chapter 6

Genetic Engineering

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Public perceptions of biotechnology and genetic engineering will be shaped in part by the public's awareness and knowledge of the issues. Prior reports on science information have generally suggested that the vast majority of the public is scientifically illiterate (see ch. 3). Whether or not this is true, an even casual content analysis of newspapers and news magazines clearly reveals that the American people are being exposed to information about biotechnology, biology, and genetics on a frequent basis.

The OTA survey explored the degree to which the public is currently aware of biotechnology and genetic engineering; what the public understands genetic engineering to mean; and the perceived impact of genetic engineering on their lives. According to the survey results, awareness and concern about genetic engineering are not restricted to a small group of scientifically observant persons, rather, the concepts and issues of genetic engineering have diffused widely into the public consciousness. A combination of science interest and media exposure has produced an American public that is aware—if not necessarily sophisticated—about genetic engineering.

AWARENESS OF GENETIC ENGINEERING

The OTA survey found moderate awareness of genetic engineering among the American public. Less than a quarter of the public (24 percent) report they have heard or read "almost nothing" about genetic engineering. A substantial portion (39 percent) reports hearing or reading "relatively little" about genetic engineering. But more than a third of Americans (35 percent) say they have heard '(a fair amount" (29 percent) or "a lot" (6 percent) about genetic engineering (table 28).

Those under 50 years old are more likely to state they have heard a lot or a fair amount about genetic engineering (38 to 40 percent) than those 50 years and older (29 to 30 percent). The most dramatic differences in awareness, however, are seen when educational attainment is considered. The proportion of high school graduates who say the have heard at least a fair amount about genetic engineering is 26 percent; but 44 percent of those with some college and 61 percent of college graduates report they have heard or read at least a fair amount about the topic.

Science observance also affects awareness of genetic engineering. Only one-fourth of the nonobservants (24 percent) say they have heard a fair amount about genetic engineering compared to nearly half of the science observant (49 percent). It is interesting, however, that half of science observant report "relatively little" or no exposure to information about genetic engineering, while nearly a quarter of those classified as nonobservant feel they have heard "a fair amount" about it. Thus, awareness of the issue of genetic engineering is apparently not restricted to the scientifically observant sections of the American populace. In fact, 17 percent of those who report they have a poor understanding of science say they have heard or read "a fair amount" about genetic engineering (table 29).

MEANING OF GENETIC ENGINEERING

All the survey respondents were asked to describe, based on what they know or have heard, what is meant by genetic engineering. The responses to this open-ended question indicate that self-reported exposure to information about genetic engineering is a reasonable—if imperfect—guide. Three quarters (75 percent) of those who say they have heard almost nothing about genetic engineer-

Table 28.—Awareness of Genetic Engineering

Question (Q17a):[a] How much have you heard or read about genetic engineering—a lot, a fair amount, relatively little, or almost nothing?

	A lot	A fair amount	Relatively little	Almost nothing	Not sure
Total . . . . . (1,273)[b]	**6%**	**29%**	**39%**	**24%**	**1%**
Age:					
18 to 34 . . . . . (546)	7	**31**	**38**	**24**	<1
35to49 . . . . . (343)	6	**34**	35	**24**	<1
5o to 64 . . . . . (252)	4	**26**	**40**	**27**	2
65 And over.... . . . . (127)	7	**22**	**46**	**24**	<1
Education:					
Less than high school... . . . . (165)	**4**	**22**	**40**	33	<1
High school graduate . . . . . (458)		**21**	**41**	31	**2**
Some college . . . . . (300)	38	**38**	**42**	13	**<1**
College graduate . . . . . (347)	**12**	**49**	30	8	**<1**
Science understanding:					
Very good . . . . . (236)	**15**	38	**27**	**18**	1
Adequate . . . . . (707)	**6**	**34**	**41**	**18**	1
Poor . . . . . (316)	1	**16**	**42**	**40**	1
Science orientation:					
Observant . . . . . (628)	**10**	**39**	**34**	**16**	**<1**
Nonobservant . . . . . (647)	**3**	**21**	44	**31**	**1**

[a]The code number of the question in the survey instrument (see app. B)
[b]Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Officeof Technology Assessment, 1987.

Table 29.–Meaning of Genetic Engineering

Question (Q17b)[a] Based on what you know or have heard, what is meant by genetic engineering?

Total	A lot/ fair amount	Relatively little	Almost nothing
(1,273)[b]	(514)	(486)	(257)
Don't know 44%	180/0	**47%**	**75%**
Altering/manipulating genes 20	**29**	**18**	**8**
Producing improved/superior organisms	**12**	**6**	**2**
Crossbreeding/producing hybrids 6	**10**	**6**	**3**
Producing cures for genetic diseases/defects 6	**9**	**6**	1
Producing desired/particular characteristics 5	**9**	**4**	**2**
Producing new organisms/ forms of life 4	**8**	**4**	
Producing super race/perfect people . . . 4	**4**	**4**	**3**
Altering/manipulating chromosomes . . . 3	6	3	<1
Altering gene to produce desired/ specific result 3	**5**	**3**	**<1**

[a]The code number of the question in the survey instrument (See app. B)
[b]Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can recalculated.

SOURCE: Office of Technology Assessment, 1987

ing are also unable to explain what is meant by the term. Nearly half (47 percent) of those who say they have heard relatively little about it cannot explain the meaning of genetic engineering. Only 18 percent of those who say they have heard a lot or a fair amount about genetic engineering cannot explain it. Overall, more than half of American adults (56 percent) can provide a meaningful—though not necessarily strictly accurate-explanation of genetic engineering.

Survey respondents commonly describe genetic engineering as "altering or manipulating genes" (20 percent). "Producing improved or superior organisms" is suggested by 7 percent, The classical biological techniques of "crossbreeding and producing hybrids" are identified as genetic engineering by 6 percent of the public-although many scientists would not include these descriptions. Another 6 percent describe genetic engineering as "producing cures for genetic diseases or defects ." One in twenty Americans (5 percent) explains genetic engineering in terms of "producing desired or particular characteristics. " "Producing new organisms or forms of life" is suggested by 4 percent. For another 4 percent of the public, genetic engineering means "producing a super race or perfect people" (table 29).

With few exceptions, the public's attempts to explain genetic engineering reflect a general, if imperfect, understanding of the concept. Interestingly, the concept of eugenics does not loom large in these explanations. Rather, the half of the adult population who can explain genetic engineering describe it in terms of manipulating genetic material for human gene therapy or providing new and superior organisms. Thus, although not always technically precise, about one-half of the American public has a good general sense of what genetic engineering means.

CONCEPTS IN BIOTECHNOLOGY

Like all disciplines, biotechnology has a unique vocabulary. The OTA survey found the general American public says that many of the basic terms are familiar. It is important to note that survey respondents tend to overestimate their understanding of vocabulary.

Eighty-five percent of the public say they understand the meaning of "gene. " Nearly, three-quarters (73 percent) say they understand the meaning of "chromosome ." More than two-thirds (69 percent) say they understand the meaning of "cloning. "

Although only a few decades ago the term "DNA" was unknown outside research laboratories, the survey found that today half the adult population (52 percent) report they understand its meaning. Sizable minorities of the public also claim they understand the meaning of techniques such as in vitro fertilization (45 percent) and human gene therapy (39 percent), Furthermore, one in seven (14 percent) believes he or she understands the meaning of "monoclinal antibodies, " a more rarified concept (table 30).

Table 30.—Understanding Concepts of Biotechnology[a]

Question (Q16a-h):[b] I'd like you to tell me whether you think you understand the meaning of (READ ITEM).	Yes	No	Not sure
Gene	85%	15%	<1%
Chromosome .,	73	25	2
Cloning.	69		1
Genetic engineering.	66	32	1
	52	47	1
In vitro fertilization	45	54	1
Human gene therapy	39	59	2
Monoclinal antibodies	14	85	2

[a]Percentages are presented es weighted sample estimates. The unweighed base from which the sampling variance can be calculated is 1,273,
[b]The code number of the question in the survey instrument (See aPP B.)

SOURCE: Office of Technology Assessment, 1987.

Two-thirds of the public (66 percent) feel they understand the meaning of genetic engineering, and these persons are much more likely to say they understand the basic meaning of chromosome (83 percent), cloning (79 percent), and DNA (66 percent). About half of those who say they understand genetic engineering report that they understand its application in human gene ther-

Table 31.—Comparison of Understanding the Meaning of Genetic Engineering v. Meaning of Other Concepts of Biotechnology

Question (Q16):[a] I'd like you to tell me whether you think you understand the meaning of (READ ITEM).	Understand genetic engineering	
	Yes	No
	(906)[b]	(267)
Understand meaning of:		
Genes	91%	74%
Chromosome	83	54
Cloning	79	40
DNA	66	24
in vitro fertilization	54	27
Human gene therapy	49	19
Monoclonal antibodies	20	2

[a]The code number of the question in the survey instrument (eea app. B.)
[b]Percentages are presented as weighted sample estimates. The unweighed sample base Is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

apy (49 percent). One in five (20 percent) of those who believe they understand genetic engineering also say they understand the meaning of monoclinal antibodies (table 31). While these findings do not prove that two thirds of the public really understand the meaning of genetic engineering the data indicate that a substantial number of Americans believe they understand the concepts of genetic engineering and biotechnology.

Understanding the concept of genetic engineering divides the public into two distinct age groups: those under 50 years old and those 50 and over (about 70 to 57 percent.) These two groups report considerably different levels in their understanding of genetic engineering. There is no significant difference in the self-reported understanding of genetic engineering between those 18 to 34 years old (72 percent) and those 35 to 49 years old (70 percent). Similarly, there is no difference in the level of self-reported understanding between those 50 to 64 years old (57 percent) and those 65 and over (57 percent) (table 32).

Self-reported understanding of the topic increases infrequency from 58 percent of high school graduates to 88 percent of college graduates. Science observant (75 percent) are far more likely to report they understand genetic engineering than are nonobservants (59 percent). The best predictor of understanding genetic engineering, however, is the degree of exposure to information

Table 32.–Profile of Population That Understands the Meaning of Genetic Engineering

Question (Q16):[a] I'd like you to tell me whether you think you understand the meaning of genetic engineering.		Yes	No	Not sure
Total	(1,273)[b]	66%	32%	1%
Age:				
18 to 34	(546)	72	28	<1
35 to 49	(343)		28	
50 to 64	(252)	57	40	3
65 and over	(127)	57	42	1
Education:				
Less than high school	(165)	58	40	2
High school graduate	(458)	58	41	
Some college	(300)		23	2
College graduate	(347)	88	10	1
Science orientatlon:				
Observant	(626)	75		2
Nonobservant	(647)	59	40	1
Heard about genetic *engineering:*				
A lot/fair amount	(514)			
Relatively little	(486)	66	32	2
Almost nothing	(257)	Xi	69	2

[a]The code number of the question in the survey instrument (see app. B.)
[b]Percentages are presented ss weighted sample estimates. The unweighed sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

about it, Nearly all (93 percent) who say they have heard at least a fair amount about genetic engineering feel they understand it, whereas two-thirds (66 percent) of those who say they have heard relatively little about genetic engineering believe they understand it. Less than one-third (29 percent) of those who say they have heard almost nothing about it feel that they understand genetic engineering.

IMPACTS OF GENETIC ENGINEERING

What does the American public believe the impacts of genetic engineering will be? Survey participants were asked whether they thought each of five scientific developments (solar energy, organ transplants, genetic engineering, robots and automation, and nuclear power) will make life better or worse for people like themselves. The generally positive orientation of the American public toward science is reflected in a majority view that all five developments will improve the quality of life. However, the degree of positive reaction to the five innovations varies widely.

At one end of the scale, nearly everyone (92 percent) feels that solar energy will make the quality of life better. In contrast, about half (51 percent) of the public believe that nuclear power will make life better. Opinions on genetic engineering fall between these two: two-thirds of the public (66 percent) say it will make life better for persons like themselves. This perception is more widespread than the belief that the quality of life will improve with robots and automation (60 percent), but less than the belief that organ transplants will improve life (87 percent) (table 33).

The proportion of those who feel that genetic engineering will make life better has remained essentially the same between 1982 (67 percent) (1) and 1986 (66 percent). However, two significant shifts in perceptions of genetic engineering appear to have occurred during that period. First,

Table 33.—Comparison of the Impact of Genetic Engineering on the Quality of Life to Impacts of Other Scientific Innovations

Question (Q10a):[a] Now, let me ask you about some specific developments. From what you know or have heard, do you think (READ ITEM) will make the quality of life a lot better for people such as yourself, somewhat better, somewhat worse. or much worse?	*Effect of genetic engineering on qualty of life*		
	Total	**Better**	**Worse**
	(1,273)[b]	**(824)**	**(291)**
Effect on quality of life of:			
Solar energy:			
Better	**92%**	**93%**	**94%**
Worse	**4**	**3**	**4**
Organ transplants:			
Better	**87**	**91**	**77**
Worse	**9**	**6**	**18**
Genetic engineering:			
Better	**66**	**100**	
Worse	**22**		**100**
Robots and automation:			
Better	**60**	**66**	**48**
Worse	**33**	**28**	**47**
Nuclear power:			
Better	**51**	**57**	**41**
Worse	**43**	**39**	**57**

[a] The code number of the question in the survey instrument (See aPP. B.)
[b] percents are presented as weighted sample estimates. The unweighed sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

the proportion believing that genetic engineering will make life "a lot better" has declined from 32 percent in 1982 to 18 percent in 1986. Second, the proportion of Americans who think genetic engineering will make life worse ("somewhat worse" or "a lot worse") has increased from 16 percent in 1982 to 22 percent in 1986 (table 34).

Thus, while a substantial majority of **Americans still believes that genetic engineering will make life better rather than worse, the OTA survey found that public enthusiasm about the benefits of genetic engineering has declined since 1982.**

Table 34.—Population Profile and the Effect of Genetic Engineering on the Quality of Life

Question (Q10):[a] Now, let me ask you about some specific developments. From, what you know or have heard, do you think genetic engineering will make the quality of life a lot better for people such as yourself, somewhat better, somewhat worse, or much worse?

	A Jot better	Somewhat better	Somewhat worse	Much worse	Not sure	No effect
Total 1986 . . . . . (1,273)	**18%**	**48%**	**13%**	**90/0**	**11%**	**2%**
1982	32	35	9	7	17	NA[d]
Education:						
Less than high school. . . . . (165)	18	52	10	6	12	3
High school graduate . . . . . (458)	18	46	13	9	12	2
Some college . . . . . (300)	17	45	17	11	10	1
College graduate . . . . . (347)	19	48	13	10	7	3
Science understanding:						
Very **good . . . . . (236)**	32	47	8	4	8	1
Adequate . . . . . (707)	16	50	15	9	8	2
Poor . . . . . (316)	12	43	12	11	19	3
Heard about genetic engineering:						
A lot/fair amount . . . . . (514)	24	50	13	9	3	1
Relatively little . . . . . (486)	14	48	13	8	13	3
Almost nothing . . . . . (257)	13	45	13	9	17	2

[a]The code number of the question in the survey instrument (See aPP. B.)
[b]Percentages are presented as weighted sample estimates. The unweighed sample base is presented in parentheses so that the sampling variance fOr these estimates can be calculated.
[c]Louis Harris & Associates, *The Road After 1984*, 1983.
[d]Not asked.

SOURCE: Office of Technology Assessment, 1987.

TYPES OF ORGANISMS FOR GENETIC MANIPULATION

The concept and techniques of genetic manipulation can be applied to any living organism. However, public acceptance of genetic manipulation could vary considerably with the type of organism manipulated. The survey was designed to determine how much the views of the public might differ in accepting the genetic manipulation of different organisms.

On a scale of 1 to 10 (where 1 is **totally unacceptable** and 10 is totally acceptable) the public was asked to rank the genetic manipulation in the laboratory of: human cells, animal cells, plant cells, and bacteria. Using this scale, an expected neutral score is 5.5—i.e., a score midway between 1 and 10.

The OTA survey found that the public clearly differentiates between types of organisms in stating their "degree of acceptability" for genetic manipulation. The mean acceptability of genetic manipulation of human cells in the laboratory is 4.5—below the midpoint between totally acceptable and totally unacceptable (table 35). In contrast, the public believes genetic manipulation of animal cells in the laboratory and manipulation of bacteria are more acceptable than human cell manipulation. The average ratings for animal cell and bacteria manipulation are 5.3 and 5.6 respectively—about midway between totally acceptable and totally unacceptable. Finally, genetic manipulation of plant cells receives the high-

Table 35.-Acceptability of Different Organisms for Genetic Manipulation

Question (Q17c):[a] On a scale of 1 to 10 where 1 is totally unacceptable and 10 is totally acceptable, where would you rank genetic manipulation of (READ ITEM)?

		Average acceptability of genetic rnanipulation of:			
		In laboratory			
		Human cells	Animal cells	Bacteria	Plant cells
Total. ,	**(I,273)[b]**	**4.5[c]**	**5.3**	**5.6**	**6.6**
Science understanding:					
Very **good**	*(236)*	*5.2*	*6.1*	*5.9*	*7.2*
Adequate.	**(707)**	**4.5**	**5.3**	**5.6**	**6.6**
Poor	**(316)**	**4.1**	**4.9**	**5.4**	**6.2**
Heard about genetic engineering:					
A lot/fair amount	**(514)**	**4.9**	**5.9**	**6.0**	**7.2**
Relatively little	**(486)**	**4.3**	**5.2**	**5.4**	**6.3**
Almost nothing	**(257)**	**4.3**	**4.7**	**5.2**	**6.0**
Effects of genetic engineering:					
Better.	**(824)**	**5.1**	**5.8**	**6.1**	**6.8**
Worse	**(291)**	**2.9**	**4.1**	**4.3**	**5.9**
Religious:					
Very	*(618)*	*4.4*	*5.2*	*5.5*	*6.3*
Somewhat	**(437)**	**4.5**	**5.3**		**6.8**
Not too/not at all	**(308)**	**5.1**	**5.9**	**5.8**	**7.2**

[a]The code number of the question in the survey instrument (See app. B)
[b]Percentages are presented as weighted sample estimates, The unweighted sample base is presented in parenthesesso that thesamplirrg variance for these estimates can be calculated.
[c]Mean score

SOURCE" Office of Technology Assessment, 1987

est level of public acceptance. The survey group gives genetic manipulation of plants an average rating of 6.6, clearly on the acceptable side of the scale.

Regardless of the type of organism, the average acceptability score for genetic manipulation increases with general understanding of science. Acceptance also increases with the amount heard about genetic engineering. At the same time, the degree of acceptance of genetic manipulation for all types of organisms declines with religiousness.

The effect of religiousness on the acceptance of genetic manipulation is marked, and its impact persists across opinions about all types of organisms. The acceptability rating of human cell manipulation drops from 5.1 for the "not too religious" to 4.4 for the "very religious ." Similarly, the acceptability scores given by the '(not too religious" and the "very religious" shift from 5.9 to 5.2 for animal cell manipulation; 5.8 to 5.5 for bacteria manipulation; and 7.2 to 6.3 for plant cell manipulation, respectively.

Although the effects of religiousness on accept - ance of genetic manipulation is basically constant across organisms, an interesting difference is noted when the sample is separated by perceptions of the effects of genetic engineering. Those who believe genetic engineering will make life worse give a significantly lower rating to human cell manipulation (2.9)-clearly in the unacceptable range—than they do to other forms (4.1 animal cells; 4.3 bacteria; 5.9 plant cells) of genetic engineering. This may indicate that those who worry about the risks of genetic engineering are primarily concerned with its use in and consequences for humans,

DANGERS OF GENETICALLY ENGINEERED PRODUCTS

The OTA survey found that only 19 percent of the public say they have heard of any potential dangers from genetically engineered products. Awareness of potential dangers rises with education, general understanding of science, and how much has been heard about genetic engineering.

Table 36.-Awareness of Dangers of Geneticaiiy Engineered Products

Question (Q20a):[a] Have you heard about any potential dangers from genetically engineered products?		Yes	No	Not sure
Total	(1,273)[b]	19%	80%	1%
Education:				
Less than high school	(165)	16	84	<1
High school graduate	(458)	13	86	1
Some college	(300)	24	73	3
College graduate	(347)	34	65	1
Science understanding:				
Very good	(236)	34	65	1
Adequate	(707)	19	80	1
Poor	(316)	12	87	2
Heard about genetic engineering:				
A lot/fair amount	(514)	30	68	2
Relatively little	(486)	18	82	1
Almost nothing	(257)	7	92	1
Effect of genetic engineering:				
Better	(824)	20	79	1
Worse	(291)	21	77	2

[a]The code number of the question in the survey instrument (see app. B.)
[b]Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.
SOURCE: Office of Technology Assessment, 1987.

Those who believe genetic engineering will make life worse are no more likely to say that have heard of potential dangers from genetically engineered products than those who report they think it will make life better (table 36).

Smaller still is the portion of the public who can specify a potential danger of genetically engineered products. Over one-third (35 percent) of those who say they have heard of potential dangers of genetically engineered products are unable to say what dangers they have heard. Put differently, only 12 percent of the public can cite a specific potential danger they say they have heard associated with genetically engineered products (table 37).

Among those who report they have heard of potential dangers from genetically engineered products, the problem of containment—the difficulty of controlling the product's spread—is most often cited (16 percent). This is followed by concerns about health hazards and side effects (12 percent), and concern about mutations (10 percent). Other potential dangers cited include environmental contamination (7 percent), unforeseen consequences (7 percent), new diseases (6 percent), cancer (6 percent), antibiotic-resistant diseases (3 percent), side effects (3 percent), and dangers to people and animals who consume the product (3 percent) (table 37).

Tabie 37.—identification of Specific Dangers Associated With Genetically Engineered Products

Question (Q20b):[a] What potential dangers have you heard of?	Total
	@ &
Don't know	
Difficult to control growth/spread	16
Health hazards/harmful effects	12
Create mutations/monsters	10
Environmental harm/contamination	7
Unforeseen/unintended consequences	7
Create new bacteria/disease	6
Cause cancer	6
Danger to people/animals who consume product	3
cause side effects	
Create antibiotic-resistant disease	3
No natural enemies	1
Create chemical warfare	1
All other	16

[a]The code number of the question in the survey instrument (see app. B.)
[b]Percentages are presented as weighted sample estimates. The unweighted sample base (number of individuals who had heard about dangers) is presented in parentheses so that the sampling variance for these estimates can be calculated.
SOURCE: Office of Technology Assessment, 1987.

Although only 19 percent say they have ever heard of a danger from genetically engineered products, all individuals surveyed were asked how

likely they thought it would be that genetically engineered products will represent a serious danger to people or the environment. Half of the public (52 percent) state they think it is at least "somewhat likely" (43 percent "somewhat likely)" 9 percent "very likely") that genetically engineered products will represent a serious danger (table 38)-even though just 19 percent of the public have ever heard of a potential danger.

At first glance this contradiction could be construed as a survey artifact. However, it could point to an important consideration in public opinion about science policy. Beliefs about the risks of scientific developments are not necessarily based on factual information, such as having heard of potential dangers of genetic engineering. Note that while self-reported awareness of identifiable, potential dangers increases with education, the perceived likelihood of the danger declines with education (table 36 and table 38). A relatively widespread general sense that a serious danger from genetically engineered products is at least somewhat likely exists in the population, and is independent of education or information about the products (table 38).

The perceived likelihood of danger from genetically engineered products and the general perception of the current rate of technological growth are positively correlated. Among those who say they think the current rate of growth is too fast, 61 percent report they think a serious danger from genetically engineered products is likely. This sense of impending danger declines to 50 percent of those who feel the current growth rate is about right, and drops further to 46 percent of those who believe the current rate is too slow. Thus, the current unease about genetically engineered products could be a background concern with science and technology in general.

Table 38.—Likelihood of Serious Danger From Genetically Engineered Products

Question (Q21):[a] From what you have heard and read, how likely do you think it is that genetically engineered products will represent a serious danger to people or the environment-very likely, somewhat likely, somewhat unlikely, or very unlikely?

		Very likely	Somewhat likely	Somewhat unlikely	Very unlikely	Not sure
Total	(1,273)	9%	43%	31%	11%	6%
Education:						
Less than high school	(165)	15	42		16	8
High school graduate	(458)		45	32	8	7
Some college	(300)	9	43	34	10	3
College graduate	(347)	5	37	41	11	6
Science understanding:						
Very good	(236)	13		30	18	6
Adequate	(707)	8	45	32	11	4
Poor	(316)	9	44	30	6	10
Heard about genetic engineering:						
A lot/fair amount	(514)	10	39	35	14	3
Relatively little	(486)		45	33	9	6
Almost nothing	(257)	14	43	23	10	11
Rate of growth:						
Too fast	(309)	14	47	22	11	6
About right	(549)		44	36	9	
Too slow	(371)	10	36	33	15	6

[a] The code number of the question in the survey instrument (see app. B.)
bp_ercen t_ages are presented as weighted sample estimates. The unweighed sample base is presented in parentheses SO that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.