

# **Awareness Of And Attitudes Toward Nanotechnology And Synthetic Biology**

## **A Report Of Findings**

Based On A National Survey Among Adults

Conducted On Behalf Of:

**Project On Emerging Nanotechnologies  
The Woodrow Wilson International Center For Scholars**

**By Peter D. Hart Research Associates, Inc.**

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*From August 20 to 25, 2008, Peter D. Hart Research Associates, Inc., conducted a nationwide survey among 1,003 adults about awareness of and attitudes toward both nanotechnology and synthetic biology. This is the third consecutive year a survey has been conducted about nanotechnology and the first year that questions have been asked about synthetic biology. At the 95% confidence level, the data's margin of error is  $\pm 3.1$  percentage points.*

*Two focus group sessions were conducted in Baltimore, Maryland, on August 6, 2008, among adults—one among women and one among men—to explore both unaided and informed impressions of synthetic biology. This qualitative research provides context for better understanding some of the survey findings about synthetic biology.*

### Overview

The large majority of Americans have little or no awareness of nanotechnology: less than one in four (24%) adults have heard some or a lot about it, including just 7% who have heard a lot, while three in four adults have heard just a little or nothing about it. Nearly half (49%) of adults say that they have heard nothing at all about it. There is a positive association between awareness of nanotechnology and the belief that the benefits of nanotechnology will outweigh the risks. Those who are more familiar with the technology are more likely to think that the benefits will outweigh the risks, while large proportions of those who have heard a little or nothing at all about it do not express an opinion about it either way.

Respondents were read a brief statement summarizing the potential benefits and risks of nanotechnology, and in both their initial and informed view of the tradeoff between risks and benefits, adults who are more familiar with nanotechnology are more likely to be optimistic that benefits will outweigh risks. On the other hand, those who are less informed are notably more likely to move toward risks after hearing the statement.

Public awareness of synthetic biology is considerably lower than that of nanotechnology. Just less than one in 10 (9%) Americans say that they have heard some or a lot about it, including a mere 2% who have heard a lot, and 89% say they have heard just a little (22%) or nothing at all (67%). Despite their lack of familiarity with the subject, seven in 10 (71%) adults volunteer some description or association regarding what they think synthetic biology is. Furthermore, two-thirds of those surveyed voice an initial opinion on the tradeoff of risks and benefits for synthetic biology. Initially, 29% believe that there will be an equal tradeoff between risks and benefits of synthetic biology, and only slightly more believe that benefits will outweigh risks (21%) than believe risks will outweigh benefits (16%). After hearing a statement describing potential risks and benefits of synthetic biology, however, the proportion of those who are inclined toward risks (35%) surpasses the proportion of those who are inclined toward benefits (28%), while the share of adults who think that the risks and benefits will be equal

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remains the same. As is similar to nanotechnology, those more familiar with synthetic biology are more inclined to have a positive assessment of the tradeoff.

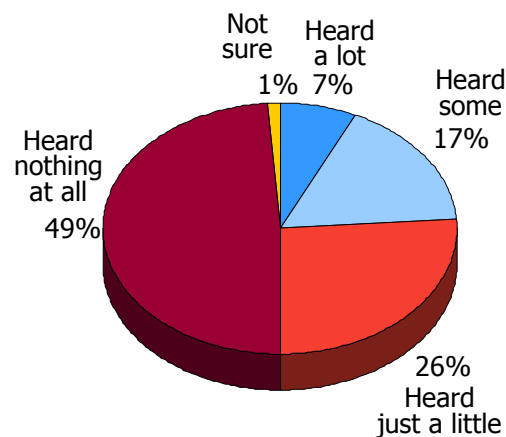
While nanotechnology and synthetic biology are at different stages in terms of their scientific development and current applications, a comparison of the American public's uninformed and informed impressions of the risk-benefit tradeoff for each reveals that the public is more likely to form an opinion about the tradeoff for synthetic biology without knowledge of the science. Just as the public's low level of familiarity with nanotechnology presents an opportunity for government, industry, and the scientific community to establish confidence in nanotechnology-enabled products, there is a similar opportunity with synthetic biology. Indeed, there is perhaps an even greater risk in not beginning to inform the public about synthetic biology now before it is framed by misimpressions, misinformation, or skepticism.

## Key Findings

**P**ublic awareness of nanotechnology remains low, with three in four adults saying that they have heard just a little or nothing at all about it. Nearly half (49%) of adults say that they have heard nothing at all about nanotechnology. Today, 24% of Americans say they have heard a lot or some about nanotechnology, including just 7% who say they have heard a lot. This represents a slight decline in awareness since last year (27% said they had heard a lot or some in 2007) and the year before (30% said they had heard a lot or some in 2006).

## Public Awareness Of Nanotechnology

*How much have you heard about nanotechnology?*



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Echoing findings from previous polls, awareness of nanotechnology is greatest among men (33% heard a lot or some), especially men under age 50 (36%), as well as adults with higher incomes (32% among those with household incomes of more than \$75,000) and education levels (36% among college graduates). Nonetheless, the proportion reporting at least some awareness does not surpass 36% among any demographic group.

Awareness is lowest among women, especially women age 50 and over (64% have heard nothing at all), adults who have acquired a high school degree or less education (68%), those whose annual household income is less than \$30,000 (59%), and African Americans (68%).

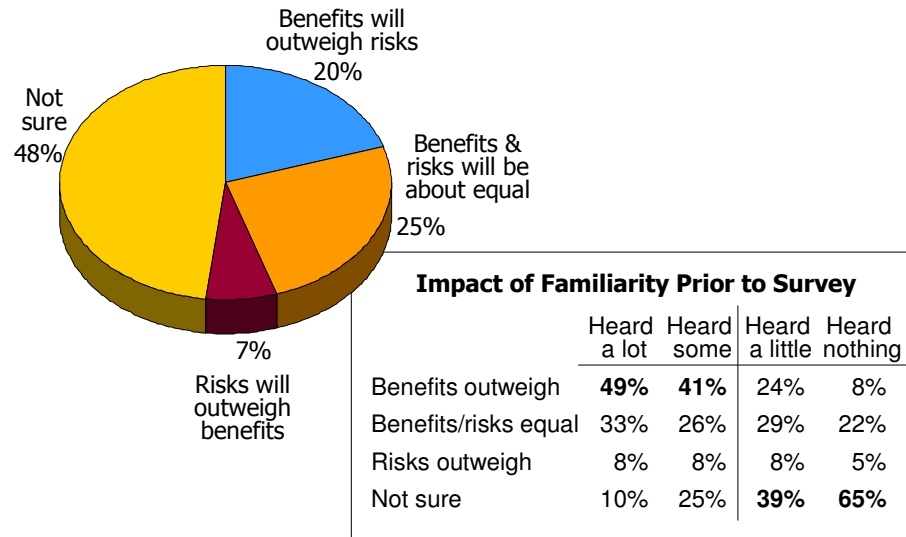
When those who express at least a minimal awareness of nanotechnology are asked where they heard about it, television is the top-tier source. They also mention the Internet, magazines and journals, and news programs and newspapers. Interestingly, adults with the highest level of awareness are most likely to cite magazines and journals as their information sources, while less-informed individuals are most likely to say that they heard about nanotechnology via television.

**Nearly half of adults are too unsure about nanotechnology to make an initial assessment on the tradeoffs between risks and benefits. Of those who are willing to make a judgment, by three to one they think that benefits will outweigh risks (20%) as opposed to thinking risks will outweigh benefits (7%). The plurality, however, believe that risks and benefits will be about equal (25%).**

When asked to weigh the risks and benefits of nanotechnology in the absence of any definition or information about it, 48% of adults simply do not express an opinion. One in four believes that the risks and benefits will be about equal, 20% think that the benefits will outweigh the risks, and just 6% believe that the risks will outweigh the benefits.

A comparison of the public's initial, unaided impression of nanotechnology over the past three years reveals a slight trend toward a more positive assessment. In 2006, 15% of adults said that the benefits will outweigh the risks, and that proportion increased to 18% last year. There has been no shift in the proportion of adults who believe risks will outweigh benefits.

## Initial Impression Of Risks And Benefits Of Nanotechnology



There is a strong association between awareness of nanotechnology and respondents' initial impression that the benefits will outweigh the risks. Those who have heard more about nanotechnology are more likely to think that the benefits will outweigh the risks. Nearly half (49%) of those who have heard a lot about nanotechnology believe that the benefits will outweigh the risks, and the proportion who have this opinion decreases to 41% among those who have heard some about nanotechnology, 24% among those who have heard just a little, and just 8% among those who have not heard anything at all about it. (Men, college graduates, and higher-income individuals report the highest levels of awareness of nanotechnology, and they are the groups most likely to think that benefits will outweigh risks.)

A lack of awareness does not translate into greater skepticism of nanotechnology though. Rather, two-thirds (65%) of adults who have not heard anything about the technology do not make a judgment on the risk-benefit tradeoff.

Across all demographic subgroups, respondents are more likely to think that the benefits will outweigh the risks than to have the opposing point of view. The groups who are the least convinced about the benefits are African Americans (16% benefits outweigh risks; 11% risks outweigh benefits; 24% both about equal) and evangelicals (16% benefits outweigh risks; 9% risks outweigh benefits; 29% both about equal). (See detailed table on page 7).

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**A**fter hearing a statement about both potential risks and potential benefits of nanotechnology, most adults are willing to express an opinion about these tradeoffs, and the largest proportion continue to think that the benefits and the risks will be about equal (38%). Nonetheless, the proportion of adults who think that the benefits will outweigh the risks increases, as does the proportion who think that the risks will outweigh the benefits. Respondents were read the following information about nanotechnology, and then asked again to assess the tradeoff between benefits and risks.

Nanotechnology is the ability to measure, see, predict, and make things on the extremely small scale of atoms and molecules. Materials created at the nanoscale are called nanomaterials, and they often can be made to exhibit very different physical, chemical, and biological properties than their normal-sized counterparts.

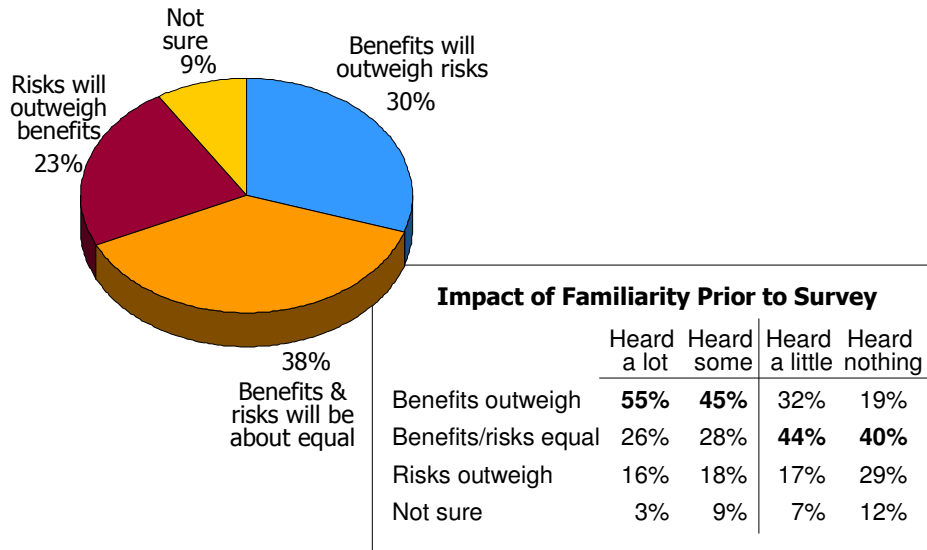
I would like to read you statements about the potential benefits and potential risks of nanotechnology and get your reaction.

The potential BENEFITS of nanotechnology include the use of nanomaterials in products to make them stronger, lighter, and more effective. Some examples are food containers that kill bacteria, stain-resistant clothing, high-performance sporting goods, faster, smaller computers, and more effective skin care products and sunscreens. Nanotechnology also has the potential to provide new and better ways to treat disease, clean up the environment, enhance national security, and provide cheaper energy.

While there has not been conclusive research on the potential RISKS of nanotechnology, there are concerns that some of the same properties that make nanomaterials useful might make them harmful. It is thought that some nanomaterials may be harmful to humans if they are breathed in and might cause harm to the environment. There also are concerns that invisible, nanotechnology-based monitoring devices could pose a threat to national security and personal privacy.

After hearing this information there is a 10-point increase in the proportion of adults who think that the benefits will outweigh the risks (from 20% to 30%), a 16-point increase in the share who think that the risks will outweigh the benefits (from 7% to 23%), and a 13-point increase in the proportion who say the benefits and the risks will be equal. Just 9% remain unwilling to make a judgment.

## Informed Impression Of Risks And Benefits Of Nanotechnology



Reflecting trends in the previous two surveys, individuals with the greatest awareness of nanotechnology remain considerably more optimistic than other groups who think that the benefits will outweigh the risks. The informed assessment of those who say that they had not heard anything about nanotechnology is less optimistic: this is the single group in which a larger proportion think that the risks will outweigh the benefits (29%) than think the benefits will outweigh the risks (19%). This represents a 24-point shift toward risk. (And whereas 65% of these individuals said they were not sure of the benefits versus risks in the initial question, only 12% said they were not sure in the informed question.)

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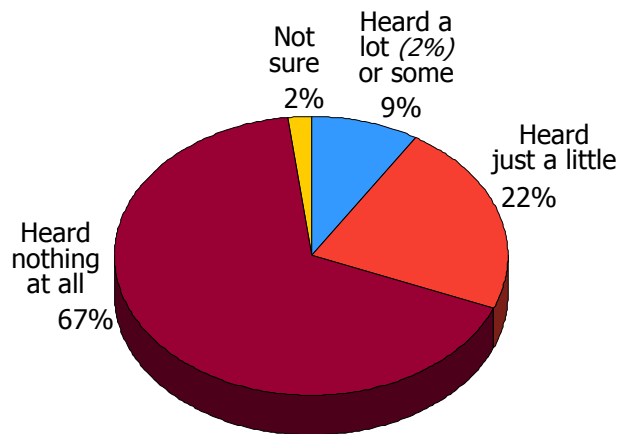
Initial And Informed Impressions Of Nanotechnology						
	Initial Impressions			Informed Impressions		
	Benefits Outweigh Risks %	Risks Outweigh Benefits %	Risks And Benefits About Equal %	Benefits Outweigh Risks %	Risks Outweigh Benefits %	Risks And Benefits About Equal %
<b>All adults</b>	<b>20</b>	<b>7</b>	<b>25</b>	<b>30</b>	<b>23</b>	<b>38</b>
<b>Men</b>	<b>29</b>	<b>6</b>	<b>28</b>	<b>39</b>	<b>17</b>	<b>33</b>
Women	12	7	23	21	26	43
Age 18 to 34	21	6	30	31	21	40
Age 35 to 49	23	9	30	30	24	42
Age 50 to 64	22	7	21	32	20	38
Age 65 and over	14	6	18	23	28	31
<b>Men 18 to 49</b>	<b>31</b>	<b>7</b>	<b>30</b>	<b>41</b>	<b>18</b>	<b>32</b>
Men 50 and over	27	6	26	36	18	33
Women 18 to 49	14	8	29	20	27	50
Women 50 and over	12	6	16	21	29	37
High school or less	13	4	29	20	25	44
Some college/tech	17	9	25	27	26	37
<b>College grad or more</b>	<b>31</b>	<b>7</b>	<b>22</b>	<b>40</b>	<b>19</b>	<b>34</b>
<b>Less than \$30,000</b>	<b>14</b>	<b>7</b>	<b>28</b>	<b>22</b>	<b>32</b>	<b>37</b>
\$30,000-50,000	14	6	34	25	21	47
\$50,000-\$75,000	19	7	32	30	23	40
<b>More than \$75,000</b>	<b>34</b>	<b>7</b>	<b>22</b>	<b>42</b>	<b>18</b>	<b>34</b>
Whites	21	6	24	31	27	36
African Americans	16	11	24	17	23	51
Hispanics	23	6	32	33	21	39
<b>Heard a lot</b>	<b>49</b>	<b>8</b>	<b>33</b>	<b>55</b>	<b>16</b>	<b>26</b>
<b>Heard some</b>	<b>41</b>	<b>8</b>	<b>26</b>	<b>45</b>	<b>18</b>	<b>28</b>
Heard just a little	24	8	29	32	17	44
<b>Heard nothing</b>	<b>8</b>	<b>5</b>	<b>22</b>	<b>19</b>	<b>29</b>	<b>40</b>



**S**ynthetic biology is even more unknown than nanotechnology, with nearly nine in 10 Americans saying that they have heard just a little or nothing at all about it. Just 9% of Americans say that they have heard a lot or some about this area of science, including a mere 2% who indicate they have heard a lot about it. Another 22% of adults say they have heard just a little about synthetic biology, while fully 67% have heard nothing at all about it.

## Public Awareness Of Synthetic Biology

*How much have you heard about synthetic biology?*



While men (12%), college graduates (13%), and individuals with an annual household income over \$75,000 (14%) report the highest levels of awareness, there is no demographic subgroup with more than 14% who say that they have heard at least some about synthetic biology. The exception are individuals who say that they have heard a lot or some about nanotechnology—they are three times as likely as adults overall to say they have heard at least some about synthetic biology (26% heard a lot or some about synthetic biology).

For the small proportion of Americans who express any awareness of synthetic biology, they are most likely to say that they heard about it on television, from the news media, or a newspaper. The Internet, magazines and journals are second-tier sources.

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**D**espite their limited awareness of synthetic biology, seven in 10 Americans offer some remark about what they think synthetic biology is or what images, words, and phrases it conjures in their minds. More than any other comment, adults mention some variation on the theme that synthetic biology is “man-made,” “artificial,” or “not natural.” Respondents were asked the following open-ended question: “Regardless of how much you have heard about synthetic biology, what do you think synthetic biology is? What ideas, images, words, or phrases do you associate with synthetic biology?” Nearly three in 10 (29%) adults mention that synthetic biology is something man-made, artificial, fake, not natural, or not real. One in 10 (11%) says that it has to do with cloning, genetic engineering, or genetic manipulation, another 7% say it has to do with altering biology or biological make-up, and 4% describe it as creating artificial life. To the extent that they do focus on the applications and benefits without any prompting, adults are more likely to mention medical applications than other types of applications: 7% simply say it is used in medical research, and 6% say it is used to create human skin, organs, and tissue.

Impressions of synthetic biology and the associations that individuals make with it were explored in greater detail in focus groups. While only two sessions were conducted, impressions of what synthetic biology is mirror the responses in the survey.

**“Creating man-made items to replace naturally occurring living objects or cells.”**

**–Baltimore woman**

**“Anything that’s man made, science and the like, stuff like replacing what we call natural with the artificial.”**

**–Baltimore man**

**“It sounds like a man-made replacement for existing biological organisms or products, like everything from it almost seems artificial flavoring up to artificial tissue for the body.”**

**–Baltimore man**

**“Robots.”**

**–Baltimore woman**

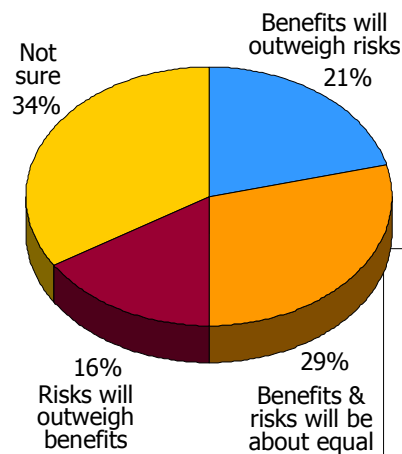
**“Cloning and stem cells and harvesting organs for the future.”**

**–Baltimore man**

**E**ven with very low awareness of synthetic biology, a solid two-thirds majority of adults are willing to express an initial opinion regarding the tradeoff between the potential benefits and risks of synthetic biology. The American public approaches synthetic biology differently than they do nanotechnology: while they report a higher level of awareness of nanotechnology (49% have heard nothing at all about nanotechnology; 67% have heard nothing at all about synthetic biology), they actually are more willing to make an assessment of the synthetic biology risk-benefit tradeoff (52% express an opinion about the risks versus benefits of nanotechnology; 66% take a position on the risks versus benefits of synthetic biology).

Just as with nanotechnology, respondents were asked to evaluate the risks and benefits of synthetic biology without receiving any information about it. They are slightly more likely to think that benefits will outweigh the risks (21%) than risks will outweigh the benefits (16%), while 29% believe that the risks and benefits will be equal.

## Initial Impression Of Risks And Benefits Of Synthetic Biology



**Impact of Familiarity Prior to Survey**

	Heard a lot/some	Heard a little	Heard nothing
Benefits outweigh	41%	25%	16%
Benefits/risks equal	31%	34%	27%
Risks outweigh	12%	17%	17%
Not sure	16%	24%	40%

Likewise, focus group participants recognize the possible benefits of synthetic biology, but hold serious concerns about the risk of unanticipated or uncontrollable consequences.

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**“I view it like sci-fi movies, where something is created in a laboratory, and it always seems great in the beginning, but down the line, something goes wrong because they didn’t think about this particular situation or it turning this way.”**

**–Baltimore woman**

**“It could help heal illnesses, feed the world, but there’s concern it could create plants or illnesses from it that can’t be controlled or cured, you know, same concerns we have in modifying genetics in people.”**

**–Baltimore man**

As is the case with nanotechnology, those with greater familiarity of synthetic biology make a more positive assessment of the risks versus benefits. Forty-one percent of Americans who report hearing a lot or some about synthetic biology think that the benefits will outweigh the risks, compared with 25% who have heard just a little about it, and 16% among those who have not heard anything at all about it. (Among those who have not heard anything about synthetic biology, 40% do not express an opinion about the risk-benefit tradeoff. That stands in contrast to nanotechnology: among those who have not heard anything about it, 65% do not give an evaluation.)

There is a notable gender gap in Americans’ evaluation of the risk versus benefits tradeoff regarding synthetic biology, with men more positive (28% benefits will outweigh risks; 10% risks will outweigh benefits) than women (13% benefits will outweigh risks; 20% risks will outweigh benefits). African Americans (11% benefits will outweigh risks; 16% risks will outweigh benefits) also are more skeptical than are whites (22% benefits will outweigh risks; 15% risks will outweigh benefits) and Hispanics (22% benefits will outweigh risks; 18% risks will outweigh benefits). Groups that are evenly divided about the risks versus benefits include adults age 65 and over, those with less than a college education, those with an annual household income below \$50,000, individuals who attend religious services weekly, and Evangelicals. (See table on page 13.)

**A**fter being informed of the potential risks and benefits of synthetic biology, the greatest shift in public opinion is toward risk, making this the plurality opinion. Upon hearing the statement about synthetic biology (page 12), 29% of adults say that the risks and benefits are equal (no change from the initial question), 28% believe benefits outweigh risks (a seven-point increase), and 35% think that risks outweigh benefits (a 19-point increase).

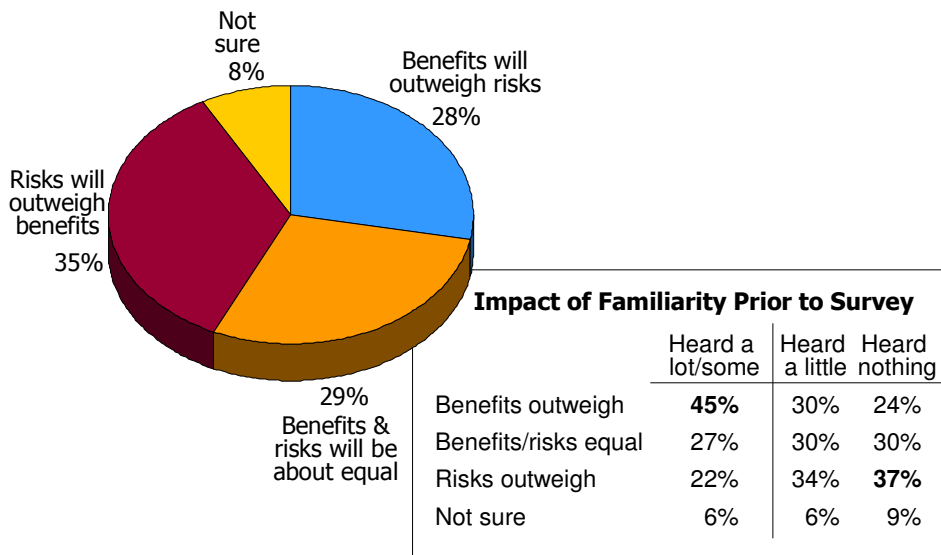
Synthetic biology is the use of advanced science and engineering to make or re-design living organisms, such as bacteria, so that they can carry out specific functions. Synthetic biology involves making new genetic code, also known as DNA, that does not already exist in nature.

I would like to read your 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.

## Informed Impression Of Risks And Benefits Of Synthetic Biology



Evangelicals, women (especially those under 50), individuals who regularly attend religious services, lower-income and less-educated individuals are those most likely to think the risks outweigh the benefits. Men, college-educated individuals, those with an annual household income over \$75,000, adults with no religious affiliation, and those who never attend religious services are the only demographic subgroups in which individuals are more likely to think that the benefits outweigh the risks than to have the opposite view.

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## 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
	%	%	%	%	%	%
<b>All adults</b>	<b>21</b>	<b>16</b>	<b>29</b>	<b>28</b>	<b>35</b>	<b>29</b>
<b>Men</b>	<b>28</b>	<b>10</b>	<b>30</b>	<b>35</b>	<b>29</b>	<b>30</b>
<b>Women</b>	<b>13</b>	<b>20</b>	<b>30</b>	<b>20</b>	<b>41</b>	<b>29</b>
Age 18 to 34	22	15	31	28	34	34
Age 35 to 49	25	17	31	29	39	26
Age 50 to 64	18	16	30	29	34	30
Age 65 and over	17	14	24	21	35	28
<b>Men 18 to 49</b>	<b>31</b>	<b>8</b>	<b>33</b>	<b>35</b>	<b>27</b>	<b>33</b>
Men 50 and over	25	15	25	34	31	26
<b>Women 18 to 49</b>	<b>16</b>	<b>25</b>	<b>28</b>	<b>22</b>	<b>45</b>	<b>26</b>
Women 50 and over	11	16	30	18	38	31
<b>High school or less</b>	<b>14</b>	<b>15</b>	<b>35</b>	<b>23</b>	<b>39</b>	<b>29</b>
Some college/tech	16	17	29	22	41	27
<b>College grad or more</b>	<b>29</b>	<b>16</b>	<b>25</b>	<b>35</b>	<b>29</b>	<b>31</b>
<b>Less than \$30,000</b>	<b>15</b>	<b>16</b>	<b>35</b>	<b>24</b>	<b>42</b>	<b>28</b>
\$30,000-50,000	15	19	38	18	41	35
\$50,000-\$75,000	22	17	31	30	41	25
<b>More than \$75,000</b>	<b>29</b>	<b>15</b>	<b>26</b>	<b>35</b>	<b>28</b>	<b>31</b>
Whites	22	15	28	29	35	28
African Americans	11	16	40	21	34	38
Hispanics	22	18	30	28	37	29
<b>Attend religious services weekly</b>	<b>18</b>	<b>19</b>	<b>28</b>	<b>22</b>	<b>40</b>	<b>30</b>
Attend religious services less often	22	15	32	25	33	34
<b>Never attend religious services</b>	<b>23</b>	<b>9</b>	<b>31</b>	<b>41</b>	<b>29</b>	<b>23</b>
Protestants	19	16	31	24	36	32
Catholics	22	17	32	28	37	27
Other religion	21	21	23	29	33	31
<b>No religion</b>	<b>27</b>	<b>11</b>	<b>26</b>	<b>40</b>	<b>36</b>	<b>18</b>
<b>Evangelicals</b>	<b>18</b>	<b>18</b>	<b>30</b>	<b>23</b>	<b>44</b>	<b>29</b>
Non-evangelicals	21	14	30	29	33	29
Heard a lot/some	41	12	31	45	22	27
Heard just a little	25	17	34	30	34	30
Heard nothing	16	17	27	24	37	30

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Focus group participants express a spectrum of views when it comes to their informed impression of the risks-benefits tradeoff.

**“Well, I guess I think that there’s not any advancements that we all use on a daily basis that when it first came out, that we didn’t think of as that’s scary and new. I don’t think there’s any advancement that any of us, you know, our cell phones, our computers, our electricity...our automobiles, that when they first came out, people didn’t...have the same discussions that we’re having today about them. I’m feeling this is similar to that, that with time, eventually, we’ll look back and see all the positives with it. I mean, there are always going to be negatives as well, but I think every new advancement brings...brings a sense of fear and questioning whether we’re going in the right direction, and controversy.”**

**–Baltimore woman**

**“They identify a lot of risks, but then they also use these words that, things like ‘might,’ ‘potentially,’ there are questions. So there’s all these advancements. They don’t know what the side effects are going to be, and they may not be able to research it until these things have been around for 20 to 30 years. And at that point, it’s maybe too late. So I think there’s too many might’s and too many possibly’s for me to feel totally comfortable with all those things that have been identified on the other handout [about benefits].”**

**–Baltimore woman**

**“Well, to me, the most important benefits, I put the cleaning of the environment and creating biofuels. And my concerns would be it getting into the wrong hands and the possible adverse environmental consequences. I’ll give you an example is nuclear power, or nuclear technology. We’re all concerned about who gets their hands on the weapons now. It just kind of runs with that.”**

**–Baltimore man**