Awareness & Impressions Of Synthetic Biology

A Report Of Findings

Based On A National Survey Among Adults

Conducted On Behalf Of:

Synthetic Biology Project

The Woodrow Wilson International Center For Scholars

By Hart Research Associates

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From January 10 to 14, 2013, Hart Research Associates conducted a nationwide telephone survey among 804 adults, including 243 who use only a cell phone. The survey explored attitudes toward the entities involved in the oversight of new scientific and technological advances, awareness of nanotechnology, and awareness of and attitudes toward synthetic biology, and impressions of potential applications of synthetic biology. This is the sixth year we have asked questions about nanotechnology and the fourth year we have questioned respondents about synthetic biology. At the 95% confidence level, the data's margin of error is ±3.5 percentage points.

Overview

- There has been little change in public awareness of either nanotechnology or synthetic biology since previous surveys. Today, 31% of adults say they have heard a lot or some about nanotechnology, compared with 23% who say the same about synthetic biology. The most common associations that respondents make with synthetic biology are that it is unnatural, man-made, and artificial or that it has to do with reproducing life.
- When first asked about the potential risks and benefits of synthetic biology, a plurality of adults thinks the risks and benefits will be about equal (40%). Similar proportions think the benefits will outweigh the risks (18%) as think the risks will outweigh the benefits (15%), and fully 27% are not sure.
- After adults are given more information about what synthetic biology is and its potential risks and benefits, their impressions move more toward concern about risks than optimism about benefits. The proportion of adults who say risks will outweigh benefits increases from 15% initially to 33% once informed, an increase of 18 percentage points. By contrast, there is a six-percentage-point increase in impressions that the benefits will outweigh risks (18% initial, 24% informed). The proportion saying the benefits and risks will be about equal stays largely the same (40% initial, 38% informed).
- Public confidence in university scientists and researchers to maximize benefits and minimize risks associated with scientific and technological advancements is greatest, with 69% of adults expressing a great deal or fair amount of confidence in such individuals. Half say they have a great deal or fair amount of confidence in business to manage risks and benefits associated with scientific advancements, while a lesser 46% feels this way about non-government organizations. Just one in three expresses this level of confidence in the federal government to maximize benefits and minimize risks.
- Opinions are divided on regulation of synthetic biology. Nearly equal proportions of adults say that synthetic biology research should be regulated by the federal government (45%) and that voluntary research guidelines should be developed jointly by industry and government (43%). This reveals an increase in support for voluntary guidelines over

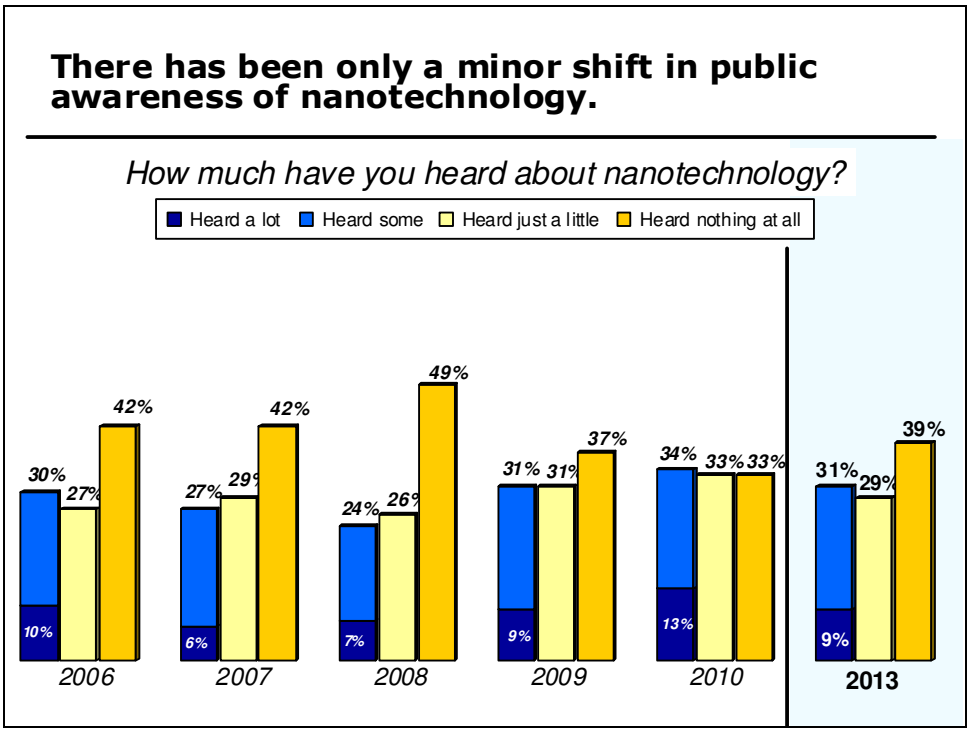
government regulation since 2010 when 52% supported regulation by the federal government and 36% favored voluntary guidelines.

- Adults express a variety of concerns about synthetic biology. Similar proportions say they are most concerned about synthetic biology being used to create harmful things like biological weapons (28%), that it is morally wrong to create artificial life (27%), and that synthetic biology could cause negative health effects for humans (20%). A smaller proportion (12%) expresses concern about potential damage to the environment.
- Despite these concerns, a majority of adults support continuing synthetic biology research. By 61% to 34%, adults say that synthetic biology research should move forward rather than be banned until its implications and risks are better understood.
- Public reactions the use of synthetic biology depend on the application in question, but none of the three applications tested is viewed favorably by more than half of Americans. Among those tested, a bare majority of adults express support for the use of synthetic biology to engineer mosquitoes to assist in controlling the spread of disease. By contrast, a majority of adults view both the creation of a crop-enhancing fertilizer and new food additives through the application of synthetic biology as negative developments.
- Nine in 10 (92%) adults report having no awareness of the Do-It-Yourself Biology movement. Just 7% say that they have heard of citizens and amateur scientists taking part in DIYBio.

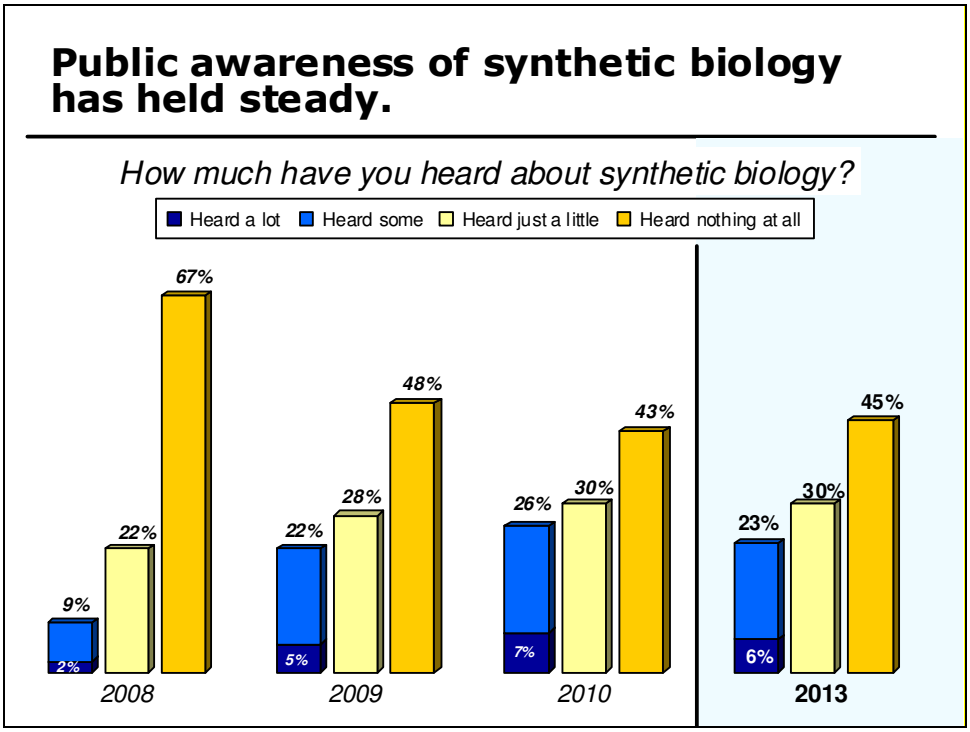
Key Findings

Awareness of nanotechnology largely has held steady over the past three years, with three in 10 Americans today saying they have heard a lot or some about it. Thirty-one percent (31%) of Americans report having heard a lot (9%) or some (22%) about nanotechnology. Awareness has changed little compared with past surveys conducted in September 2009 (31% heard a lot/some) and August 2010 (34% heard a lot/some). Meanwhile, 29% of adults today say they have heard just a little about nanotechnology, and 39% say they have heard nothing at all.

Men (40% heard a lot/some), particularly 18- to 49-year-old men (43%), and 18- to 34-year-olds in general (38%) report the highest levels of awareness about nanotechnology. Education and income also play an important role. College graduates report having higher levels of awareness (46%) than do adults with a high school education or less (13%), and high-income earners (43% among households who earn $75,000 or more) are more likely to say they have heard about nanotechnology than are adults who earn less than $30,000 annually (18%).



Likewise, public awareness of synthetic biology has changed little in recent years, with just one in four today saying they have heard a lot or some about it. Nearly one in four (23%) adults has heard a lot (6%) or some (17%) about synthetic biology today, while the remainder report having heard just a little (30%) or nothing at all (45%) about it. The level of awareness is similar to those reported in August 2010 (26% heard a lot or some) and August 2009 (22% heard a lot or some). The biggest jump in awareness was from 2008 (9% heard a lot or some) to 2009.



Those who have heard about nanotechnology are most likely to report awareness of synthetic biology. Among those who say they have heard a lot or some about nanotechnology, 46% say they have heard about synthetic biology. Similarly, the same groups who report higher levels of awareness of nanotechnology are most likely to have heard about synthetic biology: adults with a household income of $75,000 or greater (32%) and college graduates (31%) are most likely to report awareness of synthetic biology.

When asked to think about what synthetic biology involves, adults are most likely to associate the science with something that is man-made and artificial.

Respondents were asked in an open-ended question to volunteer their ideas of what synthetic biology is, and the types of images, words, or phrases they associate with the concept. The most commonly volunteered responses link synthetic biology to something that is unnatural, man-made, and artificial (31%). Other associations that respondents make with synthetic biology

include recreating life, cloning, or genetic manipulation (15%, including 5% who mention cloning specifically), prosthetics (10%), or synthetic oils and materials (9%). Other less common associations with synthetic biology that are mentioned include the development of medicines (6%), agricultural applications (6%), and general scientific experimentation (5%). Overall, fully 76% of respondents volunteer some association that they make with synthetic biology.

The public tends to associate synthetic biology with something man-made and artificial.

What Do You Think Synthetic Biology Is?

(Volunteered Comments)

Unnatural, man-made, something that isn't real, artificial	31%
Reproducing/recreating life, cloning, genetic/DNA manipulation	15%
Prosthetics, artificial limbs/organs/tissues	10%
Synthetic oils/composites/materials	9%
Development of medicines/treatments for diseases	6%
Agricultural applications, weather-resistant plants/crops	6%
Based in science/scientific experimentation/ research	5%
Don't know; no response	24%

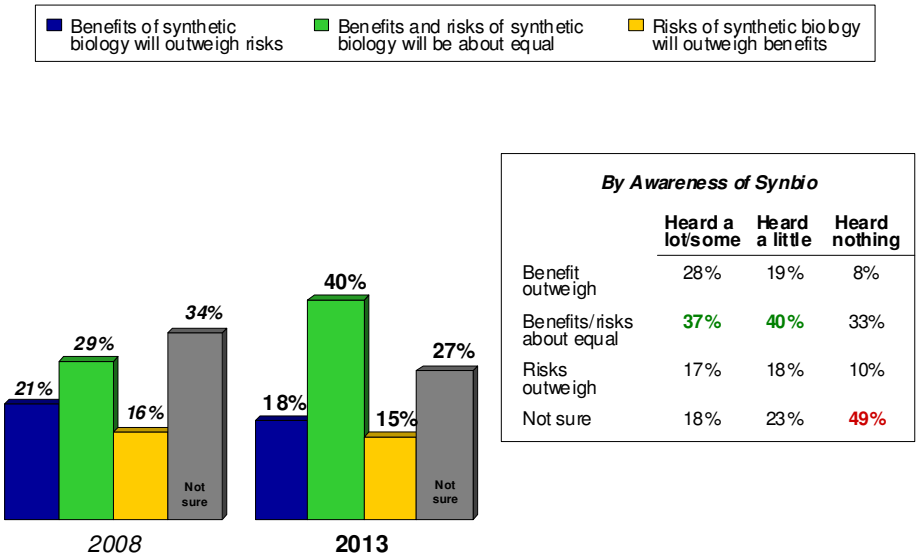
The public's initial, uninformed impressions about the potential risks and benefits of synthetic biology tend to be neither largely positive or largely negative. A plurality of adults believes that the risks and benefits will be about equal (40%), and 27% of adults feel they do not know enough to have an opinion. The remainder is evenly divided between those who say the benefits will outweigh the risks (18%) and those who think the risks will outweigh the benefits (15%).

Adults who report having higher levels of awareness of synthetic biology are slightly more likely to say the potential benefits of the science outweigh the risks. Among those who report having heard a lot or some about synthetic biology, 28% say the benefits outweigh the potential risks, while 17% say the risks outweigh the benefits. The largest proportion (37%) believes the risk and benefits will be equal, and 18% are not sure. Adults who say they have *heard only a little* about synthetic biology are divided in their initial impressions of the potential risks and benefits of the science: 19% say the benefits outweigh risks, while 18% say the risks outweigh the benefits. Most say the risks and benefits are equal (40%), while 23% are not sure.

About half (49%) of adults who say they have *heard nothing at all* about synthetic biology do not express an opinion about the science and another 33% think the risks and benefits are about equal.

Demographic groups that offer the most positive outlook regarding the potential effects of synthetic biology include adults with a household income greater than $75,000 (27% benefits outweigh risks), men overall (24%), 18- to 49-year-old men (25%), and college graduates (21%). Nonreligious adults (22% benefits outweigh risks) also are more likely to express optimism than are followers of specific religions. Just 16% of Protestants, 16% of Evangelicals, and 11% of Catholics say the benefits of synthetic biology will outweigh the risks.

Initially, a plurality thinks that the risks and benefits of synthetic biology are about equal.



By Awareness of Synbio

	Heard a lot/some	Heard a little	Heard nothing
Benefit outweigh	28%	19%	8%
Benefits/risks about equal	37%	40%	33%
Risks outweigh	17%	18%	10%
Not sure	18%	23%	49%

Upon hearing more information about synthetic biology, including some of its potential benefits and risks, a greater proportion of adults move toward concern about the risks associated with synthetic biology than express optimism about its potential benefits.

Brief Description Of Synthetic Biology Read To Respondents:

Synthetic biology is the use of advanced science and engineering to make or re-design living organisms, such as bacteria, so that they can carry out specific functions. Synthetic biology involves making new genetic code, also known as DNA, that does not already exist in nature.

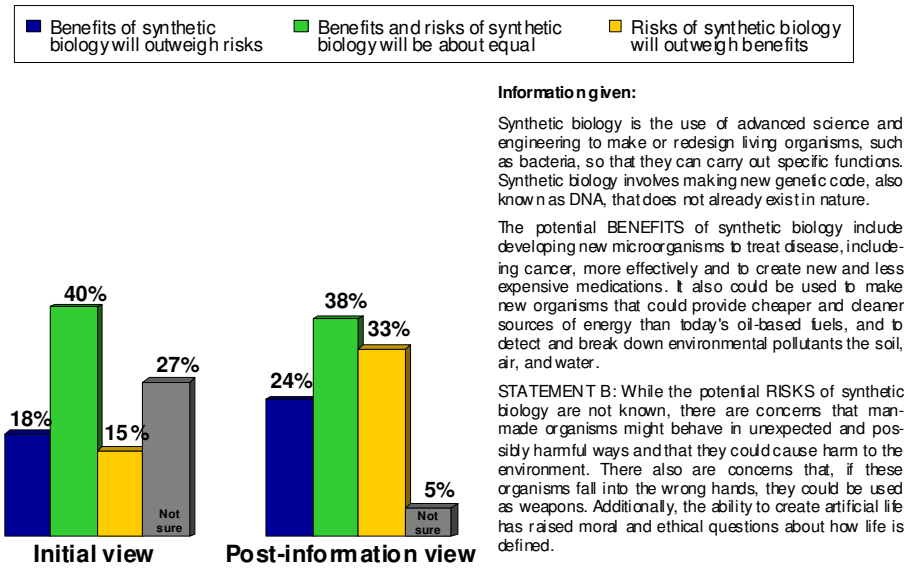
I would like to read you statements about the potential benefits and potential risks of synthetic biology and get your reaction.

The potential BENEFITS of synthetic biology include developing new micro-organisms to treat disease, including cancer, more effectively and to create new and less expensive medications. It also could be used to make new organisms that could provide cheaper and cleaner sources of energy than today's oil-based fuels, and to detect and break down environmental pollutants in the soil, air, and water.

While the potential RISKS of synthetic biology are not known, there are concerns that man-made organisms might behave in unexpected and possibly harmful ways and that they could cause harm to the environment. There also are concerns that, if these organisms fall into the wrong hands, they could be used as weapons. Additionally, the ability to create artificial life has raised moral and ethical questions about how life is defined.

Once respondents are read a more detailed description of the concept of synthetic biology and its potential risks and benefits, a plurality of adults (38%) continue to believe that the risks and benefits of the science are about equal. Among the remainder of adults, a greater proportion moves toward concern about the risks of synthetic biology than toward optimism about its potential benefits. Upon learning more about the science, one in three (33%) says the risks outweigh the benefits, compared with 15% who say so initially—an increase of 18 percentage points. By comparison, the increase in the proportion of adults who say benefits will outweigh the risks is smaller (18% initial, 24% informed, a difference of six percentage points). Just 5% of informed adults say they are not sure either way about the science.

After learning about synthetic biology, more move toward concern about risks than toward optimism about benefits.



The groups who show the greatest movement toward risk after being presented with information about potential implications include Evangelicals (+27 percentage points), adults with a high school diploma or less (+25), Hispanics (+22), adults who attend religious services weekly (+22), those who report having heard nothing about synthetic biology (+22), individuals age 65 and older (+20), and those with household incomes less than $30,000 (+20).

Initial And Informed Impressions Of Synthetic Biology

	Initial Impressions			Informed Impressions		
	Benefits Outweigh Risks %	Risks Outweigh Benefits %	Risks And Benefits About Equal %	Benefits Outweigh Risks %	Risks Outweigh Benefits %	Risks And Benefits About Equal %
All adults	**18**	**15**	**40**	**24**	**33**	**38**
Men	26	13	36	31	30	35
Women	11	18	43	18	35	41
Age: 18 to 34	19	13	45	26	27	44
Age: 35 to 49	18	16	39	28	32	36
Age: 50 to 64	18	23	35	21	38	36
Age: 65 and over	**14**	**10**	**37**	**23**	**30**	**38**
Men: 18 to 49	26	13	41	37	27	34
Men: 50 and over	25	14	29	25	33	36
Women: 18 to 49	11	15	44	17	32	46
Women: 50 and over	10	21	42	19	37	37
High school or less	**11**	**13**	**49**	**18**	**38**	**35**
Some college/tech	16	18	39	21	34	42
College grad or more	24	16	33	32	27	38
Less than $30,000	**11**	**13**	**45**	**18**	**33**	**43**
$30,000-50,000	16	18	45	20	30	43
$50,000-$75,000	24	19	41	35	32	31
More than $75,000	28	15	35	32	32	35
Whites	19	17	36	27	33	36
African Americans	15	12	45	19	30	47
Hispanics	**13**	**8**	**51**	**17**	**30**	**47**
Attend religious services weekly	**14**	**20**	**40**	**19**	**42**	**34**
Attend religious services less often	23	13	41	25	27	46
Rarely/never attend religious services	18	14	40	29	26	40
Protestants	17	19	40	22	38	35
Catholics	13	14	43	21	32	43
No religion	24	13	35	33	20	40
Evangelicals	**17**	**16**	**41**	**19**	**43**	**34**
Heard about Synthetic Biology:						
Heard a lot/some	28	19	40	34	27	37
Heard just a little	19	19	44	29	34	33
Heard nothing	**11**	**12**	**37**	**18**	**34**	**42**

The public expresses the most confidence in university researchers to maximize benefits and minimize risks associated with scientific and technological advancements. They are much less likely to trust the federal government to manage risk-benefit tradeoffs.

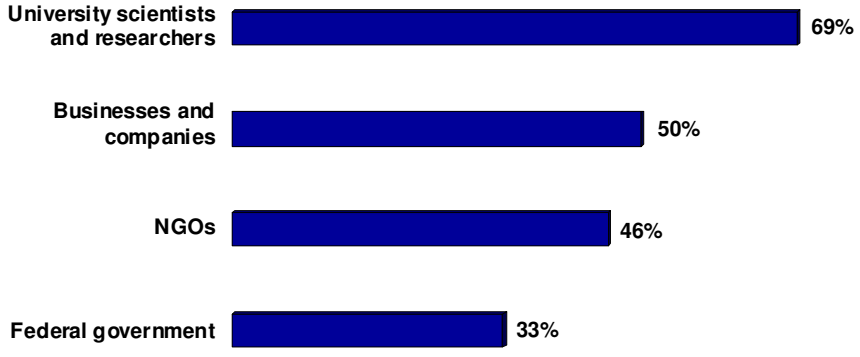
More than two-thirds (69%) of adults say they place a great deal or fair amount of confidence in university researchers and scientists to maximize benefits and minimize risks associated with scientific advancements, the highest level of confidence among the four groups tested. A lesser 26% say they trust universities just some or very little to manage new findings in the industry.

Confidence in business and non-governmental organizations (NGOs) to maximize benefits and minimize risks is more divided. Half of adults express a great deal (11%) or fair amount (39%) of confidence in businesses and companies, while 46% say they have just some or less trust in corporations to manage risk in their industries. Confidence in NGOs is divided similarly (46% great deal/fair amount, 44% just some/very little).

Public confidence in the federal government in this arena is lowest. By nearly two to one, adults place just some or very little confidence in the federal government to carry out the role of managing benefits and mitigating risks (64%), compared with those who have a great deal or fair amount of confidence in government (33%).

The public has varied levels of confidence in several groups to maximize benefits and minimize risks of synthetic biology.

I have a great deal/fair amount of confidence in this group to maximize benefits and minimize risks associated with scientific and technological advancement:

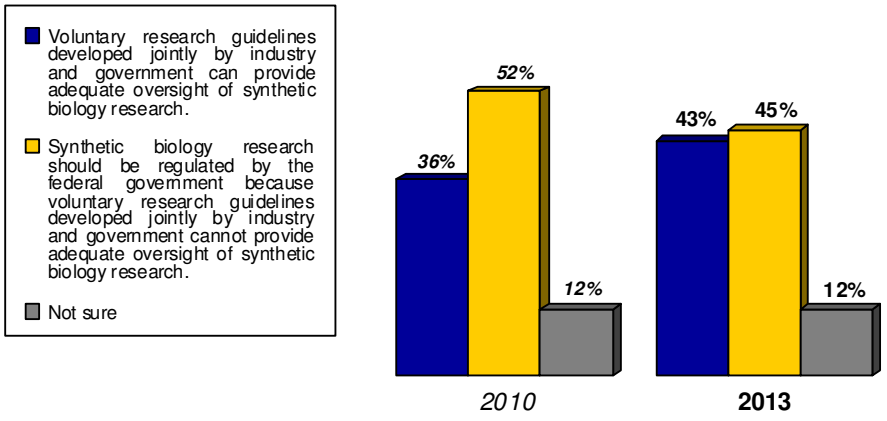


Public opinion largely is divided over the best approach to providing oversight of synthetic biology research. Nearly equal proportions of adults say industry and government should work together to develop voluntary research guidelines and that the federal government should oversee synthetic biology research.

Adults are divided in their views of the best approach to regulating synthetic biology research. The proportion of adults who say the federal government should regulate synthetic biology (45%) is roughly equal to the proportion who instead believe that voluntary guidelines developed jointly by industry and government can provide adequate oversight of synthetic biology (43%). The remaining 12% of adults are not sure either way. This reveals an increase in support for voluntary guidelines over government regulation since 2010.

The public is split over voluntary guidelines versus government regulation of synthetic biology.

Which best describes your point of view on voluntary research guidelines for synthetic biology research?



African Americans (58%), Hispanics (57%), adults with household incomes below $30,000 (55%), women (49%), and adults with a high school education or less (49%) are most supportive of federal regulation. Those who express a great deal or fair amount of confidence in the federal government to maximize benefits and minimize risks associated with new scientific advancements are more likely to support government regulation of synethic biology (59%) versus voluntary guidelines (33%).

Moreover, opinions about regulation vary by political affiliation. Democrats are more likely to favor federal regulation of synethic biology (60% favor federal regulation, 31% voluntary guidelines), while a majority of Republicans favor voluntary guidelines (32% federal regulation, 56%

voluntary guidelines). A plurality of independents also support voluntary guidelines developed jointly by government and industry, though opinions among this group are more divided (39% federal regulation, 45% voluntary guidelines).

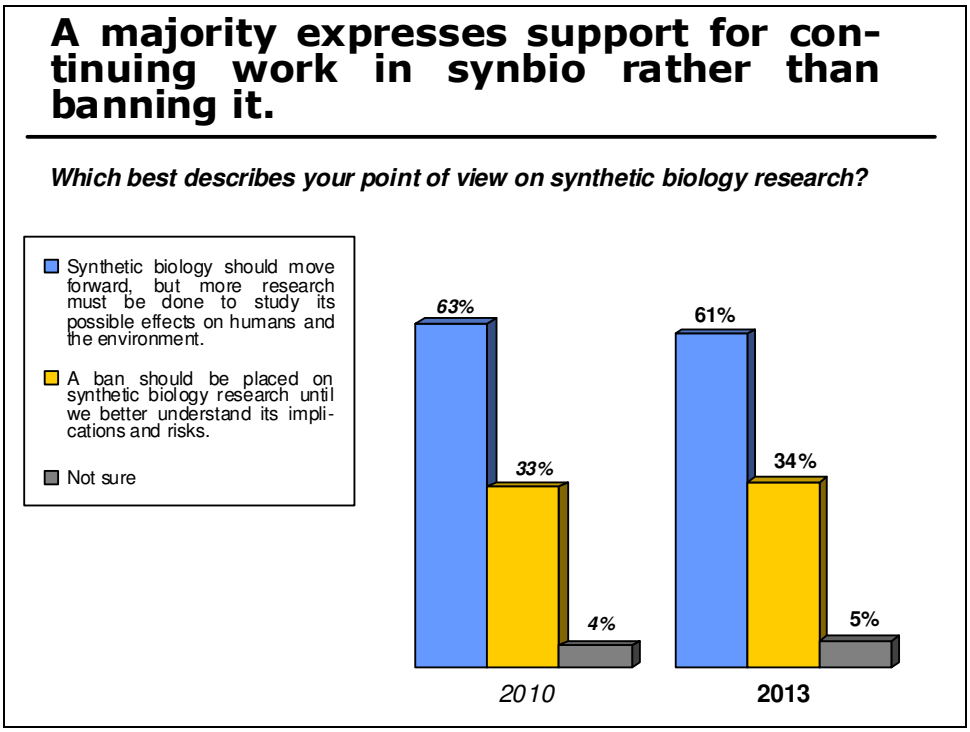
Government Regulation Vs. Voluntary Guidelines, Among Key Subgroups

	Need Government Regulation %	Need Voluntary Guidelines %
All adults	**45**	**43**
Men	41	48
Women	**49**	**37**
High school/less	**49**	**38**
Some college/tech ed	46	44
College graduates	41	45
Whites	41	47
African Americans	**58**	**32**
Hispanics	**57**	**30**
Income: under 30k	**55**	**35**
Income: 30k-50k	42	46
Income: 50k-75k	42	44
Income: over 75k	41	48
Democrats	**60**	**31**
Republicans	32	56
Independents	39	45
Confidence in federal government to maximize benefits/minimize risks:		
Great deal/fair amount	**59**	**33**
Just some/very little	38	49
Confidence in business to maximize benefits/minimize risks:		
Great deal/fair amount	43	47
Just some/very little	48	39

Despite differing views over how synthetic biology should be regulated, a majority of the public supports continued work in the field, rather than a ban on future research.

Today, a majority (61%) of adults support moving forward with research in synthetic biology to better understand its effects on humans and the environment. Nonetheless, a notable one in three adults (34%) suggest banning additional research until its implications are fully known.

Current support is similar to the levels expressed in August 2010, when by nearly two to one, the public favored moving forward (63%) rather than banning (33%) future synthetic biology research.



Support for moving forward with synthetic biology research differs most by gender, education, income, and race—the groups most likely to have heard of synthetic biology also are most likely to support continued research in this field. Men (65% move forward, 30% ban) are more likely than women (57% move forward, 38% ban) to favor additional research, while a greater proportion of college graduates believe that research should continue (72% move forward, 24% ban) than do adults with a high school diploma or less (48% move forward, 47% ban). Adults with household incomes above $75,000 also support moving forward with future research (70% move forward, 26% ban) in greater numbers than do adults with incomes below $30,000 (50% move forward, 46% ban). Looking at support by race, whites (66% move forward, 30% ban) are more likely to favor moving forward with synthetic biology than are African Americans (46% move forward, 48% ban) or Hispanics (46% move forward, 47% ban). Evangelicals are also among those most likely to support a ban until the implications and risks are better understood (49% move forward, 47% ban).

In additon, adults with greater awareness of synthetic biology (heard a lot/some: 71% move forward, 26% ban) demonstrate more support for continued research than do those who had not heard of the science (52% move forward, 41% ban). Moreover, support is strongest among adults whose informed perception of synthetic biology is that the benefits will outweigh the risks (88% move forward, 12% ban) versus informed voters who say that risks will outweigh benefits (34% move forward, 61% ban).

Support For Continued Work Vs. Ban, Among Key Subgroups		
	Move Forward %	Ban %
All adults	**61**	**34**
Men	**65**	**30**
Women	57	38
High school/less	48	47
Some college/tech ed	60	33
College graduates	**72**	**24**
Whites	**66**	**30**
African Americans	46	48
Hispanics	46	47
Income: under 30k	50	46
Income: 30k-50k	62	34
Income: over 75k	**70**	**26**
Attend religious services weekly	54	40
Evangelicals	49	47
Awareness of Synthetic Biology:		
Heard a lot/some	**71**	**26**
Just a little	65	32
Nothing at all	52	41
Informed Support for Synthetic Biology:		
Benefits outweigh risks	**88**	**12**
Risks outweigh benefits	34	61
Risks and benefits equal	68	26

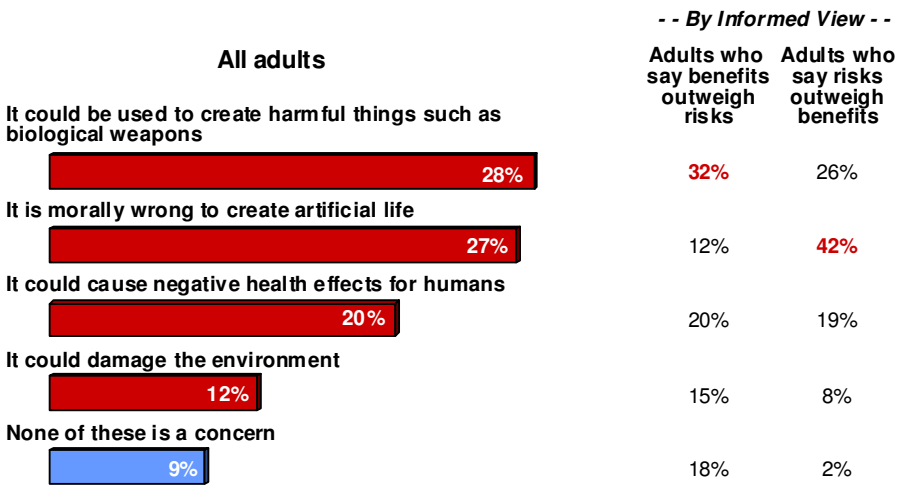
The public's top concerns about synthetic biology are that it could be used to create harmful things such as biological weapons (28%), that it is morally wrong to create artificial life (27%), and that it could cause negative health effects for humans (20%). Those whose informed view of the science is that the risks will outweigh the benefits are most concerned about the moral implications.

Concern that it is morally wrong to create artificial life is the top concern among those who have heard nothing about synthetic biology (32%), those whose informed impressions are that the risks will outweigh the benefits (42%), and those who support a ban until the risks are better understood (44%). It also is the criticism selected most often by evangelicals (53%), Hispanics (32%), and African Americans (29%).

Notably, of all the concerns tested, adults are the least concerned about the possibility of synthetic biology damaging the environment (12% most concerning).

Top Concerns About Synthetic Biology

Which ONE of these concerns you most about synthetic biology?



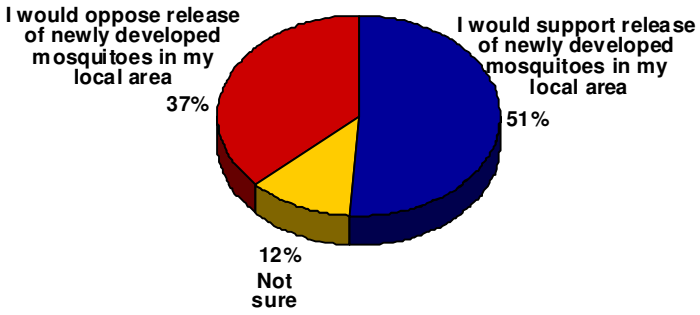
Support for the use of synthetic biology varies depending on the specific application in question. Of the three applications tested, however, none receives a favorable reception from more than half of adults.

When adults are presented with the idea of using synthetic biology to engineer new versions of mosquitoes to help control disease in their neighborhood, half (51%) say they would support this use of synthetic biology to promote the health of their local area. More than one in three (37%) adults would oppose the release of newly developed mosquitoes, while 12% are simply unsure.

Support for the use of synthetic biology to engineer new organisms to control the spread of disease is greater among men (57% support, 34% oppose) than among women (46% support, 39% oppose), and whites (56% support, 33% oppose) are more supportive of it than are African Americans (34% support, 49% oppose) and Hispanics (43% support, 43% oppose). Adults whose informed impressions of synthetic biology are that the benefits will outweigh the risks (79% support, 17% oppose) are most likely to favor applying synthetic biology to disease control. Those who favor moving forward with synthetic biology research (60% support, 29% oppose) support this application by a two-to-one margin.

A bare majority supports using mosquitoes developed with synthetic biology to control disease in neighborhoods.

Synthetic biology can be used to engineer new versions of insects, such as mosquitoes, to help control diseases like West Nile virus. The insects are modified using synthetic biology so that their offspring die or so that male insects are sterile, thus reducing insect populations that spread the disease. These new types of mosquitoes have already been released in Brazil and the Cayman Islands, and there is discussion of releasing them in Key West, Florida. If a mosquito-borne disease became an issue in my neighborhood:

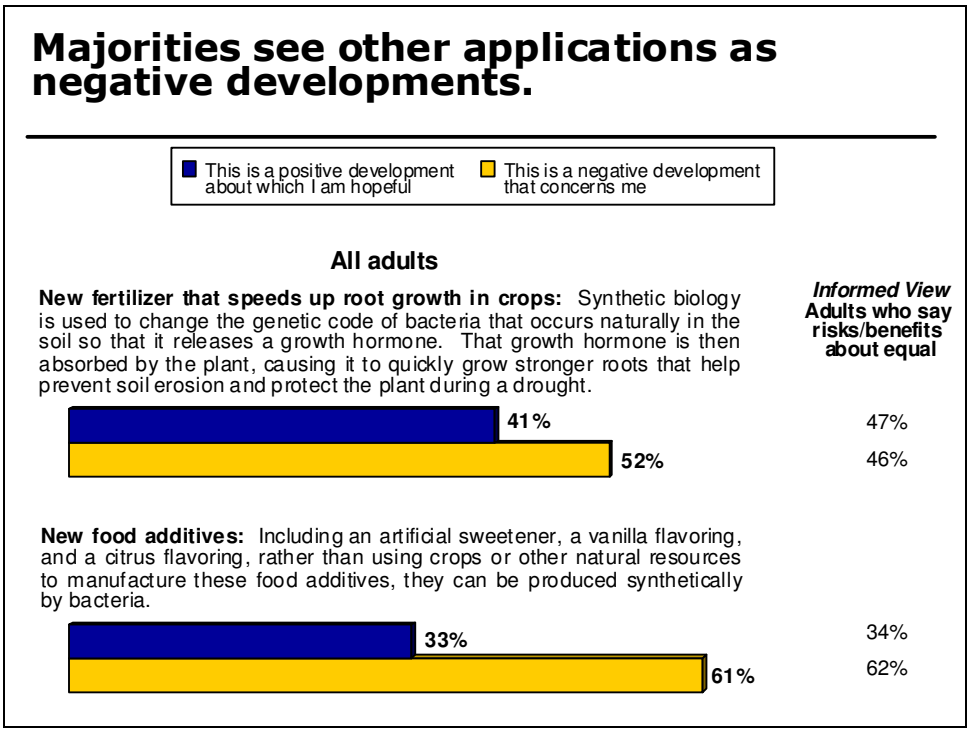


Informed adults who say the risks of synthetic biology will outweigh the benefits (34% support, 56% oppose), and those who support a ban on further research until the effects are better understood (34% support, 54% oppose) express the most opposition.

Other applications of synthetic biology generate more concern than optimism: majorities of adults see the use of synthetic biology to speed up root growth in crops and to create new food additives as negative developments.

Respondents were presented with two additional applications of synthetic biology: (1) to create a new form of crop fertilizer that speeds up root growth in plants by modifying the genetic code of bacteria to enable it to release growth hormones in soil that can then be absorbed by plants, and (2) to create new food additives, such as artificial sweetener, vanilla, and citrus flavorings, produced synthetically by bacteria.

Majorities express more concern than hopefulness about both applications. Fully 52% of adults say that using synthetic biology to create a new form of crop fertilizer is a negative development, versus 41% who say the application is positive and hopeful. A greater proportion (61%) of adults express concern about this new way of making food additives, while just 33% say this is a positive development.



In the case of both applications tested, the demographic groups who are most concerned about the use of synthetic biology include women, adults with a high school education or less, and those with religious affiliations, particularly evangelicals. Attitudes and awareness also affect adults' evaluations of specific uses of synthetic biology. Those who say they have not heard anything about synthetic biology, adults whose informed impression of synthetic biology is that risks will outweigh benefits, and those in favor of banning further research in the field are most likely to say the use of synthetic biology to promote crop growth and create new food additives are negative developments and causes for concern.

Impressions Of Potential Applications Of Synthetic Biology				
	Synthetic Biology In Fertilizer		Synthetic Biology In Food Additives	
	Positive Development %	Negative Development %	Positive Development %	Negative Development %
All adults	**41**	**52**	**33**	**61**
Men	53	41	46	48
Women	**30**	**62**	**22**	**73**
High school/less	**38**	**55**	**26**	**70**
Some college/tech ed	39	56	35	59
College graduates	44	47	37	56
Whites	41	52	35	60
African Americans	34	60	24	72
Hispanics	45	50	28	65
Income: under 30k	37	55	32	65

(con't) Impressions Of Potential Applications Of Synthetic Biology	Synthetic Biology In Fertilizer		Synthetic Biology In Food Additives	
	Positive Development %	Negative Development %	Positive Development %	Negative Development %
All adults	**41**	**52**	**33**	**61**
Synthetic Biology Future:				
Move forward/ further research	55	38	47	49
Ban until better understand	**20**	**77**	**13**	**81**
Confidence in federal government to maximize benefits/minimize risks:				
Great deal/ fair amount	52	42	32	61
Just some/very little	37	57	33	63
Confidence in business to maximize benefits/minimize risks:				
Great deal/ fair amount	48	45	35	60
Just some/very little	34	59	30	63

The public has little to no awareness of the Do-It-Yourself Biology movement.

The vast majority of adults surveyed say they have not heard of the Do-It-Yourself Biology movement, or DIYBio. Fully 92% of adults say they have not heard that citizens and amateur scientists experiment with biotechnology at home or in shared laboratory settings, while just 7% say they are aware of this trend.