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ENVIRONMENTAL APPLICATIONS OF BIOTECHNOLOGY: Focus Groups

— Final Report —

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TABLE OF CONTENTS

		Page
FOREWORD		1
IMPLICATIONS		6
HIGHLIGHTS		9
DETAILED FINDINGS		
SECTION 1:	ATTITUDES TOWARDS SCIENCE AND TECHNOLOGY	13
SECTION 2:	AWARENESS OF BIOTECHNOLOGY	
	2.1 Initial Associations	18
	2.2 Awareness of Environmental Applications	21
	2.3 Awareness of Specific Technologies	23
	2.4 Awareness of Current Applications in Canada	25
SECTION 3:	ATTITUDES TOWARDS BIOTECHNOLOGY	
	3.1 Initial Impressions of Biotechnology	27
	3.2 Initial Reaction to Specific Technologies	30
	3.3 Perceived Benefits and Risks of Specific Technologies	33
	3.4 Genetically Altered versus Naturally Occurring	47
	3.5 Reaction If Applied in Community	49
SECTION 4:	COMMUNICATIONS ISSUES	
	4.1 Need To Know	52
	4.2 Credible Sources	54
SECTION 5:	THE ROLE OF GOVERNMENT	
	5.1 Perceived Current Role	58
	5.2 Desired Role	59
	5.3 Confidence in Government	61
SECTION 6:	PRIORITIES	63
SECTION 7:	SUGGESTIONS FOR FUTURE RESEARCH	65

APPENDIX

FOREWORD

Background

Biotechnology has always been a part of mankind's interaction with the environment — from using natural processes to break down his refuse to breeding crops and domestic animals having desirable characteristics.

In recent years, science and engineering have evolved to a point that new technologies using organisms, or parts of organisms, are now capable of performing a wide range of services. These new technologies could help to solve some of the more serious problems bedeviling our civilization, and may prove to be a boon to the country's economy and status.

However, as with anything new, the public's reaction is a crucial component of a successful technology introduction.

Understanding the public's current knowledge and perceptions of biotechnology is a crucial first step to successful introductions. Research into public knowledge on food applications has been undertaken, but the results of this work cannot be extrapolated to environmental applications. Exposure, perceptions, motivations and fears might be quite different.

The Clean Technology Advancement Division (CTAD) of the Environmental Technologies Advancement Division (ETAD), Environment Canada has in place initiatives to support the use of environmental biotechnology. The current project has been undertaken by this group, as part of initiatives led and coordinated by Industry Canada to achieve better understanding of public perceptions of and attitudes towards biotechnology applications. These initiatives are being undertaken in the context of the government's National

Biotechnology Strategy (NBS). This project was guided by an advisory and research team that included: Dr. Geneviève Béchard, NRCan - BIOMINET; Ms. Kate Devine, Biotreatment News; Dr. Terry McIntyre, Environment Canada and Mr. Terry Leung, Office of Consumer Affairs, Industry Canada.

Creative Research International has been brought in to conduct and report on the research. This report outlines the findings from the study.

Objectives

The current project is designed to provide information that would be useful in helping to increase public understanding of biotechnology.

Within this context, Environment Canada is interested in exploring:

- the public's understanding of the concept of biotechnology and their awareness of specific applications;
- awareness of potential benefits and risks of biotechnology;
- perceptions of current use of these applications;
- acceptability of specific applications *in their community*;
- perceptions of trade-offs and willingness to make them;
- credibility of alternative messages and information sources to calm fears; and
- the role for government agencies in funding, encouraging, regulating and undertaking biotechnology applications.

- **Methodology**

A series of 8 focus groups were conducted in 4 Canadian communities where environmental applications of biotechnology are close to implementation: Montreal, Toronto, Saskatoon and Vancouver.

The distribution of the groups was as follows:

	Montreal (French)	Toronto	Saskatoon	Vancouver	
University educated	1	1	1	1	
High school or less	1	1	1	1	
TOTAL	2	2	2	2	**8**

Groups were differentiated by education — generally an important differentiator when addressing knowledge and communications issues. Each group included 9 or 10 individuals, evenly divided between males and females and a mix of socio-economic groups. In order to improve the homogeneity of the groups, ages were restricted to those aged 25 to 55.

Environmental activists were excluded from the groups to avoid a situation where their superior knowledge and strongly held opinions would colour the attitudes of the other participants.

All groups followed a detailed discussion guide built on recommendations from previous research. A copy is included in the appendix of this report. An effort was made to ensure that parallels exist between the guide used for this project and the guide used to conduct the food biotechnology groups simultaneously underway.

Results

The results are presented as follows:

- Implications;
- Highlights;
- Detailed Findings; and
- Appendix.

Throughout the report, verbatim quotations from participants are in *italics* and quotation marks. The purpose of this report is to relay what respondents said — whether correct or not — and to attempt to understand the perceptions and beliefs underlying what was said. The discussions were not mean to educate respondents. Creative Research's recommendations are generally restricted to the Implications section of the report.

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- **A Note Of Caution**

Focus groups are designed to establish hypotheses and explore the range of opinions that exist, whether correct or not. Because of the qualitative nature of the study design, the reader is cautioned to view the findings as hypotheses rather than as definitive conclusions. Although consistencies and logic lend confidence to the analysis and interpretations, there is no way of determining the degree to which the opinions expressed are reflective of the study population at large.

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IMPLICATIONS

This section presents Creative Research's views on the implications of the research findings, based on our analysis and our broader experience.

- Knowledge of environmental biotechnology applications is minimal at best, even among the university-educated. Where knowledge is lacking, reactions are generally characterized by suspicion. Thalidomide, breast implants, asbestos and Urea Formaldehyde insulation are all fodder for this distrust of new technologies. As a result, more than ever before, public support for the technologies is going to require a better informed population.

- While *knowledge* of environmental applications lags behind that of food applications, the public clearly considers the former to be a priority. The public tends to believe that health and environmental biotechnologies have societal benefits while food biotechnologies are associated more with the profit motive. This suggests that public priorities would encourage an emphasis on environmental issues.

- On the other hand, suspicion around environmental applications are probably higher. Participants feel that they can choose to avoid engineered food (as long as it is labeled as such), but can be affected by the environment without knowing about it. At the same time, they know what a tomato is, but may not be as clear on what an enzyme is. Finally, they are familiar with Canada's system of food inspectors, and see evidence stamped on products, but they know much less about and see less evidence of environmental inspections.

- Semantics are extremely important. Jargon breeds suspicion. "Bio" sounds friendly. "Genetic" conjures up images from mutant-filled horror movies. "Bioremediation" and "biolixiviation" are impenetrable. The public is more comfortable with "biofiltering" and "biorestauration" because they recognize parts of the terms.

- Comfort levels seem to increase when new technologies are linked with tried and true technologies. Placing composting and biologically produced fuels on the list with the newer technologies tended to add a degree of acceptance.

- Currently, *knowledge* levels tend not to vary by education level. No one knows much about the technologies. However, *comfort* levels do vary. Those with more education tend to be less suspicious — perhaps feeling that they are better able to judge the validity of the information they are given. This suggests that the university-educated group may be more receptive to and more accepting of public education efforts.

- Many participants see a direct impact on their own lives from these biotechnologies and express concern that they are being asked to trust the work being done by people they don't know, people who don't know the consequences of what they are doing. Should a communications campaign be a part of any future plans, it may make sense to include a component that introduces the public to the people implementing the technology and the rigour of their work.

- Public education, should it be undertaken, is going to require communications pieces. These should give the public the "straight goods" — pros and cons of any technology. Communications initiatives that acknowledge potential risks will have more credibility than those that provide

only the benefits.

- Even the most uninformed understand that there could be benefits from biotechnologies, but believe that at some point, "a line is crossed". The debate over the next few years will focus on where that line is to be drawn. The setting of guidelines, of a "code of ethics" for biotechnology, should be a very open process so that all can understand how the "line" has been drawn and where. The public *expects* to be consulted.

- It is important to note that the groups were conducted before the "mad cow disease" scare hit the news. Mentions of AIDS and the Ebola virus suggest that the newest scare will only heighten concerns about the havoc wreaked by "things biological" getting out of control.

•HIGHLIGHTS

The highlights section summarizes some of the key findings of the research — what the participants said.

- Many participants had mixed feelings about "science and technology". They associate the term with advances in health, communications and productivity, but see it balanced by an increasingly complex, dehumanized and stressful existence. Knowing when to draw the line is a core issue.

- When asked what first came to mind when they heard the term "biotechnology", participants responded with a broad list of impressions and examples. Most had to do with health and food. Very few mentioned environmental applications.

- Non-chemical pesticides and bacteria that eats oil slicks top participants' very short top-of-mind list of environmental applications of biotechnology.

- When presented with a list of biotechnologies, few participants were aware of any beyond composting and biologically produced fuels.

- Participants assumed that the biotechnologies listed are being used in Canada, but apart from composting and biologically produced fuels, few knew for sure.

- While benefits were acknowledged, participants were cautious, if not fearful of biotechnology. They felt that there are too many unanswered questions about eventual impacts. However, many were resigned to the inevitability of the technologies' introduction.

- With the briefest of introductions to specific environmental biotechnologies, participants were generally supportive, particularly when links were made to known technologies — composting and biologically produced fuels. However, they harboured serious reservations about long-term consequences and feared that knowing clean-ups are available will lead corporations to ignore the real problems.

- With the benefit of a brief definition for each biotechnology, participants provided support ratings ranging between 7.5 and 8.8 out of 10. The one exception was biological pesticides at 6.5, primarily because of the mention of genetically altered crops. The university educated are generally more comfortable with the technologies than those with less education. The actual names of the technologies may have an impact on support.

- Most of the perceived benefits focused on the technologies' promise to clean up vexing problems. Disadvantages, often worded as questions, tended to focus more on uncertain side-effects, long term impacts or distrust of players.

- Virtually all participants were uncomfortable with technologies that involve genetically altering organisms. Some, particularly among the university educated groups, could also list problems with naturally-occurring organisms.

- Participants said that they would be unlikely to protest the application of a biotechnology in their neighbourhood as long as they were kept informed of the benefits and risks. However, providing only a little information appears to raise suspicions.

- Most wanted to hear the "cons" as well as the "pros" of a biotechnology application. They wanted to know what controls are in place and what the

long term consequences will be. And they wanted to hear it in everyday language.

- Apart from David Suzuki, no information sources had the complete confidence of all participants. A consistent message from several sources is the best bet for increasing comfort with biotechnologies.

- None knew what the government is currently doing in biotechnology. They assumed that funding, research, standards, monitoring and "propaganda" are all happening.

- The government should be involved in most aspects of biotechnology, including funding, research, setting and enforcing standards and public education. It is also deemed important that government establish independent watch groups and give citizens a say.

- Participants generally had more confidence in an "independent" body overseeing biotechnology, than in the government. However, there was grudging respect for the government's abilities.

- Environmental and health applications of biotechnology were considered a higher priority than food production.

SECTION 1: ATTITUDES TOWARDS SCIENCE AND TECHNOLOGY

•DETAILED FINDINGS

SECTION 1: ATTITUDES TOWARDS SCIENCE AND TECHNOLOGY

Many participants had mixed feelings about "science and technology". They associate the term with advances in health, communications and productivity, but see it balanced by an increasingly complex, dehumanized and stressful existence. Knowing when to draw the line is a core issue.

When asked for their first reactions to the term "science and technology", most participants rhymed off a list associated with technology and the future, with no judgement or values attached. *Computers* are most frequently mentioned along with:

- *satellites*
- *laboratory*
- *future*
- *space*
- *discoveries*
- *change*
- *Japan*
- *internet*
- *government grants*
- *robotics*
- *aero-industry*
- *test tubes*
- *Quebec Science*
- *biology*
- *music*
- *Technical schools*
- *bank machines*
- *museum of sci / tech*
- *pharmacy*
- *communications*
- *education*
- *mutual funds*
- *economics*
- *chemistry / drugs*
- *automation*
- *David Suzuki*
- *university*

Some of the top-of-mind comments pointed to a very positive orientation. These include:

- *better things*
- *improvements*
- *easier*
- *necessary*

fast paced

adventure

nouveauté

good to have job

time savings

rigour

interesting

big money

These positive views were balanced to some extent by negative terms, including:

- *dislocations*
- *mise-à-pieds*
- *leaves people aside*
- *complicated*
- *waste of government money*
- *alienating*
- *lose human touch*
- *complications*
- *impersonal*
- *taking over*
- *use head less*
- *speed is spooky*
- *unapproachable*

Overall, participants in all four cities spoke of an appreciation of the advances and successes of science and technology:

- medical advances that cure diseases,
- communications technology that help emergency crews respond faster,
- everyday tools that make life easier — faxes, voice mail, cell phones, microwave ovens, phone banking, debit cards.

Personal experiences with science and technology speak to these advantages. One man had avoided a leg amputation after a car accident because of medical advances; a musician was exploring a whole new way of undertaking his art.

However, dissatisfaction tended to focus on a few key, interrelated areas:

- the frustration of the speed of technology;
- the loss of jobs;
- the loss of the human touch,
- increasing expectations, particularly at work;

- increased stress in general; and
- concern about knowing when to draw the line.

The speed of technology is unsettling for many Canadians, particularly those who feel that they are being left behind. A common example is the speed at which a home computer becomes obsolete. *"It's coming at us too fast". "You feel frustration because you can't keep up when things develop too fast".*

However, this can also undermine personal security: *"I used to work in offices. Now it's all computers and I'm in the dark". "If you don't keep up you are on the outside looking in". "It leaves some people behind".* Job losses are a common concern.

The loss of the *"human touch"* was a frequently mentioned concern, focusing particularly on voice mail and other computerized phone systems. For some, the "*dehumanizing"* nature of science and technology means that we are losing the ability to do things for ourselves: *"if we rely too much on technology, we'll be left with nothing between the ears".*

In the workplace, science and technology has led to improved productivity and, as a result, *"everything is faster, so more is expected of you".* This faster pace is seen as a major contributor to stress in modern life.

A key concern about science and technology focuses on the dangers of ambition. Several participants pointed out that mankind is curious to a fault and as a result, unable to respect moral or ethical limits to progress. This concern about limits was summed up succinctly by the following line:

> *"How are we going to know where to draw the line? How many organs do you transplant [from a monkey to a human] before you become a monkey?"*

While some say that the benefits and risks of science and technology balance each other out, others suggest that *"we are living just fine without those advances now"*. This suggests different orientations — those who accept some risk for the sake of progress, and those who fear any risk. *"It's scary, we don't know what we are getting into"*.

Suspicion of science and technology seems to run deeper among those with a high school education or less.

A common theme throughout the discussions was that the problem was not with the technology, but with the people who use it.

SECTION 2:
AWARENESS OF BIOTECHNOLOGY

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2.1 Initial Associations

When asked what first came to mind when they heard the term "biotechnology", participants responded with a broad list of impressions and examples. Most had to do with health and food. Very few mentioned environmental applications.

The term "biotechnology" tends to be associated with biology. As a result, it is seen to apply to humans, plants and animals and relates primarily to advances in **health care**.

Examples that were provided by participants include the following:

- *DNA testing*
- *in vitro fertilization*
- *genetic selection*
- *genetic engineering*
- *selecting fetus' sex*
- *penicillin mold*
- *germs (AIDS, Ebola)*
- *the ear grown on the back of a mouse*

- *cures for diseases*
- *biomedical waste*
- *pharmaceuticals*
- *biofeedback*

- *laser treatment*
- *artificial limbs*
- *hearing aids*
- *plastic heart valves*
- *computer diagnoses*

Participants' reference to AIDS and the Ebola virus stems from their suspicions voiced in both Montreal groups that the AIDS virus was an experiment in biotechnology (e.g. germ warfare) that escaped from a Belgian lab in Zaire.

While those examples in the first column can be linked to biotechnology, the other examples show that a variety of other technologies can be seen to be part

of the field. References to prosthetics indicate that participants believe that anything relating to the human body can be included in "biotechnology".

While health issues were the most top-of-mind, some of the first impressions related to **food production**. Those mentioned included:

- low cholesterol eggs
- cross-breeding
- bovine growth hormone

more fibre in beans

things grow faster

exploring new ways of producing

plants with tomatoes on top and potatoes below

Olestra

fewer pesticides

genetically engineered wheat

The food-related impressions were less specific and less detailed than the health references.

Very few of the first impressions of biotechnology had anything to do with the **environment**. One or two individuals mentioned:

- *cleaner fuels; and*
- *the purification of contaminated soil*

These examples were provided by individuals who admitted an interest in the field that had led them to do some reading on the subject. Otherwise, top-of-mind awareness of environmental applications of biotechnology is extremely low.

A few of the first impressions mentioned in the groups do not fall as easily into the three categories of health, food and environment. This **other** category includes:

- *germ warfare;*
- *stocks; and*
- *construction material made from the shells of mussels.*

Those who mentioned "stocks" were referring to biotech companies that have been listed on the various stock exchanges.

The fact that environmental implications of biotechnology are rarely, if ever, top-of-mind confirms one of the initial hypotheses of this research — that public knowledge is further along on health and food applications than it is on the environment.

• 2.2 Awareness Of Environmental Applications

Non-chemical pesticides and bacteria that eats oil slicks top Canadians' very short top-of-mind list of environmental applications of biotechnology.

Once biotechnology was defined for them (see the discussion guide in the appendix), respondents were asked to list the environmental applications that came to mind.

The list they produced is a relatively short one.

Mention was made in all of the university-educated groups and in two of the less-educated groups of pest control. The most common form of this was *"breeding another bug to take care of pests"*, and *"using other pests for pest control"*. Variations on this included *"destroying pests on crops by making them infertile"*, and *"eliminating mosquitoes ... by spraying biochemicals"*.

Another frequently mentioned environmental application was the bioremediation of oil slicks. Participants referred to this as *"bacteria that eats oil"*. One participant mentioned the use of this technology in Saudi Arabia (perhaps referring to clean-up operations in Kuwait following the Gulf War).

Other examples mentioned by one or two participants each included:

- composting (*"organisms eat through garbage and turn it into something useful"*);
- cleaning up water, air and soil (*"mushrooms de-pollute the environment"*, *"cleaning up nuclear wastes"*, *"reducing waste"*, *"fewer chemicals in the soil"*);

- repairing the ozone layer (*"create more ozone"*);
- reducing acid rain;
- biodegradable products;
- hydroponics;
- *"canaries in mines"*;
- *"bacteria that cleans off buildings"*;
- forestry (*"speeding up the growth of trees ... more oxygen, faster replacement"*);
- *"growing crops in dry earth to avoid future dustbowls";* and
- recycling (e.g. plastics).

While the examples cover a lot of ground, the low frequency of mentions underscores the fact that Canadians do not have significant knowledge about biotechnology.

2.3 Awareness Of Specific Technologies

When presented with a list of biotechnologies, few participants were aware of any beyond composting and biologically produced fuels.

The chart below indicates the numbers of participants, out of the 75 attending the groups, who claimed to be aware of each of the technologies listed. Note that this project was not a quantitative research study and that the numbers should not be considered projectable to the larger population. They do however, provide a general indication of awareness levels.

Technology	University educated	High school or less	Total
Specialty chemicals like bioplastics	5	5	10
Biosensors	4	2	6
Bioremediaton	3	1	4
Bioleaching	4	0	4
Biofiltering	10	4	14
Biologically produced fuels	29	24	53
Biological pesticides	20	25	45
Phytoremediation	0	1	1
Composting	38	37	75

Clearly composting and biologically produced fuels are the most widely known. Every respondent in every group knew about composting. Awareness of the fuels was virtually unanimous in Vancouver and Saskatoon where the Mohawk gas stations have marketed a gasohol product.

Biological pesticides appear to have a fairly strong level of awareness, but most of these participants were referring to the introduction of predatory species rather than the technology that we were using in the discussion (genetically altering crops to permit the use of less environmentally harmful pesticides).

Biofiltering was also frequently understood to be the use of marshes to clean waste waters (phytoremediation) rather than the gas-related bioremediation that

we had defined.

The university-educated participants tended to claim more awareness than those with lower levels of education. Overall, awareness levels appear to be consistently lower in Toronto than in the other centres.

2.4 Awareness Of Current Applications In Canada

Participants assumed that the biotechnologies listed are being used in Canada, but apart from composting and biologically produced fuels, few knew for sure.

When asked which if any of the environmental applications of biotechnologies listed and defined for them were currently in use in Canada, all could point to composting and most knew of biologically produced fuels. However, few if any knew of applications of the other technologies.

For the most part, responses suggested that they assumed these technologies were in place, at least at the experimental stage. *"It must be, but I don't know where". "Probably, but I don't know for sure".*

Participants understood that developments happen quickly and did not expect to be aware of everything going on in technological fields. They suggested that they would not be surprised to learn that technologies they know nothing about are already in place.

SECTION 3:
ATTITUDES TOWARDS BIOTECHNOLOGY

SECTION 3: ATTITUDES TOWARDS BIOTECHNOLOGY

3.1 Initial Impressions Of Biotechnology

While benefits were acknowledged, participants were cautious, if not fearful of biotechnology. They felt that there are too many unanswered questions about eventual impacts. However, many were resigned to the inevitability of the technologies' introduction.

Following the initial questioning on awareness of biotechnology (and before narrowing the focus to the environment), participants were read the following definition of biotechnology:

> the use, through science or engineering, of living organisms or parts of living organisms, in their natural or modified forms, for the production of goods or services.

Positive comments focused on the fact that society was finding new ways to solve old problems. Mankind's insatiable curiosity and inventiveness were considered positive characteristics, and biotechnology as evidence of further progress.

However, none of the participants were overwhelmingly supportive of this concept. Some expressed support but inevitably qualified it with reservations: *"It's very exciting ... we get to play god ... but will we destroy ourselves? Look at our track record". "As long as it's better for mankind, but who defines that?"*

Rather than support, those who held positive views expressed acceptance of biotechnology. *"You can't stop human beings from advancing, from curiosity". "You can't do nothing, you'll stagnate". "There are always risks". "I'm not worried. My religion [Bhuddism] tells me that there is a plan. It will work out".*

Reactions, however, were universally tinged with caution. This caution stems

from two principal sources:

- a distrust of players, and
- the sense that no one really knows what the long term impacts of these technologies will be.

Distrust focuses on the fact that these technologies are new and that the research process has risks. *"We haven't researched it enough". "It's all trial and error", "The scientists are flying by the seat of their pants".*

At the same time, participants questioned the motives of those involved. *"There's so much money in new technologies ... profit drives the companies". "There are a lot of dollars involved. The competition ... it could mean sloppy work". "Even with controls, someone is going to find a loophole". "All it takes is one scientist and one mistake". "There are other countries out there. They don't know what they are doing, but it's going to affect us."*

In both Montreal groups, participants suggested that AIDS was a result of a biotechnology experiment gone wrong. One participant suggested that the Ebola virus was as well. *"The danger is we don't know. We don't know what the CIA is doing".*

Even with pure motives and strict controls, participants felt that no one really knows what will happen. They pointed to things that have gone wrong in the past — citing Thalidomide, radiation and DDT in several of the groups. Zebra mussels and rabbits in Australia were given as examples of man's activities gone awry.

The questions are numerous:

"What will the impact be down the food chain?"

"It's like the sorcerer's apprentice. Where will it all end?"

"How will one gene altered affect the rest?"

"It can snowball ... take us places we don't want to go".

"When does nature say 'that's enough'?"

Participants seem to see biotechnology as a continuum where the starting point has many benefits. However, at some point, the science will cross a line to produce some unacceptable outcome. *"It's OK if it prolongs life, but not if you use it to alter the fetus before birth".*

Even if there were guidelines, the impact of crossing the line could be very personal and disastrous. As a result, the most common first impression of the technology is *"it depends"* on who is using it and what it is being used for.

Key concerns, at current levels of information (before more detailed information was presented) were:

- that there be a code of ethics;
- that there be accountability for cleaning up and compensating for any problems that arise; and
- that public information not be *"at too high a level"* so that they can understand and react to it.

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3.2 Initial Reaction To Specific Technologies

With the briefest of introductions to specific environmental biotechnologies, participants were generally supportive, particularly when links were made to known technologies — composting and biologically produced fuels. However, they harboured serious reservations about long-term consequences and fear that knowing clean-ups are available will lead corporations to ignore the real problems.

Participants were read brief definitions of each of the technologies tested (see discussion guide in the Appendix) and asked to individually rate each one. These ratings are provided in the next section of this report.

Following the rating exercise, participants discussed their reactions.

In each group, the initial comments were positive — more positive than their reactions to the overall concept of "biotechnology". However, each positive comment was followed by a *"but ..."*.

Positive comments generally focused on:

- the fact that these technologies were overcoming a greater evil — *"It can't be any worse than what they are cleaning up"; "It's achieving what we want"; "at least something's being done"; "I'm in favour as long as it does the job";*

- that technological advances are inherently desirable, despite risks — *"we have to go with technology or else we'll become illiterate"; "50 years ago, people were sitting around discussing the merits of what we*

take for granted now ... aerosols";

Neither of these perspectives reflected an overwhelmingly positive position.

Positive initial reactions were generally helped by the presence on the list of two familiar technologies — composting and biologically produced fuels. Canadians have lived with both and participants expressed the view that they are safe. Discussions indicated that there may be some degree of "coat-tail" approval for other biotechnologies — perhaps they are OK if they are related.

At the same time, the prefix "bio" has positive associations. *"C'est bien doux". "The name feels good". "It means friendly".*

However, each group, university-educated and less educated, quickly moved from positive comments into expressions of doubt. Many felt frustrated — *"it sounds good, but my instinct tells me it isn't".*

Their distrust is based on top-of-mind examples of technology gone wrong, including Thalidomide, breast implants, DDT, asbestos and even the Love Canal. They wonder if the technologies will create an even larger problem: *"they keep fooling with nature ...[they will] have to come up with something new to fix it ... to clean up the clean up."*

Participants suggest that one of the most serious problems with the specific biotechnologies is that they are so new and untested. *"It sounds really good, but they never do what you want them to".*

The fear is compounded by a general distrust in the players: *"It will remain the toy of scientists ... we never know about it, but we have to live with the consequences." "I don't have much faith in government. They don't do what they say they'll do".* While participants generally did not differentiate between politicians and government institutions and bureaucrats, they appeared to be referring to politicians.

Several participants suggested that the introduction of these new biotechnologies will remove accountability and responsibility: *"They can pollute because there's a way to clean it up after". "There's no need to focus on the real problem — instead of cleaner fuels, we need fewer cars".*

The key, many participants felt, was management. The technologies could be good, or bad, depending on who uses it and how it is used.

3.3 Perceived Benefits And Risks Of Specific Technologies

With the benefit of a brief definition for each biotechnology, participants provided support ratings ranging between 7.5 and 8.8 out of 10. The one exception was biological pesticides at 6.5, primarily because of the mention of genetically altered crops. The university educated are generally more comfortable with the technologies than those with less education. The actual names of the technologies may have an impact on support.

Most of the perceived benefits focused on the technologies' promise to clean up vexing problems. Disadvantages, often worded as questions, tended to focus more on uncertain side-effects or long term impacts.

Participants individually rated each biotechnology on a scale of 1 to 10 (where 1 is very opposed and 10 is very supportive) then discussed the advantages and disadvantages of each one. This section presents these findings for the 7 biotechnologies tested. The figures below are averages of the ratings provided by all members of each group. They are not statistically projectable to the larger population and should be taken as directional indications only.

Specialty Chemicals such as Bioplastics

	Ratings (out of 10)		
	University educated	High school or less	
City			Average
Toronto	7.6	7.9	7.8
Montreal	8.4	9.1	8.8
Vancouver	8.1	7.6	7.9
Saskatoon	6.7	7.4	7.0
Average	**7.7**	**8.0**	**7.9**

This application of biotechnologies scored well across all groups, particularly in Montreal. This is the only application on which the less educated provide scores

higher than the university educated — in all cities except Vancouver.

The participants' perceived **advantages** of this technology are:

•less going into landfill;

•less of a dependence on petrochemicals; and

•the fact that it disappears if it gets into the environment.

However, some participants suggested that because plastics can be recycled, it shouldn't really be a priority.

The participants' list of **disadvantages** — expressed largely in the form of questions — takes up on this theme:

•does it distract us from the real problem? (*"will we consume more and not recycle because we don't have to worry about it any more?)*

•will it be as strong? (*"how long will it last if you store something in it?" "what if it disintegrates in the fridge?")*

•does it produce more pollution in manufacturing than other plastics?

•what does it break down into? (*"what does it become?" "Is the residue harmful?" "plastic doesn't degrade, it breaks down into small pieces, so their are no consequences")*;

•how long will it take to degrade? (*"a 1000 years?")*;

•will its byproducts be absorbed into food? (*"does it put carcinogens into food even faster?" "what if we put substances we've never tested into the containers?"*).

Despite the relatively high support levels in the individual ratings, discussions of possible downsides far outweighed the positive comments.

Biosensors

City	Ratings (out of 10) University educated	High school or less	Average
Toronto	8.3	7.3	7.8
Montreal	8.3	7.6	8.0
Vancouver	8.2	5.8	7.0
Saskatoon	7.7	6.6	7.2
Average	**8.2**	**6.8**	**7.5**

Initial, individual reactions to this biotechnology were universally more positive among the university educated than among those with less education — and the gap is quite large. Residents of Toronto and Montreal seem to be more supportive of biosensors than those in Vancouver or Saskatoon.

The **advantages** of biosensors were numerous and easy for the participants to find:

•finding toxins to help in removal or avoidance (*"It would let you know if the water was safe for swimming", "It would show you radiation", "It's an advantage to know what's on a site"*);

•finding culprits (*"see who's polluting", "after a company moved out, find if they left a mess and go after them to clean up".*);

•finding resources (*"finding oil and other resources ... faster, cheaper and less destructive");*

•faster reaction to accidents (*"On a construction site, you'd know sooner about a leak", "around farm land, you could find bad run-off");*

•assisting farmers (*"could show if the soil is rich enough", "farmers could check for fertilizer content").*

Participants tended to see this as a natural extension of existing technologies — from a canary in a mine and litmus tests, to sonar or radar.

However, there were **disadvantages** that kept surfacing, again, generally worded as questions:

•What is the potential toxicity of the biosensor? (*"what about the toxicity of what is doing the testing?", "Il y a des bacteries qui sont drôlements dangereuses", "will it contaminate other things?", "will it poison people who drink the water?", "how do we know that what they are using is safe?", "to what extent would we be exposed?"*);

•What becomes of the biosensors once their job is done? (" *"will the sensors have to be cleaned up?", "the trouble with cells is that they multiply and change ... mutate");*

•Privacy issues (*"it could be a menace to my privacy ... if they find my DNA on something I've touched"*);

•Cost (*"Is it going to be expensive ... for the taxpayers?"*)

Several spoke of a desire for choice — being able to decide whether or not they want to be exposed to it, rather than having it imposed. This was likened in Saskatoon to the debate over softening the water supply.

- **Bioremediation**

City	Ratings (out of 10) University educated	High school or less	Average
Toronto	8.9	8.6	8.8
Montreal	9.3	9.2	9.3
Vancouver	9.4	8.4	8.9
Saskatoon	9.1	7.4	8.3
Average	**9.2**	**8.4**	**8.8**

After hearing the definition, participants gave this technology the highest approval rating. Again the university educated are more supportive of this technology than are those with less education, particularly in Western Canada. Quebecers are slightly more supportive than are others.

An important observation is that the French term "biorestauration" has relatively positive connotations — referring to restoration or repair. The English "bioremediation" does not carry this meaning.

The **advantages** were obvious to participants:

- cleans up the environment (*"it will clean something polluted", "it gets rid of toxins", "toxic sites ... waste sites could be cleaned up", "it would work on oil spills", "clean up germ warfare", "we'd be able to get rid of PCBs");*
- allows an ecosystem to re-establish itself (*"help repair what we've damaged").*

In Vancouver, a few participants were aware of the bioremediation taking place on the Expo '86 site. This tended to raise their comfort levels. In Saskatoon, one individual was a fireman who dealt occasionally with toxic spills — *"it takes days to find someone who will dispose of the stuff".* With these positive examples on the table, support tended to increase.

However, perceived **disadvantages** were always available:

- a false sense of security (*"it encourages us to try more harmful things." "make it easier to create a problem", "we should worry about never capsizing an oil tanker rather than 'don't worry, we can clean it up'", "complacent")*

- what does the process release (*"if you remove one element, is there something left ... something that might evaporate into the environment?" "could it contaminate the water?");*

- what happens to the micro-organisms after (*"how long does it keep on working?", "you don't know what will happen in the long term", "does it multiply?");*

- Is there a danger in losing control? (*"if the bacteria went underground and destroyed all of our oil fields")*

- supply (*"is it readily available and in sufficient quantities when we need it quickly?"*)

- cost (*"it's very expensive ... and it benefits only real estate"*)

Several participants felt that our society should be focusing more on modifying our lifestyle and avoiding toxic problems than on cleaning them up. Some see it as a powerful tool that could easily be misused. Throughout the discussions, participants tended to make easy leaps from micro-organisms and bacteria to germ warfare. Concerns that it could be *"dangerous in the wrong hands"* were not unusual.

- **Bioleaching**

	Ratings (out of 10)		
	University educated	High school or less	Average
City			
Toronto	8.1	7.7	7.9
Montreal	9.0	7.7	8.4
Vancouver	8.2	6.8	7.5
Saskatoon	7.0	6.8	6.9
Average	**8.1**	**7.3**	**7.7**

Bioleaching scored well. Again the university educated are consistently more supportive of the technology, particularly in Montreal.

The English term was slightly more familiar than the French for this item. "Biolixiviation" was considered both intriguing and a little scary.

This was one technology where the advantages seemed to be easier to find than the disadvantages. First the **advantages**:

•less waste (*"It is doing it better", "good for communities ... get rid of the unsightly waste", "more profitable ... more efficient ... less time to get more out", "less dust, acids, smoke, water pollution");"*

•resources last longer (*"don't have to mine more", "less likely to have problems with rare metals ... you can re-mine", "it finds other metals");*

•less damage from mining (*"less of the environment is destroyed with holes",*

"you don't have to dig any further);

•rejuvenation of mining communities (*"more money for communities with dead mines," "it's good for the industry").*

Vancouverites spoke of the rejuvenation of Trail B.C. through the removal of its slag heaps. This was technology which spurred a debate on the importance of doing something: *"We can't be doom and gloom all of the time. Everything has a risk. Either we do something or we do nothing. It's better to do something".*

The list of **disadvantages** was less extensive:

•encourages more mining (*"it would only encourage them to strip the earth quicker ... short term rather than long term");*

•concern about long term effects (*"no one knows what damage could be done", "we'll never know until the consequences show up", "I'm concerned about using it on a massive scale ... there will be too much of the enzyme ... we won't know what to do with it," "how safe is the stuff?", "what happens to the bacteria?", "where does it go next?");*

•distrust of the motives (*"we're in the hands of the scientists and the money-makers", "it's only for capital gain", "what if we lose them ... what if there's a lab that wants to go to the top too much?");*

•concern about the quality of the metals (*"could be that the metals wouldn't be as good quality ... as strong").*

Mining itself has a somewhat environmentally unfriendly reputation. A cleaner technology would be seen as an improvement if there were assurances about the longer term consequences of its use.

Biologically Produced Fuels

City	Ratings (out of 10) University educated	High school or less	Average
Toronto	8.9	8.8	8.9
Montreal	8.8	8.4	8.6
Vancouver	9.3	7.9	8.6
Saskatoon	8.8	7.9	8.4
Average	**9.0**	**8.3**	**8.6**

This technology receives universally high scores across the country. Less educated participants were a little less enthusiastic than those with university educations.

Familiarity with the technology, particularly in Western Canada, made it easy for participants to list **advantages**:

- already tested (*"it's less of a problem ... it's already investigated and already used"*);
- fewer emissions (*"it's less polluting ... saves the ozone layer ... fewer toxins"*);
- uses garbage / less cost (*"great ... it uses garbage as a source of energy", "economique", "it costs nothing)"*;
- saves petroleum resources (*"a future source when gas runs out", "saving oil", "it becomes a renewable resource"*);
- good for the economy (*"more money for Saskatchewan [from growing raw resources]"*).

In Vancouver and Saskatoon, Mohawk sells a gasohol product, advertising it as safer for the environment. However, even with this degree of visibility and familiarity, there are perceived **disadvantages**:

•distracting us from the real problem (*"there's no incentive to reduce usage ... riding a bike", "it encourages the urban structure", "it may be preventing us from going to the next stage");*

•unsure of emissions (*"you don't know what's going to happen", "if you burn something, you create a problem", "what will the emissions give?" "what do they do to the air?");*

•are we ready for it? (*"all cars must be able to use it ... it wrecks fuel filters", "can we do it on the scale we need");*

•redirecting food resources to produce fuel (*"need to grow greens just for fuel", "can we do it on the scale we need and still feed the world?" "using land for fuel and not for food crops").*

The issue of cleaner fuels distracting us from the real problem is the most prominent disadvantage, surfacing in most of the groups. The concern about using food producing land to grow greens for fuel surfaced primarily in Saskatoon.

- **Pesticides**

City	Ratings (out of 10) University educated	High school or less	Average
Toronto	7.7	7.9	7.8
Montreal	6.8	6.8	6.8
Vancouver	5.1	3.6	4.4
Saskatoon	6.7	7.2	7.0
Average	**6.6**	**6.4**	**6.5**

This technology received the lowest overall scores, from both the university educated and the less educated respondents. Vancouverites were particularly uncomfortable with it. References to "genetically altering crops" in the definition appears to be the source of this discomfort.

The **advantages** enumerated during the discussions were not numerous:

•may reduce pesticide usage (*"less pesticides to achieve the same effect"*);

•lead to the use of less harmful pesticides (*"OK if you can use more natural pesticides"*);

•advantageous for farmers (*"can grow in more hostile environments", "more volume ... more money for the farmer").*

Disadvantages dominated most of the discussions of this technology:

•unknown impact on humans (*"playing with genetics ... it gets into our food chain ... we may all be transformed", "will it alter the cells in the human being that it is feeding?" "mutations ... like in the movies");*

•impact on nutritional value (*"what food value are we getting?" "any nutrition?" "can they kill nutrients in the food?");*

•impact on taste (*"how would this change the taste?"*);

•not the best solution to the problem (*"not thinking about cutting out herbicides", "why not alter the crops so we don't need pesticides?" "They are making the plant stronger so they can use stronger poisons"*);

•losing traditional farming methods (*"safer methods of farming are going by the wayside ... crop rotation ... biodiversity suffers).*

Because the definition suggested that chemical pesticides would still be used, participants wondered what the point was. Had the technology involved replacing chemical pesticides with natural predators, support might have been higher.

- **Phytoremediation**

	Ratings (out of 10)		
	University educated	High school or less	
City			Average
Toronto	9.2	7.6	8.4
Montreal	9.3	9.1	9.2
Vancouver	7.3	7.4	7.4
Saskatoon	8.5	7.4	8.0
Average	**8.6**	**7.9**	**8.2**

This technology scored well among participants in all centres, particularly Montreal. As with most of the other technologies, the university educated were more favourable disposed than those with less education.

The list of **advantages** showed a level of comfort with the use of plants for bioremediation.

•plants have always done this (*"ça as toujours été là", "office plants take toxins out of the air", "swamps are very useful for this"*);

•it is natural (*"plants are natural", "a natural thing is the best way"*);

•there is less of an element of unknown (*"we already know a lot about plants").*

But there is also an awareness of potential **disadvantages** from phytoremediation:

•the dangers of introducing new species (*"it might kill the plants next door", "what are the consequences if the mushrooms get out of control?" "it could harm another ecosystem", "we have to look at the whole ecosystem"*);

•the impact of the activity (*"what do they send out with the oxygen?", "the ground may be the safest place for the toxins"*);

•what to do with the plants after (*"do the toxins stay in the plant?" "is the fruit produced by the plant OK?" "the plant dies, it's still in the plant and becomes part of the earth again*").

Even with this technology that, on the surface, appears to be very natural, well tested and benign, participants expressed concern about the longer term consequences.

- **Summary**

Technology	University educated	High school or less	Average
Specialty chemicals like bioplastics	7.7	8.0	7.9
Biosensors	8.2	6.8	7.5
Bioremediaton	9.2	8.4	8.8
Bioleaching	8.1	7.3	7.7
Biologically produced fuels	9.0	8.3	8.6
Biological pesticides	6.6	6.4	6.5
Pytoremediation	8.6	7.9	8.2

Support for 6 of the 7 environmental applications of biotechnologies tested ranged from 7.5 to 8.8. The one exception was biological pesticides with a rating of only 6.5. This technology scored relatively low across most groups because it had the only definition that specifically mentioned genetic engineering, not as an alternative to chemicals, but to aid in the use of other chemicals (even though they may be less harmful). As a result, some had trouble understanding the advantages.

Overall, the university educated were more comfortable with the biotechnologies, bioplastics being the sole exception.

3.4 Genetically Altered versus Naturally Occurring

Virtually all participants were uncomfortable with technologies that involve genetically altering organisms. Some, particularly among the university educated groups, could also list problems with naturally-occurring organisms.

After the various technologies were discussed in detail, participants were asked if they had different reactions to those that involved naturally occurring organisms or substances and those that had been genetically altered.

Virtually all expressed more comfort with those that occur naturally. The reasons given for discomfort with genetic biotechnology included:

- discomfort with the word "genetic" (*"it sounds like mutants", "70s sci-fi horror movies", "natural means healthier, safer"*);
- a sense of interfering with the system (*"playing god ... sticking our noses in where they shouldn't be", "everything now serves a purpose", "you're messing with the balance", "if you get rid of one link, the rest of the chain crumbles"*);
- uncertainty based on a lack of experience with the new organisms (*"there's no history to look at", "what else comes along for the ride", "do they really understand what they are doing?" "we have to trust someone we don't know", "it's roulette"*);
- examples of experiments gone wrong in the past (*"killer bees in the U.S.", "TB in elk that have been raised on farms", "could make the*

same mistake as Thalidomide").

Interestingly, many participants assumed that if an organism was genetically altered, it would no longer exist in its original form. This led to concerns about altering the food chain and a loss of biodiversity.

There were also individuals who saw risks inherent in the use of naturally occurring organisms for biotechnology. Although few, these individuals tended to be more common in the university educated groups.

Their concerns about naturally occurring organisms included:

- nature is not always safe (*"if you bring a lion into the city, it will attack", "uranium is a natural rock, but look at the harm it does"*);
- even nature creates genetic mutations (*"natural selection produces a range of choices ... mistakes that survive will take over"*);
- nature is not as controllable (*"we'd have more say if we were in control of the genes"*);
- too much of anything can upset the balance (*"purple loosestrife is natural", "rabbits in Australia are natural"*).

The bottom line for these individuals is that both approaches carry risks and the outcome *"always depends on what we do".*

A few individuals made attempts to defend genetic manipulation:

> *"if you remove the thorns from a rose, it is still beautiful, but less dangerous"*

> *"what if we could extract a substance that could cure AIDS?"*

One individual ventured the opinion that the two approaches were similar, just on a different scale: *"it's the same process ... moving a plant from one environment to another or moving a gene from one location to another".*

3.5 Reaction If Applied In Community

Participants say that they are unlikely to protest the application of a biotechnology in their neighbourhood as long as they are kept informed of the benefits and risks. However, providing a little bit of information appear to raise suspicions.

Participants were asked how they would react if one of the biotechnologies examined during the discussion were to be introduced into their neighbourhoods.

Despite the outstanding questions and the discomfort with their inadequate knowledge, participants generally said that they would accept the application so close to home. *"I wouldn't be an activist ... I wouldn't get in their way if they think its OK". "I'm not against, but I'm cautious". "I would not react ... I'm not that way". "I'd like to give it a chance".*

Many felt that cleaning up a mess close to home (e.g. a contaminated site) would be better than leaving it sit vacant. *"Sounds good ... get rid of the crap". "I'd prefer to have them clean up the messes than have the original problem". "Which is more dangerous? I'd want asbestos out".*

But most participants insisted that they would want to be kept informed. *"I'd want to be told before, not after the fact". "We need information ... maybe a public meeting". "I don't want to feel I've been a guinea pig without knowing about it."*

They would expect to be told of the pros and cons and perhaps see the results of a small scale test.

Only one individual among the 75 participating said that she did not want to be kept informed. *"The average Joe is never going to understand. I would hope whoever is doing it has done their research".*

The groups did illustrate the impact of information on public opinion. As one participant pointed out: *"I would never have questioned the result of adding enzymes before tonight's discussion. Now I would question things ... would want more information".*

The same effect is likely to occur in the real world. An activist providing negative information could easily win converts among the uninformed: *"I might go with the flow if someone came to my door with a petition".*

SECTION 4: COMMUNICATIONS ISSUES

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4.1 Need To Know

Most want to hear the "cons" as well as the "pros" of a biotechnology application. They want to know what controls are in place and what the long term consequences will be. And they want to hear it in everyday language.

Participants were asked what they would need to know to be more comfortable with the various biotechnologies. Their responses included:

- the long term consequences (*"the results of 25 to 50 years of trial or experiments", "what happens 10 years from now");*
- direct impact on them (*"how it touches us ... now we hear that suntan lotion is a carcinogen");*
- research that has been undertaken (*"the amount of research ... what kind of testing", "what they are using, where it's from, how it's been tested, the success rate", "what the natural models are"*)
- controls that are in place (*"qu'ils sont très rigides, serieux", "not a free-for-all", "controlled by the government", "what the current processes are");*
- who's responsible for the technology and for mistakes.

Clearly the most important piece of information involves hearing both sides of the story to help them make up their own minds about the benefits and risks and decide whether they want to accept them. *"I'd have to hear a lot of sides". "I'd like a company to be honest enough to list the cons as well as the pros".*

As a result, it is very important that the information be provided using easy-to-understand terminology: *"less technobabble", "in layman's terms", "I'd demand to have it explained to me".*

Perhaps naively, participants spoke of being given *"the truth"*, an indication that they often don't have confidence in the information sources available to them.

Not everyone wanted to make the effort to inform themselves. *"I'd prefer to have confidence in experts than trying to make up my own opinion". "I wouldn't have the capacity to understand it all".*

Despite the highly technical nature and the obviously low degree of public understanding, some participants spoke of having a say in the application of technologies: *"a referendum to give people a choice".*

4.2 Credible Sources

Apart from David Suzuki, no information sources have the complete confidence of all participants. A consistent message from several sources is the best bet for increasing comfort with biotechnologies.

At the moment, much of the information about biotechnology seems to come from the popular media. Horror movies, including The Fly, are cited as examples of what could go wrong. News media also tend to emphasis the dramatic.

Participants were asked where they would like to get their information on biotechnology from.

David Suzuki was mentioned in over half of the groups. *"He exposes the crap that's going on".* One individual suggested Jacques Cousteau.

In Vancouver, Svend Robinson is mentioned as a credible source *"because he's not afraid to stand up for what he believes in".*

Other sources that are mentioned include:

- government reports,
- the FDA (many thought it was Canadian),
- some reporters,
- Protegez-Vous (the Quebec consumer magazine),
- universities ("*they have ethical standards, values ... it's not such a closed door, board room type of thing*"),
- worldwide organizations (World Health Organization),

- Greenpeace,
- advocate groups (*"like Ralph Nader's"*),
- on the internet, and
- a watch group (like the Better Business Bureau).

However, groups also supplied a list of sources that they would not trust:

- scientists funded by corporations,
- private corporations,
- Greenpeace (*"they are always too negative", "they promote their own cause"),*
- manufacturers' scientists,
- university scientists (*"with funding cuts they are too dependent on money from the chemical companies"*), and
- government (can be manipulated).

Participants suggest that a credible source has the following characteristics:

- someone not afraid to tell the truth,
- a neutral group,
- with experience,
- no vested interest, and
- no profit motive.

One participant in Montréal suggested a "*regroupement*" of people from various backgrounds, with complementary experience yet no vested interest in the introduction of any of these technologies. Other focus groups spoke of an audit group, an independent third body at arms length from the government.

Participants were asked to give verbal ratings — from 1 to 10 — indicating their confidence in various sources of information on biotechnology. This was not a quantitative exercise, but collects overall impressions on the credibility of each

source as far as biotechnology is concerned. The following chart indicates the most common low-end ratings in each group and the most common high-end ratings.

Information source	Low	High	Most Common
Media	0 - 4	6 - 8	-
Government	0 - 3	3 - 8	3 - 5
Religious leaders	0	3 - 7	0 - 3
Environmental groups	1	6 - 9	1 - 8
Doctors	0 - 4	6 - 9	3 - 7
Consumer associations	2 - 6	8	6 - 8
University scientists	4 - 6	8 - 9	-
Industry associations	0 - 2	2 - 6	-
Corporations	0 - 1	2 - 5	1 - 3

These non-quantifiable reactions to the various sources suggest the following observations:

- that each source has its "believers" and its skeptics;
- that the broadest range of opinions are reserved for environmental groups; and
- that those with the least credibility on biotechnology issues include religious leaders, corporations and industry associations.

SECTION 5: THE ROLE OF GOVERNMENT

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5.1 Perceived Current Role

None knew what the government is currently doing in biotechnology. They assume that funding, research, standards, monitoring and "propaganda" are all happening.

Participants were quick to admit that they have no idea what government is currently doing in the area of biotechnology.

The most common guesses include:

- providing funding for research,
- providing start-up grants for companies,
- setting standards and guidelines,
- monitoring activities,
- handing out patents,
- exchanging information internationally, and
- public education.

An unsettling thread that ran through several of the discussions is that the government is controlling what the public is hearing about biotechnologies. Propaganda was a term used more than once, particularly in Saskatoon. Suspicion is a common theme.

5.2 Desired Role

The government should be involved in most aspects of biotechnology, including funding, research, setting and enforcing standards and public education. It is also deemed important that government establish independent watch groups and give citizens a say.

The most important role for the government to undertake, according to participants, is ensuring the public's safety. This might involve any of the following activities:

- setting standards and guidelines (*"a code of ethics and responsibilities", "'acceptable' standards are not enough"*),
- inspecting and monitoring, and
- enforcing standards (*"pulling grants, fining them if they are not doing it right", "close 'em down"*)

Public education is another important role that the government should undertake. Participants felt it necessary to add that this should provide "honest" information. Publishing *"unbiased"* studies, *"making us aware of third party information sources"*, *"letting the truth be known"* are all ways of expressing this need.

Some felt that the information exchange had to be a two-way channel. The government should encourage *"grassroots organizations [to inform themselves and others]."* It should also *"feel out residents ... let taxpayers have a decision"*. This concept also included a referendum on whether or not to implement the

technologies: *"it would give people time to think, give them a choice."*

Assisting the establishment of independent auditors is a role that was mentioned in several groups. This includes: *"paying independent scientists to verify the research", "ètablir une regroupement indépendante".* One novel suggesting is to give the public *"microbiotic kits ... so you can try it yourself".*

There was some debate on whether or not the government should be undertaking the research itself. Some felt that it was the most trustworthy, while others felt that the work could be done more efficiently and at lower cost by the private sector, as long as the government kept an eye on things.

Those who felt that biotechnology should be encouraged say room for the government to promote research and commercialization.

• 5.3 Confidence In Government

Participants were generally more confident in an "independent" body to oversee biotechnology, rather than in the government. However, there is grudging respect for the government's abilities.

The public mood is less than supportive of government ventures. This is apparent in reactions to the question regarding the degree of confidence that participants feel in the government's ability to oversee biotechnology.

Participants tended to express grudging support (*"We have not choice, they represent us, we have to trust them." "Environment is a high priority so they'll be watched. They are likely to do a fair job". "Government is trustworthy, but not efficient."*

Interestingly, some felt that there would be more control with an independent body.

One concern is that government doesn't have the personnel to follow up with each user of biotechnology.

SECTION 6: PRIORITIES

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Environmental and health applications of biotechnology are considered a higher priority than food production.

Offered three areas of development for biotechnology — health, the environment or food production — some participants chose health and some chose the environment. None suggested that food production was number one.

Those who felt that the environment should be the highest priority generally believed that it had a bearing on all other issues. A clean environment means better health. *"It affects the others. The rest will follow".*

Those who felt that health should be a priority pointed to the potential for life-saving breakthroughs. *"A lot of people will be dead from AIDS before the environment affects any of us". "We are on the verge of major advances".*

Food is not as important. Biotechnology in this area is often seen to be meant to increase the profits of corporations. Health and environmental applications have more altruistic motives.

SECTION 7:
SUGGESTIONS FOR FUTURE RESEARCH

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In a December 1995 report, Ekos Research Associates Inc. examined the question of future directions for public opinion research on biotechnology. They examined the existing research gaps and concluded that work was required in the following areas:

- developing biotechnology and technology *literacy measures* or indices to measure the public's true awareness and knowledge;
- collecting information on the *underlying values* that affect perceptions of biotechnologies and demand;
- understanding the public's perceptions of appropriate *roles for the government* in biotechnology and how this fits with other priorities;
- deepening our understanding of how the public makes *trade-offs* between benefits and risks; and
- exploring how public will respond to biotechnology *products and uses* (e.g. the gap between intentions and actual behaviour).

Ekos then proceeded to outline some short-term and longer term research opportunities.

The current project on environmental applications and a parallel project on food applications fulfill one of the shorter term suggestions: focus groups on awareness and knowledge levels as input for the development of literacy measures. This was to be followed by quantification and a questionnaire design project using focus groups to prepare for a longer term quantitative survey.

The longer term project was to be a complex system to "validate and quantify the conceptual model for predicting consumer attitudes, opinions and behaviour and to track, analyze and predict changes in public attitudes, knowledge and behaviour."

Our role is not to critique Ekos' research plan, but Creative Research International Inc. would suggest consideration of the following issues:

- There are clear distinctions in public knowledge, perceptions, concerns and expected behaviour between the three principal branches of biotechnology — health, food and environmental applications. These are detailed in Section 6 of this report. Future research should make clear distinctions between the three areas, to the extent of addressing them in separate studies.

- To date, most biotechnology-related research has focused on *food* applications. Because public knowledge about *environmental* applications seems to lag, it might be useful to quantify current awareness levels in this area (separate from food and health) to establish a separate baseline measure. Before this happens, however, we would have to develop environment-specific indices of awareness and knowledge that could be applied consistently in future tracking programs. These indices should be parallel to but not replicate indices developed for other areas of biotechnology.

- Syndicated segmentation studies of the Canadian population on environmental issues currently exist — most notably, Creative Research's Green Action Trends — but environmental applications of biotechnology appear to have proponents and opponents across the entire environmental spectrum. This would suggest that support for biotechnology might key into

different social values than environment issues or nutrition. Creative Research would recommend that values-based research be undertaken specifically for environmental applications of biotechnology and be focused on linkages between environmental values and biotechnology-related values.

With these considerations in mind, Creative Research proposes the following "next steps":

1. A working session involving all players in the current research (Industry Canada, Environment Canada, Creative Research and Ekos Research) to reconcile the results of this study with those of the parallel study on food applications, and to lay the foundations for the development of awareness and knowledge indices for both areas;

2. A developmental program for the creation of awareness and knowledge indices specific to environmental applications and *parallel* to those developed for food applications, perhaps including some secondary research and consultation;

3. the quantification of awareness and knowledge levels through an interviewer-administered survey employing the indices developed; and

4. the development and conduct of a large-scale survey designed to identify the underlying values that drive reaction to environmental applications of biotechnologies, distinct from but parallel to the other biotechnology applications.

This program will result in a knowledge base and potential for on-going tracking that will help all involved in biotechnology in this country understand public concerns and anticipate reaction to the introduction of specific technologies. The program will be a tool to help players identify Canadians' comfort levels with