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# Most Americans Accept Genetic Engineering of Animals That Benefits Human Health, but Many Oppose Other Uses

*Public concerns about animal biotechnology focus on risks to animals, humans and the ecosystem*

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**FOR MEDIA OR OTHER INQUIRIES:**

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## Most Americans Accept Genetic Engineering of Animals That Benefits Human Health, but Many Oppose Other Uses

*Public concerns about animal biotechnology focus on risks to animals, humans and the ecosystem*

As Americans consider the possible uses of genetic engineering in animals, their reactions are neither uniformly accepting nor resistant; instead, public reactions vary depending on the mechanism and intended purpose of the technology, particularly the extent to which it would bring health benefits to humans.

Presented with five different scenarios of animal genetic engineering that are currently available, in development or considered possible in the future, Americans provide majority support only for the two that have clear potential to pre-empt or ameliorate human illness.

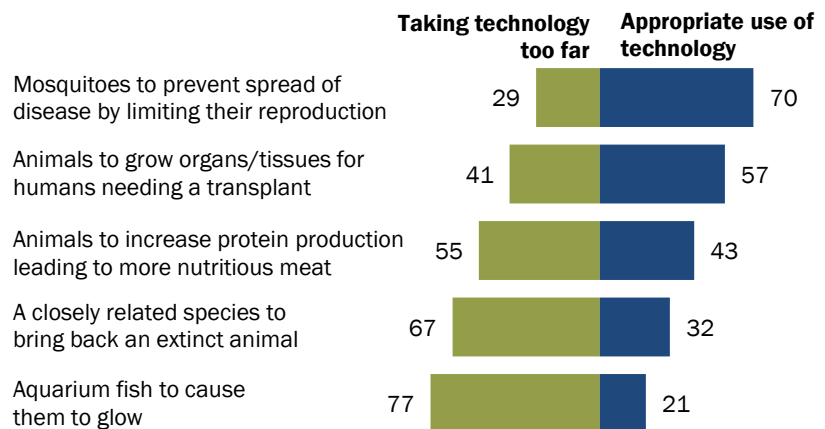
The survey's most widely accepted use of genetic intervention of animals involves mosquitoes. Seven-in-ten Americans (70%) believe that genetically engineering mosquitoes to prevent their reproduction

and therefore the spread of some mosquito-borne diseases would be an appropriate use of technology, while about three-in-ten (29%) see the use of genetic engineering for this purpose as taking technology too far.

And a 57% majority considers it appropriate to genetically engineer animals to grow organs or tissues that could be used for humans needing a transplant.

### Americans' views on genetic engineering of animals vary widely by its intended purpose

*% of U.S. adults who say genetic engineering of each of the following is ...*



Note: Respondents who did not give an answer are not shown.

Source: Survey conducted April 23-May 6, 2018.

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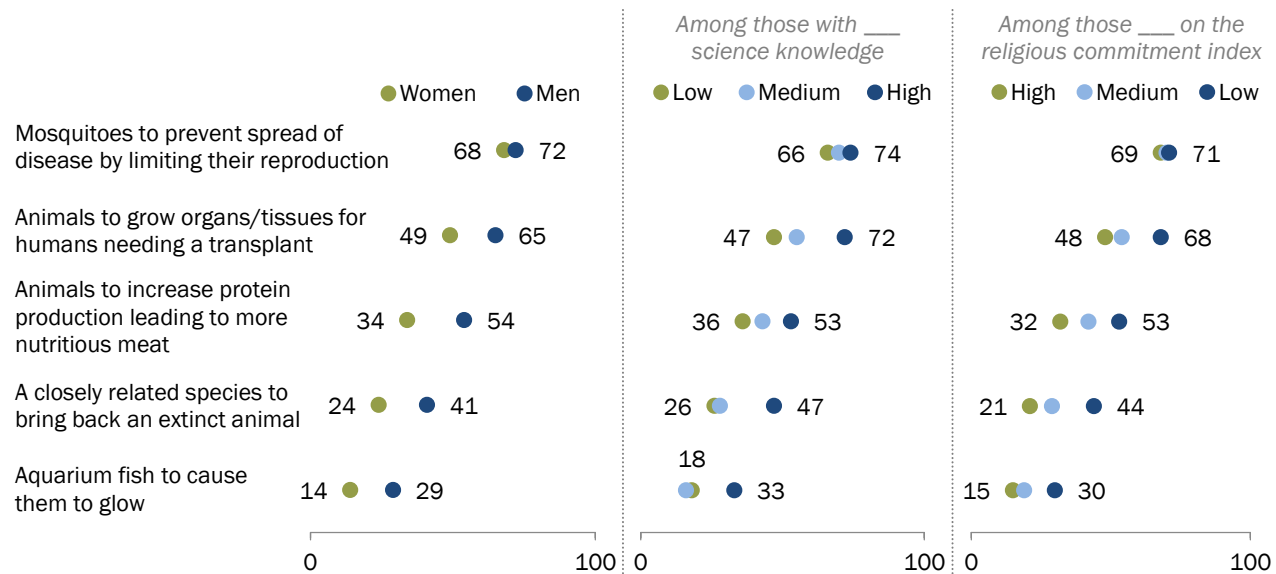
But other uses of animal biotechnology are less acceptable to the public, including the creation of more nutritious meat for human consumption (43% say this is appropriate) or restoring an extinct animal species from a closely related species (32% say this is appropriate). And one application that is already commercially available is largely met with resistance: Just 21% of Americans consider it an appropriate use of technology to genetically engineer aquarium fish to glow using a fluorescence gene, while 77% say this is taking technology too far.

These are some of the findings from a new Pew Research Center survey, conducted April 23-May 6 among a nationally representative sample of 2,537 U.S. adults that looks at public views about [genetic engineering of animals](#) – a term that encompasses a range of biotechnologies that can add, delete or change an animal’s existing genetic material and thereby introduce new traits or characteristics.

Although most Americans are largely in agreement that using genetic engineering in mosquitoes to prevent the spread of mosquito-borne illnesses is appropriate, views about other uses of genetic engineering of animals considered in the survey differ by gender, levels of science knowledge and

### Men, those with high science knowledge and those low in religiosity are more inclined to see these varied uses of animal biotechnology as appropriate

% of U.S. adults in each group who say genetic engineering of \_\_\_ would be an appropriate use of technology



Note: Respondents who gave other responses or who did not give an answer are not shown. See Methodology for details on indices of science knowledge and religious commitment.

Source: Survey conducted April 23-May 6, 2018.

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religiosity. Men are more accepting of these uses of technology than women, those with high science knowledge are more accepting than those with medium or low science knowledge and those low in religious commitment are more accepting than those with medium or high levels of religious commitment.

For example, about two-thirds of men (65%) see genetic engineering of animals to grow human organs or tissues for transplants as appropriate, compared with about half of women (49%). Also, Americans with high science knowledge (72%) are more inclined than those with medium (55%) or low (47%) science knowledge to say this would be appropriate. And a larger share of those with low religious commitment (68%) than medium (54%) or high (48%) religious commitment consider genetic engineering of animals to grow human organs or tissues for transplants to be appropriate.

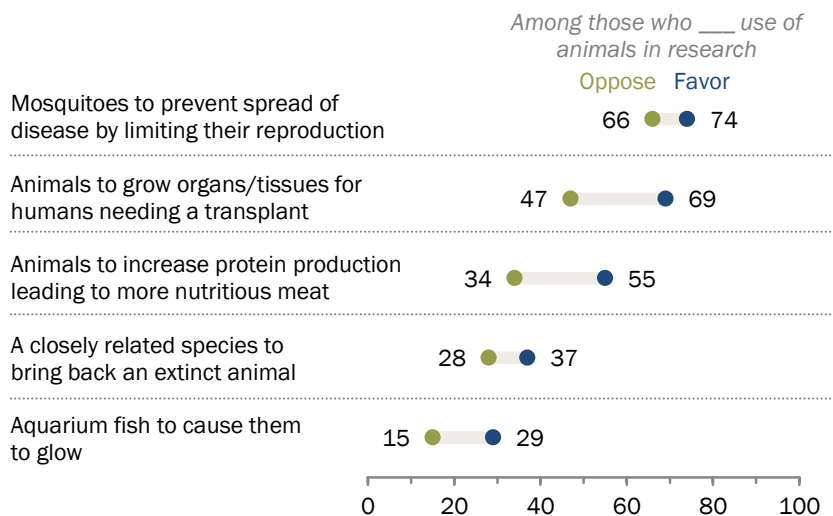
Emerging developments in [animal biotechnology](#) raise new social, ethical and policy issues for society, including the potential impact on [animal welfare](#).

The survey finds that the 52% of Americans who in general oppose the use of animals in scientific research are, perhaps not surprisingly, also more inclined to consider specific uses of genetic engineering of animals to be taking technology too far.

There are large differences between these groups when it comes to using animal biotechnology for humans needing an organ or tissue transplant and the idea of using such technology to produce more nutritious meat.

### Opponents of research using animals are less likely to see animal biotechnology as appropriate

*% of U.S. adults in each group who say genetic engineering of \_\_\_ would be an appropriate use of technology*



Note: Respondents who gave other responses or who did not give an answer are not shown. Source: Survey conducted April 23-May 6, 2018.

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## Reasoning behind public qualms over animal biotechnology

To better understand people's beliefs about genetic engineering of animals, the survey asked a subset of respondents to explain, in their own words, the main reason behind their view that genetic engineering in each of these circumstances would be taking technology too far.

A common refrain in these responses raised the possibility of unknown risks for animals, humans or the ecosystem. Some saw these technologies as humankind inappropriately interfering with the natural world or raised general concerns about unknown risks.

About three-in-ten of those who said genetic engineering of mosquitoes would be taking technology too far explained that humankind would be disrupting nature (23%) or interfering with God's plan (8%).

One respondent put it this way:

*"Nature is a balance and every time man interferes with it, it doesn't turn out well."*

Some 24% of those with objections to the idea of reducing the fertility of mosquitoes through genetic engineering in order to reduce mosquito-borne illnesses raised concerns about the possible impact on the ecosystem.

Such responses include:

*"I do not think we know enough about the effects of removing a whole class of insects*

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### Objections to genetically engineering mosquitoes to prevent disease include potential harm to ecosystem

*Main reason for saying genetic engineering of mosquitoes to prevent the spread of some diseases by limiting their reproduction is taking technology too far*

	% of those asked
MESSING WITH NATURE, GOD'S PLAN	29
Messing with nature and the natural balance of things	23
Messing with God's plan	8
ECOSYSTEM CONCERNS	24
Effect on ecosystem, other species	23
Accidental extinction of mosquitoes	2
General concerns about risk of unintended consequences/long term effects	18
NOT NEEDED, OTHER WAYS TO ACHIEVE	8
Can achieve the same goal with different methods	7
Unnecessary	1
HUMAN HEALTH CONCERNS	
Could create new dangers to human health	4
We don't know enough about this, need more research	2
This is a slippery slope; could be abused	1
General negative	3
All other responses	8
Don't know/No answer	19

Note: Based on random sample of those who say genetic engineering of mosquitoes that would prevent them from reproducing in order to prevent the spread of some mosquito-borne diseases would be taking technology too far (n=181). Open-end responses are coded into categories. Figures add to more than 100% because multiple responses were allowed.

Source: Survey conducted April 23-May 6, 2018.

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*from the environment. What would be the effects on those animal and plants ‘up the chain?’”*

*“Mosquitoes are part of a complex ecosystem and food chain. By preventing their reproduction, we risk disrupting the entire ecosystem.”*

Objections to the idea of using animal biotechnology to grow organs or tissues for transplant in humans focused on beliefs about using animals for human benefit (21%) and potential risks for human health from creating human organs from animals (16%).

For example:

*“In manufacturing organs, the existence of these animals would be miserable ... in order to cultivate such organs the animals would need to be in a lab setting and would more than likely never see the light of day. I can’t ethically say that I would agree with such a practice.”*

*“When you mix human and nonhuman genetics I believe that will cause extreme problems down the road.”*

*“Animal organs are not made for humans even though some animal and human organs may be very similar. Who knows what side effects this could cause? Even human-to-human organ transplants often reject, so I can only imagine the bad side effects that an animal-to-human transplant would cause. Keep things simple and the way nature intended.”*

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## **Objections to genetic engineering for human organ transplant include concern for animals, risk to humans**

*Main reason for saying genetic engineering of animals to grow organs or tissues for humans needing a transplant is taking technology too far*

	% of those asked
ANIMAL WELFARE	
Animal suffering/harmful to animals	21
MESSING WITH NATURE, GOD’S PLAN	
Messing with God’s plan	18
Messing with nature, should leave things the way they are	11
	6
HUMAN HEALTH CONCERNS	
Negative effect on human health, opposed to mixing animal and human genetics	16
General concerns about risk of unintended consequences/long term effects	9
NOT NEEDED, OTHER WAYS TO ACHIEVE	
Waste of time and resources	4
There are other options/methods for those needing a transplant	3
	1
This is a slippery slope; could be abused	4
We don’t know enough about this, need more research	2
General negative	7
All other responses	5
Don’t know/No answer	31

Note: Based on random sample of those who say genetic engineering of animals to grow organs or tissues that can be used for humans needing a transplant would be taking technology too far and were given the question (n=293). Open-end responses are coded into categories. Figures add to more than 100% because multiple responses were allowed.

Source: Survey conducted April 23-May 6, 2018.

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Genetic engineering could produce more nutritious meat by altering animal proteins. Those who think this is taking technology too far raised a number of different concerns. Some cited general concerns about as-yet-unknown risks (20% of those asked), while a similar share (19%) saw this as messing with nature or God’s plan in a way that goes beyond what humans should do.

One respondent put it this way:

*“Should we as human beings change the course of nature’s ‘natural selection’ and potentially introduce unintended serious consequences?”*

About one-in-ten (12%) objected to the idea on the grounds that people should rely less on meat in their diet or that any genetic engineering in foods is a likely health risk.

One example of these concerns:

*“Meat is nutritious as it is. There is no need to try to increase nutrition. Rather we should be decreasing human reliance on meat as a foodstuff.”*

## Objections to genetic engineering for more nutritious meat include risk to human health and animal welfare

*Main reason for saying genetic engineering to create more nutritious meat is taking technology too far*

	% of those asked
General concerns about risk of unintended consequences/long term effects	20
MESSING WITH NATURE, GOD’S PLAN	19
Messing with nature; should leave things the way they are	13
Messing with God’s plan	9
People should eat less or no meat; beliefs that such meat would not be safe	12
HUMAN HEALTH CONCERNS	
Negative effect on human health	11
ANIMAL WELFARE	
Animal suffering/harmful to animals	9
NOT NEEDED, OTHER WAYS TO ACHIEVE	9
There are other ways to accomplish this	6
Unnecessary	2
Waste of time and resources	2
We don’t know enough about this, need more research	4
This is a slippery slope; could be abused	3
General negative	5
All other responses	6
Don’t know/No answer	23

Note: Based on random sample of those who say genetic engineering of animals to increase their production of specific proteins that will lead to more nutritious meat would be taking technology too far (n=457). Open-end responses are coded into categories. Figures add to more than 100% because multiple responses were allowed.

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Those who objected to the idea of bringing back extinct species often raised concerns about unintended harm to the ecosystem. Roughly two-in-ten (18%) of those asked explained their views by saying there is a reason that these animals are currently extinct, with some saying these animals would be unlikely to survive if brought back, and another 12% of this group raised potential risks to other species and the ecosystem from bringing an extinct animal into a different world.

For example:

*“Beware of unintended consequences.’ The universe is in balance with them extinct. Consider the problems man has created by reintroducing species that have become extinct [in] a given area, i.e., wolves and mountain lions to areas now occupied by humans and domestic livestock.”*

Others discussed these ideas in terms of God’s plan and human interference with the natural world (23%).

A few examples:

*“God is the creator of all living things, not mankind. Extinction is part of evolution of the universe.”*

*“Nature has selected species to become extinct over millions and millions of years. We have no right to bring animals back and play God.”*

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## Objections to genetic engineering to bring back extinct species include risk to ecosystem

*Main reason for saying genetic engineering to bring back an extinct species is taking technology too far*

	% of those asked
ECOSYSTEM CONCERNS	28
They are extinct for a reason	18
Effect on ecosystem, habitats, other species	12
MESSING WITH NATURE, GOD’S PLAN	23
Messing with God’s plan	12
Messing with nature and the natural balance of things	12
NOT NEEDED, WASTE OF RESOURCES	14
Does not serve a need or purpose, unnecessary	7
Waste of time and resources	4
Should focus efforts on protecting living/endangered animals	3
General concerns about risk of unintended consequences/long term effects	11
This is a slippery slope; could be abused	5
Possibility of “Jurassic Park” scenario	4
General negative	4
All other responses	7
Don’t know/No answer	21

Note: Based on random sample those who say bringing back an animal that is currently extinct by genetically engineering a closely related species would be taking technology too far (n=560). Open-end responses are coded into categories. Figures add to more than 100% because multiple responses were allowed.

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And 14% said they regard bringing back an extinct species as taking technology too far because they do not see a need or purpose to this, especially as it does not seem to bring any benefit to humans, or that resources should be focused elsewhere.

A sampling of these concerns:

*“For what purpose would it be done? Is there a benefit to humanity other than having a rare zoo specimen? Would the extinct species cease to become extinct through natural reproduction – if not that, the whole effort is without merit.”*

*“I don’t see the purpose of bringing any animal back. Would it provide a better way of life for humans?”*

Objections to the idea of changing the appearance of aquarium fish using genetic engineering to make the fish glow often focused on the lack of apparent need or benefit to either humans or animals.

About half (48%) of those who say engineering a glowing fish takes technology too far said they do not see the purpose for humans or society, questioned its necessity or considered it frivolous or a waste of resources.

Some examples:

*“... [While] changing a fish to glow might sound like something people would want to see it’s not something beneficial to humankind. At this point it would just [be] playing God to entertain rather [than] help us.”*

## Objections to genetic engineering of aquarium fish raise questions about need, benefit

*Main reason for saying genetic engineering of aquarium fish takes technology too far*

	% of those asked
NOT NEEDED, WASTE OF RESOURCES	48
No purpose or benefit to fish, humans or society	23
Unnecessary	15
Frivolous, changing fish for cosmetic reasons	13
Waste of time and resources	9
MESSING WITH NATURE, GOD’S PLAN	18
Messing with nature, should leave things the way they are	12
Messing with God’s plan	8
ANIMAL WELFARE	
Animal welfare, possibility of harm to fish	6
General concerns about risk of unintended consequences/long term effects	5
ECOSYSTEM CONCERNS	
Potential ecosystem effects if fish were to be released into the wild	2
This is a slippery slope; could be abused	5
General negative	6
All other responses	4
Don’t know/No answer	18

Note: Based on random sample of those who say genetic engineering of aquarium fish to change their appearance, causing them to glow, would be taking technology too far (n=764). Open-end responses are coded into categories. Figures add to more than 100% because multiple responses were allowed.

Source: Survey conducted April 23-May 6, 2018.

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*“It’s frivolous. Technology should be used to help people, animals and the environment, not put on a glow show.”*

*“Why? If you only do something because you can is not a good reason. If any genetic engineering is allowed it will get out of hand. It would be a fine line that I am sure we would cross.”*

*“It seems a frivolous thing to do, much like someone getting plastic surgery to remove wrinkles or other signs of aging. The person’s life is not extended by a ‘better’ appearance. The aquarium fish also do not benefit from their changed appearance.”*

## Acknowledgments

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[pewresearch.org/science](http://pewresearch.org/science).

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## Methodology

This report is drawn from a survey conducted as part of the American Trends Panel (ATP), a nationally representative panel of randomly selected U.S. adults living in households recruited from landline and cellphone random-digit-dial (RDD) surveys. Panelists participate via monthly self-administered web surveys. Panelists who do not have internet access are provided a tablet and wireless internet connection. The panel, which was created by Pew Research Center, is being managed by GfK.

Data in this report are drawn from the panel wave conducted April 23-May 6, 2018, among 2,537 respondents. The margin of sampling error for the full sample of 2,537 respondents is plus or minus 2.8 percentage points.

Members of the ATP were recruited from several large, national landline and cellphone RDD surveys conducted in English and Spanish. At the end of each survey, respondents were invited to join the panel. The first group of panelists was recruited from the 2014 Political Polarization and Typology Survey, conducted Jan. 23-March 16, 2014. Of the 10,013 adults interviewed, 9,809 were invited to take part in the panel and a total of 5,338 agreed to participate.<sup>1</sup>

The second group of panelists was recruited from the 2015 Pew Research Center Survey on Government conducted Aug. 27-Oct. 4, 2015. Of the 6,004 adults interviewed, all were invited to join the panel, and 2,976 agreed to participate.<sup>2</sup> The third group of panelists was recruited from a

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### Margins of error

	Sample size	Margin of error in percentage points
U.S. adults	2,537	+/- 2.8
Men	1,272	+/- 4.0
Women	1,265	+/- 3.8
<i>Religious commitment index</i>		
High	440	+/- 6.7
Medium	1,291	+/- 3.8
Low	566	+/- 5.7
<i>Science knowledge index</i>		
High	679	+/- 5.2
Medium	1,274	+/- 3.9
Low	584	+/- 5.7
<i>Use of animals in research</i>		
Favor	1,279	+/- 4.0
Oppose	1,219	+/- 3.9

Note: The margins of error are reported at the 95% level of confidence and are calculated by taking into account the average design effect for each subgroup.

Source: Survey conducted April 23-May 6, 2018.

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<sup>1</sup> 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.

<sup>2</sup> Respondents to the 2014 Political Polarization and Typology Survey who indicated that they are internet users but refused to provide an email address were initially permitted to participate in the American Trends Panel by mail but were no longer permitted to join the panel after Feb. 6, 2014. Internet users from the 2015 Pew Research Center Survey on Government who refused to provide an email address were not permitted to join the panel.

survey conducted April 25-June 4, 2017. Of the 5,012 adults interviewed in the survey or pretest, 3,905 were invited to take part in the panel and a total of 1,628 agreed to participate.<sup>3</sup>

The overall target population for Wave 34 was non-institutionalized persons ages 18 and older, living in the United States, including Alaska and Hawaii. The sample for Wave 34 consisted of 3,099 ATP members that were invited to Wave 33 and were still active. This subsample was selected using the following approach:

1. Panelists were grouped into three strata based on how underrepresented they are demographically. Then we analyzed response rates to the last five panel survey waves (W28-32) to project the number of panelists in each stratum who would respond to the W33 survey.
2. We then determined how many panelists we wanted to sample from each stratum in W33 in order to finish with around 2,500 completed interviews and have a responding sample that is as representative as possible.
  - Stratum A consists of panelists who are non-internet users, are black non-Hispanic, are Hispanic, or have high school or less education. There were 1,819 total panelists in this stratum and they are sampled at a rate of 100% for W33. Of these, 1,806 were active panelists.
  - Stratum B consists of panelists who are ages 18 to 34 or are non-volunteers. The 1,684 total panelists in this stratum are subsampled at a rate of 63%, yielding 1,061 sampled for W33 (1,057 were active).
  - Stratum C consists of the remaining 2,009 panelists not in stratum A or B. This group is subsampled at a rate of 12%, yielding 241 panelists sampled for W33 (239 were active).

The ATP data were weighted in a multistep process that begins with a base weight incorporating the respondents' original survey selection probability and the fact that in 2014 some panelists were subsampled for invitation to the panel. Next, an adjustment was made for the fact that the propensity to join the panel and remain an active panelist varied across different groups in the sample. The final step in the weighting uses an iterative technique that aligns the sample to population benchmarks on a number of dimensions. Gender, age, education, race, Hispanic origin

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<sup>3</sup> White, non-Hispanic college graduates were subsampled at a rate of 50%.

and region parameters come from the U.S. Census Bureau's 2016 American Community Survey. The county-level population density parameter (deciles) comes from the 2010 U.S. decennial census. The telephone service benchmark comes from the July-December 2016 National Health Interview Survey and is projected to 2017. The volunteerism benchmark comes from the 2015 Current Population Survey Volunteer Supplement. The party affiliation benchmark is the average of the three most recent Pew Research Center general public telephone surveys. The internet access benchmark comes from the 2017 ATP Panel Refresh Survey. Respondents who did not previously have internet access are treated as not having internet access for weighting purposes. Sampling errors and statistical tests of significance take into account the effect of weighting. Interviews are conducted in both English and Spanish, but the Hispanic sample in the ATP is predominantly U.S. born and English speaking.

Margins of error tables shown here provide 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 taking into account the average design effect for each subgroup. 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 April 2018 wave had a response rate of 82% (2,537 responses among 3,099 individuals in the panel). Taking account of the combined, weighted response rate for the recruitment surveys (10.1%) and attrition from panel members who were removed at their request or for inactivity, the cumulative response rate for the wave is 2.3%.<sup>4</sup>

### **Religious commitment index**

Survey respondents were classified into high, medium and low levels of religious commitment based on three indicators: frequency of religious service attendance, self-reported importance of religion in their lives and frequency of prayer. Those who attend worship services at least weekly, pray at least once a day and say religion is very important in their lives are classified as high in religious commitment. Those low in commitment say religion is not too or not at all important in their lives, that they seldom or never attend worship services, and seldom or never pray. All others are classified as exhibiting a medium level of religious commitment.

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<sup>4</sup> Approximately once per year, panelists who have not participated in multiple consecutive waves are removed from the panel. These cases are counted in the denominator of cumulative response rates. Note that for the March 2018 survey, we calculated the response rates by computing the mean rates for the subsampled respondents (based on the rates from the recruitment survey they joined the panel on).

## Science knowledge index

The Pew Research Center survey included a set of nine questions to tap public knowledge of science across a range of principles and topics. Most respondents (n=1,901) completed these questions as part of a previous wave of the American Trends Panel, conducted May 10-June 6, 2016. Respondents who did not participate in the previous wave answered these questions in this survey (n=636). The following shows the measurement properties of the index for the combined set of 2,537 respondents.<sup>5</sup>

As shown in the accompanying table, the internal reliability or consistency of the scale as measured by Cronbach's alpha is 0.75. Each of the items in the scale is at least moderately correlated with the other items.

An exploratory factor analysis finds one common factor explaining 76% of the common variance in the items. The factor loadings show that each of the nine questions is moderately correlated with the common factor. These indicators suggest a set of items is measuring a single underlying dimension.

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## Scale reliability and factor analysis

Knowledge index 9-items	Item-rest correlation	Alpha for scale	Common variance explained by first factor
		0.75	76%
		Alpha if item is dropped	Factor loadings
KNOSCT22. Use of a control group to determine whether a new drug is effective	0.39	0.74	0.46
KNOSCT23. Carbon dioxide is made as a consequence of burning fossil fuels	0.47	0.73	0.55
KNOSCT27. The probability of an old-bridge collapsing after a period of time	0.50	0.72	0.59
KNOSCT28. Only bacterial infections can be treated effectively by antibiotic medications	0.31	0.75	0.35
KNOSCT29. The use of a control "sugar pill" in a new drug trial is to rule out a possible placebo effect	0.43	0.73	0.50
KNOSCT31. The health benefits occurring when most people in a population get a vaccine is called herd immunity	0.45	0.73	0.52
KNOSCT32. An apple, salmon, corn and a mosquito can all be genetically modified.	0.47	0.73	0.55
KNOSCT33. Humans and mice share 50% or more of the same genetic makeup	0.43	0.73	0.50
KNOSCT34. Nitrogen makes up most of the Earth's atmosphere.	0.44	0.73	0.52

Source: Surveys conducted May 10-June 6, 2016, and April 23-May 6, 2018. "Most Americans Accept Genetic Engineering of Animals That Benefits Human Health, but Many Oppose Other Uses"

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<sup>5</sup> In statistical models controlling for demographics and education, there were no significant differences between respondents who completed the science knowledge items in 2016 (W17) and those who completed them in 2018 (W34) on either the overall index measure or the individual questions.



Note that each of the science knowledge questions are coded as binary variables (correct/incorrect). Both Cronbach’s alpha reliability analysis and the factor analysis are based on a Pearson’s correlation matrix. Pearson correlations with binary variables are restricted to a limited range, underestimating the association between two variables when compared with tetrachoric correlations. We do not anticipate that the use of a Pearson’s correlation matrix affects the unidimensional factor solution for the scale, however.

We also ran an item-response theory analysis (IRT) to check how well each question distinguishes between those who know relatively more or less on the scale. This analysis

fits a two-parameter logistic model, allowing discrimination and difficulty to vary across the items. Discrimination shows the ability of the question to distinguish between those with higher and lower science knowledge. Difficulty shows how easy or hard each question is for the average respondent. We did not include a guessing parameter in the model; the questionnaire offered respondents an explicit option of not sure on the survey.

The results show variation in difficulty across the items. The easiest item required respondents to identify carbon dioxide as the gas that is made as a consequence of burning fossil fuels, while the most difficult item required respondents to identify nitrogen as the gas that makes up most of the Earth’s atmosphere.

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### Two parameter item response theory analysis

	% Correct	Discrimination	Difficulty
KNOSCT22. Use of a control group to determine whether a new drug is effective	68	1.36	-0.73
KNOSCT23. Carbon dioxide is made as a consequence of burning fossil fuels	72	1.74	-0.82
KNOSCT27. The probability of an old-bridge collapsing after a period of time	62	2.14	-0.38
KNOSCT28. Only bacterial infections can be treated effectively by antibiotic medications	46	0.81	0.25
KNOSCT29. The use of a control “sugar pill” in a new drug trial is to rule out a possible placebo effect	59	1.60	-0.33
KNOSCT31. The health benefits occurring when most people in a population get a vaccine is called herd immunity	34	1.39	0.65
KNOSCT32. An apple, salmon, corn and a mosquito can all be genetically modified.	39	1.66	0.38
KNOSCT33. Humans and mice share 50% or more of the same genetic make-up	34	1.37	0.66
KNOSCT34. Nitrogen makes up most of the Earth’s atmosphere.	31	1.55	0.74

Source: Surveys conducted May 10-June 6, 2016, and April 23-May 6, 2018.  
 “Most Americans Accept Genetic Engineering of Animals That Benefits Human Health, but Many Oppose Other Uses”

PEW RESEARCH CENTER

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Most of the questions also discriminate between those with higher and lower science knowledge. The item with strongest ability to discriminate was the question asking respondents to calculate the conditional probability of an old bridge over time. The question with the weakest ability to discriminate was the question about the effectiveness of antibiotics to treat bacterial, but not other kinds of infections.

The test information curve mirrors a normal curve centered around zero, suggesting that the science knowledge index provides the most information about Americans near the mean level of knowledge.

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## Survey questionnaire and topline

2018 PEW RESEARCH CENTER'S AMERICAN TRENDS PANEL  
 APRIL 23-MAY 6, 2018  
 TOTAL N=2,537

### ADDITIONAL QUESTIONS PREVIOUSLY RELEASED OR HELD FOR FUTURE RELEASE

#### ASK ALL:

SCI5 On another topic...

All in all, do you favor or oppose the use of animals in scientific research?

Apr 23-

May 6

2018

47	Favor
52	Oppose
2	No answer

#### TREND FOR COMPARISON

*Pew Research Center surveys conducted by telephone: All in all, do you favor or oppose [INSERT ITEM, RANDOMIZE: the use of animals in scientific research]?*

	Aug 15-25 <u>2014</u>	Apr 28-May 12 <u>2009</u>
<i>Favor</i>	47	52
<i>Oppose</i>	50	43
<i>Don't know/Refused (VOL.)</i>	3	6

### ADDITIONAL QUESTIONS PREVIOUSLY RELEASED OR HELD FOR FUTURE RELEASE

#### RANDOMIZE BIOTECHA-BIOTECHE

#### ASK ALL:

**[SHOW ON SAME SCREEN FOR FIRST BIOTECH ITEM ONLY:** Genetic engineering can be used to change the genetic characteristics of animals. Thinking about the following applications of genetic engineering...]

BIOTECHA Do you think genetic engineering of animals to increase their production of specific proteins that will lead to more nutritious meat would be...

Apr 23-

May 6

2018

43	An appropriate use of technology
55	Taking technology too far
2	No answer

**ASK ALL:**

BIOTECHB

Do you think bringing back an animal that is currently extinct by genetically engineering a closely-related species would be...

Apr 23-

May 6

2018

32

An appropriate use of technology

67

Taking technology too far

1

No answer

**ASK ALL:**

BIOTECHC

Do you think genetic engineering of mosquitoes that would prevent them from reproducing in order to prevent the spread of some mosquito-borne diseases would be...

Apr 23-

May 6

2018

70

An appropriate use of technology

29

Taking technology too far

1

No answer

**ASK ALL:**

BIOTECHD

Do you think genetic engineering of animals to grow organs or tissues that can be used for humans needing a transplant would be...

Apr 23-

May 6

2018

57

An appropriate use of technology

41

Taking technology too far

2

No answer

**ASK ALL:**

BIOTECH E

Do you think genetic engineering of aquarium fish to change their appearance, causing them to glow would be...

Apr 23-

May 6

2018

21

An appropriate use of technology

77

Taking technology too far

1

No answer

**ASK WHEN ANY BIOTECHA-BIOTECH=2 AND FILL TOPIC FROM QUESTION STEM. IF MORE THAN ONE BIOTECHA-BIOTECH=2, RANDOMLY SELECT ONE ITEM TO FILL TOPIC [N=2,255]:**

NOBIOTECH What is the MAIN REASON you think that [FILL FROM SELECTED ITEM] would be taking technology too far?  
**[OPEN END RESPONSES NOT SHOWN]**

**NUMBER OF RESPONSES FILLED AT NOBIOTECH**

457	Genetic engineering of animals to increase their production of specific proteins that will lead to more nutritious meat
560	Bringing back an animal that is currently extinct by genetically engineering a closely-related species
181	Genetic engineering of mosquitoes that would prevent them from reproducing in order to prevent the spread of some mosquito-borne diseases
293	Genetic engineering of animals to grow organs or tissues that can be used for humans needing a transplant
764	Genetic engineering of aquarium fish to change their appearance, causing them to glow

NOBIOTECHA What is the MAIN REASON you think that genetic engineering of animals to increase their production of specific proteins that will lead to more nutritious meat would be taking technology too far? **[N=457]**

Apr 23-  
May 6  
2018

20	General concerns about risk of unintended consequences/long term effects
13	Messing with nature; should leave things the way they are
12	Beliefs about eating meat, nutrition NET
6	<i>We should eat less meat anyways</i>
5	<i>Adding anything synthetic (GMOs, chemicals) to food is bad</i>
1	<i>Beliefs about and standards of nutrition change</i>
11	Negative effect on human health
9	Animal suffering/harmful to animals
9	Messing with God's plan
6	There are other ways to accomplish this
4	We don't know enough about this, need more research
3	This is a slippery slope; could be abused
2	Unnecessary
2	Waste of time and resources
1	Unsure of the motivations of scientists and funders behind this
5	General negative
6	Other
1	Don't know
22	No answer

NOBIOTECHB What is the MAIN REASON you think that bringing back an animal that is currently extinct by genetically engineering a closely-related species would be taking technology too far? **[N=560]**

Apr 23-  
May 6  
2018

18	They are extinct for a reason
12	Effect on ecosystem, habitats, other species
12	Messing with God's plan
12	Messing with nature and the natural balance of things
11	General concerns about risk of unintended consequences/long term effects
7	Does not serve a need/purpose, unnecessary
5	This is a slippery slope; could be abused
4	Possibility of a Jurassic Park scenario
4	Waste of time and resources
3	Should focus efforts on protecting living/endangered animals
<1	We don't know enough about this, need more research
4	General negative
7	Other
<1	Don't know
21	No answer

NOBIOTECHC What is the MAIN REASON you think that genetic engineering of mosquitoes that would prevent them from reproducing in order to prevent the spread of some mosquito-borne diseases would be taking technology too far? **[N=181]**

Apr 23-  
May 6  
2018

23	Effect on ecosystem, habitats, other species
23	Messing with nature and the natural balance of things
18	General concerns about risk of unintended consequences/long term effects
8	Messing with God's plan
7	Other methods can achieve the same goal
4	Could create new dangers to human health (diseases, etc.)
2	Accidental extinction of mosquitoes
2	We don't know enough about this, need more research
1	Unnecessary
1	This is a slippery slope; could be abused
3	General negative
8	Other
0	Don't know
19	No answer

NOBIOTECHD What is the MAIN REASON you think that genetic engineering of animals to grow organs or tissues that can be used for humans needing a transplant would be taking technology too far? [**N=293**]

Apr 23-  
May 6  
2018

21	Animal suffering/harmful to animals
16	Negative effect on human health, opposed to mixing animal and human genetics
11	Messing with God's plan, morally unacceptable
9	General concerns about risk of unintended consequences/long term effects
6	Messing with nature, should leave things the way they are
4	This is a slippery slope; could be abused
3	Waste of time and resources
2	We don't know enough about this, need more research
1	There are other options/methods for those needing a transplant
1	Only available for the wealthy
1	Don't need to extend human life; will lead to overpopulation
1	Unsure of the motivations of scientists and funders behind this
7	General negative
2	Other
<1	Don't know
30	No answer

NOBIOTECHE What is the MAIN REASON you think that genetic engineering of aquarium fish to change their appearance, causing them to glow would be taking technology too far? [**N=764**]

Apr 23-  
May 6  
2018

23	No purpose or benefit to fish, humans, society
15	Unnecessary
13	Frivolous, changing fish for a cosmetic reason
12	Messing with nature, should leave things be
9	Waste of time and resources
8	Messing with God's plan
6	Animal welfare, possibility of harm to fish
5	This is a slippery slope; could be abused
5	General concerns about risk of unintended consequences/long term effects
2	Potential ecosystem effects if fish were to be released into the wild
1	This already occurs naturally
<1	We don't know enough about this, need more research
<1	Unsure of the motivations of scientists and funders behind this
6	General negative
3	Other
1	Don't know
17	No answer

**ADDITIONAL QUESTIONS PREVIOUSLY RELEASED OR HELD FOR FUTURE RELEASE**

**NOTE: RESULTS SHOWN FOR KNOSCT22-KNOSCT34 INCLUDE 636 RESPONDENTS WHO ANSWERED THESE QUESTIONS APR 23-MAY 6, 2018 COMBINED WITH 1,901 RESPONDENTS WHO ANSWERED THESE QUESTIONS IN A PREVIOUS WAVE FIELDDED MAY 10-JUNE 6, 2016.**

**ASK ALL:**

Here's a different kind of question. (If you don't know the answer, select "Not sure." As far as you know...

KNOSCT22 Here's a different kind of question. (If you don't know the answer, select "Not sure.") As far as you know...

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... **[RANDOMIZE OPTIONS 1 AND 2]**

Apr 23-  
May 6  
2018

68	Give the drug to half of them but not to the other half, and compare how many in each group get better ( <i>Correct</i> )
32	NET Incorrect/Not sure/No answer
14	Give the drug to all of them and see how many get better
18	Not sure
<1	No answer

**[RANDOMIZE ITEMS KNOSCT23 TO KNOSCT34; KNOSCT22 ALWAYS FIRST]****ASK ALL:**

KNOSCT23 Which gas is made as a consequence of burning fossil fuels? Is it... **[RANDOMIZE OPTIONS 1-4]<sup>6</sup>**

Apr 23-  
May 6  
2018

72	Carbon dioxide ( <i>Correct</i> )
28	NET Incorrect/Not sure/No answer
4	Hydrogen
1	Helium
3	Radon
20	Not sure
<1	No answer

**NO QUESTION KNOSCT24, KNOSCT25 AND KNOSCT26**

<sup>6</sup> In the Wave 17 May 2016 survey, the question had a minor wording difference: "What gas is made as a consequence of burning fossil fuels? Is it..."



**ASK ALL:**

KNOSCT27

If the chances that an old bridge will collapse starts at 1% in week 1 and doubles each week (as shown below), what is the chance that the old bridge will collapse during week 7?

Chances the bridge will collapse is...

1% at Week 1  
2% at Week 2  
4% at Week 3  
8% at Week 4

Enter the % chance that the bridge will collapse at Week 7 (if the bridge is still standing after Week 6)<sup>7</sup>

Apr 23-

May 6

2018

62	64% ( <i>Correct</i> )
38	NET Incorrect/Not sure/No answer
20	All other numeric responses
17	Not sure
1	No answer

**ASK ALL:**

KNOSCT28

Which of the following conditions can be treated effectively by antibiotic medications?

[Check all that apply] **[RANDOMIZE ITEMS WITH ITEMS e AND f ALWAYS LAST]**

Apr 23-

May 6

2018

46	Bacterial infection only ( <i>Correct</i> )
54	NET Incorrect/Not sure/No answer

**KNOSCT28 INDIVIDUAL ITEM RESPONSES**

	<u>Selected</u>	<u>Not selected</u> <u>/No answer</u>
a. Viral infections (such as a cold)	23	77
b. Fungal infections (such as athlete's foot)	28	72
c. Bacterial infections (such as strep throat infections)	83	17
d. Allergic reactions to insect bites	17	83
e. None of these <b>[EXCLUSIVE PUNCH]</b>	2	98
f. Not sure <b>[EXCLUSIVE PUNCH]</b>	9	91

<sup>7</sup> The phrase "(if the bridge is still standing after Week 6)" was added for clarity in the Apr 23-May 6, 2018 wave.

**ASK ALL:**

KNOSCT29 If a scientist wants to determine if a new drug is effective at treating high blood pressure by giving half of a group of 1,000 volunteers a new medication and the other half a "sugar pill" she wants to rule out... **[RANDOMIZE OPTIONS 1-3]**

Apr 23-  
May 6  
2018

59	A placebo effect ( <i>Correct</i> )
41	NET Incorrect/Not sure/No answer
4	A third person effect
16	A false consensus effect
20	Not sure
1	No answer

**NO QUESTION KNOSCT30****ASK ALL:**

KNOSCT31 Which of these terms refers to health benefits occurring when most people in a population get a vaccine? **[RANDOMIZE OPTIONS 1-3]**

Apr 23-  
May 6  
2018

34	Herd immunity ( <i>Correct</i> )
66	NET Incorrect/Not sure/No answer
8	Population control
35	Vaccination rate
23	Not sure
1	No answer

**ASK ALL:**

KNOSCT32 Which of the following can be genetically modified?

*[Check all that apply]* **[RANDOMIZE ITEMS WITH ITEMS e AND f ALWAYS LAST]**

Apr 23-  
May 6  
2018

39	Selected all ( <i>Correct</i> )
61	NET Incorrect/Not sure/No answer

**KNOSCT32 INDIVIDUAL ITEM RESPONSES**

	<u>Selected</u>	<u>Not selected</u> <u>/No answer</u>
a. An apple	61	39
b. Salmon	53	47
c. A mosquito	46	54
d. Corn	70	30
e. None of these <b>[EXCLUSIVE PUNCH]</b>	2	98
f. Not sure <b>[EXCLUSIVE PUNCH]</b>	20	80

**ASK ALL:**

KNOSCT33 Humans and mice share the same genetic make-up by... **[RANDOMIZE ORDER LOW TO HIGH; HIGH TO LOW with NOT SURE ALWAYS LAST]**

Apr 23-

May 6

2018

34	About 50% or more ( <i>Correct</i> )
66	NET Incorrect/Not sure/No answer
8	Less than 10%
14	Between 11% and 49%
44	Not sure
1	No answer

**ASK ALL:**

KNOSCT34 Which gas makes up most of the Earth's atmosphere? **[RANDOMIZE OPTIONS 1-4]**

Apr 23-

May 6

2018

31	Nitrogen ( <i>Correct</i> )
69	NET Incorrect/Not sure/No answer
9	Hydrogen
9	Carbon dioxide
35	Oxygen
15	Not sure
1	No answer

**TOTAL NUMBER CORRECT KNOSCT22 THROUGH KNOSCT34:**

Apr 23-

May 6

2018

4	9 out of 9
10	8 out of 9
10	7 out of 9
13	6 out of 9
12	5 out of 9
13	4 out of 9
11	3 out of 9
12	2 out of 9
9	1 out of 9
6	0 out of 9
24	High science knowledge (7-9 correct)
49	Medium science knowledge (3-6 correct)
26	Low science knowledge (0-2 correct)