PewResearchCenter

April 22, 2013

Public's Knowledge of Science and Technology

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http://www.pewresearch.org/quiz/science-knowledge/

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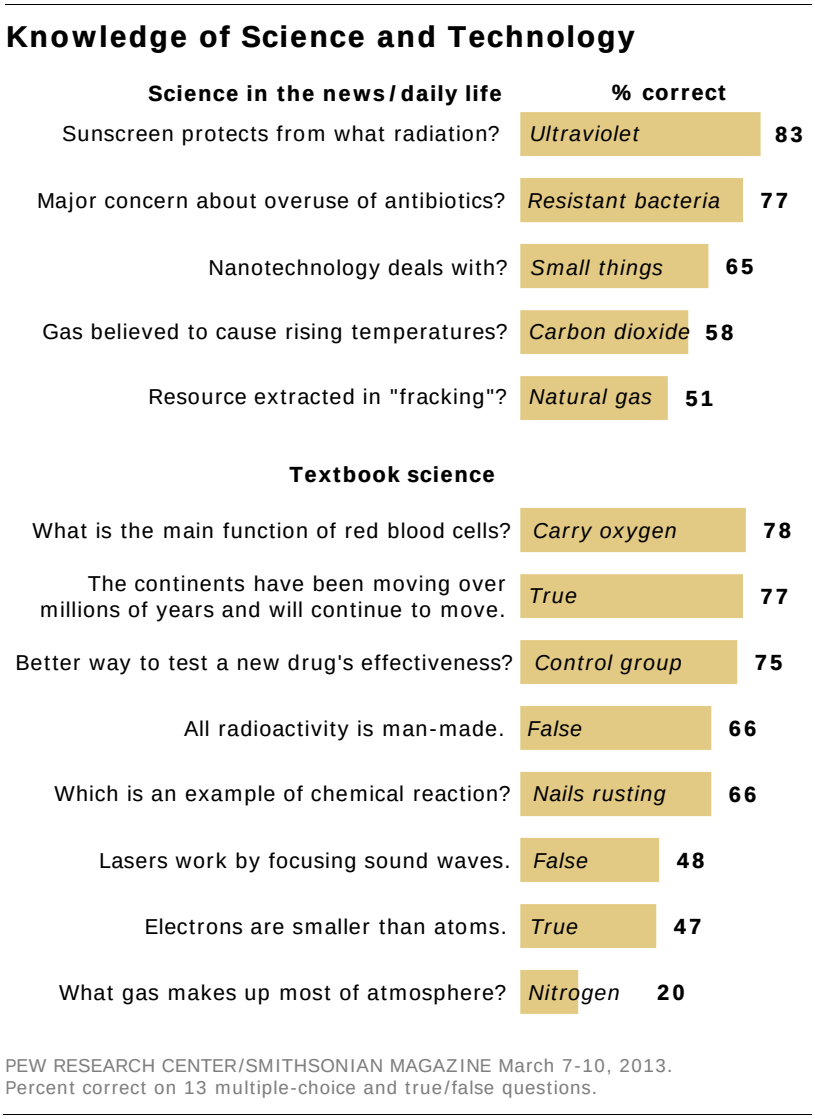
Public's Knowledge of Science and Technology

The public's knowledge of science and technology varies widely across a range of questions on current topics and basic scientific concepts, according to a new quiz by the Pew Research Center and *Smithsonian* magazine. [Click here to take the quiz yourself before reviewing the answers.]

About eight-in-ten Americans (83%) identify ultraviolet as the type of radiation that sunscreen protects against. Nearly as many (77%) know that the main concern about the overuse of antibiotics is that it can lead to antibiotic-resistant bacteria.

However, only about half (51%) of the public knows that "fracking" is a process that extracts natural gas, not coal, diamonds or silicon from the earth.

Similarly, knowledge of basic scientific concepts differs greatly across questions. While most Americans (78%) know that the basic function of red blood cells is to carry oxygen to all parts of the body, just 20% could identify nitrogen as the gas that makes up most of the atmosphere.



The quiz is part of a nationwide survey, conducted March 7-10 among 1,006 adults, which also probed opinions and perceptions about science and math in education. The survey was conducted with *Smithsonian* magazine for an edition focusing on STEM (science, technology, engineering and mathematics) education (see "How Much Do Americans Know about Science?").

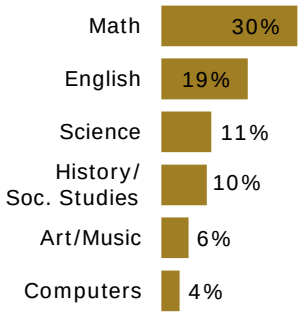
The public underestimates how well American high school students perform on standardized science tests compared with students in other developed nations. A plurality (44%) believes that 15-year-olds in other developed nations outrank U.S. students in knowledge of science; according to an international student assessment, U.S. 15-year-olds are in the middle ranks of developed nations in science knowledge.

Nearly half of Americans (46%) say that the main reason that many young people do not pursue degrees in math and science is mostly because they think these subjects are too hard; just 22% say it is mostly because young people think math and science are not useful for their careers while 20% say it is because they think these subjects are too boring. Women (54%) are more likely than men (37%) to say that the main reason young people do not pursue math and science degrees is because they think these subjects are too difficult.

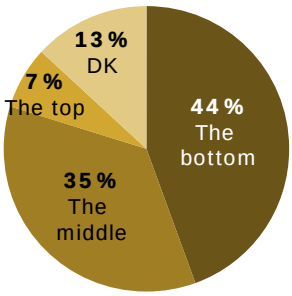
The survey asked an open-ended question about what one subject K-12 schools should emphasize more these days; 30% of respondents say math; 19% say English, grammar or writing, while 11% say science; and 10% say history, social studies or government. Overall, 45% mention some aspect of science, technology, engineering or mathematics.

American Views on Science & Math Education

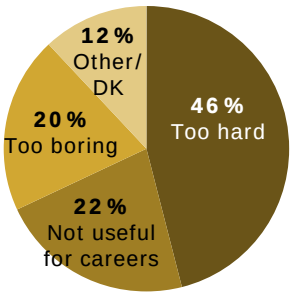
What one subject should K-12 schools emphasize more than they do now?
(top six open ended answers)



On standardized science tests, how do U.S. 15-year-olds rank compared with those in other developed nations?



What's the main reason many young people don't pursue degrees in math and science?



PEW RESEARCH CENTER/
SMITHSONIAN MAGAZINE
March 7-10, 2013. Figures in pie charts may not add to 100% because of rounding.

About the Quiz: Chemical Reactions, Control Groups and CO_2

The new survey includes a mix of 13 knowledge questions; some are the type that might be found in a science textbook while others come from news coverage of science and technology issues.

Among the textbook-type questions, the quiz asks which is a chemical reaction – water boiling, sugar dissolving or nails rusting. Two-thirds (66%) correctly say that nails rusting is an example of a chemical reaction; much smaller percentages incorrectly say that water boiling (12%) and sugar dissolving (also 12%) are examples of chemical reactions.

The survey also asks about basic scientific knowledge in a series of true-false questions. Most Americans (77%) correctly say it is true that the continents have been moving for millions of years and will continue to move in the future. But only about half (47%) say it is true that electrons are smaller than atoms. The percentages answering these and other true-false questions correctly are little changed from a June 2009 survey.

Other questions test knowledge of scientific methods and current scientific issues. Most Americans know that scientists use control groups to test the effectiveness of new drugs in treating disease. Three-quarters (75%) correctly say that scientists give a new drug to half of a group of volunteers, but not to the other half, and compare how many in each group get better. Just 19% say it would be more effective to give the drug to the entire group.

Textbook Science

	Mar 7-10
Which is an example of a chemical reaction?	%
Nails rusting	**66**
Water boiling	12
Sugar dissolving	12
Don't know	10
	100
Electrons are smaller than atoms …	
True	**47**
False	27
Don't know	25
	100

PEW RESEARCH CENTER/ SMITHSONIAN MAGAZINE
March 7-10, 2013. Figures may not add to 100% because of rounding.

Most Know Control Groups Are Used for Testing Drugs

	Mar 7-10
Better way to determine effectiveness of new drug in treating a disease on a group of 1,000 volunteers with the disease?	%
Give the drug to half, but not the other half, and compare how many in each group get better	**75**
Give the drug to all of them and see how many get better	19
Don't know	6
	100
What gas do most scientists believe causes atmospheric temperatures to rise?	
Carbon dioxide	**58**
Hydrogen	10
Helium	8
Radon	7
Don't know	16
	100

PEW RESEARCH CENTER/SMITHSONIAN MAGAZINE
March 7-10, 2013. Figures may not add to 100% because of rounding.

Demographic Differences in Knowledge about Science & Technology

Education is the strongest demographic predictor of knowledge about science and technology. People with at least some exposure to college do much better than those with no college experience on nearly all of the questions.

On several questions, there also are wide differences between college graduates and those who have attended college but not graduated. For instance, 76% of college graduates but just 55% of those with some college experience identify carbon dioxide as the gas that most scientists believe causes atmospheric temperatures to rise.

Wide Educational Differences in Knowledge

	HS or less	Some coll	Coll grad+	Coll-HS diff
% who answered each correctly	%	%	%	%
Nanotechnology deals with? (Small things)	46	72	84	+38
Major concern about overuse of antibiotics? (Resistant bacteria)	58	85	95	+37
All radioactivity is man-made. (False)	54	69	82	+28
Which is an example of a chemical reaction? (Nails rusting)	54	68	81	+27
Gas believed to cause rising temperatures? (Carbon dioxide)	49	55	76	+27
Resource extracted in fracking? (Natural gas)	39	53	66	+27
Electrons are smaller than atoms. (True)	34	54	59	+25
What is the main function of red blood cells? (Carry oxygen)	66	86	89	+23
Lasers work by focusing sound waves. (False)	35	56	58	+23
Sunscreen protects from what radiation? (Ultraviolet)	72	91	91	+19
Better way to test effectiveness of new drug? (Control group)	67	76	86	+19
What gas makes up most of earth's atmosphere? (Nitrogen)	12	22	31	+19
Continents have been moving for millions of years and will continue to move. (True)	68	83	85	+17
Average number correct overall	6.5	8.7	9.8	+3.3

PEW RESEARCH CENTER/SMITHSONIAN MAGAZINE March 7-10, 2013.

There are only modest partisan differences in knowledge about which gas is generally seen by scientists as causing atmospheric temperatures to rise; 63% of independents say it is carbon dioxide, as do 58% of Republicans and 56% of Democrats.

Notably, even most college graduates could not identify the gas that makes up most of the earth's atmosphere. Just 31% correctly say it is nitrogen, while an identical percentage (31%) incorrectly says it is oxygen. Among those with a high school education or less, oxygen is the most frequent response.

In previous Pew Research Center surveys measuring knowledge of politics and public affairs, young people typically have not fared as well as older people. But that pattern does not hold for most questions about scientific topics. As a group, those younger than 30 do about as well as those in the 30-49 and 50-64 age groups.

Meanwhile, people 65 and older scored relatively low on many questions. Just 37% know that nanotechnology deals with small things; majorities in younger age groups know this. And just 27% correctly answered a question about how lasers work, compared with about half in older age groups.

Older People Less Aware of Nanotechnology; Fewer Young People Know about Fracking

	18-29	30-49	50-64	65+
% who answered each correctly	%	%	%	%
Nanotechnology deals with? (Small things)	76	71	63	37
What is the main function of red blood cells? (Carry oxygen)	86	75	84	63
Electrons are smaller than atoms. (True)	56	50	44	33
Lasers work by focusing sound waves. (False)	50	53	50	27
Continents have been moving for millions of years and will continue to move. (True)	87	77	77	66
Sunscreen protects from what radiation? (Ultraviolet)	88	86	82	71
Better way to test effectiveness of new drug? (Control group)	76	75	80	62
All radioactivity is man-made. (False)	68	66	71	56
What gas makes up most of earth's atmosphere? (Nitrogen)	25	22	18	14
Gas believed to cause rising temperatures? (Carbon dioxide)	59	64	56	48
Which is an example of a chemical reaction? (Nails rusting)	66	66	68	58
Major concern about overuse of antibiotics? (Resistant bacteria)	68	84	80	68
Resource extracted in fracking? (Natural gas)	35	52	61	50
Average number of correct answers	8.4	8.4	8.4	6.5

PEW RESEARCH CENTER/SMITHSONIAN MAGAZINE March 7-10, 2013.

However, half (50%) of those 65 and older identify natural gas as the resource extracted in fracking, compared with 61% of those 50-64, 52% of those 30-49 and just 35% of those under 30. This was the only question on which those 65 and older scored higher than those younger than 30.

Overall, men outperformed women on the quiz, though in many cases the differences are modest. On average, men answered 8.6 items correctly, compared with 7.7 items for women.

On the health-related questions on the quiz, however, women did as well as or better than men. Women are more likely than men to know that a major concern of the overuse of antibiotics is that it can lead to antibiotic-resistant bacteria (81% of women know this vs. 72% of men).

Gender Differences in Knowledge

	Men	Women	M-W diff
% who answered each correctly	%	%	%
Lasers work by focusing sound waves. (False)	57	38	+19
Gas believed to cause rising temperatures? (Carbon dioxide)	66	51	+15
Resource extracted in fracking? (Natural gas)	58	45	+13
What gas makes up most of earth's atmosphere? (Nitrogen)	27	14	+13
Continents have been moving for millions of years and will continue to move. (True)	83	72	+11
Electrons are smaller than atoms.(True)	54	41	+13
All radioactivity is man-made (False)	70	63	+7
Nanotechnology deals with? (Small things)	68	62	+6
Sunscreen protects from what radiation? (Ultraviolet)	85	81	+4
What is the main function of red blood cells? (Carry oxygen)	79	77	+2
Which is an example of a chemical reaction? (Nails rusting)	67	65	+2
Better way to test effectiveness of new drug? (Control group)	72	78	-6
Major concern about overuse of antibiotics? (Resistant bacteria)	72	81	-9
Average number correct overall	8.6	7.7	+0.9

PEW RESEARCH CENTER/SMITHSONIAN MAGAZINE March 7-10, 2013.

What Subject Should Receive More Emphasis in K-12 Schools?

Asked in an open-ended format what one subject being taught in K-12 schools should receive greater emphasis than it does now, 30% volunteer math and arithmetic. About one-in-five (19%) say English, grammar, writing and reading should receive more emphasis, while about one-in-ten cite science (11%) or history (10%).

Republicans (35%) are more likely than Democrats (24%) to say that math and arithmetic should be emphasized more by schools. More Republicans (13%) than Democrats (5%) also say that history, social studies and civics should get greater attention.

By contrast, while 17% of Democrats say that science should receive greater emphasis in K-12 schools, just 7% of Republicans agree. Comparable percentages of Republicans and Democrats say other subjects – including English and grammar, art and music, and religion and Christianity – deserve more emphasis than they are currently receiving.

Partisan Differences over Subjects That Deserve Greater Emphasis

What one subject should K-12 schools emphasize more than they do now?	Total %	Rep %	Dem %	Ind %
Math/Arithmetic	30	35	24	32
English/Grammar/Reading	19	23	21	17
Science	11	7	17	10
History/Social studies	10	13	5	14
Art/Music	6	4	6	8
Computers	4	5	4	4
Physical ed/Health/Sex ed	2	1	3	2
Religion/Christianity/Bible	2	2	2	1
Economics/Finances	2	2	2	1
Foreign languages	1	1	1	1
Manners/Respect	1	1	*	1
Other	3	3	3	4
Don't know/No answer	7	5	10	6

PEW RESEARCH CENTER/SMITHSONIAN MAGAZINE
March 7-10, 2013. Open-ended responses. Figures may not add to 100% because of rounding.

Many Say U.S. Students Are Outranked in Science

A plurality of Americans (44%) say that average American 15-year-olds rank at the bottom on standardized tests of science knowledge, when compared with students in other developed nations. That is incorrect: According to the most recent available data from the Program for International Student Assessment, U.S. students rank among the middle of OECD nations.

The survey finds that 35% correctly know that U.S. 15-year-olds are about in the middle when it comes to science knowledge; 7% say incorrectly that American students rank among the top of developed nations.

College graduates are more likely than those with less education to underestimate the performance of U.S. teens on standardized science tests. More than half of college graduates (56%) say that American students rank near the bottom among developed countries. That compares with 46% of those with some college experience who do not have a degree and 36% of those with no more than a high school education.

There are no significant partisan differences in evaluations of student performance on standardized science tests: 46% of Republicans and about as many Democrats (45%) and independents (45%) say they rank near the bottom among developed nations.

Where Do American Students Rank in Science?

Compared with students in other developed nations, Americans rank at…	Top	Middle	Bottom	DK
	%	%	%	%
Total	7	35	44	13=100
Men	6	37	43	14=100
Women	8	33	45	13=100
18-29	11	36	37	16=100
30-49	7	31	48	14=100
50-64	6	35	47	13=100
65+	5	41	43	10=100
College grad+	3	35	56	6=100
Some college	9	33	46	12=100
HS or less	9	36	36	19=100

PEW RESEARCH CENTER/SMITHSONIAN MAGAZINE
March 7-10, 2013. Figures may not add to 100% because of rounding.

When asked why many young people do not pursue degrees in math and science, a 46% plurality says it is mostly because they view these subjects as too difficult. Fewer say young people are turned off because they see math and science as not useful for their careers (22%) or because they are too boring (20%).

Young people have about the same opinions as older people for why many do not pursue math and science degrees: 47% say it is because those subjects are seen as too difficult. More women (54%) than men (37%) say many young people do not go after degrees in math and science mainly because they perceive those subjects as being too difficult.

Many See Difficulty of Math, Science as Main Stumbling Block

Main reason many young people don't pursue math and science degrees?	Too hard	Too boring	Not useful	Other/ DK
	%	%	%	%
Total	46	20	22	12=100
Men	37	25	26	13=100
Women	54	17	19	11=100
18-29	47	23	22	7=100
30-49	46	18	24	11=100
50-64	43	23	22	13=100
65+	45	18	24	13=100
College grad+	52	17	18	14=100
Some college	45	20	27	8=100
HS or less	42	24	21	13=100

PEW RESEARCH CENTER/SMITHSONIAN MAGAZINE
March 7-10, 2013. Figures may not add to 100% because of rounding.

About the Survey

The analysis in this report is based on telephone interviews conducted March 7-10, 2013 among a national sample of 1,006 adults 18 years of age or older living in the continental United States (501 respondents were interviewed on a landline telephone, and 505 were interviewed on a cell phone, including 242 who had no landline telephone). The survey was conducted by interviewers at Princeton Data Source and Universal Survey under the direction of Princeton Survey Research Associates International. A combination of landline and cell phone random digit dial samples were used; both samples were provided by Survey Sampling International. Interviews were conducted in English. Respondents in the landline sample were selected by randomly asking for the youngest adult male or female who is now at home. Interviews in the cell sample were conducted with the person who answered the phone, if that person was an adult 18 years of age or older. For detailed information about our survey methodology, see: http://people-press.org/methodology/.

The combined landline and cell phone sample are weighted using an iterative technique that matches gender, age, education, race, Hispanic origin and region to parameters from the 2011 Census Bureau's American Community Survey and population density to parameters from the Decennial Census. The sample also is weighted to match current patterns of telephone status, based on extrapolations from the 2012 National Health Interview Survey. The weighting procedure also accounts for the fact that respondents with both landline and cell phones have a greater probability of being included in the combined sample and adjusts for household size among respondents with a landline phone. Sampling errors and statistical tests of significance take into account the effect of weighting. 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:

Group	Unweighted sample size	Plus or minus ...
Total sample	1,006	3.7 percentage points
Men	518	5.2 percentage points
Women	488	5.3 percentage points
18-29	172	9.0 percentage points
30-49	223	7.9 percentage points
50-64	296	6.8 percentage points
65+	268	7.2 percentage points
College grad+	409	5.8 percentage points
Some college	282	7.0 percentage points
HS or less	305	6.7 percentage points

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.

PEW RESEARCH CENTER
March 7-10, 2013 OMNIBUS
FINAL TOPLINE
N=1,006

PEW.1 PREVIOUSLY RELEASED

ASK ALL:
PEW.2 Thinking about what's being taught in kindergarten-through-12th-grade schools these days, what ONE subject should schools emphasize more than they do now? **[OPEN END. ACCEPT ONLY ONE RESPONSE. USE PRECODED LIST IF RESPONSE CLEARLY FITS. OTHERWISE RECORD VERBATIM RESPONSE. PROBE FOR CLARITY – DO NOT PROBE FOR ADDITIONAL MENTIONS.]**

March 7-10 2013	
30	Math/Mathematics/Arithmetic
19	English/Grammar/Writing/Reading
11	Science
10	History/Social studies/Civics/Politics/Current events/Government
6	Art/Arts/Music
4	Computers/Computer science
2	Physical education/Health/Sex education/Abstinence
2	Religion/Christianity/Bible/Prayer/Creationism
2	Economics/Finances
1	Foreign languages
1	Manner/Respect/Anti-bullying
3	Other
7	Don't know/No answer
45	**(NET) STEM subjects**

ASK ALL:
PEW.3 What's the main reason many young people don't pursue degrees in math and science? Is it mostly because they think these subjects … **[READ AND RANDOMIZE]**

March 7-10 2013	
46	Are too hard
20	Are too boring
22	Are not useful for their careers
7	Other **(VOL.)**
4	Don't know/Refused **(VOL.)**

PEW.4-PEW.5 PREVIOUSLY RELEASED

NO QUESTION PEW.6

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

PEW.7 CONTINUED…

		True	False	(VOL.) DK/Ref
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
c.	Lasers work by focusing sound waves			
	March 7-10, 2013	19	**48**	34
	June 18-21, 2009	22	**47**	31
	TREND FOR COMPARISON:			
	General Social Survey, 2012	24	**45**	31
	General Social Survey, 2010	19	**48**	33
	General Social Survey, 2008	24	**48**	28
	General Social Survey, 2006	17	**45**	38
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.9 Does nanotechnology deal with things that are extremely **[READ AND RANDOMIZE]**

March 7-10 2013	
65	Small *(Correct)*
3	Large
2	Cold
4	Hot
26	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.11 What is the main function of red blood cells? Is it… **[READ AND RANDOMIZE]**

March 7-10 2013	
9	To fight disease in the body
78	To carry oxygen to all parts of the body *(Correct)*
6	To help the blood to clot
7	Don't know/Refused **(VOL.)**

ASK ALL:
PEW.12 Which of these is a major concern about the overuse of antibiotics? **[READ AND RANDOMIZE]**

March 7-10 2013	
77	It can lead to antibiotic-resistant bacteria *(Correct)*
6	Antibiotics are very expensive
10	People will become addicted to antibiotics
7	Don't know/Refused **(VOL.)**

ASK ALL:
PEW.13 Which is an example of a chemical reaction? **[READ AND RANDOMIZE]**

March 7-10 2013	
12	Water boiling
12	Sugar dissolving
66	Nails rusting *(Correct)*
10	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.15 What gas do most scientists believe causes temperatures in the atmosphere to rise? Is it **[RANDOMIZE AND READ]**?

March 7-10 2013		June 18-21 2009	April 28-May 12 2009
58	Carbon dioxide *(Correct)*	65	66
10	Hydrogen	7	7
8	Helium	4	4
7	Radon	5	6
16	Don't know/Refused **(VOL.)**	20	17

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.)**

ASK ALL:

PEW.17 On standardized tests of science knowledge, do average American 15 year olds rank at **[READ IN REVERSE ORDER FOR HALF THE SAMPLE:** the top, the middle, or the bottom**]** compared with 15 year olds in other developed nations?

March 7-10 2013	
7	Top
35	Middle *(Correct)*
44	Bottom
13	Don't know/Refused **(VOL.)**