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A Look at What the Public Knows and Does Not Know About Science

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About This Report

This report examines the general public's knowledge about 12 science-related topics. The data were collected on the Pew Research Center's American Trends Panel. This report also includes a series of tables with findings from the new Pew Research survey and from previous Pew Research studies on science knowledge to allow for comparisons across a wider array of questions and topics.

This report is a collaborative effort based on the input and analysis of the following individuals. Find related reports online at pewresearch.org/science2015.

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(SPOILER ALERT: *Before reading this report, take the quiz yourself by clicking here.)*

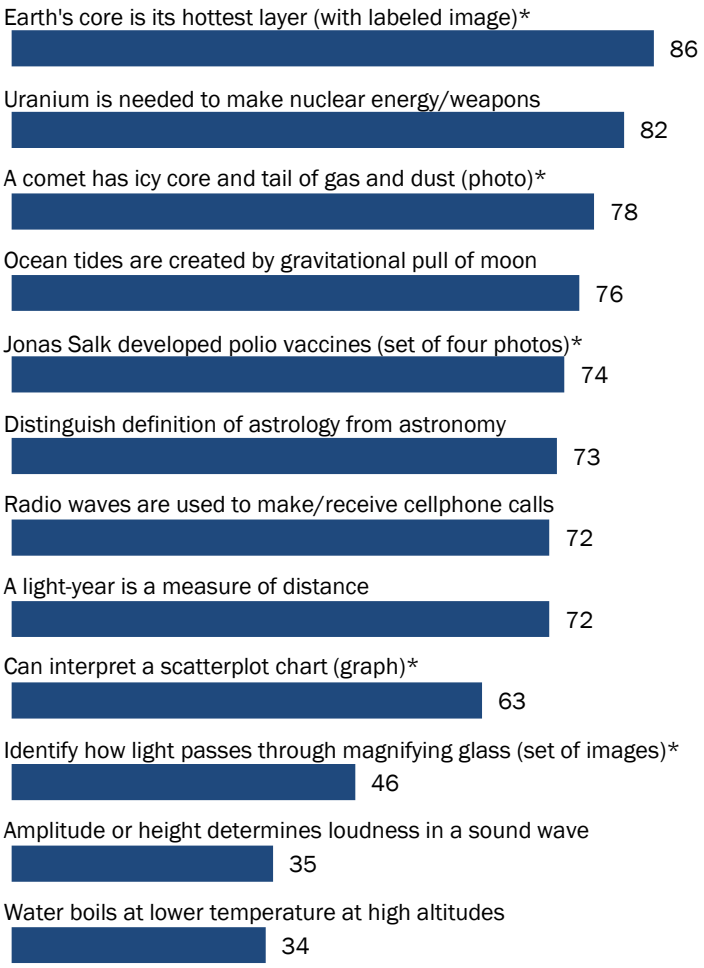
A new Pew Research Center survey finds that most Americans can answer basic questions about several scientific terms and concepts, such as the layers of the Earth and the elements needed to make nuclear energy. But other science-related terms and applications, such as what property of a sound wave determines loudness and the effect of higher altitudes on cooking time, are not as well understood.

Most Americans (86%) correctly identify the Earth's inner layer, the core, as its hottest part, and nearly as many (82%) know uranium is needed to make nuclear energy and nuclear weapons.

But far fewer are able to identify the property of a sound wave that determines loudness. Just 35% correctly answer amplitude, or height. Some 33% incorrectly say it is frequency and 23% say it is wavelength. And just 34% correctly state that water boils at a lower temperature in a high-altitude setting (Denver) than near sea level (Los Angeles).

A Snapshot of What Americans Know About Science

% of U.S. adults answering each question correctly



American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline. * Indicates a question for which respondents were shown images.

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Fully 73% of Americans distinguish between astronomy and what is commonly considered a pseudoscience: astrology. Twenty-two percent of Americans incorrectly say that *astronomy* – not astrology – is the study of how the positions of stars and planets can influence human behavior. Another 5% give some other incorrect response.

How much Americans appear to know about science depends on the kinds of questions asked, of course. Science encompasses a vast array of fields and information, and the questions in the new Pew Research survey represent a small slice of science knowledge. On Pew Research Center's set of 12 multiple-choice questions – some of which include images as part of the questions or answer options – Americans gave more correct than incorrect answers; the median was eight correct answers out of 12 (mean 7.9). Some 27% answered eight or nine questions correctly, while another 26% answered 10 or 11 items correctly. Just 6% of respondents got a perfect score.

These findings come from Pew Research Center's American Trends Panel, a nationally representative panel of randomly selected U.S. adults. The survey of 3,278 adults (including 2,923 adults online and 355 respondents by mail) was conducted Aug. 11-Sept. 3, 2014.

Why science knowledge matters

A variety of scholars have argued that public understanding of science issues and concepts is a hallmark of an informed public.[1] As developments in science and technology raise new issues for public debate – from driverless cars and space exploration to climate change and genetically modified crops – a public with more knowledge of scientific facts and principles is often seen as one better able to understand these developments and make informed judgments.[2]

One major avenue for science learning is through the schools. But neither the public nor those connected to science have strongly positive views about America's science and technology education. A 2015 Pew Research report found that the general population and members of the American Association for the Advancement of Science (AAAS) both see U.S. K-12 education in science, technology, engineering and mathematics (STEM) fields as "average" or "below average" compared with other industrialized countries.

A minority of 29% of Americans and 16% among AAAS members consider the country's K-12 STEM education to be among the best in the world.

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[1] See, e.g., Jon D. Miller, 1998. "Measurement of Civic Scientific Literacy," Public Understanding of Science, 7: 3-24.
[2] See review by Martin W. Bauer, Nick Allum and Steve Miller, 2007. "What We Can Learn from 25 Years of PUS Survey Research: Liberating and Expanding the Agenda," Public Understanding of Science, 16: 79-95. But see Susannah Priest, 2013. "Critical Science Literacy: What Citizens and Journalists Need to Know to Make Sense of Science," Bulletin of Science and Technology & Society, 33:138-145.

Moreover, 84% of AAAS members consider Americans' limited knowledge about science to be a major problem for the scientific enterprise. Further, most of the AAAS members say that too little STEM education is a major reason that the public has limited science knowledge.

Those with higher education levels are more likely to know answers to questions about science. There are also times when gender, age, race and ethnicity matter.

There are substantial differences among Americans when it comes to knowledge and understanding of science topics. In the new survey, education proves to be a major factor distinguishing higher performers on our science questions from those who get fewer correct. Adults with postgraduate and college degrees performed better than those with a high school diploma or less. This pattern is consistent with a 2013 Pew Research report on this topic.

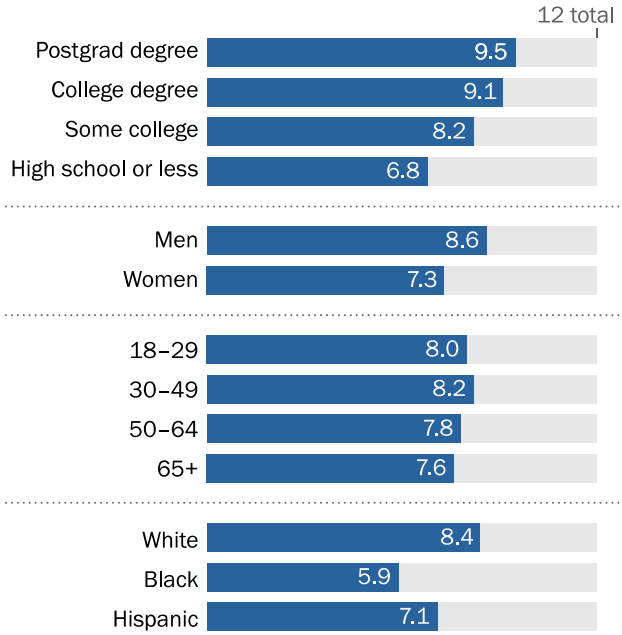
Pew Research's findings are also consistent with analysis of the factual knowledge index in the National Science Board's Science and Engineering Indicators. That research finds that higher educational levels are associated with more factual knowledge of science, and that college graduates who took at least three college-level courses in science or mathematics have higher levels of science knowledge than do those who took fewer science and math courses.[3]

The new Pew Research survey also finds gaps in science knowledge between men and women, with men outperforming women on many questions – even when comparing men and women with similar levels of education.

Questions on this survey deal primarily with topics tied to the physical sciences, rather than life sciences such as those related to health and medicine. Research by the federal government has found that gender differences in science knowledge tend to be larger on questions about

Science Knowledge Varies by Education and Demographic Factors

Mean number of correct answers



American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline. Whites and blacks include only non-Hispanics; Hispanics are of any race.

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[3] Science and Engineering Indicators 2014, See Chapter. 7, Figure 7-7.

the physical sciences than the life sciences.[4]

In previous Pew Research surveys that are also detailed in this report, there were no differences or only modest knowledge differences between men and women on four health and biomedical topics in the news. For instance, on one previous question, women were more likely than men to answer correctly that antibiotics do not kill both viruses and bacteria. At the same time, men were more likely than women to know that the main function of red blood cells is to carry oxygen throughout the body. The Science and Engineering Indicators report found no difference between adult men and women on factual knowledge of biomedical topics.[5]

Generally, younger adults display slightly higher overall knowledge of science than adults ages 65 and older on the 12 questions in the new Pew Research survey. On some questions, younger adults are particularly well-informed. For example, 80% of adults ages 18 to 29 correctly identify radio waves as the waves that are used to transmit cellphone calls, as do 77% of those ages 30 to 49; fewer adults (57%) ages 65 and older know this. On at least one question, however, adults ages 65 and older are more informed than younger adults: 86% of adults 65 and older correctly identify the developer of the polio vaccine as Jonas Salk, compared with 68% of those ages 18 to 29.

There are also differences associated with race and ethnicity in the new survey's 12 questions. Whites are more likely than Hispanics or blacks to answer more of these questions correctly, on average; the mean number of items correct is 8.4 for whites, 7.1 for Hispanics and 5.9 for blacks. The pattern across these groups and the size of the differences vary, however.

The findings on race and ethnicity are broadly consistent with results on science knowledge questions in the General Social Surveys between 2006 and 2014. Pew Research analysis of the GSS data finds white adults scored an average of 6.1 out of 9 questions correctly, compared with 4.8 for Hispanics and 4.3 for blacks. While whites, blacks and Hispanics with higher education levels know more factual science items on average, mean differences by race and ethnicity occur among all education levels.[6] As with gender differences, differences by race and ethnicity could tie to a number of factors, including differences in areas of study at the high school, college and postgraduate levels and other factors.[7] To the extent that science knowledge, especially on issues in the news and emerging scientific developments, is learned in connection with adult life activities,

[4] Science and Engineering Indicators 2014, See Chapter 7, table 7-7 and appendix table 7-10.
[5] Science and Engineering Indicators 2014. See Chapter 7, table 7-7 and appendix table 7-10.
[6] Pew Research Center analysis of combined GSS 2006 to 2014.
[7] See Science and Engineering Indicators 2014, Chapter 1 and Chapter 2.

the long-standing underrepresentation of blacks and Hispanics in the science, technology, engineering and mathematics workforce could also be a contributing factor.[8]

The questions in the new Pew Research Center survey represent only a small slice of science knowledge. Science encompasses a vast array of fields and information. Across the set of 12 science knowledge questions in this survey, it is clear that some information is widely known while other information is much less so. To allow for comparisons across a wider array of questions and topics, we include a series of tables in this report with findings from the new Pew Research survey and from previous Pew Research studies. Comparisons across surveys should be made cautiously. The new survey includes several questions with images or photographs displayed online or in a print questionnaire. Past surveys were, with one exception, conducted by telephone and thus relied solely on respondents' aural and verbal skills. Little is known about how different modes of interview could influence the findings. Nonetheless, these comparisons help illustrate that the broad patterns of differences in science knowledge by education and demographic subgroups in this new survey are generally in keeping with previous Pew Research surveys that tapped public knowledge about science.

[8] See Science and Engineering Indicators 2014. Chapter 3. Also see Liana Christin Landivar, 2013. "Disparities in STEM Employment by Sex, Race and Hispanic Origin; American Community Survey Reports," ACS-24, U.S. Census Bureau, Washington, DC.

What Americans Know About Science, Question by Question

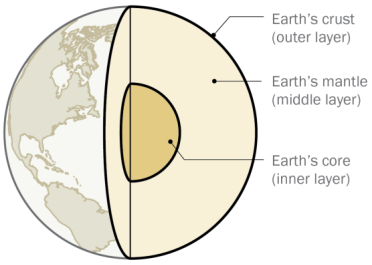
Among the science questions in the new Pew Research Center survey that were easiest for most to answer correctly: 86% identify the Earth's inner layer, called the core, as its hottest part.[9] A nearly equal share, 82%, knows that uranium is needed to make nuclear energy and nuclear weapons.

In addition, 78% of Americans correctly identify a comet when looking at a photograph described as having an icy core with a tail of gas and dust that extends millions of miles. And 72% of Americans know that radio waves, not sound waves, are used to make and receive cellphone calls. The same share of the public (72%) also knows that a light-year measures distance, not time.

Elaboration on our question language: In designing the question about cellphones, we tried to use language that would be commonly understood among the non-expert public. Several readers and quiz-takers wrote to suggest that one of the response options we offered would be better expressed as "visible light waves" rather than the way we listed it, "light waves." They noted that radio waves are also on the electromagnetic spectrum that includes both radio waves and light waves. Our question used the phrase to "send and receive cellphone calls" to try to convey to those being asked the question that we were referring to the waves needed to transmit calls between cellphone towers, not just the sound involved in talking with someone by telephone. Just 3% selected "light waves" in our national survey and some 72% of the general public responded that radio waves are needed to make and receive cellphone calls, an explanation that is consistent with explainers for the general public by the Institute for Physics.

Most Adults Can Identify Earth's Hottest Layer

86% of U.S. adults correctly identify the Earth's core as the hottest layer



American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline.

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[9] This question was adapted with permission from the Trends in International Mathematics and Science Study (TIMSS) grade 8 science assessment items in 1999. Image from Pew Research Center.

Some 76% know that ocean tides are created by the moon's gravitational pull. (But just 5% know that tides are affected not just by the moon but by the gravitational pull of the sun and the rotation of the Earth as well.)

Americans fare well as a whole when it comes to one aspect of science history: Fully 74% of Americans correctly identify Jonas Salk as the person who developed the polio vaccine from among a list of other scientists that included Marie Curie, Albert Einstein and Isaac Newton.

Most Americans can distinguish between astronomy and astrology. Seventy-three percent of adults recognize the definition of astrology as the study of how the position of the stars and planets can influence human behavior. By comparison, 22% of adults incorrectly associate this definition with *astronomy,* while another 5% give some other incorrect response.

Some 63% Americans correctly say that the findings from a scatterplot chart show the average number of decayed teeth per person in different countries, plotted along with average sugar consumption per person, per day.[10]

But several questions prove more difficult for a majority of U.S. adults.

What Is This Called?

78% of U.S. adults correctly identify this picture as a comet

American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline.

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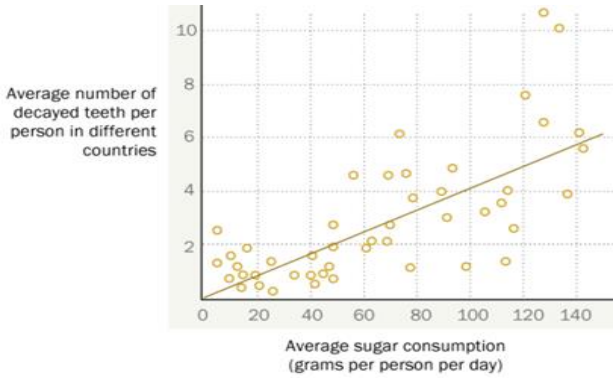
Most Adults Can Understand This Chart

63% of U.S. adults correctly identify this chart as showing that "the more sugar people eat, the more likely they are to get cavities"



American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline.

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[10] This question was adapted with permission from the OECD (2009), *Take the Test: Sample Questions from OECD's PISA Assessments*, PISA, OECD Publishing. Image from Pew Research Center.

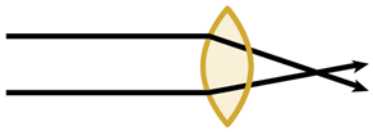
Survey respondents have comparatively more trouble identifying, from a set of four images, how light passes through a magnifying glass; 46% identify the correct image showing the lines crossing after they pass through a magnifying glass. More than half of the public (54%) choose an incorrect option, including 34% who incorrectly identify the image showing the lines moving outward from each other after passing through the glass.[11]

Even fewer Americans are able to identify what property of a sound wave determines the loudness of sound. In all, 35% correctly answer the amplitude, or height, of the wave.

And most Americans are unclear how altitude affects the boiling temperature of water. When asked to consider Denver (at a high elevation) and Los Angeles (near sea level), and whether the boiling temperature of water would change at the higher elevation, 34% correctly answer that water boils at a lower temperature in Denver than in Los Angeles.

What Happens When Light Passes Through a Magnifying Glass?

46% of U.S. adults correctly identify this image as best illustrating what happens when light passes through a magnifying glass



American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline.

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[11] This question was adapted with permission from the Trends in International Mathematics and Science Study (TIMSS) grade 8 science assessment items in 1999. Images from Pew Research Center.

Science Knowledge Is Higher Among Highly Educated Adults

In the new Pew Research Center survey, more-educated Americans generally score better overall in answering science-related questions than those who have a high school degree or less. And those with a college degree or higher tend to perform better on the toughest questions.

Adults with a college or postgraduate degree are more than twice as likely to get at least eight out of 12 questions right, compared with adults with a high school diploma or less (82% vs. 40%). Those with a postgraduate degree score an average of 9.5 correct answers out of 12, while those with a high school education or less get an average of 6.8 correct.

Fully 57% of adults with a postgraduate degree get 10 to 12 correct answers, whereas this is true for 18% of those with a high school diploma or less.

College Graduates and Postgraduates Most Knowledgeable About These Science Topics

% answering each question correctly

	HS or less	Some college	College degree	Post-grad degree	Post-grad-HS diff.
	%	%	%	%	
Amplitude (or height) determines loudness in a sound wave	20	38	52	62	+42
Interpret a scatterplot chart (with graph)	50	65	79	84	+34
Ocean tides are created by gravitational pull of the moon	65	79	90	91	+26
Jonas Salk developed polio vaccine (set of four with photos)	64	79	83	88	+24
A light-year is a measure of distance	61	76	82	84	+23
Uranium is needed to make nuclear energy/weapons	73	85	93	94	+21
Distinguish definition of astrology from astronomy	64	74	83	85	+21
Water boils at lower temperature when at high altitudes	27	36	42	47	+20
Radio waves are used to make/receive cellphone calls	63	76	81	81	+18
Comet as object in space with icy core and tail of gas and dust (from photo)	71	79	87	88	+17
Earth's core is its hottest layer (with labeled image)	79	89	93	93	+14
Identify illustration of how light passes through magnifying glass (from set of images)	40	49	49	53	+13
Average number correct overall	6.8	8.2	9.1	9.5	+2.7

American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline. Significant differences in **bold**.

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On all 12 questions, there is at least a 13 percentage point difference in correct answers between the highest- and lowest-educated groups. The largest difference is found in a question about the loudness of a sound. A 62% majority of those with a postgraduate degree correctly

identify the amplitude (height) of the sound wave as determining its loudness, as do 52% of those with a four-year college degree. By contrast, 20% of those with a high school education or less answer this question correctly. And there is a 34-point gap between these groups in correctly interpreting a scatterplot chart from among a list of four options. Half (50%) of those with a high school diploma or less answer this question correctly, compared with 84% among those who completed a postgraduate degree.

Differences by education in science knowledge were also found in previous Pew Research surveys on this topic, as detailed in a later section. These findings are also consistent with analysis of the factual science knowledge index in the National Science Board's Science and Engineering Indicators. That research finds higher education levels associated with more factual knowledge of science. College graduates who took at least three college-level courses in science or mathematics have higher levels of knowledge about science than do those who took fewer science and math courses.[12]

[12] Science and Engineering Indicators 2014, See Chapter 7, Figure 7-7.

Gender Gaps Evident on Topics in the Physical Sciences

Men tend to answer more of these science knowledge questions correctly than do women, the new Pew Research Center survey found. Men score an average of 8.6 out of 12 correct answers, compared with women's 7.3 correct answers.

Some 24% of women answer 10 or more questions correctly, compared with 43% of men who did this. And 69% of men get at least eight of the questions right, compared with 51% of women.

The largest difference between men and women occurs on a question asking respondents to select from a set of four images that illustrate what happens to light when it passes through a magnifying glass. Some 55% of men and 37% of women identify the correct image showing the lines crossing after they pass through a magnifying glass, a difference of 18 percentage points. There was also a 15-point difference between the sexes on knowledge about one topic commonly discussed in world news and foreign policy: While three-quarters of women (75%) correctly identify uranium as an element needed to make nuclear energy and nuclear weapons, nine-in-ten men answer this correctly.

Men (73%) and women (72%) are equally likely to identify the definition of astrology from a set of four options, however. And on the question about which layer of the Earth is hottest, there are only modest differences, with 89% of men and 84% of women selecting the correct

Science Knowledge Differs by Gender; No Difference on Pseudoscience

% answering each question correctly

	Men	Women	Men-women diff.
	%	%	
Identify illustration of how light passes through magnifying glass (from set of images)	55	37	+18
Uranium is needed to make nuclear energy/weapons	90	75	+15
Radio waves are used to make/receive cellphone calls	79	66	+13
A light-year is a measure of distance	78	66	+13
Ocean tides are created by gravitational pull of the moon	83	71	+12
Amplitude (or height) determines loudness in a sound wave	42	30	+12
Comet as object in space with icy core and tail of gas and dust (from photo)	84	73	+11
Interpret a scatterplot chart (with graph)	69	58	+11
Jonas Salk developed polio vaccine (set with photos)	79	70	+9
Water boils at lower temperature when at high altitudes	39	30	+9
Earth's core is its hottest layer (with labeled image)	89	84	+5
Distinguish definition of astrology from astronomy	73	72	+1
Average number correct overall	8.6	7.3	+1.3

American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline. Significant differences in **bold**.

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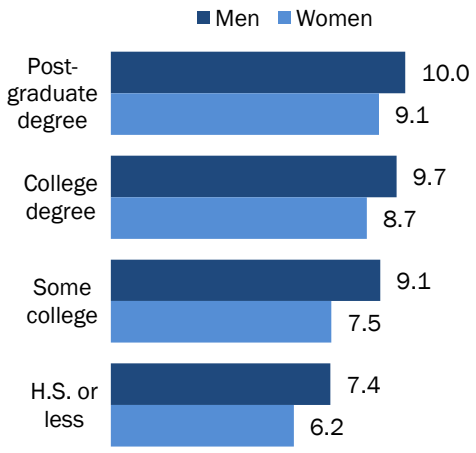
response.

Education differences between men and women, particularly among older generations of adults, may explain some of these gendered patterns in science knowledge. For example, men and women who hold a postgraduate degree are about equally likely to correctly interpret a scatterplot chart and to know that ocean tides are influenced by the gravitational pull of the moon. But, on average, men tend to know more of the answers to these science questions than do women, even when controlling for each of four levels of education.

Men Score Higher on Science Questions at All Educational Levels, on Average

Mean number of correct answers out of 12 items



American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline.

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According to government research on issues of science knowledge, males and females tend to differ in their expressed interest in science topics and in their course selection at the high school, college and postgraduate levels. Men, on average, express greater interest in the physical sciences than women. This could in part explain the tendency for men to know the right answers to more of these questions, which focus mostly on the physical sciences, than women, even when controlling for educational level.[13] The U.S. government's Science and Engineering Indicators 2014 report shows that women and men tend to score about equally high on factual knowledge items in the biological sciences, while men tend to score higher on scales of factual knowledge in the physical sciences.[14]

Pew Research Center surveys have included only a handful of biological science knowledge questions over the years. As detailed in a later section, on four questions related to health and biomedical issues in the news, there were no differences or only modest differences between men and women. And, on two other questions that tie more closely to the kinds of knowledge taught in school, women (59%) were more likely than men (49%) to know that antibiotics will not kill viruses, according to a 2009 Pew Research survey. However, a 2014 Pew Research survey found

[13] See U.S. Dept. of Education, National Center for Education Statistics, Stats in Brief Feb. 2015 "Gender Differences in Science, Technology, Engineering, and Mathematics (STEM) Interests, Credits Earned and NAEP Performance in the 12th Grade." Also see Chapter 2 and 3 of National Science Board on differences in higher education fields and in the workforce. 2014. "Science and Engineering Indicators 2014."
[14] Science and Engineering Indicators 2014. See Chapter 7, table 7-7 and appendix table 7-10.

men (80%) more likely than women (73%) to correctly identify the main function of red blood cells.

In addition, the questions on the Pew Research survey ask for knowledge or applications of scientific principles, such as the definition of a light-year or the principles underlying sound, rather than questions designed to measure understanding of scientific processes or methods used to test scientific theories. The Science and Engineering Indicators report found no difference between adult men and women on measures designed to tap understanding of probabilities, experiments, or a basic understanding of the scientific method.[15] Previous Pew Research surveys have included only one question measuring understanding of scientific processes. On that question, women (78%) were slightly more likely than men (72%) to identify comparison groups as a better way to study the effectiveness of a drug treatment than a single treatment group.

[15] Science and Engineering Indicators 2014. See Chapter 7, appendix table 7-12.

Other Demographic Patterns in Science Knowledge

People's science knowledge sometimes varies by age, race and ethnicity, though the patterns are far from uniform across this set of 12 questions in the new Pew Research survey. On some questions, younger adults tend to know more than their elders (such as which kind of waves underlie cellphone calls). But that pattern is reversed when it comes to awareness that Jonas Salk developed the polio vaccine. Differences by race and ethnicity also vary across the set, with whites answering more of these questions correctly on average than Hispanics or blacks.

Mixed Patterns by Age on Science Knowledge

% answering each question correctly

	18-29	30-49	50-64	65+	Youngest-oldest diff.
	%	%	%	%	
Radio waves are used to make/receive cellphone calls	80	77	68	57	+23
Identify illustration of how light passes through magnifying glass (from set of images)	49	50	46	33	+16
Interpret a scatterplot chart (with graph)	67	68	61	54	+13
Amplitude (or height) determines loudness in a sound wave	40	38	34	28	+12
Water boils at lower temperature when at high altitudes	38	36	32	29	+9
Earth's core is its hottest layer (with labeled image)	90	87	84	84	+6
Comet as object in space with icy core and tail of gas and dust (from photo)	77	79	80	74	+3
A light-year is a measure of distance	70	76	70	70	0
Distinguish definition of astrology from astronomy	68	75	75	71	-3
Ocean tides are created by gravitational pull of the moon	76	77	74	80	-4
Uranium is needed to make nuclear energy/weapons	74	86	82	87	-13
Jonas Salk developed polio vaccine (set of four with photos)	68	73	72	86	-18
Average number correct overall	8.0	8.2	7.8	7.6	0.4

American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline. Significant differences in **bold**.

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Generations and Knowledge

There are notable age gaps in knowledge about some science topics. Fully eight-in-ten (80%) adults ages 18 to 29 correctly identify radio waves as the technology underlying cellphone calls. By contrast, 57% of those ages 65 and older know this.

On some questions there are no differences in knowledge across age groups. For example, both younger and older adults are about equally likely to identify a given definition as that of astrology from a list of other choices, including astronomy.

And, when it comes to one aspect of science history, older adults (ages 65 and older) are more likely than younger adults to identify Jonas Salk as the person who developed the polio vaccine when given a list of scientists that also includes Marie Curie, Albert Einstein and Isaac Newton. Fully 86% of those ages 65 and older correctly identify Salk as the vaccine's developer, compared with 68% of adults ages 18 to 29.

Overall, differences by age across this set of questions are generally modest. The oldest adults – ages 65 and up – score lower, on average 7.6 out of 12 items, compared with younger age groups (ages 18 to 49). But adults under age 30 and those ages 30 to 49 tend to identify a similar mean number of items correctly.

Some Science Knowledge Varies by Race, Ethnicity

% answering each question correctly

	White	Black	Hispanic
	%	%	%
Earth's core is its hottest layer (with labeled image)	89	75	76
Uranium is needed to make nuclear energy/weapons	87	61	76
Ocean tides are created by gravitational pull of the moon	83	46	70
Comet as object in space with icy core and tail of gas and dust (from photo)	81	61	74
Jonas Salk developed polio vaccine (set of four with photos)	79	53	69
A light-year is a measure of distance	77	49	67
Distinguish definition of astrology from astronomy	76	65	64
Radio waves are used to make/receive cellphone calls	76	48	64
Interpret a scatterplot chart (with graph)	67	51	58
Identify illustration of how light passes through magnifying glass (from set of images)	49	29	44
Amplitude (or height) determines loudness in a sound wave	39	23	25
Water boils at lower temperature when at high altitudes	36	33	25
Average number correct overall	8.4	5.9	7.1

American Trends Panel (wave 6). Survey of U.S. adults conducted Aug. 11-Sept. 3, 2014. All questions are multiple-choice; for full wording see survey topline. Whites and blacks include only non-Hispanics; Hispanics are of any race.

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Race and Ethnicity

There are also differences by race and ethnicity across these items, on average, with whites knowing the correct answer to more of these questions overall than Hispanics or blacks. Whites score a mean of 8.4 items out of 12 correct, compared with 7.1 among Hispanics and 5.9 among blacks. [16]

[16] Among Hispanics born in the U.S. the mean is 7.4 items out of 12 correct.

One of the largest differences between blacks and whites occurs on a question about the ocean tides: 83% of whites compared with 46% of blacks correctly identify the gravitational pull of the moon as one factor in ocean tides. (Hispanics fall in between these two groups, with 70% answering this question correctly.) On one of the more difficult questions, a roughly equal share of whites (36%) and blacks (33%) correctly identify a difference found in cooking at higher altitudes: that water boils at a lower temperature. A quarter (25%) of Hispanics answered this question correctly.

Educational differences across race and ethnic groups may contribute to science knowledge differences among whites, blacks and Hispanics. But whites tend to score higher, on average, on this set of science knowledge questions than do either Hispanics or blacks, even after controlling for education. Such comparisons need to be made cautiously due to the smaller number of respondents in this survey who are African-American (n=259) or Hispanic (n=247). The sample size of these subgroups does not allow for detailed comparisons by education level.

Science knowledge differences by race and ethnicity have also been found in other surveys. As detailed in a later section, previous Pew Research surveys have also found knowledge differences by race and ethnicity on a range of science topics. On the factual science knowledge questions collected on the General Social Survey (GSS) between 2006 and 2014, for example, whites scored an average of 6.1 out of 9 questions correctly, compared with 4.3 for blacks and 4.8 for Hispanics. Racial and ethnic group differences in mean numbers of correct responses on that scale occur even when controlling for education level.[17]

Differences by race and ethnicity could tie to a number of factors, including long-standing disparities among race and ethnic groups on science achievement tests; differences in areas of study at the high school, college and postgraduate levels; and other factors.[18] To the extent that science knowledge, especially on issues in the news and emerging scientific developments, is learned in connection with adult life activities, the continued underrepresentation of racial and ethnic minority groups in science, technology, engineering and mathematics workforce could also be a contributing factor.[19]

[17] Pew Research Center analysis of aggregated GSS surveys from 2006 to 2014. This analysis also finds that the mean number correct is 5.2 among U.S.-born Hispanics and 4.4 among foreign-born Hispanics out of 9 questions.
[18] See Science and Engineering Indicators 2014, Chapter 1 and Chapter 2.
[19] See Science and Engineering Indicators 2014. Chapter 3. Also see Liana Christin Landivar, 2013. "Disparities in STEM Employment by Sex, Race and Hispanic Origin; American Community Survey Reports," ACS-24, U.S. Census Bureau, Washington, DC.

Comparison of Science Knowledge Questions Across Pew Research Center Surveys

The set of 12 questions from the new Pew Research Center survey is, of course, only a small fraction of the possible topics and approaches to measuring public knowledge and understanding about science. In this section, we show the 12 questions from the new survey alongside other science knowledge questions asked across a handful of past Pew Research surveys conducted since 2009. This overview of findings underscores the caution that how much the public appears to know or not know about science depends on the nature of the questions asked. Some information is widely held, other information much less so. It also shows that the broad patterns described above of differences in science knowledge by educational level and across demographic groups tend to be consistent with the patterns found in earlier surveys that used different science knowledge questions and different survey methods.

People who happen to know more, on average, about the particular questions on a given survey are expected to know more about other topics within the broad domain of science. But there may be differences depending on the fields of science covered, as well as the extent to which the questions tap information that may be learned from developments in the news or applications of scientific principles in everyday life. Thus, the tables here show the questions grouped into broad topical categories related to the life sciences, earth sciences and energy issues, as well as other physical sciences. The questions are also grouped into broad types, such as those that might come from news coverage of science and technology issues or applications of science in everyday life and those that might be found in science education textbooks.

Knowledge of science facts, especially those typically covered in science textbooks, tends to be stable over time. For example, the average number of items correct on a nine-item scale of factual knowledge of science collected on behalf of the National Center of Science and Engineering Statistics has stayed about same the over the past two decades.[20] Topics connected with emerging science and science-related issues covered in the news may be more likely to change over time.

The new Pew Research survey findings were collected primarily online with a nationally representative sample of adults (in the center's American Trends Panel), so the large majority of respondents completed the survey using a computer or smartphone.[21] Most of the past Pew Research surveys with science knowledge questions were conducted by telephone, however. Little is known about how different modes of data collection might influence estimates of science knowledge. Prior to fielding the new science knowledge survey online, we did one mode

[20] See Science and Engineering Indicators 2014. See Chapter 7, figure 7-6.
[21] A small number of respondents completed the survey by paper questionnaire.

experiment in which half the respondents from the American Trends Panel were randomly assigned to answer an item about the most common source of electricity in the U.S. via a phone survey, and the other half were presented the question online. There were no significant differences in knowledge across the two modes. For more on mode differences, see the Pew Research report "From Telephone to the Web: The Challenge of Mode of Interview Effects in Public Opinion Polls."

Readers should also keep in mind that the estimates of public knowledge about science may vary depending on the extent to which respondents are encouraged to guess. Respondents in these surveys were instructed to provide their best guess, even if they were not certain of the correct answer, and while they were able to skip questions, there was no explicit option to say "don't know." One recent analysis of science knowledge questions collected on the General Social Survey suggests that instructions that *discourage* guessing (e.g., by making it easier to record a don't know response) may provide a more valid measure of science understanding because some of those who guess will provide the correct response by chance without holding a clear understanding of the scientific principles.[22]

However, some studies of adult knowledge in the political domain have argued that surveys that discourage guessing by offering an explicit "don't know" option *underestimate* knowledge because some respondents have meaningful, though partial, information but are less inclined to guess in those situations.[23] One recent study of political knowledge argues that visual cues tap into different stores of political knowledge than do questions based only on verbal cues, and that educated respondents may have more of an advantage on verbal than visual knowledge questions.[24]

These issues go beyond what we can disentangle here. Despite the limitations of any survey, Pew Research Center's science knowledge findings provide a nationally representative snapshot of what the public knows on new and older scientific developments, textbook principles covered in K-12 education, and topics discussed in the news. The overall findings and the divides among key demographic groups provides a fresh look at the American public's science knowledge and may provide new insights for the larger civic effort on science education among both children and adults.

[22] See Roger Tourangeau, Aaron Maitland and Yanna Yan. Forthcoming, "Assessing the Scientific Knowledge of the General Public: The Effects of Question Format and Encouraging or Discouraging Don't Know Responses." Public Opinion Quarterly.
[23] See Jeffrey J. Mondak, 2000. "Reconsidering the Measurement of Political Knowledge." Political Analysis 8 (1): 57–82. Also Markus Prior, and Arthur Lupia. 2008. "Money, Time, and Political Knowledge: Distinguishing Quick Recall and Political Learning Skills." American Journal of Political Science 52 (1): 168–82.
[24] See Marcus Prior, 2014. Visual Political Knowledge: A Different Road to Competence? Journal of Politics, 76(1): 41-57.

Overview of Knowledge Questions Related to the Life Sciences

% answering each item correctly

	U.S. adults	HS or less	Some college	College grad	Postgrad degree	Men	Women	Source
Science in the news/daily life								
How are stem cells different from other cells: they can develop into many types of cells	54	40	61	68	79*	54	54	Combined responses May and June 2009
Major concern about overuse of antibiotics is resistant bacteria	74	62	79	85	92	73	76	Aug. 15-25, 2014
Sunscreen protects from which kind of radiation: ultraviolet	83	72	91	90	93	85	81	Mar. 7-10, 2013
Which over-the-counter drug is recommended to help prevent heart attacks: aspirin	90	86	92	96	97*	88	92	Combined responses May and June 2009
Textbook knowledge								
Antibiotics will kill viruses as well as bacteria (false)	54	42	58	68	76*	49	59	June 18-21, 2009
Who developed the polio vaccine: Salk (set of four with photos)	74	64	79	83	88	79	70	ATP (wave 6) 2014
Main function of red blood cells is to carry oxygen throughout body	76	68	78	83	93	80	73	Aug. 15-25, 2014
Scientific processes								
Better way to determine if new drug is effective in treating a disease: comparison groups	75	67	76	86	87	72	78	Mar. 7-10, 2013

All surveys conducted by Pew Research Center during dates listed under source. American Trends Panel (ATP) survey conducted primarily online and by mail with a representative sample of U.S. adults. All other surveys conducted by telephone. * Indicates figures based on those who have some postgraduate education in addition to those who have completed a postgraduate degree.

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Overview of Knowledge Questions Related to Earth Sciences and Energy Issues

% answering each item correctly

	U.S. adults	HS or less	Some college	College grad	Postgrad degree	Men	Women	Source
Science in the news/daily life								
The most electricity in the U.S. comes which source: coal	49	36	52	61	69	59	40	ATP (wave 5) 2014
Which natural resource is extracted in fracking: natural gas	51	39	53	61	75	58	45	Mar. 7-10, 2013
U.S. energy output has been … increasing (2014)	54	44	54	63	74	61	47	Dec. 3-7, 2014
Gas believed to cause rising temperatures: carbon dioxide	71	64	69	80	89	83	60	Aug. 15-25, 2014
Ocean tides are created by … gravitational pull of moon	76	65	79	90	91	83	71	ATP (wave 6) 2014
Which may cause a tsunami: an earthquake under the ocean	77	67	83	88	88*	80	74	June 18-21, 2009
Element needed for nuclear energy/weapons is uranium	82	73	85	93	94	90	75	ATP (wave 6) 2014
Textbook knowledge								
Which gas makes up most of the Earth's atmosphere: nitrogen	20	12	22	28	36	27	14	Mar. 7-10, 2013
The continents have been moving over millions of years and will continue to move (true)	77	68	83	83	87	83	72	Mar. 7-10, 2013
Identify hottest layer of Earth as the core (with labeled image)	86	79	89	93	93	89	84	ATP (wave 6) 2014

All surveys conducted by Pew Research Center during dates listed under source. American Trends Panel (ATP) survey conducted primarily online and by mail with a representative sample of U.S. adults. ATP (wave 5) conducted by random assignment to online or telephone mode of data collection. All other surveys conducted by telephone. * Indicates figures based on those who have some postgraduate education in addition to those who have completed a postgraduate degree.

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Overview of Knowledge Questions Related to Other Physical Sciences

% answering each item correctly

	U.S. adults	HS or less	Some college	College grad	Postgrad degree	Men	Women	Source
Science in the news/daily life								
This was recently (2009) discovered on Mars: water	60	51	64	69	79*	66	55	Combined responses May and June 2009
Which of these is no longer considered a planet: Pluto	60	49	64	74	81*	63	58	June 18-21, 2009
Nanotechnology deals with things that are extremely … small	64	48	69	80	90	71	58	Aug. 15-25, 2014
Which kind of wave is used to make cellphone calls: radio	72	63	76	81	81	79	66	ATP (wave 6) 2014
GPS system relies on … satellites	82	75	87	90	97*	88	78	June 18-21, 2009
Textbook knowledge								
Water boils at a lower temperature when at higher altitudes	34	27	36	42	47	39	30	ATP (wave 6) 2014
Loudness is determined by this property of sound wave: amplitude	35	20	38	52	62	42	30	ATP (wave 6) 2014
Identify illustration of light passing through magnifying glass (from set of images)	46	40	49	49	53	55	37	ATP (wave 6) 2014
Electrons are smaller than atoms (true)	47	34	54	55	67	54	41	Mar. 7-10, 2013
Which is an example of a chemical reaction: nails rusting	63	55	61	74	86	64	62	Aug. 15-25, 2014
Lasers work by focusing on sound waves (false)	65	56	67	75	79	74	56	Aug. 15-25, 2014
All radioactivity is man-made (false)	66	54	69	79	89	70	63	Mar. 7-10, 2013
A light-year measures … distance	72	61	76	82	84	78	66	ATP (wave 6) 2014
Identify photo of comet as object in space with icy core (with photo)	78	71	79	87	88	84	73	ATP (wave 6) 2014
Chart reading								
Identify statement described in scatterplot (with graph)	63	50	65	79	84	69	58	ATP (wave 6) 2014
Pseudoscience								
Recognize definition of astrology (from astronomy)	73	64	74	83	85	73	72	ATP (wave 6) 2014

All surveys conducted by Pew Research Center during dates listed under source. American Trends Panel (ATP) survey conducted primarily online and by mail with a representative sample of U.S. adults. All other surveys conducted by telephone. * Indicates figures based on those who have some postgraduate education in addition to those who have completed a postgraduate degree.

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Overview of Knowledge Questions Related to the Life Sciences

% answering each item correctly

	U.S. adults	18-29	30-49	50-64	65+	White	Black	Hispanic	Source
Science in the news/daily life									
How are stem cells different from other cells: they can develop into many types of cells	54	56	60	54	39	59	42	38	Combined responses May and June 2009
Major concern about overuse of antibiotics is resistant bacteria	74	72	81	76	65	82	55	60	Aug. 15-25, 2014
Sunscreen protects from which kind of radiation: ultraviolet	83	88	86	82	71	86	65	77	Mar. 7-10, 2013
Which over-the-counter drug is recommended to help prevent heart attacks: aspirin	90	75	94	97	92	95	87	73	Combined responses May and June 2009
Textbook knowledge									
Antibiotics will kill viruses as well as bacteria (false)	54	49	64	52	43	62	23	40	June 18-21, 2009
Who developed the polio vaccine: Salk (set of four with photos)	74	68	73	72	86	79	53	69	ATP (wave 6) 2014
Main function of red blood cells is to carry oxygen throughout body	76	79	77	77	69	80	74	60	Aug. 15 25, 2014
Scientific processes									
Better way to determine if new drug is effective in treating a disease: comparison groups	75	76	75	80	62	80	62	64	Mar. 7-10, 2013

All surveys conducted by Pew Research Center during dates listed under source. American Trends Panel (ATP) survey conducted primarily online and by mail with a representative sample of U.S. adults. All other surveys conducted by telephone.

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Overview of Knowledge Questions Related to Earth Sciences and Energy Issues

% answering each item correctly

	U.S. adults	18-29	30-49	50-64	65+	White	Black	Hispanic	Source
The most electricity in the U.S. comes which source: coal	49	44	50	50	52	56	24	33	ATP (wave 5) 2014
Which natural resource is extracted in fracking: natural gas	51	35	52	61	50	59	29	34	Mar. 7-10, 2013
U.S. energy output has been … increasing	54	49	52	59	54	56	42	49	Dec. 3-7, 2014
Gas believed to cause rising temperatures: carbon dioxide	71	78	73	69	63	72	64	68	Aug. 15-25, 2014
Ocean tides are created by … gravitational pull of moon	76	76	77	74	80	83	46	70	ATP (wave 6) 2014
Which may cause a tsunami: an earthquake under the ocean	77	74	83	75	70	83	55	69	June 18-21, 2009
Element needed for nuclear energy/weapons is uranium	82	74	86	82	87	87	61	76	ATP (wave 6) 2014
Textbook knowledge									
Which gas makes up most of the Earth's atmosphere: nitrogen	20	25	22	18	14	20	15	20	Mar. 7-10, 2013
The continents have been moving over millions of years and will continue to move (true)	77	87	77	77	66	79	73	75	Mar. 7-10, 2013
Identify hottest layer of Earth as the core (with labeled image)	86	90	87	84	84	89	75	76	ATP (wave 6) 2014

All surveys conducted by Pew Research Center during dates listed under source. American Trends Panel (ATP) survey conducted primarily online and by mail with a representative sample of U.S. adults. ATP (wave 5) conducted by random assignment to online or telephone mode of data collection. All other surveys conducted by telephone.

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Overview of Knowledge Questions Related to Other Physical Sciences

% answering each item correctly

	U.S. adults	18-29	30-49	50-64	65+	White	Black	Hispanic	Source
Science in the news/daily life									
This was recently (2009) discovered on Mars: water	60	58	61	62	58	63	50	52	Combined responses May and June 2009
Which of these is no longer considered a planet: Pluto	60	75	67	57	36	67	36	53	June 18-21, 2009
Nanotechnology deals with things that are extremely ... small	64	76	70	64	40	71	45	48	Aug. 15-25, 2014
Which kind of wave is used to make cellphone calls: radio	72	80	77	68	57	76	48	64	ATP (wave 6) 2014
GPS system relies on ... satellites	82	87	91	82	62	86	72	83	June 18-21, 2009
Textbook knowledge									
Water boils at a lower temperature when at higher altitudes	34	38	36	32	29	36	33	25	ATP (wave 6) 2014
Loudness is determined by this property of sound wave: amplitude	35	40	38	34	28	39	23	25	ATP (wave 6) 2014
Identify illustration of light passing through magnifying glass (from set of images)	46	49	50	46	33	49	29	44	ATP (wave 6) 2014
Electrons are smaller than atoms (true)	47	56	50	44	33	48	37	45	Mar. 7-10, 2013
Which is an example of a chemical reaction: nails rusting	63	61	68	64	59	70	42	50	Aug. 15-25, 2014
Lasers work by focusing on sound waves (false)	65	72	75	63	42	68	60	51	Aug. 15-25, 2014
All radioactivity is man-made (false)	66	68	66	71	56	73	47	52	Mar. 7-10, 2013
A light-year measures ... distance	72	70	76	70	70	77	49	67	ATP (wave 6) 2014
Identify photo of comet as object in space with icy core (with photo)	78	77	79	80	74	81	61	74	ATP (wave 6) 2014
Chart reading									
Identify statement described in scatterplot (with graph)	63	67	68	61	54	67	51	58	ATP (wave 6) 2014
Pseudoscience									
Recognize definition of astrology (from astronomy)	73	68	75	75	71	76	65	64	ATP (wave 6) 2014

All surveys conducted by Pew Research Center during dates listed under source. American Trends Panel (ATP) survey conducted primarily online and by mail with a representative sample of U.S. adults. All other surveys conducted by telephone.

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Appendix A: About the American Trends Panel Survey

The American Trends Panel (ATP), created by Pew Research Center, is a nationally representative panel of randomly selected U.S. adults living in households. Respondents who self-identify as internet users (representing 89% of U.S. adults) participate in the panel via monthly self-administered Web surveys, and those who do not use the internet participate via telephone or mail. The panel is being managed by Abt SRBI.

Data in this report are drawn from the August wave of the panel, conducted Aug. 11-Sept. 3, 2014, among 3,278 respondents (2,923 by Web and 355 by mail). The margin of sampling error for the full sample of 3,278 respondents is plus or minus 2.3 percentage points.

All current members of the American Trends Panel were originally recruited from the 2014 Political Polarization and Typology Survey, a large (n=10,013) national landline and cellphone random digit dial (RDD) survey conducted Jan. 23 to March 16, 2014, in English and Spanish. At the end of that survey, respondents were invited to join the panel. The invitation was extended to all respondents who use the internet (from any location) and a random subsample of respondents who do not use the internet.[25]

Of the 10,013 adults interviewed, 9,809 were invited to take part in the panel. A total of 5,338 agreed to participate and provided either a mailing address or an email address to which a welcome packet, a monetary incentive and future survey invitations could be sent. Panelists also receive a small monetary incentive after participating in each wave of the survey.

The ATP data were weighted in a multi-step process that begins with a base weight incorporating the respondents' original survey selection probability and the fact that some panelists were subsampled for invitation to the panel. Next, an adjustment was made for the fact that the propensity to join the panel varied across different groups in the sample. The final step in the weighting uses an iterative technique that matches gender, age, education, race, Hispanic origin and region to parameters from the U.S. Census Bureau's 2012 American Community Survey. Population density is weighted to match the 2010 U.S. Decennial Census. Telephone service is weighted to estimates of telephone coverage for 2014 that were projected from the July-December 2013 National Health Interview Survey. It also adjusts for party affiliation using an average of the three most recent Pew Research Center general public telephone surveys, and for internet use using as a parameter a measure from the 2014 Survey of Political Polarization. Sampling errors

[25] When data collection for the 2014 Political Polarization and Typology Survey began, non-internet users were subsampled at a rate of 25%, but a decision was made shortly thereafter to invite all non-internet users to join. In total, 83% of non-internet users were invited to join the panel.

and statistical tests of significance take into account the effect of weighting. The Hispanic sample in the American Trends Panel is predominantly native born and English speaking.

The following table shows the unweighted sample sizes and the error attributable to sampling that would be expected at the 95% level of confidence for different groups in the survey:

Sample sizes and sampling errors for other subgroups are available upon request.

In addition to sampling error, one should bear in mind that question wording and practical difficulties in conducting surveys can introduce error or bias into the findings of opinion polls.

The Web component of the August wave had a response rate of 62% (2,923 responses among 4,702 Web-based individuals enrolled in the panel); the mail component had a response rate of 64% (355 responses among 559 non-Web individuals enrolled in the panel). Taking account of the response rate for the 2014 Survey of Political Polarization (10.6%), the cumulative response rate for the August ATP wave is 3.6%.

Group	Unweighted sample size	Plus or minus ...
Total sample	3,278	2.3 percentage points
Men	1,584	3.2 percentage points
Women	1,693	3.1 percentage points
White, non-Hispanic	2,551	2.6 percentage points
Black, non-Hispanic	259	8.0 percentage points
Hispanic	247	8.2 percentage points
18-29	481	5.9 percentage points
30-49	914	4.3 percentage points
50-64	1,060	4.0 percentage points
65 and older	807	4.6 percentage points
Postgraduate degree	615	5.2 percentage points
College degree	1,071	4.0 percentage points
Some college	936	4.2 percentage points
H.S. or less	650	5.1 percentage points

Appendix B: Question Wording and Topline

2014 PEW RESEARCH CENTER'S AMERICAN TRENDS PANEL
WAVE 6 AUGUST
AUGUST 11-SEPTEMBER 3, 2014
TOTAL N=3,278
WEB RESPONDENTS N=2,923
MAIL RESPONDENTS N=355[26]

PRIOR QUESTIONS PREVIOUSLY RELEASED OR HELD FOR FUTURE RELEASE

FOR FIRST SCREEN ONLY: **Here's a different kind of question. As far as you know…**
ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS

KNOSCT1 **This picture shows an object in space that has an icy core with a tail of gas and dust that extends millions of miles. Is this**[27] **…** *(We'd like your best guess)*

78		A comet *(correct)*
22		Net incorrect/no answer
	6	A star
	16	An asteroid
	*	A moon
	1	No answer

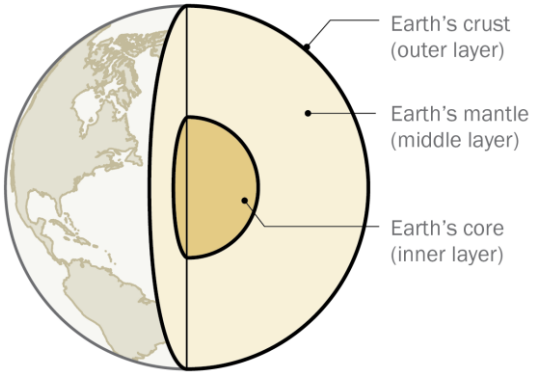
RANDOMIZE ITEMS KNOSCT2 TO KNOSCT12
ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS

KNOSCT2 **Which kind of waves is used to make and receive cellphone calls?** *(We'd like your best guess)* [28]

72		Radio waves *(correct)*
28		Net incorrect/no answer
	3	Light waves
	22	Sound waves
	2	Gravity waves
	1	No answer

[26] This topline shows question wording and order from the web version of the survey. Question wording, format, and order were adapted for the paper questionnaire delivered by mail; the mail questionnaire is available on request. All questions asked in both modes unless noted.
[27] Images were displayed for each response option on both web and mail questionnaire.
[28] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT3 **This picture shows three layers of the earth. Which layer is the hottest?**[29]
(We'd like your best guess) [30]



86 The inner layer called the Earth's core *(correct)*
14 Net incorrect/no answer
7 The outer layer called the Earth's crust
6 The middle layer called the Earth's mantle
1 No answer

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT4 **Ocean tides are created by which of the following?** *(We'd like your best guess)* [31]
[Check all that apply]

63 The gravitational pull of the moon (alone)
5 The gravitational pull of the sun (alone)
16 The rotation of the earth on its axis (alone)
1 No answers selected

NET responses
76 NET The gravitational pull of the moon (coded as correct)[32]
10 Net any two responses
5 Net all three selected

[29] This question was adapted with permission from the Trends in International Mathematics and Science Study (TIMSS) grade 8 science assessment items in 1999. Image from Pew Research Center.
[30] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.
[31] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.
[32] The index of science knowledge treats all those who selected the gravitational pull of the moon as a correct response.

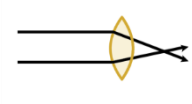
ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT5 **What does a light-year measure? Is it...** *(We'd like your best guess)* [33]

72	Distance *(correct)*
28	Net incorrect/no answer
4	Brightness
22	Time
1	Weight
1	No answer

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT6 **Denver, CO is a higher altitude than is Los Angeles, CA. Which of these statements is correct?** *(We'd like your best guess)* [34]

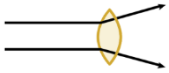
34	Water boils at a lower temperature in Denver than Los Angeles *(correct)*
66	Net incorrect/no answer
26	Water boils at a higher temperature in Denver than Los Angeles
39	Water boils at the same temperature in both Denver and Los Angeles
1	No answer

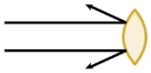
ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT7 **Which of these pictures best illustrate what happens when light passes through a magnifying glass?** [35] *(We'd like your best guess)* [36]

46  *(correct)*

54 Net incorrect/no answer

9 

34 

10 

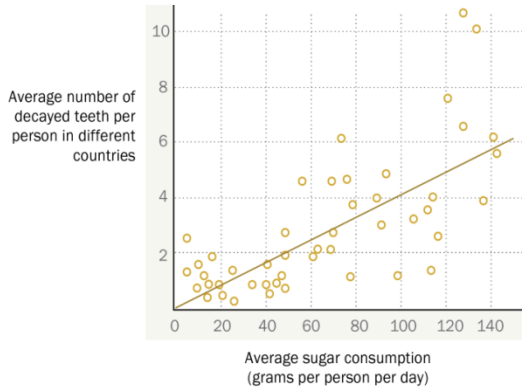
2 No answer

[33] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.
[34] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.
[35] This question was adapted with permission from the Trends in International Mathematics and Science Study (TIMSS) grade 8 science assessment items in 1999. Images from Pew Research Center.
[36] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown. Response options consisted of images only, with no verbal labels.

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT8 **The loudness of a sound is determined by what property of a sound wave? Is it…**
(We'd like your best guess) [37]

35	Amplitude or height (correct)
65	Net incorrect/no answer
33	Frequency
23	Wavelength
8	Velocity or rate of change
1	No answer

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT9 **Which of the following statements best describes the data in the graph below? Is it…**
(We'd like your best guess) [38] 39



63	The more sugar people eat, the more likely they are to get cavities (correct)
37	Net incorrect/no answer
12	In recent years, the rate of cavities has increased in many countries
6	In some countries, people brush their teeth more frequently than in other countries
17	In recent years, the consumption of sugar has increased in many countries
2	No answer

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT10 **Which of these elements is needed to make nuclear energy and nuclear weapons? Is it…** *(We'd like your best guess)* [40]

82	Uranium (correct)
18	Net incorrect/no answer
2	Sodium chloride
10	Nitrogen
4	Carbon dioxide
1	No answer

[37] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.
[38] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.
[39] This question was adapted with permission from the OECD (2009), *Take the Test: Sample Questions from OECD's PISA Assessments*, PISA, OECD Publishing. Image from Pew Research Center.
[40] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT11 **Which of these people developed the polio vaccine? Is it…** *(We'd like your best guess)*[41]

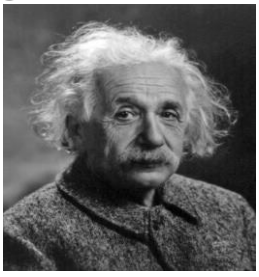
74	Jonas Salk (correct)
26	Net incorrect/no answer
5	Isaac Newton
14	Marie Curie
5	Albert Einstein
2	No answer

Response options were shown with photo images with each name as in the following example:


◉ Jonas Salk


◉ Isaac Newton


◉ Marie Curie


◉ Albert Einstein

[41] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.

ASK ALL:
RANDOMIZE ORDER OF RESPONSE OPTIONS
KNOSCT12 **Which of these terms is defined as the study of how the positions of stars and planets can influence human behavior?** *(We'd like your best guess)* [42]

73	Astrology (correct)
27	Net incorrect/no answer
2	Alchemy
22	Astronomy
3	Meteorology
1	No answer

TOTAL NUMBER CORRECT, KNOSCT1 THROUGH KNOSCT 12[43]

6	12 of 12 Correct
12	11 of 12 Correct
15	10 of 12 Correct
15	9 of 12 Correct
12	8 of 12 Correct
12	7 of 12 Correct
9	6 of 12 Correct
7	5 of 12 Correct
6	4 of 12 Correct
3	3 of 12 Correct
2	2 of 12 Correct
1	1 of 12 Correct
*	0 of 12 Correct
*	Refused all

For details on question wording of knowledge questions from other surveys see the sources below. Any other details about these surveys and their findings are also available on request.

Dec. 3-7, 2014: Pew Research Center report "As U.S. Energy Production Grows, Public Policy Views Show Little Change."

ASK ALL:
Q.19 From what you've read and heard, has the amount of energy produced in the United States been increasing, decreasing, or staying about the same in recent years?

Dec 3-7 2014		Sep 4-8 2013
54	Increasing	48
10	Decreasing	12
27	Staying about the same	31
9	Don't know/Refused **(VOL.)**	10

[42] In the web version of the survey this prompt for a best guess was only shown if the respondent attempted to skip the question. On the mail version of the survey this prompt was always shown.
[43] Figures in this table are based on N=3,269 and include all those who identified the gravitational pull of the moon in KNOSCT4 as correct. Alpha reliability coefficient based on the same twelve items is .73.

Aug. 15-25, 2014: Pew Research Center report "Americans, Politics, and Science Topics"

ASK ALL:
Here's a different kind of question. As far as you know...
[RANDOMIZE KNOSCT14 THROUGH KNOSCT19]
ASK ALL:
KNOSCT14 Which of these is a major concern about the overuse of antibiotics? **[READ AND RANDOMIZE]** **[INTERVIEWER NOTE: IF NO ANSWER, PROBE ONCE:** We're just looking for your best guess on this.]

Aug 15-25, 2014		Mar 7-10, 2013[44]
74	It can lead to antibiotic-resistant bacteria *(Correct)*	77
26	NET Incorrect/No answer	23
8	*Antibiotics are very expensive*	*6*
15	*People will become addicted to antibiotics*	*10*
2	*Don't know/Refused **(VOL.)***	*7*

[RANDOMIZE KNOSCT14 THROUGH KNOSCT19]
ASK ALL:
KNOSCT15 Is the following statement true or false? Lasers work by focusing sound waves. [IF NECESSARY: Is this statement true or false?] **[INTERVIEWER NOTE: IF NO ANSWER, PROBE ONCE:** We're just looking for your best guess on this.**]**

	(Correct) False	NET incorrect/ no answer	*True*	*DK/Ref*
Aug 15-25, 2014	65	35	27	9
Mar 7-10, 2013	48	52	*19*	*34*
May 19-June 6, 2010	60	40	*21*	*19*
June 18-21, 2009	47	53	*21*	*31*
TREND FOR COMPARISON:[45]				
General Social Survey, 2012	45	55	*24*	*31*
General Social Survey, 2010	48	52	*19*	*33*
General Social Survey, 2008	48	52	*24*	*28*
General Social Survey, 2006	45	55	*17*	*38*

[RANDOMIZE KNOSCT14 THROUGH KNOSCT19]
ASK ALL:
KNOSCT16 Does nanotechnology deal with things that are extremely **[READ AND RANDOMIZE]** **[INTERVIEWER NOTE: IF NO ANSWER, PROBE ONCE:** We're just looking for your best guess on this.**]**

Aug 15-25, 2014		Mar 7-10, 2013
64	Small *(Correct)*	65
36	NET Incorrect/No answer	35
8	*Large*	*3*
6	*Cold*	*2*
13	*Hot*	*4*
1	*Don't know/Refused **(VOL.)***	*26*

[44] 2013 Pew Research Center/Smithsonian Magazine survey. Introduction to series of questions was "Here are some questions about things you might have learned in school or seen in the news. For each statement that I read, please tell me if it is true or false. If you don't know, just tell me so, and we will skip to the next question…" Survey administration did not include probe and was conducted on an omnibus survey.
[45] Results from General Social Surveys are provided for comparison where available; these surveys were conducted in-person and thus may not be directly comparable with surveys conducted by telephone.

[RANDOMIZE KNOSCT14 THROUGH KNOSCT19]
ASK ALL:

KNOSCT17 Which is an example of a chemical reaction? **[READ AND RANDOMIZE]** **[INTERVIEWER NOTE: IF NO ANSWER, PROBE ONCE:** We're just looking for your best guess on this.**]**

Aug 15-25, 2014		Mar 7-10, 2013
63	Nails rusting *(Correct)*	66
37	NET Incorrect/No answer	34
15	*Water boiling*	*12*
17	*Sugar dissolving*	*12*
5	*Don't know/Refused* ***(VOL.)***	*10*

[RANDOMIZE KNOSCT14 THROUGH KNOSCT19]
ASK ALL:

KNOSCT18 What is the main function of red blood cells? Is it... **[READ AND RANDOMIZE] [INTERVIEWER NOTE: IF NO ANSWER, PROBE ONCE:** We're just looking for your best guess on this.**]**

Aug 15-25, 2014		Mar 7-10, 2013
76	To carry oxygen to all parts of the body *(Correct)*	78
24	NET Incorrect/No answer	22
12	*To fight disease in the body*	*9*
8	*To help the blood to clot*	*6*
4	*Don't know/Refused* ***(VOL.)***	*7*

[RANDOMIZE KNOSCT14 THROUGH KNOSCT19]
ASK ALL:

KNOSCT19 What gas do most scientists believe causes temperatures in the atmosphere to rise? Is it **[READ AND RANDOMIZE] [INTERVIEWER NOTE: IF NO ANSWER, PROBE ONCE:** We're just looking for your best guess on this.**]**

Aug 15-25, 2014		Mar 7-10 2013	June 18-21 2009	Apr 28-May 12 2009
71	Carbon dioxide *(Correct)*	58	65	66
29	NET Incorrect/No answer	42	35	34
9	*Hydrogen*	*10*	*7*	*7*
5	*Helium*	*8*	*4*	*4*
7	*Radon*	*7*	*5*	*6*
7	*Don't know/Refused* ***(VOL.)***	*16*	*20*	*17*

American Trends Panel (wave 5) 2014: Pew Research Center report "From Telephone to the Web: The Challenge of Mode of Interview Effects in Public Opinion Polls."

Q.28 **Which of the following sources of energy provides the most electricity in the U.S. Is it: [RANDOMIZE]**

Jul 7-Aug 4, 2014			
Based on total [N=3,351]	Based on web mode [N=1,509]	Based on phone mode [N=1,494]	
49	51	51	Coal *(Correct)*
21	22	21	Nuclear
22	20	21	Hydroelectric
8	7	7	Wind
1	*	1	Don't know/Refused **(VOL.)**

Mar. 7-10, 2013: Pew Research Center report "Public's Knowledge of Science and Technology" from survey conducted with Smithsonian Magazine.

ASK ALL:
Here are some questions about things you might have learned in school or seen in the news

PEW.7 For each statement that I read, please tell me if it is true or false. If you don't know, just tell me so, and we will skip to the next question. First, **[INSERT FIRST ITEM, RANDOMIZE]**…is that true or false? Next, **[INSERT ITEM, RANDOMIZE] [IF NECESSARY:** Is that true or false?**]**

		True	False	(VOL.) DK/Ref
a.	All radioactivity is man-made			
	March 7-10, 2013	22	**66**	12
	June 18-21, 2009	21	**63**	16
	TREND FOR COMPARISON:			
	General Social Survey, 2012	18	**70**	12
	General Social Survey, 2010	20	**67**	13
b.	Electrons are smaller than atoms			
	General Social Survey, 2008	18	**70**	12
	General Social Survey, 2006	14	**70**	17
	March 7-10, 2013	**47**	27	25
	June 18-21, 2009	**46**	24	30
	TREND FOR COMPARISON:			
	General Social Survey, 2012	**53**	20	27
	General Social Survey, 2010	**51**	20	29
	General Social Survey, 2008	**52**	23	25
	General Social Survey, 2006	**53**	19	28
d.	The continents on which we live have been moving their location for millions of years and will continue to move in the future			
	March 7-10, 2013	**77**	10	13
	June 18-21, 2009	**76**	10	13
	TREND FOR COMPARISON:			
	General Social Survey, 2012	**81**	7	12
	General Social Survey, 2010	**79**	9	12
	General Social Survey, 2008	**77**	10	13
	General Social Survey, 2006	**79**	8	13

Correct answers for each trend in bold

ASK ALL:
PEW.8 Which one of the following types of solar radiation does sunscreen protect the skin from? **[READ AND RANDOMIZE]**

March 7-10 2013	
3	X-rays
5	Infrared
83	Ultraviolet *(Correct)*
2	Microwaves
8	Don't know/Refused **(VOL.)**

ASK ALL:
PEW.10 Which gas makes up most of the Earth's atmosphere? **[READ AND RANDOMIZE]**

March 7-10 2013	
14	Hydrogen
20	Nitrogen *(Correct)*
19	Carbon dioxide
36	Oxygen
11	Don't know/Refused **(VOL.)**

ASK ALL:
PEW.14 Which is the better way to determine whether a new drug is effective in treating a disease? If a scientist has a group of 1,000 volunteers with the disease to study, should she **[READ AND RANDOMIZE]**

March 7-10 2013	
19	Give the drug to all of them and see how many get better
75	Give the drug to half of them but not to the other half, and compare how many in each group get better *(Correct)*
6	Don't know/Refused **(VOL.)**

ASK ALL:
PEW.16 Which natural resource is extracted in a process known as "fracking"? Is it **[READ AND RANDOMIZE]**?

March 7-10 2013	
51	Natural gas *(Correct)*
12	Coal
5	Diamonds
4	Silicon
28	Don't know/Refused **(VOL.)**

June 18-21, 2009: Pew Research Center survey released in conjunction with the report "Public Praises Sciences; Scientists Fault Public, Media"

Now I have just a few short questions such as you might see on a television game show. First,
RANDOMIZE Q11 THROUGH Q19 BLOCK WITH Q20a-e; RANDOMIZE Q11 THROUGH Q19
ASK ALL:
Q.11 According to most astronomers, which of the following is no longer considered a planet **[READ AND RANDOMIZE]**?

June 2009	
60	Pluto *(Correct)*
4	Mercury
5	Neptune [OR]
3	Saturn
27	Don't know/Refused **[VOL. DO NOT READ]**

RANDOMIZE Q11 THROUGH Q19
ASK ALL:
Q.12 Which of the following may cause a Tsunami **[READ AND RANDOMIZE]**?

June 2009	
77	An earthquake under the ocean *(Correct)*
9	A very warm ocean current
4	A melting glacier [OR]
1	A large school of fish
9	Don't know/Refused **[VOL. DO NOT READ]**

RANDOMIZE Q11 THROUGH Q19
ASK ALL:
Q.13 The global positioning system, or GPS, relies on which of these to work: **[READ AND RANDOMIZE]**?

June 2009	
82	Satellites *(Correct)*
2	Stars
2	Magnets
3	Lasers
11	Don't know/Refused **[VOL. DO NOT READ]**

RANDOMIZE Q11 THROUGH Q19
ASK ALL:
Q.15 What have scientists recently discovered on Mars…? Is it….**[READ AND RANDOMIZE]**

June 2009		May 2009
61	Water *(Correct)*	60
3	Platinum	5
9	Mold	9
5	Plants	5
21	Don't know/Refused **[VOL. DO NOT READ]**	21

RANDOMIZE Q11 THROUGH Q19
ASK ALL:
Q.16 Which over-the-counter drug do doctors recommend that people take to help prevent heart attacks … is it **[READ AND RANDOMIZE]**

June 2009		May 2009
91	Aspirin *(Correct)*	89
3	Cortisone	4
1	Antacids	1
5	Don't know/Refused **[VOL. DO NOT READ]**	5

RANDOMIZE Q11 THROUGH Q19
ASK ALL:
Q.17 How are stem cells different from other cells? **[READ AND RANDOMIZE]**

June 2009		May 2009
4	They are found ONLY in plants	4
52	They can develop into many different types of cells *(Correct)* [OR]	55
22	They are found ONLY in bone marrow	24
21	Don't know/Refused **[VOL. DO NOT READ]**	18

RANDOMIZE Q11 THROUGH Q19 BLOCK WITH Q.20a-e
ASK ALL:
Q.20 Now, for each statement that I read, please tell me if it is true or false. If you don't know or aren't sure, just tell me so, and we will skip to the next question. Remember: true, false or don't know.
[RANDOMIZE ITEMS; READ EACH ITEM, FOLLOWED BY…is that true or false?**]**
Correct answers shown in bold

		True	False	(VOL.) DK/Ref
d.	Antibiotics will kill viruses as well as bacteria.			
	June, 2009	36	**54**	10
	TREND FOR COMPARISON:			
	General Social Survey, 2008	*39*	***54***	*8*

Other items asked are shown with more recent surveys