Report of the NABC Ad-Hoc Committee on Ethics

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Recommendations

SUMMARY

1. *Each NABC member institutions should ensure that subject matter on ethical issues associated with food and agricultural biotechnology is systematically integrated into the curriculum of their institution*. The pattern of implementation will vary at each institution, but we expect that some combination of the following three strategies will be employed at most institutions.

a) Modules Included in Basic and Applied Science Courses.
b) Modules Included in General Courses on Applied Ethics
c) Special courses on Ethics and Food Biotechnology

2. *Each NABC member institution should develop an institutional mechanism for supporting faculty interest and research on ethical issues*. Again, implementation will vary. In some institutions, an informal network of interested colleagues will fulfill this function, but in many places an annual workshop or a formal faculty /center will be needed to carry this out.

3. *Each NABC institution should include information on ethical issues in its public education programs on biotechnology*. Extension and public policy education materials should be developed and NABC institutions should actively disseminate materials on ethical issues beyond the campus.

4. *NABC should support these efforts of member institutions by sponsoring regular workshops or conferences on ethical issues, aiding in the development of modules and teaching materials, and aiding in the dissemination of materials in both printed and electronic form.* In particular, NABC should support these efforts by raising funds from member institutions, from foundations and government agencies, and from the private sector, including commercial biotechnology companies.

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Main Report

BACKGROUND.

The Executive Committee of the National Agricultural Biotechnology Council moved to establish an ad hoc subcommittee on ethics at its March 1995 meeting. Each member institution had the opportunity to place a representative on the committee. In August 1995, NABC Chair Roger Mitchell charged Paul Thompson, Texas A&M University, with organizing the committee and with preparing a report to the Executive Committee. The Ad Hoc committee is charged with advising the Executive Committee on what measures member institutions, as well as NABC itself, could and should undertake to ensure that ethical issues receive an appropriate level of consideration as one component of the non-profit sector's program of research and development of food and agricultural biotechnologies. The committee interpreted this mandate in light of a particular understanding of both biotechnology and ethics. Members of the as hoc committee included: Chuck Curtis (Ohio State University), David Galbraith (University of Arizona), Desmond Jolly (University of California at Davis), Gary L. Comstock (Iowa State University), Hugh Lehman (University of Guelph), Jere L. Gilles (University of Missouri), June Fessenden MacDonald (Cornell University), Laura Meagher (Rutgers University), Lawrence M. Busch (Michigan State University), Lily Marlene Russow (Purdue University), Paul B. Thompson (Texas A&M University), Robert J. Burkhardt (University of Florida), Ronald L. Phillips (University of Minnesota), Roy E. Young (Clemson University), Stephen H. Howell (Cornell University), Steve Baenziger (University of Nebraska-Lincoln), and Thomas J. Hoban (North Carolina State University).

A. What is Biotechnology?

For the purposes of preparing this report, the committee presumed that biotechnology includes the use of recombinant DNA in developing products for virtually any application within food, agricultural and natural resources. Most clearly this includes modification of plants and animals for enhancement of agronomic value, or to development new markets for traditional agricultural plants and animals. In addition, the term biotechnology to includes use of rDNA in development of products and processes used in food and agricultural production, such as recombinant vaccines or animal drugs produced by recombinant microorganisms. All of these applications imply some form of genetic engineering, or movement of genes from one organism to another (often in a manner that would not be possible through the species' own reproductive mechanisms) using modern laboratory techniques. The definition is also intended to include use of rDNA techniques to acquire data or basic knowledge in a research setting (genome mapping, for example) even when genetic engineering proper is not involved. The definition is narrower than some in that it does not include tissue culture, cloning or embryo transfer except when these techniques are combined with genetic engineering.

The rationale for this definition is largely pragmatic. Members of the Ethics Committee agreed that the ethical issues associated with food and agricultural products of biotechnology are generally special cases of more general questions that should be raised in evaluating any new technology. As such, many of the committee's recommendations might be generalized and discussed as recommendations for institutions that research and develop food and agricultural technologies of any type. Yet to generalize our recommendations in this manner would clearly exceed the committee's mandate, as well as the scope of interest for NABC itself. As such, a restriction to biotechnology was assumed.

Furthermore, the record of NABC conferences itself testifies to the fact that whether warranted or not, there has been an unusual degree of interest in the ethical issues associated with recombinant DNA. Although reproductive technologies such as cloning and embryo transfer have been controversial when applied to human beings, there has been little criticism of them when deployed in food and agricultural settings. Ironically, the situation seems to be quite the reverse for genetic engineering of crops, animals and for products employed in food production, at least in the United States and Canada. While biomedical applications of genetic engineering have typically been heralded, food and agricultural applications have elicited a significant amount of public controversy and resistance. This controversy has served as something of a guide to where ethical issues are most acute.

B. Ethics.

The term 'ethics' is no less ambiguous than 'biotechnology'. Laboratory researchers may tend to understand ethics in terms of personal integrity in their research techniques, such as accurate recording and reporting of data or acknowledging the contributions of coworkers. The evidence from public opinion surveys indicates that where biotechnology is concerned, the general public tends to interpret 'ethics' in a manner more consistent with the way that philosophers do: ethics is the general subject of what should and should not be done in using rDNA techniques to affect food, agriculture and natural resources. Philosophers apply logic and a two thousand year tradition of articulating and defending answers to the questions "What *should* we do?" in their study of ethics. Philosophical ethics often involves developing theories about the general strategies that can be employed in thinking about norms and ethical responsibilities, and these theories show that certain strategies have weaknesses or "blind spots" to issues or concerns that are made prominent by other approaches. The main contribution of philosophical ethics to the study of food and agricultural biotechnology is an increase in the clarity and precision of normative claims (claims that something is good, or right, bad or wrong), and a greater sensitivity to the range of normative claims that might be made by others with a different vantage point or a different conceptual strategy for thinking about ethical issues.

Since philosophical ethics increases sensitivity to alternative points of view, ethics is closely tied to problems of communicating with the public about food and agricultural biotechnologies. Here ethics becomes a tool less for arriving at one's own answer to the question "What should I do?" than a tool for understanding how people from different walks of life arrive at very different answers. Understanding the views of others is the first step in truly communicating with them, hence ethics has a natural affinity with programs in extension, public communication and education. This link comes full circle when one raises the question of how

science and technology should be managed in democracy, especially when public funds or public institutions are used to do the research. Under most views of democracy, the management of public institutions must be consistent with some criteria of "consent of the governed," hence communicating with the broader public and securing their consent is itself an ethical responsibility for administrators and researchers in public research organizations.

In summary, the committee takes a broad view of ethics, to include personal conduct issues as well as public controversy over food and agricultural biotechnology. Yet the emphasis in our recommendations is on improving scientists', students' and citizens' ability to make judgments and articulate their own beliefs about what is right and wrong with respect to these challenging new technologies, and to understand and appreciate the beliefs and concerns of others.

C. The Content of Ethics Programming.

It is possible to summarize the specific areas in which one would expect teaching, public education and faculty development programs to be active. Four of these areas relate to unintended consequences of technology that might be associated with any new technology. They are product, not process related. A fifth area that is also not unique to biotechnology takes up questions in the governance of science and technology in a democracy. A sixth revolves around debates over the appropriateness of intellectual property rules for the products of genetic engineering, or for genes themselves, and a seventh takes up religious and metaphysical questions. Each area is summarized very briefly below.

1. Unintended Environmental Consequences.

Much of the public controversy over agricultural biotechnology has centered on the potential for plant biotechnology to pose unique or unacceptable ecological risks. Although a substantial part of this controversy is technical, there are crucial philosophical questions embedded in it as well. What is humanity's responsibility to protect the integrity of natural ecosystems? Do issues of risk to human beings (economic losses or fragility in the food system such as was typified by Southern Corn Leaf Blight in the 1970's) exhaust the range of significant consequences? Or does impact on the rate or character of evolution in a non-agricultural species matter, too? How should we think of the need to balance preservation of habitat with expansion of food production, especially when a product of biotechnology (such as proposed vaccines for tropical diseases in cattle) permit dramatic new expansions of agricultural production?

2. Food Safety and Quality for the Consumer.

One approach to the ethical issues here emphasizes the ethical importance of achieving an optimum degree of risk, when compared both to the relative benefits and to the costs of eliminating risk. Another approach stresses individual knowledge and consent, even when individuals may systematically make choices that deviate far from an optimum. A series of philosophical questions affect the way that one would evaluate the choice between these two approaches. For example should "spiritual health," as evidenced by religiously based dietary practices be included in our optimizing equations, or are we better to trust such choices to informed consent? Do people with a radical mistrust of government and science have a right to

opt out of any scientifically based and governmentally organized system for regulating food safety?

3. Animal Well-Being.

As techniques for modifying agricultural animals come on line, the questions that have begun to be raised about animal agriculture production practices will increasingly be applied to genetically engineered animals. Survey research shows that genetic engineering of animals has the highest level of perceived ethical significance among members of the lay public, exceeding the perceived significance of human biotechnology. What is the basis for concern with animal well-being, and how will biotechnology affect it? Would it be ethically acceptable to engineer animals that are neurologically incapable of suffering as a means to improving efficiencies in food production? The mixture of technical science and philosophy in these questions makes them some of the most interesting to be taken up.

4. Social Consequences.

The century long transition from family based to more industrialized agriculture touches biotechnology as it touches every area of agricultural technology. Concern for the perceived decline of northern dairy regions led both producer and consumer resistance to recombinant BST, for example. Why are small or family farms or diversified rural communities significant, and how would products of biotechnology affect them? These questions are especially poignant in developing country settings, where there is a high degree of vulnerability to the economic forces that are unleashed by technical change, and where social institutions for easing the transition are largely absent.

5. Technology and Democracy.

All of the issues above raise second-order issues about who should choose which technologies to develop, and when should compensation or risk mitigation be required in order to move a socially beneficial technology forward. What sorts of things should scientists and research organizations themselves do in order to deserve and win public trust? What sorts of opposition to technology are consistent with rational, democratic decision making, and when does opposition become irrational and obstructionist?

6. Intellectual Property.

Do the moral foundations for recognizing a product as own-able and transferable property apply to the products of genetic engineering? Tradition ties ownership to individual seeds or animals, but there has been significant modification of tradition (witness the Plant Variety Protection Act) for some time. Are patents an appropriate way to protect private sector investment? Are peasant farmers entitled to ownership rights in the germplasm that they have developed over generations of trial and error?

7. Religious and Metaphysical Issues.

Ever since Darwin fundamental advances in biological theory have spawned reaction and rejection on the part of those whose beliefs were being challenged. What could the theological or metaphysical basis for objecting to any form of genetic engineering possibly be? Is it possible to formulate such an objection without also denying the fundamental truth of received biological theories of evolution and molecular biology?

In sum, any and all these areas pose important philosophical puzzles. The committee has worked under the assumption that aggressive and critical inquiry into the philosophical concepts and arguments that would be deployed in thinking through or proposing an answer to any of these questions is a responsibility for institutions of research and higher learning, such as those who are members of NABC.

RECOMMENDATION 1:

Each NABC member institution should ensure that subject matter on ethical issues associated with food and agricultural biotechnology is systematically integrated into the curriculum of their institution. Consistent with the emphasis on ethics as the establishment of competencies in thinking and communicating, the committee has devoted the lion's share of its energy to a discussion of the role of ethics within the educational programs of NABC member institutions. Clearly there is an enormous variety in the student bodies, faculty and curricular structure at NABC member institutions, and some have no classroom teaching component at all. As the pattern for implementing this recommendation will vary at each institution. The committee undertook a lively discussion of three options.

Option 1: Include modules on ethical issues within the scientific and technical curriculum.

The idea here is that scientific faculty will include modules on ethics both in formal classes and in laboratory teaching or seminars. The range of modules that might be included is as extensive as are the methods. There might be a packet of readings on a particular subject or a decision case. Teaching methods might involve collaboration with faculty from other departments, or the use of film and Internet resources. Since scientific faculty are neither trained for teaching such modules, and often too busy to engage in an open-ended search for these materials, this approach presupposes institutional support that will provide training when needed, and make materials readily available.

The strengths of this approach are many. To the extent that faculty cooperate in including modules, it provides a way to integrate ethics throughout a curriculum without undertaking changes in the structure of the curriculum. Students are broadly exposed to ethical issues at multiple points in their education, and when they see scientific faculty taking these issues seriously, they are likely to do so themselves. When modules are well matched to technical subject matter, ethical issues can be seen as integral to planning and decision making with respect to research and product development. The weaknesses are two. One is that piecemeal teaching of ethics may not provide the more systematic overview of general approaches that

students would get in a course on philosophy, history or communication. The other is that faculty with little incentive or support for taking on these approaches will either do so poorly or not at all.

This second weakness erodes what might be thought of as an advantage from an administrative viewpoint, namely budget neutrality. Although this approach might be financially attractive if NABC institutions pool resources in providing institutional support it is not budget neutral. Someone will have to be developing resources, as well as mechanisms to make them available to faculty, and to support scientific faculty who wish to use modules in a variety of teaching and evaluation techniques. This approach is especially dependent on the general institutional support mechanisms discussed in Recommendation 2.

Option 2: Modules within Applied Ethics Courses.

Many institutions currently teach undergraduate courses in contemporary moral issues, technology and human values, agricultural or environmental ethics, or any number of other "public issues" courses in philosophy, political science, sociology, geography, agricultural economics and, occasionally, the agricultural sciences. The content for such courses is generally set by individual faculty members, or by departmental committees. In most cases, modules or course sections dealing with food and agricultural biotechnology would be intellectually consistent with subject matter currently being taught. Faculty and student interest in the proposed subject matter probably does more to determine whether it will be included or not.

Despite its apparent similarity, this approach has few of the advantages of Option 1. To the extent that published materials are available, this approach comes as close to being truly budget neutral as any. It's effectiveness, however, is utterly haphazard, depending as it does on a host of factors that vary tremendously not only from institution to institution, but from faculty member to faculty member, and indeed from semester to semester. This approach *is* the status quo at many NABC institutions. Although the members of the committee acknowledge that there is a clear logic to relying on these service courses as a means of achieving our overall objective, those committee members with knowledge of the planning and structure of such courses regard this as a thoroughly unsatisfactory approach. Two strategies might be deployed to enhance the effectiveness of the approach, however. First, there is no reason why this approach should not be used in conduction with Option 1. Workshops or support institutions should be open to liberal arts faculty who wish to use them, and the inclusion of applied ethics courses among science courses including the modules can do no harm. Second, faculty would certainly be willing to include these modules if they had sufficient incentive to do so, and especially when the incentive includes discretionary funds available for research or summer salary. Both of these strategies substantially increase the cost of this option, and given that low cost is its principle advantage, it is questionable whether it is worth pursuing ways of improving this option in more detail.

Option 3: Stand-Alone Courses:

Stand alone courses would be dedicated entirely or substantially to ethical issues in food and agricultural biotechnology. Our committee did not identify the existence of any such course at an

institution represented on the committee. Member institutions have courses on agricultural and environmental ethics which may include significant content on food and ag biotechnology, and members of the committee received unconfirmable reports of such courses being taught by a biology professor at UCLA. The advantage of this approach are that it is the best way, given current constraints on curriculum, to provide some subset of students with a comprehensive and coherent view of ethical issues in food and agricultural biotechnology. One can make the argument that our society will never truly be able to cope with the ethical complexities of science and technology until some significant subgroup of our student and faculty populations attain systematic understanding of the full range of ethical issues. Hence, the case here is for training an "elite." if you will, at a high level of sophistication, and coming to rely on them to disseminate ideas on ethics throughout the general population.

The disadvantages are largely practical. Unless such a course were available on a very large scale, which seems highly unlikely, only a fraction of students could take it. This strategy would require the commitment of significant and generally scarce teaching resources to the subject matter on an ongoing basis. It would be difficult for many students to include such a course in their current degree plans. At some institutions, the procedures for development and approval of such a plan are so cumbersome that such courses would not become available until the next century.

This option might be more practical, again, if NABC institutions find ways to pool resources. One can envision a course taught using teleconferencing technology, enhanced by the Internet. Such an effort would still require significant resources from each institution, but resources might be far less than the total of having individual faculty at each institution separately prepare and teach this subject matter.

Option 4: Some or All of the Above.

These are not mutually exclusive options. Member institutions can pursue some combination of them simultaneously.

RECOMMENDATION 2:

Each NABC member institution should develop an institutional mechanism for supporting faculty interest and research on ethical issues. Virtually all of the teaching approaches discussed above require some support mechanism—newsletters, periodic meetings of faculty, seminars, summer workshops, etc. But entirely apart from teaching, NABC members need to create a "corporate culture" in which attention to and discussion of ethical issues is undertaken with seriousness, creativity and excitement, and without fear of reprisal, ridicule and abuse. Here a corporate culture means a general absence of behavior that discourages discussion of ethical issues—grumbling, hostility, sarcasm, not to mention overt penalties in assignment of workspace, students or teaching assignments, disbursement of funds or other resources, merit review etc.—and a pattern of receptivity and interest in ethical issues on the part of most faculty, administrators and support staff.

Doing good work in ethics requires that one can test one's ideas, reasoning and conclusions against the reaction of others. One must not be allowed to get away with sloppy or

fallacious reasoning, much less factual errors, and the greatest service that anyone can render to someone working in ethics is to work aggressively to disprove or undercut their arguments. Ethics is, in this sense, quite like science. Yet sheer politeness often prevents the give and take necessary for progress in ethics, and the silent treatment associated with more hostile reactions is often fatal to good ethical inquiry. As such, the presence of a reinforcing institutional culture is *not* to say that people should simply hold hands and think pure thoughts! The institutional culture is vital because ethics is work that must be performed through interaction with others who are also committed to the goals of self-clarification and rational argument.

There are both formal and informal means to create and reinforce a positive institutional culture. Informally, the desired pattern of behavior will not prosper unless senior administrators embrace it themselves. Senior researchers and leaders who make a concerted effort to take ethical issues seriously will eventually find themselves surrounded by younger colleagues who do the same. While these influence of informal mechanisms should not be underestimated, the Ethics Committee agreed that member institutions should undertake formal mechanisms to help support a cadre of research and teaching faculty, graduate students, administrators, support staff, and where appropriate, members of the community who will interact with one another on ethics issues. As already noted, some of the institutions that would support a teaching program will also support the forum in which discussion must take place. But particularly if the focus is on undergraduate education, those fora may become limiting. There must be seminars, faculty retreats, and breakfast or lunch meetings committed to developing the institutional culture.

The commitment of financial resources needed to advance the second recommendation need not be large, but neither is it zero. More crucial that money will be the identification of those key individuals who will give this effort their time and presence of mind.

RECOMMENDATION 3:

Each NABC institution should include information on ethical issues in its public education programs on biotechnology. When trying to reach non-scientific audience, education about the ethics of biotechnology must be part of a larger effort that covers such basic questions as what is biotechnology and how is it being used. My survey research over the last five years shows that most people have little or no awareness of food production in general, much less biotechnology. What people have heard about biotechnology is more in terms of the applications to human health care. As a result the complex and controversial ethical issues related to the human genome project, privacy issues, and manipulation of human DNA will be much more salient and interesting to the vast majority of people than will ethical aspect of agricultural biotechnology (with the exception of ag scientists and farmers).

Biotechnology affects and is affected by many different societal values and public perceptions. Educational approaches must recognize and acknowledge the legitimacy of a broad range of social and environmental values. Although scientific information is necessary for informed decisions about biotechnology, this represents only part of the picture. Important ethical and emotional issues must be understood and respected. It will be necessary to help people understand relevant aspects of the issues and applications of biotechnology. Although not

all people desire, nor need, the same amount of technical information, some basic scientific literacy will be necessary to make informed decisions about biotechnology.

Science education may not, however, be effective when attitudes are based on fundamental moral beliefs or values. The impact of education also may be limited by lack of confidence in government or distrust of information sources. Furthermore, citizens want more effective and equitable opportunities to become involved in decisions about biotechnology. Even if most people never get personally involved in decisions about biotechnology, they want to know that mechanisms are available for such involvement. Consumers also want assurance that government agencies and other groups are protecting their interests.

The important implications of biotechnology call for an integrated national strategy for Extension education and citizen involvement. Such a commitment to education about biotechnology represents a challenging task. Providing information about biotechnology is part of a broader communication challenge. We must also listen to consumers and other decision makers to monitor their attitudes and information needs. Open and ongoing discussion about biotechnology needs to be fostered among all parties involved the food production and distribution system -- from the manufacturers of the products to the ultimate consumers of the food. This process must involve a broad representation of groups.

Educational Objectives:

Education, broadly defined, should aim to provide people with the information, perspectives, and decision making tools necessary to facilitate informed decisions about alternative foods, including those produced through biotechnology and those produced through conventional means. The overall goals of biotechnology education should be to 1) foster informed public and private decision-making by providing timely and balanced scientific knowledge, and 2) provide opportunities for interested parties to dialogue about public policy issues related to the use of biotechnology. These goals suggest three process objectives, which will be further explained in later sections:

1. Collect, evaluate, and catalog relevant educational materials about the ethical aspects of biotechnology. Available educational materials should also be assessed to determine the need for new materials. Additional materials should be developed as new food products become available and as new issues arise. This objective also suggests an ongoing commitment to social science research, including consumer studies, public policy analysis, program evaluation, and social impact assessment.

2. Develop and implement innovative mechanisms for education and information programs that meet identified needs of specific target audiences. This would include: development and dissemination of publications and audiovisual materials; special events (such as training sessions, public forums and symposia); point-of-purchase materials; and expert advice to media and other opinion leaders.

3. Establish an interdisciplinary network of scientists, ethicists, educators, and decision makers who can design and implement programs, as well as provide timely and expert information on a variety of topics. They should be ready and willing to address

ethical issues in a balanced and credible manner. This referral network should include representatives from universities, government agencies, industry and consumer groups.

At the beginning of the food production system significant efforts should be made to educate farmers and others in agribusiness. Farmers will need applied information and technical assistance so they will be able to effectively and efficiently use the latest and most appropriate technology in agricultural production. Information on the ethics of biotechnology should be integrated into Extension programs.

Various intermediaries in the food production and distribution system (such as food processors) need information about the implications of biotechnology for their businesses. At the other end of the system, people who manage and own grocery stores and restaurants need to understand the benefits and risks of alternative products so they can make informed purchasing decisions, as well as better address consumer concerns and questions. These groups are vitally important because they represent important gatekeepers, as well as the main points of contact with consumers.

Elected and appointed government leaders also need information about the ethics of biotechnology in order to improve the quality and timeliness of decisions about research funding, product development, and public policy development. These leaders need basic background information, as well as a balanced overview of the major ethical issues associated with biotechnology. Various public interest organizations and other citizen groups also represent an important target audience because they are interested in and outspoken about the use of biotechnology. Another important audience is youth. Educational modules and lessons designed to bring science alive address ethical questions, and stimulate critical thinking are essential if we are to develop a literate public capable of making informed decisions.

Information should also be provided to corporate executives, company scientists and other leaders within the biotechnology industry. They need to better understand the types of issues and concerns that are important to the public. Increasingly they will be called upon to explain their use of biotechnology in agriculture and food production. Without an adequate appreciation for public attitudes, attempts at communication could be counter-productive. The complex ethical issues associated with biotechnology demand much greater communication, understanding, and cooperation among the various groups involved.

Educational Messages:

Education about the ethics of biotechnology must be place within a larger technical and social context. Education efforts must be broad based and include a wide range of ethical, societal and environmental issues. Consumers also need more information on government policies and regulations associated with the development and application of biotechnology. Established principles and public policy education should be used to shape development of appropriate messages.

Specific types of information that should be collected, summarized, and disseminated include: the general nature of science; the historical context of biotechnology; the potential benefits and risks of alternative technologies and food products; government policies and regulations; public attitudes and values; and controversial issues. Educational messages must be developed at different levels of complexity or detail for different target audiences.

The type of information that appears most important to many people involves issues related to the safety and quality of the food products developed through biotechnology. To make informed purchase decisions, people want to know about the taste, price, safety, possible allergens, and other attributes of specific products. Most people also desire factual information about potential positive and negative impacts on the natural environment and the economy. Information about the process of government oversight and approval of biotechnology will be vital. Some consumers express considerable curiosity about the general nature and development of biotechnology. For people with high levels of scientific interest, such information may be useful and should be available upon request.

In general, education about the use of biotechnology in agriculture and food production is part of a larger educational need. Today, most consumers take their food supply for granted until they perceive a problem. People do not recognize or appreciate the past, present, and future role of technology in food production and processing. As technology becomes more complex consumers have become increasingly apprehensive about the safety of their food. People need a better understanding of the historical and technical context within which biotechnology is developing.

Communication Channels and Sources:

Communication channels range from short and simple mass media spots to more detailed print or video presentations. People will use a range of sources depending on their interest, level of detail desired, and ease of obtaining the information. Channels vary in terms of their cost, effectiveness, and credibility with consumers or other target audiences. A wide variety of communication channels and information sources should be utilized.

The Cooperative Extension system represents a well-established and credible network for implementation of educational program on biotechnology and related ethical issues. Cooperative Extension is well positioned to provide a forum for an open and ongoing dialogue. As a non-regulatory educational agency based at the nations' land-grant universities, and local county units it has a core of researchers and educators in most aspects of food, agriculture and consumer education. Cooperative Extension has the mission to bring together interested parties so they may interact and learn from each other.

Because the educational objectives are so broad and so many target audiences need to be reached, it will be important to employ many different channels and sources. It will be necessary to promote greater coordination among the various groups by establishing mechanisms to collect and disseminate information about biotechnology (such as is already done through NABC). At the national level, various government agencies (e.g., USDA, FDA, and EPA) need to establish a coordinated educational framework, much like they have done in the area of biotechnology regulation. Major national trade associations must be involved because they have important

linkages with major opinion leaders and key stakeholders in the food industry. Other groups (e.g., professional associations and public interest groups) also need to be involved as responsible and influential partners in such an effort.

At the state level, Land Grant Universities can provide credible leadership for educational programs. Such programs should involve interdisciplinary collaboration among agricultural, social, and food scientists. The university community already has established linkages with a variety of government agencies, farm businesses, industry and other important groups. Such education must be planned, coordinated, and implemented in a timely, creative, and open manner. For example, interdisciplinary referral systems or clearinghouses should be established to allow easy access to a broad range of credible expertise on all aspects of biotechnology. Such regional clearinghouses could serve as one-stop referral points for leaders or consumers interested in information about biotechnology. The Extension Service should explore the viability of and provide support for such clearinghouses that could be housed at land grant universities from different parts of the country. In fact, such collaboration is already underway through the National Agricultural Biotechnology Council.

It will be important to maintain and build public confidence in scientists. This confidence has diminished in recent years as a result of concerns over research ethics and funding arrangements. Questions have been raised about the extent to which scientists are acting in the public interest or serving private interests. One reason for a growing public skepticism about university research is the inability or unwillingness of many scientists to effectively communicate with important decision makers and the public at large. Scientists at Land Grant Universities, in particular, have the obligation to better inform the public about the objectives and outcomes of their research. University scientists will need to receive training and institutional support for work on such outreach and extension efforts.

One of the first tasks of the national and state coalition just described will be to collect, evaluate, and synthesize existing educational materials related to biotechnology. Once the information has been collected and assessed, it will be necessary to package the information and disseminate it to the various target audiences. Some of the appropriate educational mechanisms and channels could include: seminars, forums and workshops for scientists, for media representatives, industry officials, and other leaders; curriculum for schools and adult education programs; technical and popular publications; displays for use at fairs or other special events; video tapes; speakers' bureaus; and one-on-one advice. This must also include mechanisms to regularly monitor and assess the attitudes and knowledge of consumers, opinion leaders, and other groups.

A variety of educational strategies must be developed and implemented to reach those groups who are not interested in attending public forums. Educational messages must be developed at a differing levels of complexity and detail to appeal to the interests of various audiences. Vehicles for delivering such messages should include mass media, (public television, newspapers, magazines), point of purchase information (brochures, videos, addresses and toll-free numbers on labels) and points of contact for further information (consumer toll-free hot lines, computer bulletin boards, Extension agents). It is important that concerns of consumers be

addressed with clear, concise and objective information designed to help make the exotic become familiar.

RECOMMENDATION 4:

NABC should support these efforts of member institutions by sponsoring regular workshops or conferences on ethical issues, aiding in the development of modules and teaching and public education materials, and aiding in the dissemination of materials in both printed and electronic form. There have been numerous points in discussing the above recommendations where the need or efficiency of collaboration among NABC member institutions has been noted. NABC itself is well poised to be both a vehicle and a facilitator for such collaboration. While the specific programs that NABC would sponsor or provide should be identified by those who come after this ad hoc committee, we would not four general programmatic areas in which NABC could provide the institutional and financial impetus for support of ethical issues.

Activities Organized and Funded Through Member Institutions:

Given its current organizational configuration and funding base, NABC could sponsor occasional or regular events that would support the above recommendations. On an annual basis, the Executive Committee could form an ad hoc committee to organize and hold a workshop open to faculty from individual member institutions and to the general public (on a differential fee basis), much as the annual meetings are currently planned. A clear model for this sort of activity exists in the workshops held for many years at Iowa State University, and more recently on the campuses of Illinois University, Michigan State University and Purdue University. These "summer institutes" are designed to help faculty implement the modules option described in Recommendation 1.

These institutes have been funded by the Bioethics Program at Iowa State and by a grant from the National Science Foundation. Current programs provide a financial incentive to all participants, and budgets run in the neighborhood of $30,000 in direct costs. Yet if the incentive payments were eliminated from the budget, it seems likely that a one such institute could be run each year on a budget made up of $1000 contributions from each member institution, provided member institutions covered travel costs for their faculty to participate. The Committee recommends that the Executive Committee carefully consider such an opportunity for effect use of NABC funds before electing to reduce current membership fees.

Activities Organized and Funded with Foundation Support:

As noted several member institutions have received external grants from government sources to support workshop and public education activities. Partnering with NABC could enhance the competitiveness of these proposals even further. NABC could be particularly helpful in making initial contacts with private foundations that might be interested in supporting these activities.

Activities Organized and Funded with Industry Support:

The food and agricultural biotechnology industry is itself a potential source for ethics related programming. The catch to this is that anyone who would take the lead in organizing an ethics conference or workshop would need some distance from an industry funding source in order to have the freedom necessary to conduct a credible ethics activity. NABC itself could be the organization that would provide this screen, soliciting funds from industry which would be put into an NABC account designated for ethics programming. This would allow corporate clients to make contributions to a worthy cause, and it is plausible to think that substantial funds could be raised simply by writing the officers of biotech, seed and pharmaceutical companies. The funds could then be awarded on a re-grant basis to member schools who wished to undertake ethics programming. The ethics programming account and the process of submitting, evaluating and approvals for re-grant proposals would make the NABC effort function as a blind trust, screening industry influence and giving the organizers of ethics activities independence and autonomy.