyed, with a score close to the European average (13.4). The highest scoring countries were Denmark (15.6) and the Netherlands (15.3). Germany (14.8), the Czech Republic (14.6), Austria (14.2), the United Kingdom (14.1), and France (13.8) all had scores similar to those of the United States.

There were some questions on which Europeans, however, did much better than Americans. For example, for the statement, “the earliest humans lived at the same time as the dinosaurs,” about 43% of Americans correctly answered “false,” whereas 61% of Europeans in the 10 countries surveyed gave the correct response. Another question on which Americans did substantially worse focused on nuclear energy. About 47% of Americans correctly indicated that the “greenhouse effect” is not caused by the use of nuclear energy, in comparison to 58% of Europeans. Conversely, there were several questions on which Americans did substantially better (BBVA Foundation 2012a).[17]

Table 7-7
Correct answers to factual knowledge and scientific process questions in physical and biological sciences, by sex: 1999–2012
(Average percent correct)

Science topic/sex	1999	2001	2004	2006	2008	2010	2012
Physical science index[a]							
Male	72	73	73	74	74	73	75
Female	57	59	55	59	61	60	61
Biological science index[b]							
Male	59	61	62	63	60	62	59
Female	61	65	65	66	64	64	62

[a] Physical science index includes five questions:
- *The center of the Earth is very hot*. (True)
- *All radioactivity is man-made*. (False)
- *Lasers work by focusing sound waves*. (False)
- *Electrons are smaller than atoms*. (True)
- *The continents have been moving their location for millions of years and will continue to move*. (True)

[b] Biological science index includes six questions (questions 3 and 4 have two parts):
- *It is the father’s gene that decides whether the baby is a boy or a girl*. (True)
- *Antibiotics kill viruses as well as bacteria*. (False)
- *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.* (1) *Does this mean that if their first child has the illness, the next three will not?* (No); (2) *Does this mean that each of the couple’s children will have the same risk of suffering from the illness?* (Yes) Data represent a composite of correct responses to both questions.
- *Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them 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 second way because a control group is used for comparison.) Data represent a composite of correct responses to both questions.

NOTES: Data reflect the average percentage of questions in the index answered correctly. “Don’t know” responses and refusals to respond are counted as incorrect.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1999, 2001); University of Michigan, Survey of Consumer Attitudes (2004); University of Chicago, National Opinion Research Center, General Social Survey (2006–12). See appendix tables 7-9 and 7-10 for factual knowledge questions. See appendix tables 7-11 and 7-12 for scientific process questions (probability and experiment).

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Little international polling is done on the question of evolution or the big bang. However, residents of other countries have typically been more likely than Americans to say they believe that "human beings, as we know them today, developed from an earlier species of animals." For example, 70% of European respondents in 2005 (NSB 2006) and 76% of Japanese respondents in 2011 (NISTEP 2012) gave this response.

Reasoning and Understanding the Scientific Process

U.S. Patterns and Trends

Another indicator of public understanding of science focuses on understanding of how science generates and assesses evidence, rather than knowledge of particular facts. Such measures reflect recognition that knowledge of specific

Table 7-8
Correct answers to factual knowledge questions in physical and biological sciences, by country/region: Most recent year
(Percent giving correct answer)

Question	United States[a] (2012)	China (2010)	EU (2005)	India (2004)	Japan (2011)	Malaysia (2008)	Russia (2003)	South Korea (2004)
Physical science								
The center of the Earth is very hot. (True)	84	56	86	57	84	66	NA	87
The continents have been moving their location for millions of years and will continue to move. (True)	83	50	87	32	88	44	40	87
Does the Earth go around the Sun, or does the Sun go around the Earth? (Earth around Sun)	74	NA	66	70	NA	72	NA	86
All radioactivity is man-made. (False)	72	48	59	NA	69	14	35	48
Electrons are smaller than atoms. (True)	53	27	46	30	32	33	44	46
Lasers work by focusing sound waves. (False)	47	23	47	NA	32	16	24	31
The universe began with a huge explosion. (True)	39	NA	NA	34	NA	NA	35	67
Biological science								
It is the father's gene that decides whether the baby is a boy or a girl.[b] (True)	63	58	64	38	29	40	22	59
Antibiotics kill viruses as well as bacteria.[c] (False)	51	28	46	39	33	8	18	30
Human beings, as we know them today, developed from earlier species of animals. (True)	48	66	70	56	76	NA	44	64

NA = not available, question not asked.

EU = European Union; data are not available for Bulgaria and Romania.

[a] See appendix table 7-9 for U.S. trends.
[b] China and Europe surveys asked about "mother's gene" instead of "father's gene."
[c] Japan survey asked about "antibodies" instead of "antibiotics."

SOURCES: United States—University of Chicago, National Opinion Research Center, General Social Survey (2012); China—Chinese Association for Science and Technology/China Research Institute for Science Popularization, Chinese National Survey of Public Scientific Literacy (2010); EU—European Commission, Eurobarometer 224/Wave 63.1: Europeans, Science and Technology (2005), and Eurobarometer 224/Wave 64.3: Europeans and Biotechnology in 2005: Patterns and Trends (2006); India—National Council of Applied Economic Research, National Science Survey (2004); Japan—National Institute of Science and Technology Policy/Ministry of Education, Culture, Sports, Science and Technology, Survey of Public Attitudes Toward and Understanding of Science and Technology in Japan (2011); Malaysia—Malaysian Science and Technology Information Centre/Ministry of Science, Technology and Innovation, Survey of the Public's Awareness of Science and Technology: Malaysia (2008); Russia—Gokhberg L, Shuvalova O, 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); South Korea—Korea Science Foundation (now Korea Foundation for the Advancement of Science and Creativity), Survey of Public Attitudes Toward and Understanding of Science and Technology (2004).

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S&T facts is conceptually different from knowledge about the overall scientific processes (Miller 1998).

Data on three general topics—probability, experimental design, and the scientific method—show trends in Americans' understanding of the process of scientific inquiry. One set of questions tests how well respondents apply the principles of probabilistic reasoning to a series of questions about a couple whose children have a 1 in 4 chance of suffering from an inherited disease. A second set of questions deals with the logic of experimental design, asking respondents about the best way to design a test of a new drug for high blood pressure. A third, open-ended question probes what respondents think it means to "study something scientifically." Because probability, experimental design, and the scientific method are all central to scientific research, these questions are relevant to how respondents evaluate scientific evidence. These measures are reviewed separately and then as a combined indicator of public understanding about scientific inquiry.

With regard to probability, 82% of Americans in 2012 correctly indicated that the fact that a couple's first child has the illness has no relationship to whether three future children will have the illness. About 72% of Americans correctly responded that the odds of a genetic illness are equal for all of a couple's children. Overall, 65% got both probability questions correct. Understanding of probability has been fairly stable over time, with the percentage giving both correct responses ranging from 64% to 69% since 1999 and going no lower than 61% dating back to 1990 (table 7-9; appendix tables 7-11 and 7-12).[18]

With regard to understanding experiments, one-third (34%) of Americans were able to answer a question about how to test a drug and then provide a correct response to an open-ended question that required them to explain the rationale for an experimental design (i.e., giving 500 people a drug while not giving the drug to 500 additional people as a control group). A smaller percentage of people were able to answer this set of questions in 2012 than were in 2010, when 51% answered correctly (table 7-9). However, this change should be treated with particular caution because of the way these types of survey responses rely on human coders to categorize responses and because the 2010 figure represents an historical high.[19]

The percentage of people the 2012 GSS judged as understanding what it means to study something scientifically was more consistent with previous surveys. About 20% of Americans were scored as correctly answering the GSS question on this topic. When describing the scientific method, these respondents mentioned that it involves at least one of the following: testing a theory using hypotheses, conducting an experiment with a control group, or making rigorous and systematic comparisons. The percentage of Americans providing at least one of these acceptable answers has declined somewhat from a high of 26% in 2001, although the 2012 result is similar to percentages in recent years.

Table 7-9
Correct answers to scientific process questions: Selected years, 1999–2012
(Percent)

Question	1999	2001	2004	2006	2008	2010	2012
Understanding of scientific inquiry scale[a]	32	40	39	41	36	42	33
Components of understanding scientific inquiry scale							
Understanding of probability[b]	64	67	64	69	64	66	65
Understanding of experiment[c]	34	40	46	42	38	51	34
Understanding of scientific study[d]	21	26	23	25	23	18	20

[a] To be classified as understanding scientific inquiry, the survey respondent had to (1) answer correctly the two probability questions stated in footnote b and (2) either provide a theory-testing response to the open-ended question about what it means to study something scientifically (see footnote d) or a correct response to the open-ended question about experiment (i.e., explain why it is better to test a drug using a control group [see footnote c]).
[b] To be classified as understanding probability, the survey respondent had to answer correctly *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.* (1) *Does this mean that if their first child has the illness, the next three will not have the illness?* (No); and (2) *Does this mean that each of the couple's children will have the same risk of suffering from the illness?* (Yes).
[c] To be classified as understanding experiment, the survey respondent had to answer correctly (1) *Two scientists want to know if a certain drug is effective against high blood pressure. The first scientist wants to give the drug to 1,000 people with high blood pressure and see how many of them 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?* and (2) *Why is it better to test the drug this way?* (The second way because a control group is used for comparison).
[d] To be classified as understanding scientific study, the survey respondent had to answer correctly (1) *When you read news stories, you see certain sets of words and terms. We are interested in how many people recognize certain kinds of terms. First, some articles refer to the results of a scientific study. When you read or hear the term scientific study, do you have a clear understanding of what it means, a general sense of what it means, or little understanding of what it means?* and (2) (If "clear understanding" or "general sense" response) *In your own words, could you tell me what it means to study something scientifically?* (Formulation of theories/test hypothesis, experiments/control group, or rigorous/systematic comparison).

NOTES: Data reflect the percentage of survey respondents who gave a correct response to each concept. "Don't know" responses and refusals to respond are counted as incorrect and are not shown. See appendix table 7-11 for more detail on the probability questions and for years before 1999.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1999, 2001); University of Michigan, Survey of Consumer Attitudes (2004); University of Chicago, National Opinion Research Center, General Social Survey (2006–12).

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Overall, when these questions are combined into an overall measure of "understanding of scientific inquiry," the 2012 results are relatively low compared with those from other years. About 33% of Americans could both correctly respond to the two questions about probability and provide a correct response to at least one of the open-ended questions about experimental design or what it means to study something scientifically. The 2010 survey represents a high point (42%), and the current result is closest to scores seen in the late 1990s but lower than scores in the other surveys conducted since 2001 (table 7-9; appendix table 7-11). In general, respondents with more education did better on the scientific inquiry questions (figure 7-8; appendix table 7-12).

International Comparisons

The 2011 BBVA Foundation survey of 10 European countries and the United States included the standard question about probability in the context of genetic disease. In this instance, 61% of Americans could correctly indicate that a child's susceptibility to a genetic disease was unaffected by whether the child's siblings suffered from the disease. This percentage is substantially lower than the 82% found in the 2012 GSS (see previous section). The 10-country European average was 49%, but residents of both Denmark (81%) and the Netherlands (79%) did better on this question than Americans. UK residents (60%) had a score nearly identical to that of U.S. residents (BBVA Foundation 2012a).

Recent surveys from Asia also touch on reasoning and understanding. A 2010 Chinese survey reported that 49% understood the idea of probability, 20% understood the need for comparisons in research, and 31% understood the idea of "scientific research" (CRISP 2010). The exact wording of the questions used was not available, but given that much of the survey replicated past U.S. questions reported in *Science and Engineering Indicators*, it seems likely that these questions were similar to those asked in the United States. In a July 2011 Japanese survey, 62% correctly answered a multiple choice question about the use of control groups in research experiments, whereas 57% answered correctly in a follow-up December 2011 survey (NISTEP 2012). A Korean survey used self-report measures of knowledge. Koreans were most likely to say they knew "well" or "very well" about diseases (54%) and least likely to say they knew about nanotechnology (14%). Koreans were also unlikely to say they knew about stem cell research (15%) and genetic modification (20%) (KOFAC 2011).

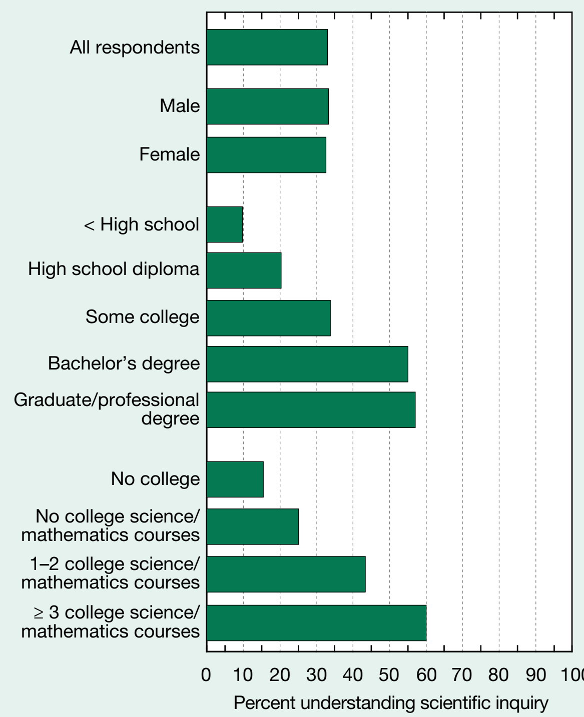
Comparisons of Adult and K–12 Student Understanding

The 2008 GSS included several additional questions on the scientific process that also indicated that many Americans lack an understanding of experimental design.[20] Between 29% and 57% of Americans responded correctly to various questions measuring the concepts of scientific experiment and controlling variables. Only 12% of Americans responded correctly to all the questions on this topic, and nearly 20% did not respond correctly to any of them (NSB 2010). These data raise further questions about how well Americans can reliably apply a generalized understanding of experimental design across different situations. Responses to these questions also allowed a comparison between adults' understanding of experimentation and that of middle school students tested on the same questions. On the three experimental knowledge questions in which direct comparison is possible, adults' scores were similar to a national sample of middle school students on one question but were lower on two others (NSB 2010).

Pseudoscience

Another indicator of public understanding about S&T comes from a measure focused on the public's capacity to distinguish science from pseudoscience. Since 1979, surveys have asked Americans whether they view astrology as being scientific. In 2012, about half of Americans (55%) said astrology is "not at all scientific." One-third (32%) said they thought astrology was "sort of scientific," and 10% said it was "very scientific." About 4% said they did not know. In comparison, in 2010, 62% of Americans said that astrology was not scientific, and this percentage has hovered between 55% (2012) and 66% (2004) since 1985. The only years

Figure 7-8
Understanding scientific inquiry, by respondent characteristic: 2012



NOTES: See appendix table 7-11 for an explanation of understanding scientific inquiry and questions included in the index. See appendix table 7-12 for additional respondent characteristics.

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012).

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when a smaller percentage of respondents said that astrology was not at all scientific were in 1979, when 50% gave this response, and in 1983, when 51% gave this response.

Respondents with more years of formal education and higher income were less likely to see astrology as scientific. For example, in 2012, 72% of those with graduate degrees indicated that astrology is "not at all scientific," compared with 34% of those who did not graduate from high school. Between 2010 and 2012, responses to the astrology question changed more among Americans with less education and factual knowledge than among other Americans. For example, in 2010, 79% of those high in factual knowledge said astrology was "not at all scientific," which was only 5% more than the 74% who gave this response in 2012. In contrast, 52% of those with the lowest factual knowledge said astrology was unscientific in 2010 compared with 35% in 2012, which is a 17% change.

Age was also related to perceptions of astrology. Younger respondents, in particular, were the least likely to regard astrology as unscientific, with 42% of the youngest age group (18–24) saying that astrology is "not at all scientific." The largest change, however, occurred in the 35–44 age group. In 2010, 64% of respondents in this group said that astrology was not scientific, whereas 51% gave this response in 2012, which is a 13% change (appendix table 7-13).[21]

International Comparisons

A 2010 Chinese survey had multiple questions about superstition. It found that 80% of respondents did not believe in "fortune telling sticks," 82% did not believe in face reading, 87% did not believe in dream interpretation, 92% did not believe in horoscopes, and 95% did not believe in "computer fortune telling" (CRISP 2010).

Perceived Knowledge about Causes and Solutions to Environmental Problems

U.S. Patterns and Trends

Along with actual knowledge, perceived knowledge may also affect individuals' attitudes and behaviors (Ladwig et al. 2012; Griffin, Dunwoody, and Yang 2013). The 2010 GSS included two questions about how much Americans believed they personally knew about the causes of and solutions to environmental problems. These questions used a 5-point scale that went from "1" for "know nothing at all" to "5" for "know a great deal." About 27% of Americans chose a "4" or "5" when asked to assess their knowledge of the causes of environmental problems, and 14% chose "4" or "5" to describe their knowledge of environmental solutions (figure 7-9; appendix tables 7-14 and 7-15).

International Comparisons

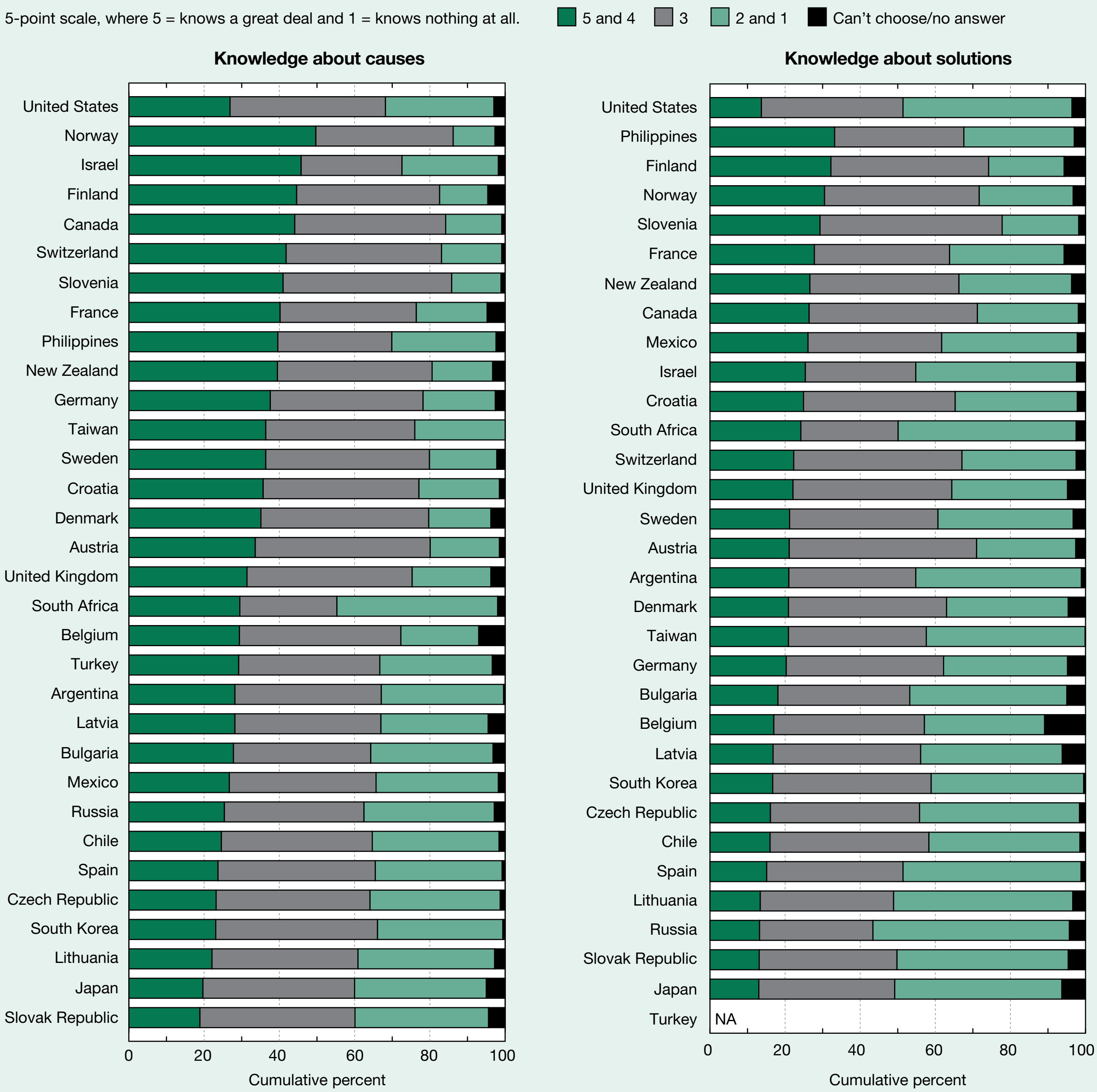
The 2010 International Social Survey Programme (ISSP) allows for international comparisons of perceived science knowledge. The 2010 ISSP asked questions in 31 countries, including the United States, about perceived knowledge bearing on environmental issues. The results show that residents of most other countries surveyed expressed more confidence than Americans about their knowledge of the causes of and solutions to environmental problems. The country with the highest percentage of survey takers choosing "4" or "5" on the 5-point scale for perceived knowledge of the causes of environmental problems was Norway (50%). The United States (27%) had a much lower percentage, although its percentage was similar to that of many other countries. Only Slovak Republic respondents reported less knowledge, on average, than U.S. respondents about causes of environmental problems. Residents of more than half of the countries surveyed gave responses that suggested they knew more. On the subject of environmental solutions, the top countries saw about one-third of residents saying they understood the solutions to environmental problems. The United States (14%) was among the countries with the lowest percentages of residents who said they understood the solutions to environmental problems. Only the Russians (13%) reported less knowledge, on average, than the Americans about environmental solutions. It is also noteworthy that no country's citizens thought they knew more about solutions than causes but that the difference in mean scores for the two questions was almost always less than half a point on the 5-point scale used by the ISSP (figure 7-9; appendix tables 7-14 and 7-15).

Public Attitudes about S&T in General

How people perceive science can matter in a range of different ways. It can affect the public's willingness to fund S&T through public investment, young people's willingness to enter into S&T training and choose jobs in S&T, and parents' willingness to encourage such career paths. Committing resources—whether time or money—to S&T means trusting that our commitment will pay off over the long term for ourselves, our families, and our communities. General views about S&T may also affect our views about specific technologies and research programs that could enhance our lives or pose new risks.

This section presents general indicators of public attitudes and orientations toward S&T in the United States and other countries. It covers views on the promises of S&T and reservations about science, overall support for government funding of research, confidence in scientific community leaders, views of science and engineering as occupations, and views about the degree to which specific fields and work activities are scientific. Overall, the data make it clear that Americans support both S&T and the people involved in S&T.

Figure 7-9
Public self-assessment of knowledge about causes of and solutions to environmental problems, by country/economy: 2010



NA = not available.

NOTES: Responses to *How much do you feel you know about the causes of/solutions to these sorts of environmental problems, where 1 indicates you feel you know nothing at all and 5 indicates you feel you know a great deal?* Percentages may not add to 100% because of rounding.

SOURCE: International Social Survey Program, Environment Module (2010). See appendix tables 7-14 and 7-15.

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Promises and Reservations about S&T

U.S. Patterns and Trends

Overall, Americans remain strong believers in the benefits of S&T even while seeing potential risks. Surveys since at least 1979 show that roughly 7 in 10 Americans see the effects of scientific research as more positive than negative for society. In 2012, this included 50% who said they believed the benefits "strongly" outweigh the negatives and 22% who said the benefits slightly outweigh the potential harms (appendix table 7-16). About 7% said science creates more harms than benefits. These numbers are generally consistent with earlier surveys; Americans saying the benefits strongly or slightly outweigh the harmful results have ranged from 68% to 80% since this question was initially asked in the 1970s (figure 7-10).

Americans with more education, income, and scientific knowledge hold a stronger belief in the benefits of science than others. For example, 55% of those who had not completed high school said they believe science does more good than harm, but 89% of those with bachelor's degrees and 92% of those with graduate degrees expressed this view. Similarly, 86% of those in the top income quartile saw more benefits than harms from science, whereas 60% of those in the lowest bracket expressed this view. Almost all (87%) of those in the top knowledge quartile said they saw more benefits than harms, but just half (50%) of those in the lowest knowledge quartile gave this response (appendix table 7-16).[22]

Americans also overwhelmingly agree that S&T will foster "more opportunities for the next generation" but continue to express worry that it may make life change too quickly. In 2012, about 87% of Americans "agreed" or "strongly agreed" that S&T will create more opportunities (appendix table 7-17). This was down very slightly from the 2006 through 2010 surveys, during which time 89%–91% agreed about the relative value of S&T (NSB 2008, 2010, 2012). Fewer Americans, however, said they were worried about the pace of change. In 2012, 42% of Americans agreed that "science makes our way of life change too fast" (appendix table 7-18). This represents a substantial drop from 2010, when 51% expressed worry about the pace of change (NSB 2012). It also represents a shift in the trend line as worry had previously increased steadily from 33% in 2004 (NSB 2006, 2008, 2010).

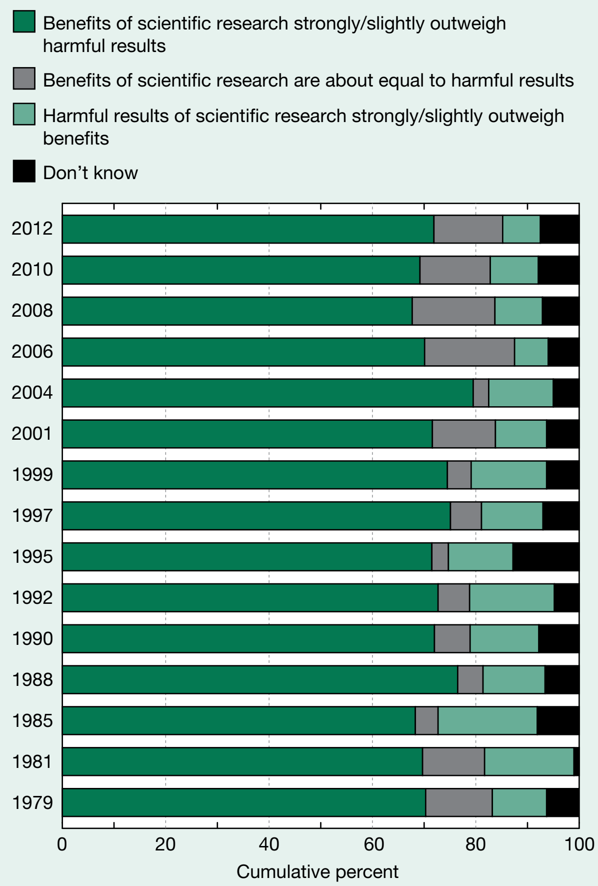
International Comparisons

The 2010 ISSP also included two questions about the promises of science. It asked respondents in 31 countries whether they thought that societies were putting too much faith in science and whether science may do more harm than good. Comparable data were also collected by the ISSP program in multiple countries in 1993 and 2000.

In 2010, about 41% of U.S. residents "agreed" or "strongly agreed" that "we believe too often in science, and not enough in feelings and faith." The average response of U.S. residents put the United States in the middle range of countries. Over time, Americans have become more likely to disagree with the statement, along with several other countries (figure 7-11; appendix table 7-19). A small proportion of Americans (14%) also said they "strongly agreed" or "agreed" that "modern science does more harm than good" in 2010 (figure 7-11). The average response has remained relatively stable across the three survey years in most countries, and most other countries surveyed also expressed more negative views toward science (appendix table 7-20).

The 2011 BBVA Foundation survey also asked a range of questions about general attitudes toward science. It found

Figure 7-10
Public assessment of scientific research: 2012–1979



NOTES: Responses to *People have frequently noted that scientific research has produced benefits and harmful results. Would you say that, on balance, the benefits of scientific research have outweighed the harmful results, or have the harmful results of scientific research been greater than its benefits?* In this figure, "Benefits...outweigh harmful results" and "Harmful results...outweigh benefits" each combine responses of "strongly outweigh" and "slightly outweigh." Figure includes all years for which data were collected. Percentages may not add to 100% because of rounding.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1979–2001); University of Michigan, Survey of Consumer Attitudes (2004); University of Chicago, National Opinion Research Center, General Social Survey (2006–12). See appendix table 7-16.

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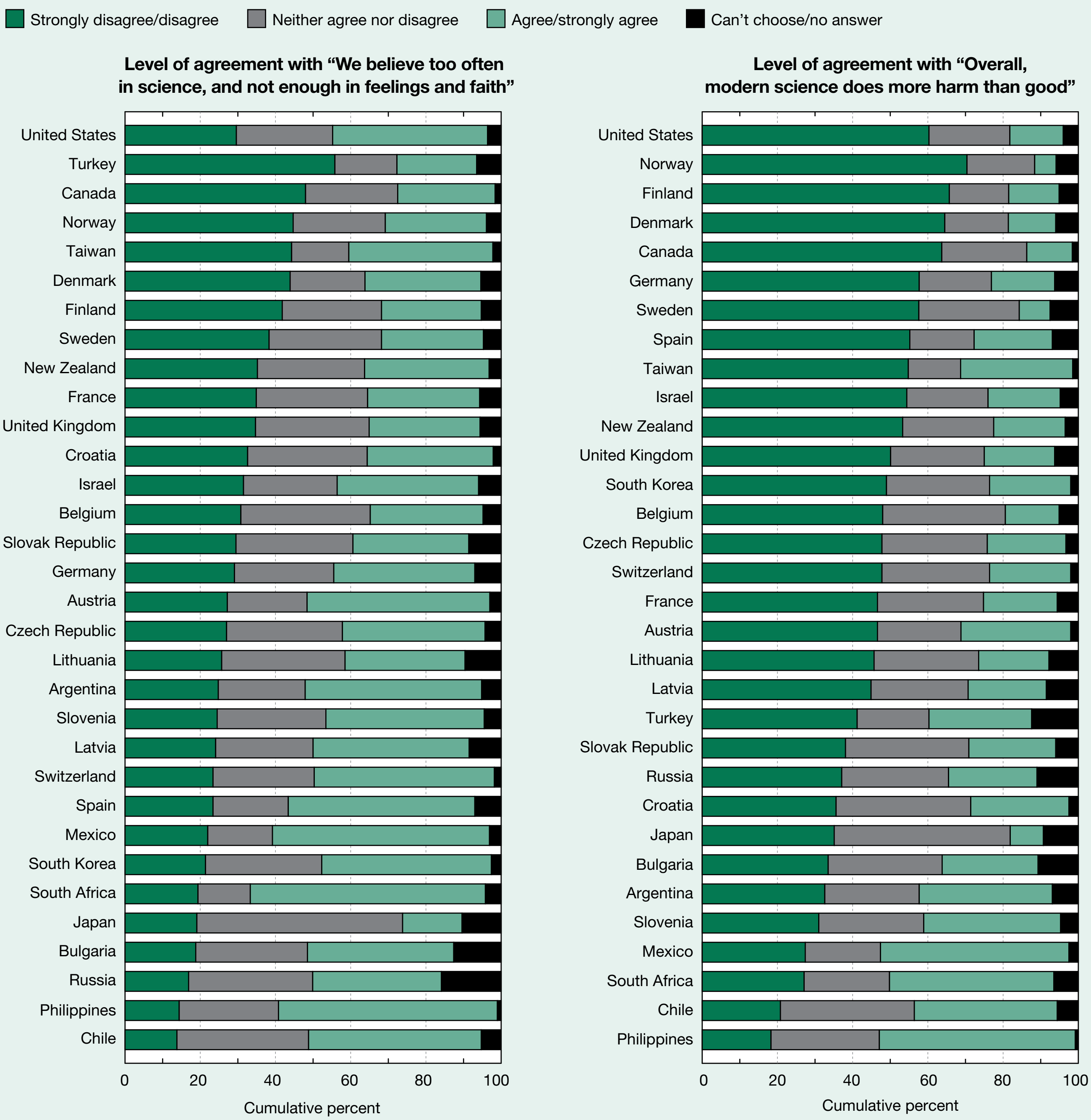
that Europeans and Americans were similar in endorsing the benefits of science but that Europeans in the 10 countries surveyed expressed more reservations. The survey used an 11-point scale that went from "totally disagree" at "0" to "totally agree" at "10" for all questions. Seven questions assessed perceptions about the "positive facets of science," and 11 questions addressed reservations (appendix table 7-21).

As noted, it appears that Americans hold similar views to the 10-country European average and, in some cases,

Figure 7-11
Public assessment of belief in science versus faith, and whether science does more harm than good, by country/economy: 2010



NOTES: Responses to *How much do you agree or disagree with the statements: We believe too often in science, and not enough in feelings and faith* and *Overall, modern science does more harm than good?* Percentages may not add to 100% because of rounding.

SOURCE: International Social Survey Program, Environment Module (2010). See appendix tables 7-19 and 7-20.

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see less promise for science than the residents of the other countries surveyed. For example, survey recipients were asked whether they disagreed or agreed with the statement that "science is the motor of progress." The U.S. average agreement was 6.9, lower than the European average of 7.4 and tied with the United Kingdom for the lowest average. The Czech Republic (7.9) and Poland (7.9) had the highest average agreement. Another statement addressed whether "science is central to a society's culture." The U.S. average was 6.3, lower than the overall European average of 6.8, although a few European countries had lower scores. The lowest was Denmark, with an average score of 5.3, and the highest was Germany, with an average score of 7.3.

On several questions, however, Americans expressed fewer reservations than Europeans. For example, fewer Americans agreed that "people would be better off if they lived a simpler life, without so much science and technology." Americans had an average score of 4.4 on this question, whereas the 10-country European average was 5.1. Germany (4.0) and Denmark (3.4) were the only countries that provided a more pro-science response than the United States. Indeed, Denmark and Germany were the only two countries that were consistently as positive, or more positive, than the United States. The United Kingdom was also often similar to the United States. Americans were the most likely to disagree that "science drives out religion" and that "science makes our way of life change too fast." The U.S. score on the religion question was 3.9, whereas the 10-country European average was 4.9. The U.S. score on the "way of life question" was 4.7, whereas the 10-country European average was 6.0 (BBVA Foundation 2012b).

Within Asia, different question wording makes comparisons difficult, but most respondents appeared to support S&T. In 2010, 75% of Chinese respondents "fully" or "basically" agreed that S&T brings more advantages than disadvantages, whereas only one-fifth (20%) said they thought that "we are too dependent on science such that we overlook belief" (CRISP 2010). In 2011, 54% of Japanese respondents said "there are more pluses" or "on the whole, there are more pluses" to S&T development (NISTEP 2012). Koreans were asked separate questions about the risks and benefits of S&T. About 78% "agreed" or "somewhat agreed" that S&T promotes a "healthy and convenient life," and 76% agreed that S&T "helps in everyday life." However, 65% also agreed that S&T "creates problems" (KOFAC 2011).

Federal Funding of Scientific Research

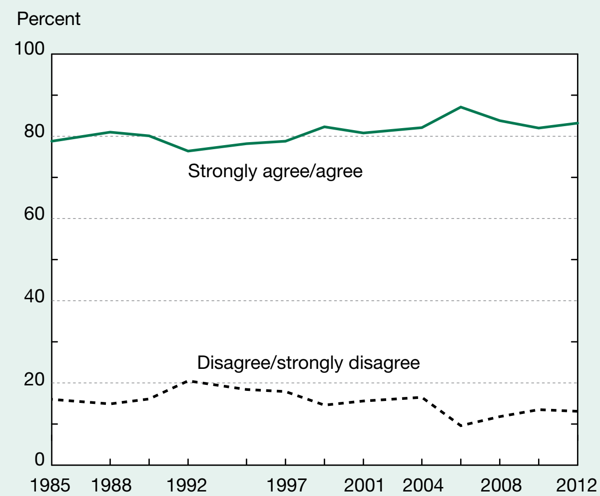
U.S. Patterns and Trends

U.S. public opinion consistently and strongly supports federal spending on basic scientific research. In 2012, 83% of Americans "agreed" or "strongly 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." This is similar to both 2010 (82%) and 2008 (84%). Since 1985, agreement with this statement has ranged from a low of 76% in 1992 to a high of 87% in 2006 (figure 7-12; appendix table 7-22).

Americans with relatively higher levels of education and more science knowledge are particularly likely to support funding scientific research. For example, 75% of those who had not completed high school agreed that funding was needed, but 94% of those with graduate degrees expressed this view. Also, 73% of those in the lowest quartile of S&T knowledge agreed that support was needed, whereas 88% of those in the highest knowledge quartile expressed this view (appendix table 7-23).

Another indicator of views about S&T is the percentage of Americans who say they think the government is spending too little on scientific research. In 2012, 38% of respondents said government was spending "too little," 45% said the amount was "about right," and 12% said it was "too much." The percentage who said they thought the government spent too little on science gradually increased from 1981 to 2006, fluctuating between 29% and 34% in the 1980s, between 30% and 37% in the 1990s, and between 34% and 41% in the 2000s and 2010s (figure 7-13; appendix table 7-24). Pew Research also found that about one-third of Americans support more spending on scientific research (Pew Research Center 2011b). Other research showed that more than half of Americans reject cuts to science (Pew Research Center

Figure 7-12
Public opinion on whether the federal government should fund basic scientific research: 1985–2012



NOTES: 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?* Responses of "don't know" are not shown.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1985–2001); University of Michigan, Survey of Consumer Attitudes (2004); University of Chicago, National Opinion Research Center, General Social Survey (2006–12). See appendix tables 7-22 and 7-23.

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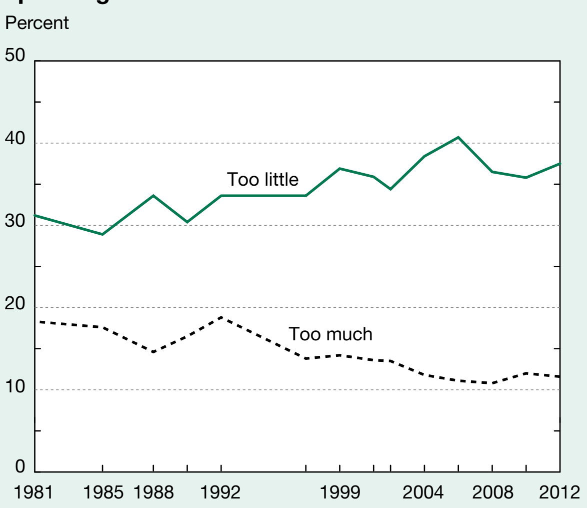
2012c) and nearly three-quarters of Americans expect that spending on scientific research will pay off in the long term (Pew Research Center 2009).

Compared with support for government spending in other areas, however, support for spending on scientific research is not especially strong, according to the GSS. Americans are more likely to say several other areas need government spending more than S&T. Education (75%) consistently receives the most support from Americans, compared with about 6 in 10 who say that government should spend more on assistance to the poor (61%), health (61%), development of alternative energy sources (60%), and environmental protection (58%). Support for increased spending on scientific research (38%) is roughly comparable to that for spending on improving mass transportation (38%) but garners more support than parks and recreation (31%), national defense (24%), space exploration (22%), and assistance to foreign countries (7%) (figure 7-14; appendix table 7-24).[23]

International Comparisons

In other countries where similar, although not identical, questions have been asked, respondents also express strong support for government spending on scientific research. In 2010, 72% of EU residents agreed that "even if it brings no immediate benefits, scientific research which adds to knowledge should be supported by government," and only 9% disagreed (European Commission 2010a). In 2010, 77% of Chinese agreed to a similar statement regarding the need for support (CRISP 2010). Although the comparable U.S. percentages for agreement with the need for support are nominally higher (83%), the absence of a middle option (e.g., "neither agree nor disagree") rather than a difference in underlying opinions may account for this difference. Levels of agreement in South Korea, Malaysia, Japan, and Brazil

Figure 7-13
Public assessment of amount of government spending for scientific research: 1981–2012



NOTES: Responses to *We are faced with many problems in this country, none of which can be solved easily or inexpensively. I'm going to name some of these problems, and for each one, I'd like you to tell me if you think that the government is spending too little money on it, about the right amount, or too much: [supporting scientific research].* Responses of "right amount" and "don't know" are not shown.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1981–2001); University of Chicago, National Opinion Research Center, General Social Survey (2002–12). See appendix table 7-24.

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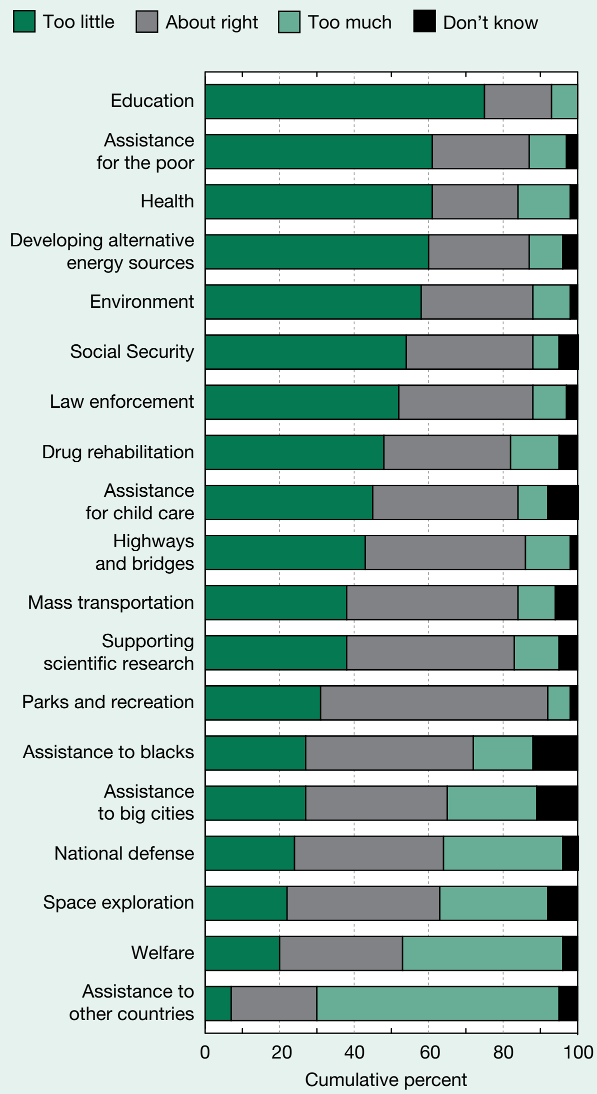
Figure 7-14
Public assessment of government spending in various policy areas: 2012



NOTE: Responses to *We are faced with many problems in this country, none of which can be solved easily or inexpensively. I'm going to name some of these problems, and for each one, I'd like you to tell me if you think that the government is spending too little money on it, about the right amount, or too much.*

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix table 7-24.

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have also been similar to the United States and Europe (NSB 2012). In 2010, 64% of Koreans said S&T "requires public support," and 35% said they wanted to see more investment in S&T research (KOFAC 2011).

Confidence in the Science Community's Leadership

U.S. Patterns and Trends

Few members of the public have the background knowledge or resources to fully evaluate scientific questions in the public sphere. People, therefore, often rely on how they perceive decision makers as a decision aid (Earle, Siegrist, and Gutscher 2007; Kahan, Jenkins-Smith, and Braman 2011). Public confidence in leaders of the scientific community can therefore affect public acceptance of findings and conclusions based on scientific research. Since 1973, the GSS has tracked public confidence in the leadership of various institutions, including the scientific community. The GSS asks respondents whether they have "a great deal of confidence," "only some confidence," or "hardly any confidence at all" in the leaders of different institutions. In 2012, 41% of Americans expressed "a great deal of confidence" in leaders of the scientific community, nearly half (49%) expressed "some confidence," and fewer than 1 in 10 (7%) expressed "hardly any confidence at all" (figure 7-15).

These results suggest that leaders of the scientific community compare well to leaders of other institutions in America. Only military leaders generated greater public confidence in 2012, with 53% of Americans saying they had a "great deal of confidence" in them. The scientific community (41%) and the medical community (40%) shared about equal levels of confidence. Since at least the 1970s, a similar percentage of Americans have said they place a "great deal of confidence" in the scientific community, whereas the percentage saying this about the medical community has fallen from highs of 61% in the mid-1970s (appendix table 7-25).

International Comparisons

The 2011 BBVA Foundation survey also found that scientists were among the most positively viewed groups in both the United States and the 10 European countries surveyed. Teachers and engineers were also viewed positively. The survey used an 11-point scale in which "0" means the respondent believed "that [the] group does not contribute at all to the welfare and progress of society" and "10" means "it contributes a great deal." Doctors scored 8.4 in the United States and 8.2 in Europe. Scientists scored 8.1 in the United States and 7.9 in Europe. Teachers were more positively viewed in the United States (8.5) than in the 10 countries surveyed in Europe (7.6), but they were still near the top for both locations. Engineers received scores of 7.9 in the United States and 7.6 in Europe (BBVA Foundation 2012b).

Levels of reported trust varied in two Asian surveys that used different questions. A 2010 Korean survey found that 32% "strongly agreed" or "agreed" that "scientists can always be trusted" (KOFAC 2011). In contrast, a 2011 survey in Japan found that 69% of respondents said scientists could be "trusted" or "somewhat trusted." Even more respondents (77%) said engineers could be trusted (NISTEP 2012).

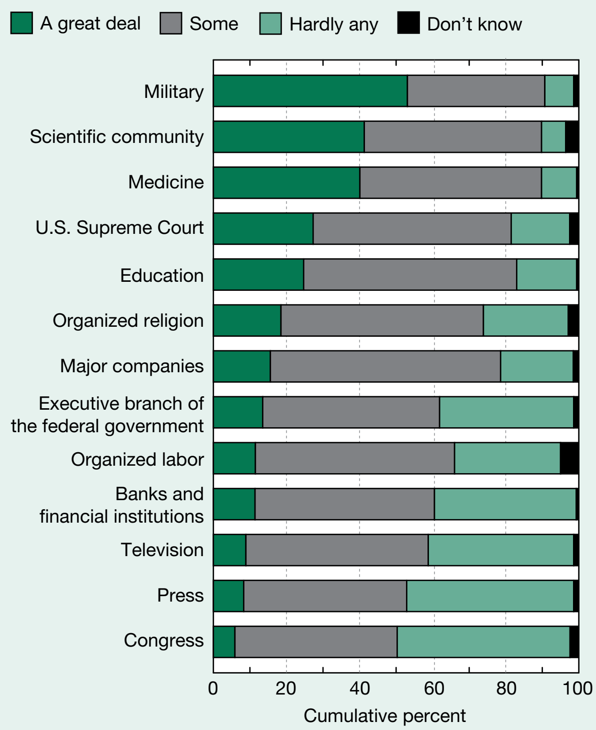
Views of S&E Occupations

U.S. Patterns and Trends

Data on public esteem for S&E occupations are an indicator of the attractiveness of these occupations and their ability to recruit talented people into their ranks. Such data may therefore have a bearing on the degree to which S&E affects the nation's well-being in the future. Perceptions of specific occupations may also provide a picture of the degree to which people have confidence in those involved in S&E. Past research shows that when people—especially children—are asked to "draw a scientist," they often rely on relatively unflattering stereotypes (Losh, Wilke, and Pop 2008).

The 2012 GSS included questions aimed at assessing how people view scientists and engineers. Half of the respondents were asked questions about scientists, and half were asked identical questions about engineers. Many of

Figure 7-15
Public confidence in institutional leaders, by type of institution: 2012



NOTE: Responses to *As far as the people running these institutions are concerned, would you say that you have a great deal of confidence, only some confidence, or hardly any confidence at all in them?*

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix table 7-25.

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the scientist-focused questions were also asked in 1983 and 2001. An analysis of these earlier surveys concluded that views about scientists were shaped by a range of factors; older respondents, women, and those who believe society relies too much on science had more negative views about scientists. In contrast, those with more education and more college courses in science were more positive about scientists (Losh 2010).

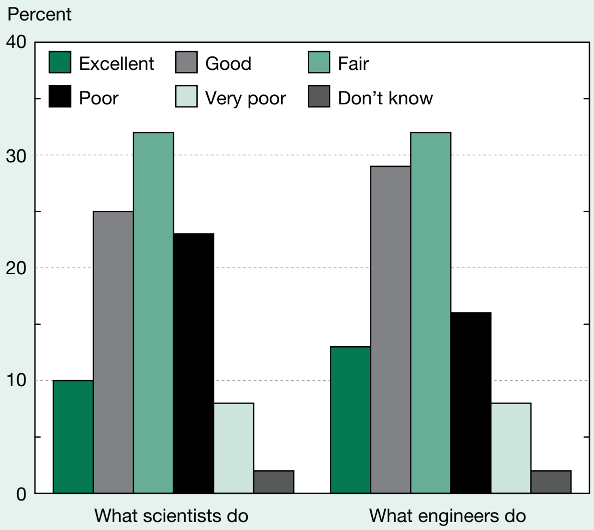
More Americans said they had an "excellent" or "good" understanding of what engineers (42%) than of what scientists (35%) do in their jobs. In contrast, more respondents said they had "considered working" in a science-related (33%) than in an engineering-related (26%) career. The percentage interested in a science career was down from 41% in 2001 and similar to the 34% who gave this response in 1983. There were few clear demographic patterns, although younger and older respondents were both less likely to say they understood S&E careers, and more education and knowledge were generally associated with more self-reported understanding (figure 7-16; appendix table 7-26).

Almost all Americans said they would be "happy" if their son or daughter were to become a scientist or engineer. In 2012, four out of five Americans (80%) said they would be happy if their son or daughter became a scientist, and even more would be happy to see their child become an engineer (84% for daughters and 85% for sons). The 2001 survey similarly found that 80% of Americans would be happy about a scientific career for their child, up from 67% for both sexes in 1983 (figure 7-17).[24]

In general, these patterns were consistent across demographic groups, although those who scored well on the test of science knowledge were somewhat more likely to be happy if their son or daughter were to become an engineer than those who scored relatively less well. For example, in 2012, 79% of respondents in the bottom quartile for science knowledge said they would be happy if their son became an engineer, whereas 88% of those in the top quartile gave this response. This pattern was not apparent in those asked about scientists (appendix table 7-27).

Americans' views about specific facets of S&E occupations are also quite positive. Americans generally believe that both scientists and engineers have a positive impact on society, and these beliefs appear to have remained stable over the past decade. Americans almost universally "strongly agree" or "agree" that scientists (95%) and engineers (91%) "are helping to solve challenging problems."

Figure 7-16
Public self-assessment of knowledge of what scientists and engineers do day-to-day on their jobs: 2012



NOTES: Responses to *Would you say your knowledge of what scientists/engineers do day-to-day on their jobs is excellent, good, fair, poor, or very poor?* Percentages may not add to 100% because of rounding.

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix table 7-26.

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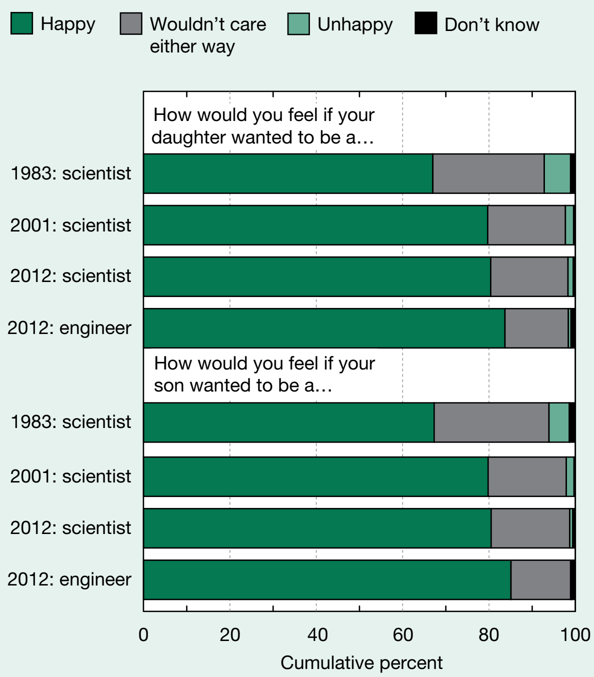
Figure 7-17
Public opinion on science and engineering careers for one's children: 1983, 2001, and 2012



NOTES: Responses to *If you had a daughter/son, how would you feel if she/he wanted to be a scientist/engineer—would you feel happy, unhappy, or would you not care one way or the other?* Percentages may not add to 100% because of rounding.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1983, 2001); University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix table 7-27.

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This is similar to the 96% who gave such responses in 2001 when asked only about scientists (NSB 2002). Americans also believe these groups are made up of "dedicated people who work for the good of humanity." Although both groups are seen positively, more respondents agreed that this description fits scientists (88%) than agreed that this description fits engineers (79%). The finding for scientists is also similar to that in 2001, when 86% of respondents gave this answer (NSB 2002). There is no meaningful difference in Americans' belief that scientists (86%) and engineers (86%) "work on things that will make life better for the average person" (table 7-10). About 89% also said this about scientists in 2001.

Americans' views about S&E careers include several elements that could be perceived by some as negative. Respondents were more likely to provide such comments when asked about scientists rather than engineers. Specifically, 50% of respondents said they "strongly agree" or "agree" with the statement that "scientific work is dangerous," but just 38% said they thought engineering work is dangerous. The percentage seeing scientific work as dangerous is essentially unchanged from 2001, when 53% of respondents gave this response. In 2012, more Americans saw scientists than saw engineers as not likely "to be very religious people" (33%, compared with 15% for engineers); as having "few other interests but their work" (28%, compared with 16% for engineers); and as likely to "earn less than other people with equally demanding jobs" (17%, compared with 9% for engineers). These numbers are also similar to those from 2001, when 30% said they thought scientists were unlikely to be religious and 29% said they believed scientists were too interested in work. About one-third of Americans saw scientists and engineers as "apt to be odd and peculiar people" (36% for scientists, compared with 28% for engineers). This percentage rose for scientists from 25% in 2001 (NSB 2002), but it is not far from the 31% response in 1983 (table 7-10; appendix table 7-28).

Americans saw few differences between scientists and engineers in 2012 for some of the less common negative ideas about which they were asked. Few Americans said they believe that scientists and engineers "don't get as much fun out of life as other people do" (19% for scientists, compared with 16% for engineers); that scientists or engineers "usually work alone" (20% for scientists, compared with 23% for engineers); or that being a scientist or engineer "would be boring" (17% for scientists, compared with 14% for engineers) (table 7-10). The percentage of people who believed that scientists have less fun was 20% in 2001 and 24% in 1983. The percentage of people who believed that scientists work alone was lower in 2001 (16%) and similar in 1983 (21%). In previous surveys, respondents were not asked about whether science was boring (appendix table 7-28).

It is also noteworthy that the Harris Poll (Harris Interactive 2009) asked about the prestige of a large number of occupations, including scientists and engineers, over a period of about 30 years. In 2009, the last year for which data are available, 57% of Americans said that scientists had "very great prestige," and 39% expressed this view about engineers. Most occupations in the surveys were rated well below engineers.[25] In recent years, scientists' ratings were comparable to those of nurses, doctors, firefighters, and teachers and ahead of those of military and police officers. Engineers' standing was comparable to those of occupations clustered just below the top group of occupations rated, including clergy, military officers, farmers, and police officers (NSB 2012).

International Comparisons

Elsewhere, S&E occupations are also highly regarded. The BBVA Foundation research in Europe and the United States found that both groups reject negative portrayals of scientists and embrace positive ones. The 2011 BBVA Foundation survey presented respondents with the idea that "films often use particular images to portray scientists" and then asked if the respondents believed these portrayals "reflect what scientists are like." About 42% of Americans and 46% of residents of the 10 European countries surveyed said they thought that a depiction of scientists as "people doing research beyond the bounds of what is morally acceptable" would reflect scientists "fairly well" or "very well." Fewer respondents—27% of Americans and 29% of Europeans—said that depictions of scientists as "people who lie about their research for personal gain" would be accurate. Even fewer—23% of Americans and 25% of Europeans—said they believed that depictions of scientists as "dangerous people" would be accurate. Americans and Europeans diverged on the degree to which residents said they believed that scientists were "people with a lot of power" or "absent-minded people." About 53% of Americans and 45% of Europeans said that they thought depictions of scientists as powerful would accurately reflect scientists. Also, 22% of Americans said they thought an absent-minded depiction would be accurate, but 35% of Europeans held this view (BBVA Foundation 2012b).

The BBVA Foundation survey also found that more Americans had "considered the possibility of taking up a career related to science" than most other countries in the survey. One-third of Americans (33%) said they had considered such a career, but only 17% of those surveyed in the other 10 European countries said they had considered this option (BBVA Foundation 2012b).

Earlier data from other countries indicate that scientists are well regarded. Chinese respondents were asked in 2010 to choose up to three occupations that they thought were the most prestigious and three that they would like their child to choose. Scientist (44%) rated close to doctor (44%) as an occupation that was among the most "prestigious," although both were behind teacher (55%). Engineering was seen as a prestigious career by 22% of Chinese respondents. When it came to careers, 36% said they would like their child to become a scientist. Teacher (51%) and doctor (49%) were the only occupations more preferred. About 17% said they would like their child to become an engineer (CRISP 2010). A 2010 Korean survey also included questions about scientists and found that 56% of respondents "strongly" or "somewhat" agreed that scientists "serve the interests of humankind," 38% agreed scientists are "neutral and objective," and 32% agreed scientists are "unique and different people." Overall, 24% said they would "strongly support" their children in pursuing an S&E career, although most (66%) indicated they would let their children choose their own path (KOFAC 2011). In 2006, the majority of Israelis said they would be pleased if their children became scientists (77%), engineers (78%), or physicians (78%) (Yaar 2006).

Which Fields and Activities Are Seen as Scientific

U.S. Patterns and Trends

The 2012 GSS included a series of questions about the degree to which Americans see various fields of research and practical activities as scientific. Such questions are important because they can provide an indicator of the degree that Americans see a role for science in everyday life. Some of these questions were also asked in the 2006 GSS as well as in a 2005 EU survey. The new data include both the earlier list of fields as well as an additional list of activities, many

Table 7-10
Public perceptions of science and engineering occupations: 2012
(Percent)

	Level of agreement					
Field/work activity	Strongly agree	Agree	Disagree	Strongly disagree	Don't know	Mean score
Scientists are helping to solve challenging problems	21	74	1	1	3	3.2
Engineers are helping to solve challenging problems	19	72	3	*	6	3.2
Scientific researchers are dedicated people who work for the good of humanity	19	69	6	1	5	3.1
Engineering researchers are dedicated people who work for the good of humanity	11	68	11	1	9	3.0
Most scientists want to work on things that will make life better for the average person	14	72	8	1	5	3.0
Most engineers want to work on things that will make life better for the average person	11	75	7	*	7	3.0
Scientific work is dangerous	6	44	39	4	6	2.6
Engineering work is dangerous	6	32	48	5	9	2.4
Scientists are apt to be odd and peculiar people	4	32	51	6	8	2.4
Engineers are apt to be odd and peculiar people	4	24	55	7	10	2.3
Scientists are not likely to be very religious people	4	29	47	6	13	2.4
Engineers are not likely to be very religious people	1	14	57	6	22	2.1
Scientists have few other interests but their work	2	26	55	5	11	2.3
Engineers have few other interests but their work	2	14	63	6	14	2.2
A scientist usually works alone	3	17	64	10	7	2.1
An engineer usually works alone	3	20	57	11	9	2.2
Scientists don't get as much fun out of life as other people do	2	17	59	11	11	2.1
Engineers don't get as much fun out of life as other people do	2	14	63	10	12	2.1
Scientists earn less than other people with equally demanding jobs	2	15	60	4	19	2.2
Engineers earn less than other people with equally demanding jobs	1	8	69	7	14	2.0
A job as a scientist would be boring	2	15	66	11	6	2.1
A job as an engineer would be boring	2	12	68	8	11	2.1

* = < 0.5% responded.

NOTES: Responses to *Now I'd like to read you some statements about scientists/engineers. Please tell me if you agree or disagree with each one. If you feel especially strongly about a statement, please say that you strongly agree or strongly disagree*. Mean agreement score is based on a 4-point scale, where 4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree. Percentages may not add to 100% because of rounding.

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix table 7-28.

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of which require practical applications of S&T knowledge, such as farming, computer programming, and counseling. Engineering was included as both a field and an activity. The results clearly show that Americans differentiate between different fields and activities.

Many of the fields and activities that Americans saw as scientific are those where the S&T element is clear. Medicine (94%) and medical treatment (96%) were the most likely to be seen as "very" or "pretty scientific." The percentage for medicine was down slightly from 97% in 2006. Many also saw the fields of physics (88%), biology (90%), and engineering (80%)—as well as the activities of engineering (90%) and architecture (75%)—as scientific. Biology was down slightly from 94% in 2006, and physics was down from 90%. Engineering (as a field) was about the same (77%) in 2006, whereas architecture was not included in the earlier survey. Respondents saw engineering as more scientific when grouped with other "activities" than when grouped with "fields." The fact that "engineering" followed "medicine" in the list of fields on the underlying GSS survey but followed "law enforcement" in the list of activities, may have contributed to this difference in perceptions (table 7-11; appendix table 7-29).

Three fields were seen as marginally scientific. About half of Americans saw the social science fields of economics (45%) and sociology (45%) as "very scientific" or "pretty scientific." These are down slightly from 2006 when economics had been at 51% and sociology at 49%. About one-third of respondents (31%) said they saw history as scientific in 2012, which is about the same as in 2006 (30%).

Americans also saw many activities as scientific and distinguished these from other activities that they saw as unscientific. Most respondents saw computer programming (85%) and farming (72%) as scientific, whereas about half of respondents saw firefighting (57%) and law enforcement (44%) as scientific.

In general, respondents with more education and more scientific knowledge were more likely to see almost all fields and activities as at least somewhat scientific. Patterns are also apparent in the percentage describing certain fields or activities as "pretty scientific." For example, the percentage of respondents saying that economics is "pretty scientific" climbs from 20% for the lowest knowledge quartile to 44% for the highest knowledge quartile. No such pattern is apparent when looking at the "very scientific" percentage for economics. Similarly, 21% of those who had not completed

Table 7-11
Public perceptions of degree to which certain fields and work activities are scientific: 2012
(Percent)

Field/work activity	Degree to which scientific: Very scientific	Pretty scientific	Not too scientific	Not scientific at all	Haven't heard of it	Mean score
Field						
Medicine	80	14	2	1	3	3.8
Physics	69	19	4	2	6	3.7
Biology	67	23	4	1	5	3.6
Engineering	49	31	10	6	5	3.3
Economics	15	30	31	18	6	2.5
Sociology	9	36	33	8	13	2.5
History	9	22	41	24	4	2.2
Accounting	8	19	35	33	5	2.0
Work activity						
Medical treatment	77	19	2	1	1	3.7
Engineering	59	31	5	3	2	3.5
Computer programming	52	33	10	3	2	3.4
Architecture	35	40	15	7	3	3.1
Farming	18	54	20	5	2	2.9
Firefighting	17	40	28	13	2	2.6
Law enforcement	12	32	33	21	2	2.3
Financial counseling	8	25	36	28	3	2.1
Journalism	4	16	46	29	4	2.0
Marriage counseling	7	18	33	39	3	1.9
Salesmanship	4	12	39	42	3	1.8

NOTES: Responses to *How scientific are each of the following fields/work activities? If you have not heard of a particular field/work activity, just say you haven't heard of it. Is [field/work activity] very scientific, pretty scientific, not too scientific, or not scientific at all?* Mean scientific score is based on a 4-point scale, where 4 = very scientific, 3 = pretty scientific, 2 = not too scientific, and 1 = not scientific at all. Percentages may not add to 100% because of rounding.

SOURCE: University of Chicago, National Opinion Research Center, General Social Survey (2012). See appendix table 7-29.

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high school said they thought law enforcement was "very scientific," but only 4% of those with graduate degrees gave this opinion. In contrast, 18% of those with less than a high school diploma viewed law enforcement as "pretty scientific," but 47% of those with bachelor's degrees gave this response. Similar patterns are apparent for education and/or literacy measures applied to occupations such as farming, firefighting, marriage counseling, law enforcement, and financial counseling. These results suggest that Americans with more understanding of science may be more likely to recognize a partial natural- or social-scientific element to fields or activities in which S&T plays a supporting role.[26]

International Comparisons

The pattern of results in the 2012 GSS remains similar to those found in a 2005 survey of EU countries. This survey used a five-point scale anchored by "not at all scientific" and "very scientific." Some 89% of Europeans chose one of the two highest categories for medicine (i.e., above the midpoint). About 83% gave such a score for physics, and 75% gave such a score for biology. About 40% indicated they believed economics was scientific, and 34% said they saw history as scientific (European Commission 2005).

Influence of Scientific Experts on Public Issues

U.S. Patterns and Trends

The 2010 GSS included a battery of questions that focused on what role the public wants scientists and others to play in policy decision making. These questions were also asked in 2006. In 2010, the survey focused on four issues: global climate change,[27] research using human embryonic stem cells, federal income taxes, and nuclear power.[28] In 2006, the issues included GM foods but not nuclear power. Respondents were asked how much influence a group of scientists or engineers with relevant expertise (e.g., medical researchers, economists, nuclear engineers) should have in deciding about each issue, how well the experts understood the issue, and to what extent each would "support what is best for the country as a whole versus what serves their own narrow interests." The same questions were asked about elected officials and either religious leaders (for stem cell research) or business leaders (for the other issues). Thus, the questions allow a comparison among leadership groups at a single point in time as well as a comparison of perceptions about these groups over time.

The 2010 GSS data indicate that most Americans believe that scientists and engineers should have either a "great deal" or "a fair amount" of influence on these public decisions. More said that scientists and engineers should have a "great deal" of influence about these issues than said the same about other groups when it comes to global warming, stem cell research, nuclear power, and GM foods. Americans also gave scientists relatively high marks for understanding each issue and for being relatively impartial. For all issues, compared with other leadership groups, S&E groups were more likely to be seen as supporting what is best for the country rather than their own narrow interests. Nonetheless, the 2010 GSS also assessed perceived consensus among scientists and found that the public thought that scientists disagreed among themselves on most issues. The public perceived the greatest consensus on stem cells and nuclear energy and the least consensus on taxes. Past research suggests that a lack of perceived consensus may limit the influence of the scientific community (Krosnick et al. 2006; NSB 2010). Americans with more education and more science knowledge tended to have more favorable perceptions of the knowledge, impartiality, and level of agreement among scientists.

Public Attitudes about Specific S&T-Related Issues

In addition to general views about S&T, most people also develop views about specific issues, and these views can shape personal and political decisions. Such specific attitudes are usually associated with general attitudes and knowledge and may come from a range of experiences. Both general and specific views about S&T may affect what people decide to study, what they decide to consume, and whom they trust. Likewise, attitudes about emerging areas of research and new technologies may influence innovation activity in important ways. The climate of opinion concerning new research areas can shape public and private investment in related technological innovations and, eventually, the adoption of new technologies and the growth of industries based on these technologies.

Even in democratic societies, public opinion about new S&T developments rarely translates directly into actions or policy. Instead, institutions selectively assess what the public believes and may magnify or minimize the effects of divisions in public opinion on public discourse and government policy (Jasanoff 2005). It is noteworthy that the public's attitudes about specific S&T issues such as climate change and biotechnology can differ markedly from the views of scientists (Pew Research Center 2009). This is partly because attitudes toward S&T involve a multitude of factors, not just knowledge or understanding of relevant science. Values, morals, judgments of prudence, and numerous other factors come into play; judgments about scientific fact are often secondary (Kahan, Jenkins-Smith, and Braman 2011).

This section describes data about views on environmental issues, including global climate change, nuclear power, and energy development; nanotechnology; agricultural biotechnology (i.e., GM food); cloning and stem cell research; and teaching evolution in schools. It concludes with recent data on attitudes toward scientific research on animals and toward science and mathematics education.

Environment

U.S. Patterns and Trends

Environmental issues—especially climate change and energy technologies—are often the subject of both public policy debate and news interest. The massive 2010 oil spill in the United States was followed by a 2011 nuclear accident in Japan and attendant calls for the development of new energy alternatives. Recent years also saw the reemergence of a domestic natural gas industry as new technologies made hydraulic fracturing ("fracking") technologically and economically feasible. A review of general public views about the environment and specific environmental issues follows, along with reviews of views about climate change and energy technologies.

Concern about Environmental Quality

The environment is important to many Americans, but other issues rate higher on their list of priorities. A 2012 Gallup survey on Americans' concerns for the nation shows "worry" about the environment rebounded slightly after tying record lows in 2010 and 2011. The 2012 poll found that 37% said they worry "a great deal" about "the quality of the environment," compared with 34% in 2010 and 2011. The percentage that worries "a great deal" has, however, fluctuated within a 9% range (34% to 43%) since Gallup began asking the question in 2001. These most recent figures are well within that range, suggesting long-term stability (figure 7-18). Overall, environmental concerns are relatively low on the list of issues about which Gallup respondents worry (Saad 2012), and in 2013, just 47% of respondents said the government is doing "too little" in terms of protecting the environment. This was down from 51% in 2012 and relatively low compared with data going back to 1983 (Newport 2013). Similar results from Pew Research said 86% of Americans think "strengthening the nation's economy" should be a top priority for the President and Congress for the year, whereas 56% said "protecting the environment" should be a top priority. About 45% said "dealing with the nation's energy problem" should be a top priority. Both environmental protection and energy issues have also fluctuated within a relatively narrow range in past polls (Pew Research Center 2013b). Another way survey researchers assess what issues are most salient in the public mind is to ask an open-ended question about what respondents believe to be "the most important problem facing the country" at the beginning of a survey. Neither Gallup (Jones and Saad 2013) nor the Pew Research Center (2012e) have found that more than about 1% of respondents offer environmental or energy issues as the country's biggest problem in recent years.

International Comparisons

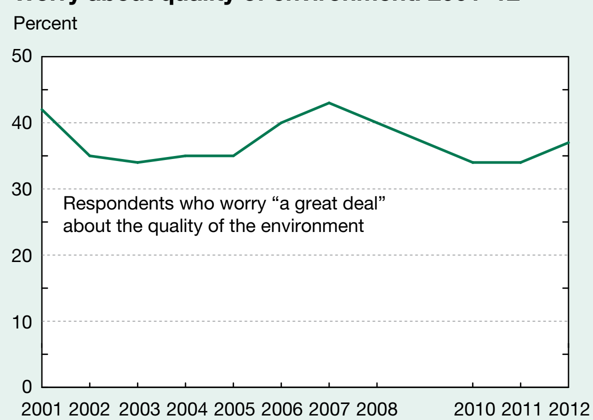
The availability of the 2010 ISSP also makes it possible to provide a number of international comparisons related to environmental issues. Particularly relevant to general environmental concerns is one general question that asked respondents "how concerned" they were "about environmental issues." It asked them to respond on a five-point scale where 1 meant "not at all concerned" and 5 meant "very concerned." About 63% of American respondents chose 4 or 5. The U.S. average score in 2010 was relatively low—residents of more than a dozen countries were more concerned about such issues—but also was statistically similar to the scores of many large, developed countries (figure 7-19; appendix table 7-30).[29] Also, in 2010, about one-quarter of Americans (23%) said they "strongly agreed" or "agreed" that "modern science will solve our environmental problems with little change to our way of life." Americans were again in the middle range of countries. In many of the countries where multiple years of data (i.e., 1993 and 2000) were available, confidence increased over time (figure 7-20; appendix table 7-31).

Within Europe alone, a 2011 Eurobarometer found that 95% of EU residents said that "protecting the environment" was personally "very important" or "important" (European Commission 2011). This figure was essentially unchanged from 2007, when it was at 96%. Further, 76% of EU residents agreed that "environmental problems" have a "direct effect" on their lives; this, too, was similar to 2007 (78%) (European Commission 2011).

Assessment of Specific Environmental Problems

The U.S. public's perceptions of hazards to the environment have been mostly stable over the past two decades. Responses to a series of questions on GSS surveys conducted in 1993, 2000, and 2010 show that Americans consider pollution of America's rivers, lakes, and streams to be more dangerous to the environment than any of several other

Figure 7-18
Worry about quality of environment: 2001–12



NOTES: Responses to *How much do you personally worry about the quality of the environment: a great deal, a fair amount, only a little, or not at all?* Poll is conducted annually in March.

SOURCE: Saad L, *Economic Issues Still Dominate Americans' National Worries*, The Gallup Poll (28 March 2012), http://www.gallup.com/poll/153485/Economic-Issues-Dominate-Americans-National-Worries.aspx, accessed 25 January 2013.

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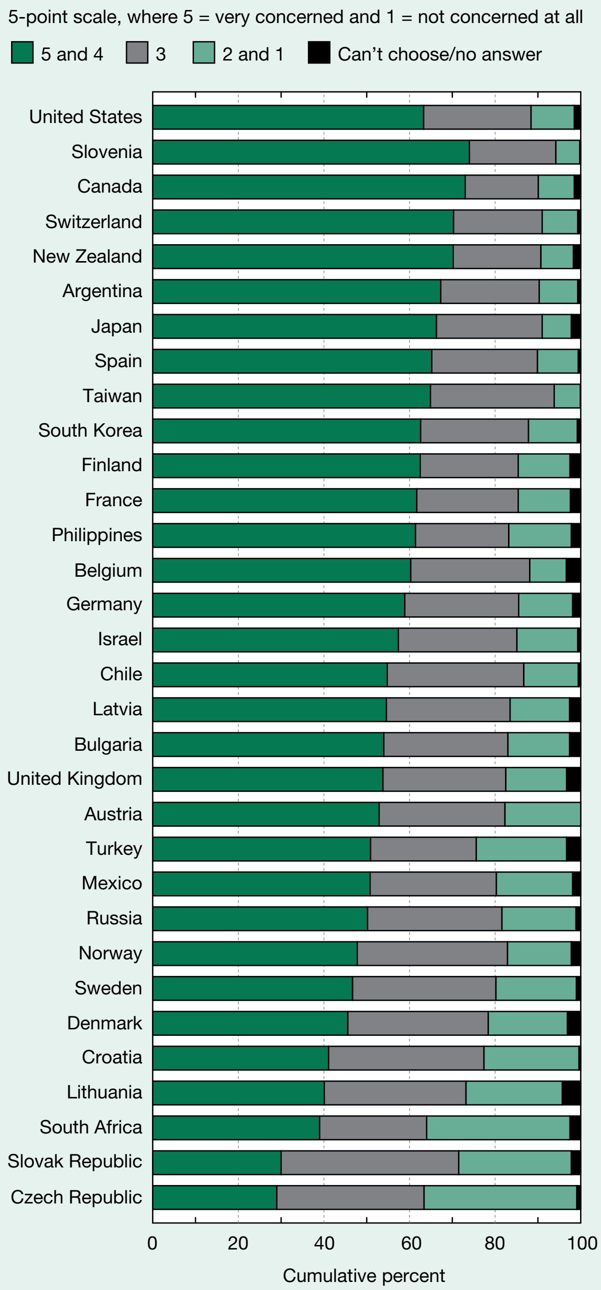
potential problems; in 2010, 68% considered water pollution to be very or extremely dangerous. Air pollution caused by industry was considered very or extremely dangerous to the environment by 62%, whereas air pollution caused by cars was less likely to be considered very or extremely dangerous to the environment (43%). Assessments of environmental

Figure 7-19
Public concern about environmental issues, by country/economy: 2010



NOTES: Responses to *Generally speaking, how concerned are you about environmental issues, where 1 means you are not at all concerned and 5 means you are very concerned?* Percentages may not add to 100% because of rounding.

SOURCE: International Social Survey Program, Environment Module (2010). See appendix table 7-30.

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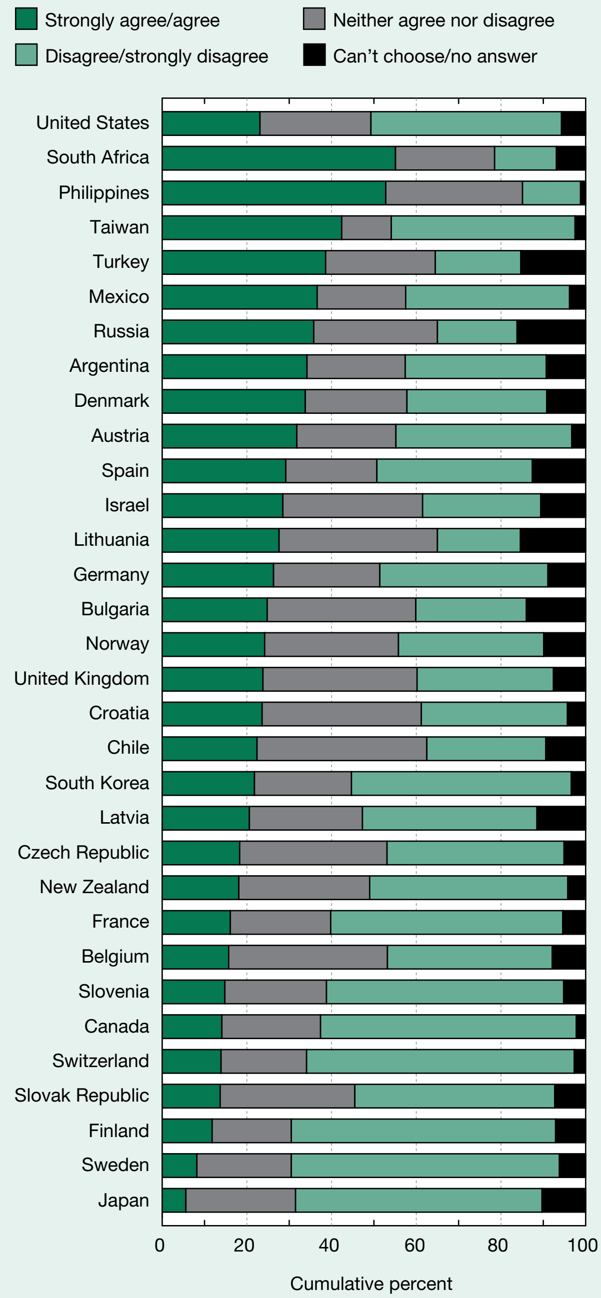
Figure 7-20
Public assessment of science's ability to solve environmental problems, by country/economy: 2010



NOTES: Responses to *How much do you agree or disagree with the statement: Modern science will solve our environmental problems with little change to our way of life?* Percentages may not add to 100% because of rounding.

SOURCE: International Social Survey Program, Environment Module (2010). See appendix table 7-31.

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dangers changed substantially on only one issue—pesticides and chemicals used in farming. About half of Americans (51%) called these very or extremely dangerous to the environment in 2010, up from 37% in 1993.

The 2010 ISSP data also allow U.S. concerns about specific issues to be compared with concerns in other countries. In 2010, the United States sat in the middle range of concern on most issues. As in the United States, the only clear trend for most other countries surveyed in multiple years was that, over time, people viewed agricultural pesticides and chemicals as more dangerous (appendix tables 7-32–7-35).

Climate Change

U.S. Patterns and Trends

Climate change (sometimes referred to as *global warming*) has become a central environmental issue for the American public. It has also been the subject of widespread polling in recent years, with evidence showing clear shifts in views.[30]

Gallup has polled on "global warming" since 1989, when it found that 63% of Americans "worry a great deal" or "a fair amount" about the issue. In March 2013, the comparable statistic was 58%, but this percentage has risen and fallen multiple times. A much smaller percentage (34%), however, told Gallup that they believed "global warming would pose a serious threat" to their "way of life" during their lifetime. As with the question about "worry," responses to this question have fluctuated over time (Saad 2013). Data from other sources show similar fluctuations (Pew Research Center 2012f; Leiserowitz et al. 2012), and these shifts come alongside shifts in the percentage of Americans who say "there is solid evidence that the average temperature on earth has been getting warmer over the past few decades" (Pew Research Center 2012f). The Brookings Institution found that people were increasingly pointing to changes in weather patterns as "the primary factor" that has led them to conclude "that temperatures on earth are increasing" (Borick and Rabe 2012).

Within the subset of Americans who believe the earth is getting warmer (i.e., 67% of Americans), about two-thirds (42% of all respondents) said it was likely because of "human activity such as burning fossil fuels," whereas the remaining third (19% of all respondents) attributed the change to "natural patterns in the earth's environment."[31] The percentage attributing perceived change to human activity reached a high of 50% in July 2006 but declined to as low as 36% in October 2009 (Pew Research Center 2012f).

Despite widespread concern, Pew Research Center also reports that "dealing with global warming" has been at, or near, the bottom of the public's priorities for the president and Congress since at least 2007. About 28% of Americans said it should be a priority in 2013, which is down from 38% in 2007 (Pew Research Center 2013b). Pew Research's September 2012 survey also found, however, that most Americans said they believe that the threat of climate change is relatively distant from their lives (Pew Research Center 2012f). Risk researchers have long known that people often see risks as more likely to harm others than themselves (Spence, Poortinga, and Pidgeon 2012).

Both Pew Research and Gallup have also asked questions about the degree to which Americans believe there is a scientific consensus around climate change. Gallup reported that, in 2013, 62% of Americans said that "most scientists believe that global warming is occurring." Gallup's research also shows that the percentage saying a consensus exists rose from 48% in 1998 to a high of 65% in 2008 before falling again (Saad 2013). Several other surveys report similar findings (Pew Research Center 2012f; Leiserowitz et al. 2012).

Survey organizations that collect public opinion data on climate change consistently find views on this topic to be related to party affiliation (Pew Research Center 2012f; Saad 2013).

International Comparisons

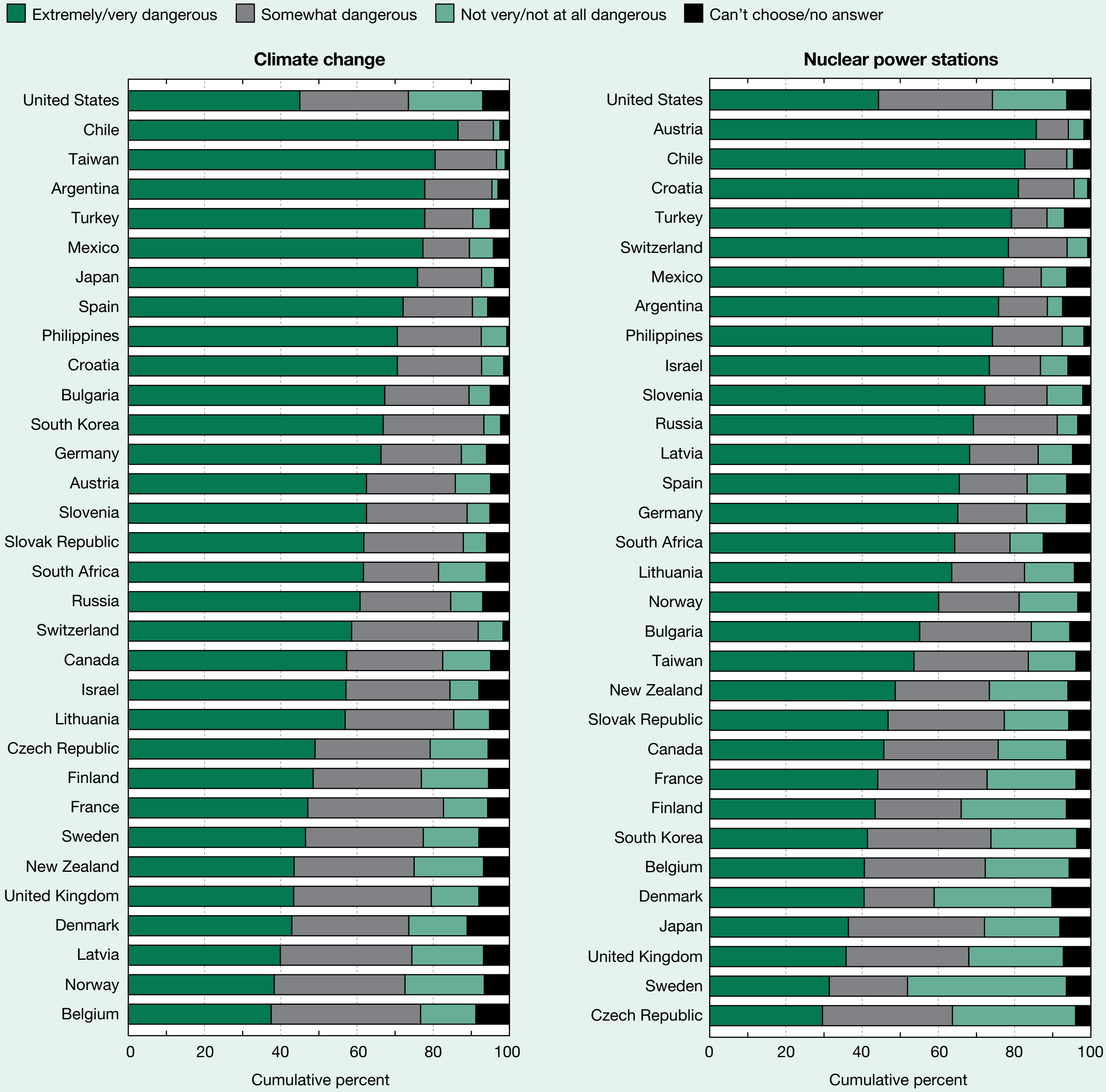
The most recent internationally comparable, representative data on public views about climate change are from 2010, a year in which Americans were at (or near) relative lows in their concerns about climate change.

The 2010 ISSP indicated that the United States is among the countries with the least concern about climate change (figure 7-21). There was no clear pattern, however, between countries over time, with some countries becoming more concerned (e.g., Japan and Spain) and others becoming less concerned (e.g., the Czech Republic and New Zealand) between 1993 and 2010 (appendix table 7-36). Almost half (45%) of Americans said climate change was "very" or "extremely dangerous" in 2010 (NSB 2012).

Gallup similarly reported that, in 2010, 53% of Americans saw global warming as a "very" or "somewhat" serious threat to themselves and their families, putting it in the middle range of the 111 countries/economies Gallup polled. The average for Western Europe was 56%. Higher percentages of respondents were concerned in Southern and Eastern Europe (60%), Canada (71%), Latin America (73%), and the developed parts of Asia (74%) than in the United States. Conversely, residents of less developed areas were less concerned than those in the United States, including those in the Commonwealth of Independent States (44%), the Middle East and North Africa (37%), Sub-Saharan Africa (34%), and developing countries in Asia (31%). Gallup also reported that the perceived threat of climate change declined between 2007–08 and 2010 in many developed countries (Ray and Pugliese 2011a).

Americans were also more likely than residents of any other country surveyed to say they believe rising temperatures are "a result of natural causes." About 47% of U.S. respondents gave this response, whereas 35% said that temperature rises are "a result of human activity." Another 14% volunteered that they believed both human and natural causes are at play (i.e., they were not explicitly given that choice but offered the opinion anyway). The next closest country to the United States was the United Kingdom, where 39% said climate change is due to natural causes, 37% said human causes, and 18% said both. Gallup reported that the average in "developed Asia" was 76%. About 49% of Western Europeans and 46% of Eastern Europeans said they think climate change is a result of human factors (Ray and Pugliese 2011b). Pew Research has also reported that Americans express less concern about climate change than people in many other countries (Pew Research Global Attitudes Project 2010).

Figure 7-21
Public assessment of danger to environment of climate change and nuclear power stations, by country/economy: 2010



NOTES: Responses to *Do you think that a rise in the world's temperature caused by climate change is extremely dangerous for the environment, very dangerous, somewhat dangerous, not very dangerous, or not dangerous at all for the environment?* and *Do you think that nuclear power stations are...?* Percentages may not add to 100% because of rounding.

SOURCE: International Social Survey Program, Environment Module (2010). See appendix tables 7-36 and 7-37.

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Nuclear Power and Other Energy Sources

U.S. Patterns and Trends

Accidents such as the 2010 *Deepwater Horizon* oil spill in the Gulf of Mexico and the 2011 nuclear accident in Fukushima, Japan, have put energy decisions at the center of policy debates. Questions about the health, environmental, and social impacts of hydraulic fracturing ("fracking") have also emerged in many parts of the country. Overall, public opinion about energy appears to change temporarily in response to new events, while showing no consistent trend over time (see sidebar, "Nuclear Energy and the Fukushima Accident").

About half of Americans support the use of nuclear energy. Gallup reports that 57% of Americans said they "strongly" or "somewhat" favored nuclear energy in 2012 (Newport 2012b), while the Pew Research Center (2012d) put the level of support at 44%.

For other energy issues, Gallup reports that Americans are about equally divided over whether "protection of the environment should be given a priority, even at the risk of limiting the amount of energy supplies—such as oil, gas, and coal—which the U.S. produces" or whether the "development of U.S. energy supplies…should be given priority, even if the environment suffers to some extent." Environmental protection was clearly more favored by respondents in 2001, when 52% chose environmental protection, and this percentage rose to 58% in 2007. However, 41% and 44% of respondents chose environmental protection in 2011 and 2012, respectively. Respondents were also asked how they thought the country should deal with "the nation's energy problems." The percentage of people choosing "more conservation by consumers of existing energy supplies" over producing "more oil, gas and coal supplies" has remained about evenly divided since 2010. Preference for conservation climbed from 56% in 2001 up to 64% in 2007 before falling back to 48% in 2011 and 51% in 2012 (Jones 2012).

The majority of Americans support both offshore energy development and alternative energy spending, but opinion on these topics has shifted in recent years. About two-thirds (67%) of Americans said they supported "allowing more offshore oil and gas drilling" in September 2008. This dropped to a low of 44% in June 2010, after the *Deepwater Horizon* spill, but climbed back to 65% by March 2012. In contrast, the percentage that favored "increasing federal spending for research on wind, solar and hydrogen technology" has steadily declined from highs of 82% in polls

Nuclear Energy and the Fukushima Accident

The combination of the 2011 Fukushima accident and a 2012 decision by the U.S. Nuclear Regulatory Commission to grant its first new license to build a new nuclear plant in decades (Wald 2012) has made nuclear energy a vibrant area of public opinion research. The Fukushima accident had a small impact on public opinion, but Americans' views appear to be relatively resilient, with more than half of Americans continuing to support nuclear energy.

Survey research by Gallup from March 2001 had about equal numbers of respondents favoring (46%) and opposing (48%) "nuclear energy as one of the ways to provide electricity for the U.S." Support climbed to 62% favoring by March 2010, a year before the Fukushima accident. Gallup conducted a poll about a month after the accident and saw favorability drop to 57%. It was still at 57% a year later, in March 2012 (Newport 2012b). A similar pattern—but with even higher levels of support for nuclear energy—was found by a GfK Roper survey that used a similar question between 1983 and 2013 (Bisconti Research 2013).

Pew Research's polling indicated a similar pattern. Support for "promoting the increased use of nuclear power" started at 39% in September 2005 and then moved upward to 52% in February 2010 before falling back to about 45% in October 2010. A poll in March 2011, about a month after Fukushima, and then another in November 2011 saw support down to 39%. A more recent March 2012 poll had support for nuclear energy back to 44%.

Question wording might explain the differences in expressed support for nuclear energy. Gallup and GfK Roper asked about nuclear energy "as one of the ways," while Pew Research asked about "promoting" nuclear energy. A comprehensive review of nuclear energy polling showed that opposition to nuclear energy declined from the 1970s, stabilized through the 1980s, and then began to rise in the 2000s (Bolsen and Cook 2008).

A Swiss study that surveyed the same people both before and after the Fukushima accident found that acceptance of nuclear energy, perceived benefits of nuclear energy, and trust in nuclear energy operators declined as a result of the accident, while risk perceptions increased. This research argued that the key drivers of acceptance stayed the same over time, and it was the decline in trust and benefits perceptions, as well as the increase in risk perceptions, that changed the level of nuclear acceptance (Visschers and Siegrist 2012). Some studies have also shown high levels of support in areas that already have nuclear facilities (Besley 2010; Greenberg and Truelove 2011).

from February 2006 and April 2009. Support reached lows of 68% in November 2011 and 69% in March 2012 (Pew Research Center 2012d).

Beyond government support, however, Americans say they would like the United States "as a country" to put "more emphasis" on "producing domestic energy" from renewable sources. About 76% of respondents told Gallup they would like more emphasis on solar power, and 71% said they would like more emphasis on wind power. In contrast, 65% would like more emphasis on natural gas, 46% would like more emphasis on oil, 37% would like more emphasis on nuclear, and 31% would like more emphasis on coal (Jacobe 2013).

International Comparisons

In the United Kingdom—which has also been debating whether to update its nuclear energy infrastructure—support for nuclear energy has declined in recent years, although the decline may have leveled off. Ipsos MORI found that the percentage of respondents who said they had a "very favourable" or "mainly favourable" "impression…of the nuclear energy industry" was 33% in 2009, 40% in 2010 (just before Fukushima), and 28% in 2011 (just after Fukushima). Similarly, the percentage who said they would "strongly support" or "tend to support" "the building of new nuclear power stations in Britain" went from 42% in 2009 up to 47% in 2010 and then down to 36% in 2011 (Ipsos MORI 2011).

Questions about nuclear energy were also included in the environment module of the ISSP that was fielded in multiple countries in 1993, 2000, and 2010. In 2010, pre-Fukushima, 44% of Americans said that nuclear power stations were very or extremely dangerous; this percentage was relatively low, although it was still similar to a range of countries. There were also many countries where concern was quite high (figure 7-21). In some countries, concern increased between surveys, while in others, concern decreased (appendix table 7-37). As noted in the 2012 NSB report, a Eurobarometer survey from 2010 showed that EU residents were split on whether or not nuclear energy will "improve our way of life" (39%) or "make things worse" (39%). Many also said that nuclear energy would have no effect (10%) or that they held no opinion (13%). Assessments of nuclear energy were more negative when this question was first asked in 1999 (Gaskell et al. 2010).

Genetically Modified Food

U.S. Patterns and Trends

Genetic modification of food has engendered less opposition in the United States than in much of Europe (Jasanoff 2005), but it remains an active issue of public debate around the world as new products continue to enter the market. Scholars often point to the emergence of an anti-GM movement as something that might have been limited if the scientific community had better communicated with the public during the early research and commercialization phases (Einsiedel and Goldenberg 2006). There has also been active discussion on the question of whether the public wants mandatory labeling of food that contains genetically modified ingredients despite arguments by scientists that such labeling would inappropriately suggest risks to buyers (Roe and Teisl 2007). The U.S. Food and Drug Administration was also reviewing an application concerning the first potential use of genetic engineering in an animal species—Atlantic salmon—in 2013.

The 2010 ISSP included a question asking about the perceived danger of "modifying the genes of certain crops." The survey found that 25% of U.S. respondents said that modification would be very or extremely dangerous to the environment. The 2000 ISSP yielded similar results (figure 7-22; appendix table 7-38).

Most U.S. surveys are focused on safety rather than the environment. A 2010 survey by Thomson Reuters found that about 21% of respondents were willing to say that "genetically engineered foods are safe" (Thomson Reuters 2010). This is consistent with a series of five surveys conducted by the Pew Initiative on Food and Biotechnology between 2001 and 2006, which found that only about one-fourth of U.S. consumers favored "the introduction of genetically modified foods into the U.S. food supply" (Mellman Group 2006).

How genetic modification is used matters to Americans. The Thomson Reuters survey found that 35% of respondents said they would eat GM fish, 38% said they would eat GM meat, and 60% said they would eat GM vegetables, fruit, or grain (Thomson Reuters 2010). Past surveys also generally found that Americans are more wary of genetic modification of animals than they are of genetic modification of plants (Mellman Group 2006).

In total, 69% of respondents said they knew that GM foods are already in U.S. stores, and 93% of respondents said "foods should be labeled to indicate that they have been genetically engineered or contain ingredients that have been genetically engineered" (Thomson Reuters 2010).

International Comparisons

The 2010 GSS/ISSP results show that the United States (25%) is less concerned about genetic modification than most other countries. There were several countries that were similar to the United States but none were more positive, on average. Also, residents of some countries became more concerned between 2000 and 2010 (e.g., Bulgaria and Mexico), while others became less concerned (e.g., Denmark and Japan) (appendix table 7-38).

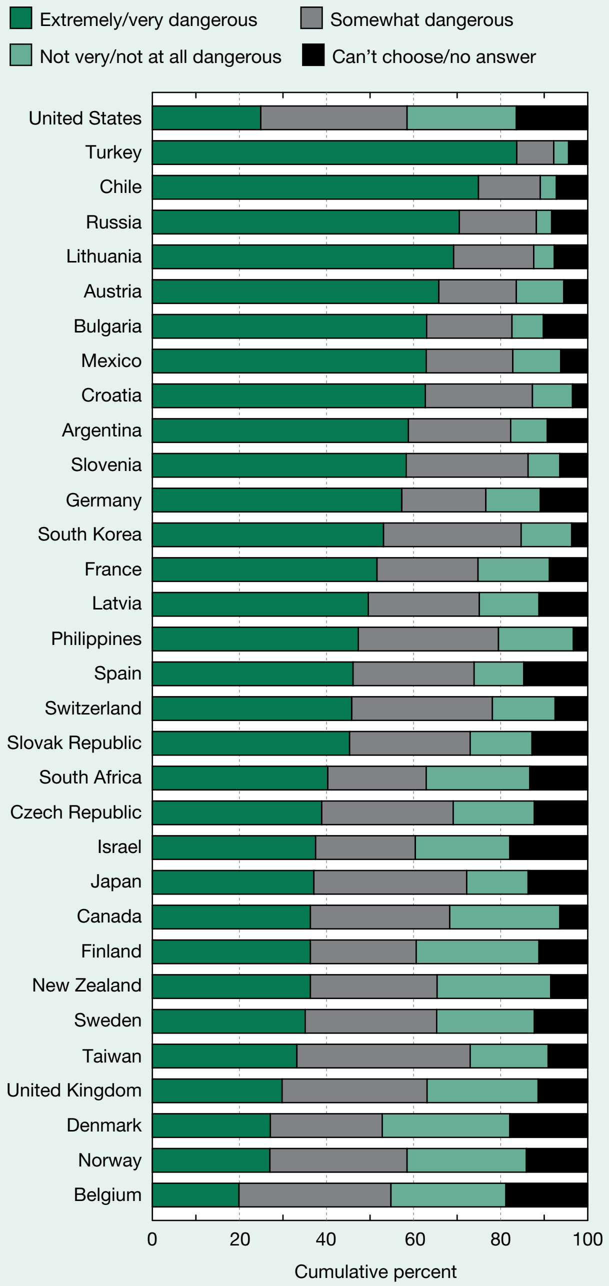
Nanotechnology

U.S. Patterns and Trends

Nanotechnology involves manipulating matter at unprecedentedly small scales to create new or improved products that can be used in a wide variety of ways. Nanotechnology has been the focus of relatively large public and private investments for more than a decade, and innovations based on nanotechnology are increasingly common. More than 1,000 nanotechnology products—more than 5 times the number available in 2006—were on the market by 2011 (Pew Project on Emerging Technologies 2011). However, relative to other new technologies, the public generally reports relatively low levels of understanding (Ladwig et al. 2012).

The 2010 GSS found that 24% of U.S. respondents said they had heard "a lot" or "some" about nanotechnology, up 4 percentage points from both 2006 and 2008. A plurality (44%) of Americans in the 2010 GSS reported having heard "nothing at all" about nanotechnology (NSB 2010). About 37% of 2010 GSS respondents also said the benefits would outweigh the harms, 9% said the benefits and harms would be about equal, and 11% expected the harms to predominate. The remaining 43% held no opinion (NSB 2010). The balance of opinion was similar in 2006 and 2008. As with GM food, attitudes toward nanotechnology vary depending on the context in which it is applied, with energy applications viewed much more positively than those in health and human enhancements (Pidgeon et al. 2009).

Figure 7-22
Public assessment of danger to environment of modifying genes of crops, by country/economy: 2010



NOTES: Responses to *Do you think that modifying the genes of certain crops is extremely dangerous for the environment, very dangerous, somewhat dangerous, not very dangerous, or not dangerous at all for the environment?* Percentages may not add to 100% because of rounding.

SOURCE: International Social Survey Program, Environment Module (2010). See appendix table 7-38.

Science and Engineering Indicators 2014

International Comparisons

More Europeans than Americans appear to have heard about nanotechnology. About 45% of EU residents said that they had heard of nanotechnology in 2010. Overall, 44% of EU residents agreed that nanotechnology should be encouraged, 35% disagreed, and 22% had no opinion about this issue (Gaskell et al. 2010). One recent study of UK residents found that providing balanced information resulted in more positive views about nanotechnology for those who started out positive about nanotechnology, while those who started out negative became more negative. Such individuals were also less likely to be "ambivalent" after receiving balanced information. Those who started out with a neutral attitude, however, became more ambivalent about nanotechnology after receiving balanced information (Fischer et al. 2012).

Stem Cell Research and Human Cloning

U.S. Patterns and Trends

Stem cell and cloning research focuses on understanding how to use genetic material to produce living cells, tissues, and organisms. Such research creates opportunities for enhanced understanding of life as well as opportunities to develop new health care treatments. The focus on health, human life, and the destruction of human embryos, however, creates a range of ethical issues that have spurred public debate.

Most Americans appear to support the use of stem cells for medical research, and support has stayed within a 5% range in recent years. Annual Gallup Poll data showed that, in 2013, 60% of Americans saw using stem cells from human embryos in medical research as "morally acceptable."

About 32% said it was "morally wrong." The percentage of Americans seeing the use of human embryos as moral climbed from 52% in 2002, when Gallup started polling on the issue, to a high of 64% in 2007. Since then, the percentage of Americans viewing stem cell research as morally acceptable has ranged between 57% and 62% (Newport and Himelfarb 2013).

Support for stem cell research is greater when the question posed asks about research that uses stem cells from sources that do not involve human embryos. About 7 out of 10 respondents (71%) favored this type of research in 2010, down slightly from 75% in 2007 (VCU 2010). Support was also greater when the question was framed as an emotionally compelling personal issue (i.e., "If you or a member of your family had a condition such as Parkinson's Disease, or a spinal cord injury, would you support the use of embryonic stem cells in order to pursue a treatment for that condition?") (VCU 2006).

Gallup has also asked Americans about human cloning. In 2013, Gallup found that only 13% of Americans said human cloning is "morally acceptable" and that 83% said it was "morally wrong." The percentage indicating that cloning is morally acceptable was 7% in 2001 and 2002 and has stayed between 8% and 13% since then (Newport and Himelfarb 2013).

It appears that Americans are particularly opposed to human cloning when there is no mention of a medical purpose. As reported in the 2012 *Indicators*, a 2010 survey showed that 8 in 10 Americans rejected the idea of cloning or genetically altering humans (VCU 2010). Opinions were more mixed when questions mentioned "cloning technology" that is used only to help medical research develop new treatments for disease; opinion about therapeutic cloning has been slowly growing more positive in recent years. Public attitudes toward cloning technology are not grounded in a strong grasp of the difference between reproductive and therapeutic cloning (see "Glossary" for definitions). In 2010, a 54% majority of Americans were "very clear" or "somewhat clear" about the difference between stem cells that come from human embryos, stem cells that come from adults, and stem cells that come from other sources (VCU 2010).

International Comparisons

A 2010 Eurobarometer found that 63% of those surveyed across the EU supported the use of stem cells from human embryos either with no special laws (12%) or "as long as this is regulated by strict laws" (51%). The use of adult stem cells, in contrast, was supported by 69% of Europeans, including 15% who saw no need for special laws and 54% who would approve of "strict laws." The survey did not address human cloning, but it included several questions about animal cloning, and the results also show widespread disapproval. About 17% said that they saw it as "safe for future generations," and 70% of EU residents disagreed that "animal cloning in food production should be encouraged" (European Commission 2010b).

Teaching Evolution in the Schools

In the United States, the topic of whether and how evolution should be taught in the public schools has been a source of controversy for almost a century. Public views about evolution and the role of teaching evolution in the schools have been relatively stable over the course of 30 years.

Public opinion about how evolution should be taught in U.S. public schools consistently shows two key patterns. First, when asked whether intelligent design should be taught alongside or in addition to evolution, a majority of Americans favor this approach to education. Second, when asked whether creation should be taught instead of evolution—thereby replacing it in the science curriculum—a majority oppose this idea, but a sizeable minority favor it. Opposition to replacing evolution ranged between 44% and 54% from 1999 to 2005, whereas support ranged from 37% to 44% over the same period (Plutzer and Berkman 2008; Berkman and Plutzer 2010). A 2007 survey of 926 high school biology teachers also found that 28% might be classified as advocates for evolutionary biology in their classrooms, whereas about 13% of teachers said they tell their students that "creationism or intelligent design" are "valid, scientific" theories about the "origin of the species." Teachers who had taken a college-level course addressing evolution were significantly more likely to advocate for evolutionary biology (Berkman and Plutzer 2011). The difficulty of sampling in such surveys of special populations, however, means that this type of data should be interpreted with caution.

Animal Research

U.S. Patterns and Trends

The medical research community conducts experimental tests on animals for many purposes, including testing the effectiveness of drugs and procedures that may eventually be used to improve human health and advancing scientific understanding of biological processes.

Most Americans support at least some kind of animal research, but support has fallen in recent years. About 56% of Americans said they saw "medical testing on animals" as "morally acceptable" in 2013, similar to the 55% who gave this response in 2011 and 2012 (Newport 2012a). These figures put support at the lowest level registered since Gallup began asking the question in 2001, when 65% said they saw such testing as acceptable (Newport and Himelfarb 2013). A comparison of surveys from 1988 and 2008 found a similar pattern of declining support (NSB 2012).

The 2011 and 2012 Gallup numbers also suggest less support than research by VCU (2007) that showed nearly two-thirds of respondents favoring "using animals in medical research." A comprehensive 2008 Gallup survey also found that a majority of respondents wanted to maintain access to animal testing animal research; 64% opposed "banning all medical research on laboratory animals," and 59% opposed "banning all product testing on laboratory animals"

(Newport 2008). There also appears to be a sizeable gender gap in opinions about animal research, with women less likely than men to support animal testing (Saad 2010), as well as an age gap with younger respondents being less supportive of animal testing (Wilke and Saad 2013).

International Comparisons

A 2010 European-wide survey showed that EU residents have a range of views about animal research but are, on balance, supportive of such practices. Respondents were asked whether "scientists should be allowed to experiment on animals like dogs and monkeys if this can help sort out human health problems." About 44% of EU residents said they "totally" or "tend to" agree that such experiments should be allowed, whereas 37% said they "totally" or "tend to" disagree. The report also indicated that, across the countries surveyed, men (49%) were much more likely to agree that animal testing should be allowed than women (39%). Those who said they were well informed about science (47%) or interested in science (48%) were also more favorable to animal testing than the average. When asked about animal research using mice—instead of dogs and monkeys—66% of EU residents indicated that would be acceptable (European Commission 2010a).

Science, Engineering, and Mathematics Education

Although the news media are important to how adults think about S&T, the formal education system remains most people's primary introduction to S&T. A 2013 Pew Research study found that 11% of Americans named science as the subject that K–12 schools should emphasize more than other subjects. This made science the third most named subject. The most commonly named subject was math (30%), followed by "English/Grammar/Writing/Reading." "Computers/Computer Science" came sixth (4%). When asked, 46% of Americans said the reason "many young people don't pursue degrees in math and science" is because these subjects "are too hard." About equal numbers said these subjects might be "too boring" (20%) or "not useful for their careers" (22%) (Pew Research Center 2013a).

In the 2008 GSS, the majority of Americans in all demographic groups agreed that the quality of science and mathematics education in American schools was inadequate. The level of dissatisfaction increased with education, science knowledge, income, and age. Dissatisfaction has also varied over time: it was 63% in 1985, peaked at 75% in 1992, and declined to 70% in 2008 (NSB 2010). Further, about half of Americans said that their local public schools did not put enough emphasis on teaching science and math, an equal portion (48%) said the emphasis was about right, and just 2% said there was too much emphasis on teaching science and math in the local schools (Rose and Gallup 2007). In addition, the percentage of Americans in the biennial GSS surveys who said they believe the government is spending too little money on improving education has remained greater than 70% since the early 1980s. This is consistently one of the top areas in which the public says government spending is too low.

Conclusion

Assessing public attitudes and understanding about S&T can involve looking at what a technologically advanced society requires to succeed, either currently or in the future. Comparisons over time and between countries can also help identify achievements and areas for concern.

Those who believe that advanced societies require strong S&T performance will likely find many of the available indicators about S&T heartening. Americans remain interested in S&T, and a majority of Americans continue to say that they visit at least one informal science institution, such as a zoo or aquarium, annually. Most Americans are also able to answer basic S&T knowledge questions. In terms of attitudes, a large majority of Americans say that they want funding for scientific research and hold scientists and engineers in high regard. Most Americans also express positive views about various emerging technologies, including nuclear energy, biotechnology, and stem cells. In most cases, indicators for these attitudes have changed little in recent years, and Americans are more positive and have more factual knowledge about S&T than residents of other countries.

However, proponents of S&T may also find some indicators less reassuring. In particular, they may note that indicators of media content show that S&T has represented just a small percentage of the available news content in recent years. Likewise, data showing that many Americans have difficulty answering relatively simple knowledge questions about S&T are not encouraging. Also, while Americans say they are interested in S&T and want to fund S&T, other issues generate greater interest and elicit more support for government funding. Although most of the available indicators have remained stable, stability may represent cause for concern to those who hope to see Americans become more knowledgeable or more supportive of science. Comparisons with other countries are not unambiguously reassuring either. Although Americans generally score better on factual knowledge questions and are more positive about S&T than residents of other countries, multinational surveys have identified several countries where residents have more knowledge or are more supportive of S&T in specific areas.

Although most of the indicators are stable, changes appearing in the most recent data might also cause concern. In 2012, fewer Americans could provide an adequate description of what makes something scientific or were willing to reject astrology as unscientific. Americans were also less supportive of stem cell research than in previous years. People focused on environmental issues might also worry that some indicators show that Americans are becoming less concerned about the environment than in previous years and are less concerned about such issues than residents of many other countries. Climate change is one topic for which substantial evidence suggests that Americans have become less concerned than in the past and where residents of most other countries are closer to sharing the assessment of the evidence that prevails in the scientific community.

One limitation of the available indicators is that much of the data come from Europe, with only limited recent data from the Asia-Pacific region, where there is a high level of S&T activity.

Regardless of the standard used in assessing public attitudes and understanding of S&T, one pattern in the data continues to stands out. Year after year, Americans who are more highly educated—particularly those who are college educated and have completed college courses in science and mathematics—tend to understand more about S&T, tend to see S&T in a more positive light, and tend to engage with S&T more often. Although it is not clear whether this association is causal, the pattern underscores the role of science, technology, engineering, and mathematics education in fostering public understanding of S&T and possibly in developing orientations toward S&T that are similar to those that prevail in the scientific community.

Notes

1. This is an example in which, in 2001, the question was part of a single-purpose telephone survey focused on S&T. In 2008, these data were collected as part of the General Social Survey, a face-to-face, multipurpose survey covering a broad range of behavior and attitudes. It is unclear whether these differences in data collection or a change in public opinion account for the decline in interest observed between 2001 and 2008.

2. The report for the survey did not provide confidence intervals or formal tests to assess the differences in means.

3. The question asked on the Eurobarometer surveys has changed over time, making the data not always strictly comparable with previous Eurobarometer surveys or with U.S. data.

4. The analysis is based on a purposive selection of five media sectors, outlets within each sector, and specific programs or articles for study. The index was designed to capture the main news stories covered each week. Coding of programs and articles was limited to the first 30 minutes of most radio, cable, and network news programs; the front page of newspapers; and the top five stories on websites. Each selected unit of study was coded on 17 variables, according to an established coding protocol. The team of individuals performing the content analysis was directed by a coding manager, a training coordinator, a methodologist, and a senior researcher. For variables that require little or no inference, intercoder agreement was 97% for 2010, the last year in which statistics were reported. For variables requiring more inference, intercoder agreement ranged from 78% to 85% in 2010. Intercoder agreement was similar in earlier years. For more details, see http://www.journalism.org/about_news_index/methodology.

5. The total amount of news consists of the space devoted to news in print and online news sources and the time devoted to news on radio and television sources.

6. "Science, space, and technology" includes stories on manned and unmanned space flight, astronomy, scientific research, computers, the Internet, and telecommunications media technology. It excludes forensic science and telecommunications media content. "Biotechnology and basic medical research" includes stem cell research, genetic research, cloning, and agribusiness bioengineering and excludes clinical research and medical technology. Stories often do not fall neatly into a single category or theme. The Tyndall and PEJ data should not be directly compared because they involve different definitions of content. The coverage of health research in the Tyndall television data represents only a small percentage of the overall health coverage on television.

7. After 11 August 2011, the PEJ used the tracking services Technorati and Icerocket to monitor blogs and Tweetmeme and Twitturly to monitor social media. Prior to August 2011, the data collection was done using Icerocket and Tweetmeme. In all cases, the services used the links embedded on the sites as a proxy for the subject of the blog post or tweet. The sites thus provide a list of the most-linked-to news stories based on the number of blogs, tweets, or other sites that link to each. Typically, the linked-to stories originate from traditional media sources. PEJ staff manually captured the list of most-linked-to stories each weekday, and the coding staff categorized the top five linked-to articles from this list of approximately 50 linked-to articles each week. The coding procedures are similar to those used for the News Coverage Index of traditional media sources. For more, see http://www.journalism.org/node/14356.

8. In general, it is difficult to obtain information about S&T content within entertainment programming, although substantial evidence suggests that the entertainment people view shapes their attitudes about a range of issues, including S&T (Brossard and Dudo 2012).

9. A 2013 report by the PEJ reported that the most popular news sites were those associated with the news divisions of the main television broadcasters and cable networks, with the Yahoo!–ABC News Network leading the way. No clear science source was listed in the summaries of various measures of news site popularity, although several weather-focused sites (e.g., http://www.weather.com) appeared (PEJ 2013).

10. People become involved with S&T through many kinds of nonclassroom activities beyond attendance at informal science institutions. Examples of such activities include participating in government policy processes, going to movies that feature S&T, attending talks or lectures, bird watching, and building computers. *Citizen science* is a term used for activities by citizens with no specific science training who participate in the research process through activities such as observation, measurement, or computation. Nationally representative data on this sort of involvement with S&T are unavailable.

11. In the 2008 GSS, respondents received two different introductions to this set of questions. Response patterns did not vary depending on which introduction was given.

12. S. Feldman, Senior Vice President of External Affairs, Association of Zoos and Aquariums, personal communication to author, 1 May 2013.

13. This question was part of a single-purpose telephone survey focused on science and technology in 2001. In 2008, these data were collected as part of a face-to-face multipurpose survey. It is unclear whether these differences in data collection or a change in visit behavior account for changes seen between 2001, 2008, and 2012.

14. Survey items that test factual knowledge sometimes use easily comprehensible language at the cost of scientific precision. This may prompt some highly knowledgeable respondents to believe that the items blur or neglect important distinctions, and in a few cases may lead respondents to answer questions incorrectly. In addition, the items do not reflect the ways that established scientific knowledge evolves as scientists accumulate new evidence. Although the text of the factual knowledge questions may suggest a fixed body of knowledge, it is more accurate to see scientists as making continual, often subtle modifications in how they understand existing data in light of new evidence. When the answer to a factual knowledge question is categorized as "correct," it means that the answer accords with the current consensus among knowledgeable scientists and that the weight of scientific evidence clearly supports the answer.

15. Although the data clearly show a difference in how respondents answer to different question types, these data do not provide guidance as to what caused the difference. A range of explanations are possible.

16. In its own international comparison of scientific literacy, Japan ranked itself 10th among the 14 countries it evaluated (NISTEP 2002).

17. Twenty questions used a true-or-false format. These included: (1) "Hot air rises" (true; Europe correct: 91%, United States correct: 95%); (2) "The continents have been moving for millions of years and will continue to move in the future" (true; Europe correct: 86%, United States correct: 80%); (3) "The oxygen we breathe comes from plants" (true; Europe correct: 83%, United States correct: 94%); (4) "The gene is the basic unit of heredity of living beings" (true; Europe correct: 82%, United States correct: 82%); (5) "Earth's gravity pulls objects towards it without being touched" (true; Europe correct: 79%, United States correct: 80%); (6) "Energy cannot be created or destroyed, but only changed from one form to another" (true; Europe correct: 66%, United States correct: 80%); (7) "Almost all microorganisms are harmful to human beings" (false; Europe correct: 63%, United States correct: 56%); (8) "Generally speaking, human cells do not divide" (false; Europe correct: 63%, United States correct: 58%); (9) "The earliest humans lived at the same time as the dinosaurs" (false; Europe correct: 61%, United States correct: 43%); (10); "Plants have no DNA" (false; Europe correct: 60%, United States correct: 64%); (11); "The greenhouse effect is caused by the use of nuclear power" (false; Europe correct: 58%, United States correct: 47%); (12) "All radioactivity is a product of human activity" (false; Europe correct: 56%, United States correct: 62%); (13) "Ordinary tomatoes, the ones we normally eat, do not have genes, whereas genetically engineered tomatoes do" (false; Europe correct: 54%, United States correct: 48%); (14) "It is the father's gene that determines a newborn baby's sex, whether it is a boy or a girl" (true; Europe correct: 52%, United States correct: 75%); (15) "Lasers work by sound waves" (false; Europe correct: 48%, United States correct: 54%); (16) "The light that reaches the Earth from the sun is made up of a single color: white" (false; Europe correct: 44%, United States correct: 55%); (17) "Today it is not possible to transfer genes from humans to animals" (false; Europe correct: 41%, United States correct: 43%); (18) "Atoms are smaller than electrons" (false; Europe correct: 38%, United States correct: 50%); (19) "Antibiotics destroy viruses" (false; Europe correct: 36%, United States correct: 47%); (20) "Human stem cells are extracted from human embryos without destroying the embryos" (false; Europe correct: 29%, United States correct: 54%). Two additional questions used a multiple choice format. These asked about (21) whether the sun moves around the Earth, whether the Earth moves around the sun (correct), or neither the sun nor the Earth moves (Europe correct: 80%, United States correct: 82%); and (22) whether light travels faster than sound (correct), sound travels faster than light, or whether they travel at equal speed (Europe correct: 74%, United States correct: 78%).

18. Earlier NSF surveys used for the *Indicators* report used additional questions to measure understanding of probability. Bann and Schwerin (2004) identified a smaller number of questions that could be administered to develop a comparable indicator. Starting in 2004, the NSF surveys used these questions for the trend factual knowledge scale.

19. The evidence for the 2012 decline in understanding of experimental design needs to be regarded with caution. It is important to note that the percentage of Americans who correctly answered the initial, multiple choice question about how to conduct a pharmaceutical trial stayed stable between 2010 and 2012. It was only the follow-up question that asked respondents to use their own words to justify the to use of a control group that saw a decline. For this question, interviewers recorded the response and then trained coders to use a standard set of rules to judge whether the response is correct. Although the instructions and training have remained the same in different years, small changes in survey administration practices can sometimes substantially affect such estimates.

20. The questions were selected from the Trends in Mathematics and Science Studies, National Assessment of Educational Progress, practice General Educational Development exams, and the American Association for the Advancement of Science Project 2061.

21. The pseudoscience section focuses on astrology because of the availability of long-term national trend indicators on this subject. Other examples of pseudoscience include the belief in lucky numbers, the existence of unidentified flying objects (UFOs), extrasensory perception (ESP), or magnetic therapy. One difficulty with this question is that astrology is based on observation of planets and stars and respondents might believe that this makes it "sort of scientific." However, the fact that those with more formal education and higher factual knowledge scores are consistently more likely to reject astrology as a science suggests that this nuance has a limited impact on results.

22. Methodological issues make fine-grained comparisons of data from different survey years particularly difficult for this question. For example, although the question content and interviewer instructions were identical in 2004 and 2006, the percentage of respondents who volunteered "about equal" (an answer not among the choices given) was substantially different. This difference may have been produced by the change from telephone interviews in 2004 to in-person interviews in 2006 (although telephone interviews in 2001 produced results that are similar to those in 2006). More likely, customary interviewing practices in the three different organizations that administered the surveys affected their interviewers' willingness to accept responses other than those that were specifically offered on the interview form, including "don't know" responses.

23. This type of survey question asks respondents about their assessment of government spending in several areas without mentioning the possible negative consequences of spending (e.g., higher taxes, less money available for higher priority expenditures). A question that focused respondents' attention on such consequences might yield response patterns less sympathetic to greater government funding.

24. As noted previously, the 1983 and 2001 surveys were telephone surveys, whereas the 2012 GSS survey was primarily a face-to-face survey. Similarly, there are only three data points for comparison, and these are separated by about a decade each. It is difficult to know the degree to which the change in survey mode may have affected the results, and the widely dispersed data points make determining the presence of a trend difficult. The between-year comparisons are therefore made with caution. Not all of the questions discussed were included each year.

25. There are many different types of specializations within occupations, and prestige may well vary within the same occupation or industry.

26. Given the relationship between education, knowledge, and views about professions, it may be that the ability to assess the degree to which a field or occupation involves the use of S&T concepts or ideas represents a form of science literacy relevant to the question of the role of science in everyday life (NSB 2012; Toumey et al. 2010).

27. The GSS questions on global climate change used the term *global warming*.

28. The 2010 GSS included ratings of nuclear engineers in addition to medical researchers, environmental scientists, and economists. As discussed, the patterns of results were similar whether the group with relevant expertise was engineers or scientists.

29. Similarity comments for ISSP data are based on post hoc statistical tests using mean scores. Also, countries described as being the most or least concerned are those that are statistically similar but in group with the highest or lowest mean score based on mean testing.

30. There is some evidence from a large-scale experimental study that the wording used in such questions ("global warming" or "climate change") can have an effect on reported beliefs about global climate change (Schuldt, Konrath, and Schwarz 2011). Earlier studies, however, suggested that such wording differences had little effect (European Commission 2008; Villar and Krosnick 2010).

31. This question was only asked to those who said they believed there was "solid evidence of increasing global temperatures."

Glossary

Biotechnology: The use of living things to make products.

Climate change: Any distinct change in measures of climate lasting for a long period of time. Climate change means major changes in temperature, rainfall, snow, or wind patterns lasting for decades or longer. Climate change may result from natural factors or human activities.

European Union (EU): Eurobarometer survey data for 2008, 2010, and 2011 include data for 27 EU member nations: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom. Eurobarometer survey data for years prior to 2008 include data for EU member nations as of the survey year (25 countries in 2005 and 15 in 1999).

Genetically modified (GM) food: A food product containing some quantity of any GM organism as an ingredient.

Global warming: An average increase in temperatures near the Earth's surface and in the lowest layer of the atmosphere. Increases in temperatures in the Earth's atmosphere can contribute to changes in global climate patterns. Global warming can be considered part of climate change along with changes in precipitation, sea level, etc.

Nanotechnology: Manipulating matter at unprecedentedly small scales to create new or improved products that can be used in a wide variety of ways.

Reproductive cloning: Technology used to generate genetically identical individuals with the same nuclear DNA as another individual.

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

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