EDUCATOR'S GUIDE

# Genetically Modified Foods: Benefits and Risks

Disney Presents


For six seasons, millions of students came to understand, appreciate and enjoy the exploration of science through the series, *Bill Nye the Science Guy*. Bill returns with *The Eyes of Nye*, a more in-depth look at science subjects making news, changing lives, and impacting policy. From the future of alternate fuel sources and genetic engineering to population growth trends and issues of race, Bill and his expert cohorts bring science to life right in your classroom, helping you **Motivate** investigation; **Assess** available information; and **Propose** lines of argumentation.

## This Educator's Guide includes:

- An **Introduction** that clearly defines the subject and offers an overview of the issue objectives of the guide; how it relates to science from both a social and personal perspective; as well as pertinent questions and insights regarding the topic.
- A listing of all **National Science Education Standards Addressed**.
- Detailed procedures highlighted in the MAP Framework (**Motivate, Assess, Propose**).
- Illustrative **Video Clips** from *The Eyes Of Nye* DVDs with pinpoint chapter cues.
- **Web Site Resources** to help students further investigate and locate research, charts, data as well as experts featured in the program material.
- Easily downloadable **Support Materials** that include articles, transparencies, charts, and much more.

## Introduction:

"Genetically modified foods" refer to foods produced by a plant whose genetic make-up, or DNA, has been altered. *The Eyes of Nye - Genetically Modified Foods: Benefits and Risks* describes basic types, purposes, and processes involved in genetic modification of food-producing plants, distinguishing between these and traditional hybridization and breeding processes, along with questions surrounding the use of genetically modified (GM) foods.

The issue of GM foods is primarily one of regulation—with the planting of the one billionth acre in the spring of 2005 (according to the Biotechnology Industry Organization), over two-thirds of which is in the United States, questions whether "to genetically modify or not" have become moot. What students will face—and what this guide addresses—is the

*Check the **MAP Teaching and Learning Framework** to explore the phases (motivate, assess, and propose) used in this guide.*

need to explore the meaning and benefits of genetic modification of food-producing plants, the processes that do or do not produce these benefits, and the most effective means for safeguarding health and preventing potential environmental damage while pursuing these benefits.

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## National Science Education Standards Addressed

### *Science As Inquiry*

- Abilities necessary to do scientific inquiry
  - Identify questions and concepts that guide scientific investigations
  - Recognize and analyze alternative explanations and models
  - Communicate and defend a scientific argument
- Understanding about scientific inquiry

### *Life Science*

- The cell
- The molecular basis of heredity
- The interdependence of organisms

### *Science in Personal and Social Perspectives*

- Personal and community health
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

### *History and Nature of Science*

- Science as a human endeavor
- Nature of scientific knowledge

## On the DVD:

### Genetically Modified Foods: Benefits and Risks – Chapters

**Chapter 1: *GM Foods Preview***
Beginning through 1:42
Ends with title screen.

**Chapter 2: *Genetically Modified Foods***
2:06—3:40
Ends with Bill saying, "I'm just making my lunch."

**Chapter 3: *Traditional Breeding***
3:41—6:19
Starts with interview with Dr. Steven Jones. Ends with Bill saying, "There's nothing blue here."

**Chapter 4: *Genetic Engineering: Processes and Hopes***
6:19—11:57
Starts with broccoli commercial. Ends after Golden Rice talk show.

**Chapter 5: *Benefits, Effects, and Prevalence of Modified Crops***
11:59—16:15
Starts with Bill saying, "Imagine being a farmer…" Ends with Bill saying "…you probably won't see the words genetically modified in the fine print."

**Chapter 6: *Ongoing Social Debates***
6:18 through end of program
Starts with Bill's interview with Dr. Hake. Ends with the close of the program.

### Genetically Modified Foods: Benefits and Risks – Activity Clips

***From Shelf to Table: GM Foods Everywhere***
14:19—16:15
(referenced in Educator's Guide step 2)
Starts with Bill saying, "One small gene to feed a man…" Ends with Bill saying "…you probably won't see the words genetically modified in the fine print."

***Transgenic Modification***
7:39—8:45
(referenced in Educator's Guide step 6)
Starts with Bill walking down the stairs with Dr. Pam Ronald.
Ends with Dr. Ronald saying "…we would inoculate it."

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***Rice and Vitamin A***
8:45—10:26
(referenced in Educator's Guide step 8)
Ends with "Critics Charge" on Golden Rice.
Toward Insect and Weed-free Crops

***Toward Insect and Weed-free Crops***
11:59—14:19
(referenced in Educator's Guide step 9)
Starts with Bill saying, "Imagine being a farmer…" Ends with statistics from Ronnie Cummins, OCA.

***Labeling and Mislabeling***
16:18—18:18
(referenced in Educator's Guide step 15)
Starts with interviewing Dr. Hake and asking, "So, do you think we should have labeling on genetically engineered foods?" Ends with her saying that "…it all sounds pretty bad to people who don't know what it is."

***This Land is My Land***
19:43—21:15
(referenced in Educator's Guide step 16)
Starts with Bill saying, "Corporations say that genetically modified food is the greatest thing, if I may, since sliced bread." Ends with Dr. Stevens saying "…stick a single gene into it and you own it."

## *Procedure: Motivate Phase*

**1)** Ask students if they have eaten corn in the last week; do the same for students who have eaten margarine. Then ask those who have an infant in their family.

**2)** Play ***"From Shelf to Table: GM Foods Everywhere,"*** and discuss with students the prevalence of genetically modified foods in our diet. Ask if this concerns them; some will indicate concern, and some will begin to ask *why* we are doing this, and what is a genetically modified food? Focus on these questions; ask them *why they need to know* the answers to these questions. Discuss responses briefly, then suggest we face a real issue with GM foods, and we clearly have some questions.

**3)** Play ***"Chapter 1: GM Foods Preview"*** Recall questions students asked in last step and reiterate those posed in the preview—what is it, do we need it, and is it safe? Explain though GM foods are a reality, there are many ways we (they) can help decide what should happen with the development and use of GM foods. Suggest, however, their questions tell us that part of the answer has to do with finding out what can happen (a more scientific endeavor).

**4)** Pose the broad question, "What should we do to help ensure we obtain the most benefit and the least possible danger from genetically modified foods?" Work with students'

previous questions and points that emerge through discussion to outline at least two scientific and one social question to help structure students' investigation of the broad question (see possibilities below).

***Potential scientific questions***

**a)** What are genetically modified foods and how do they differ from traditional foods?

**b)** What *can* happen—potentially good or bad—due to production and consumption of genetically modified foods?

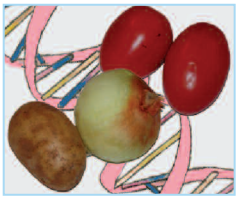
***Potential social questions***

**c)** What *should* happen due to production and consumption of genetically modified foods, and how can we make that a reality?

## *Procedure: Assess Phase*

**5)** Tell students that investigating the initial scientific question above requires exploration of both "traditional" and "transgenic" processes for developing and growing food-producing plants. Explain "transgenic" processes involve taking a gene from one organism and placing it in another. Remind them of the preview and that humans have been modifying—and improving—food-producing plants for over 10,000 years. Mention several farm-grown food types and ask students how often they see these plants (and foods) in the wild. Play ***"Chapter 3: Traditional Plant Breeding"*** (end with Bill musing about something old and something new). Ask students to note the process for improving food-producing plants (wheat) described by Dr. Steven Jones. Briefly review the method and resulting product.

**6)** Ask students to note the procedure for genetic modification described by Dr. Pam Ronald as you play ***"Transgenic Modification."*** Review the main points, then divide students into groups of 3-4. Ask them to outline each process and create one list of distinctions—points of difference and/or similarity between each. Discuss the points using suggestions and information from "Traditional and Transgenic" (see sidebar), or allow each group to present their list, amending their list as they listen and discuss input from each group.



***Teacher Note:*** *The process and result of traditional versus transgenic modification of food-producing plants is briefly presented in the Issue Support mentioned above. You may use the opportunity to encourage deeper exploration into the complexities of the science content and concepts associated with each.*

*Likewise, the volume of information and opposing views—scientific and social—related to the information that follows is overwhelming, presenting an opportunity to focus heavily on aspects that are mentioned and/or those that most pique students' interest. The extent of material also provides an excellent opportunity to learn about the nature of social influences on scientific progress, but use caution—most of the material is biased (from corporate sponsors to government to advocacy groups), heavily influenced by the organizations involved, and inflammatory and emotional. Ask students to deeply consider the experts.*

***For more, go to eyesofnye.org.***

*See* ***The Eyes of Nye*** *Issue Support* ***Traditional and Transgenic***

**7)** Ask (or remind from earlier discussions) *why* we are using transgenic processes, given that we have for millennia worked to develop plants that produce useful food. Students may suggest (if not, point out) the answer is partially in the question—direct genetic modification is much faster. Suggest it also presents a potential means of rapidly addressing agricultural problems, and therefore hunger problems that take many years through traditional means. Recall Dr. Jones' mention of the time needed to develop a new variety through traditional means.

**8)** Ask students to suggest problems that may be solved by modifying food-producing plants by either method. Many students, especially in rural areas, will be familiar with the need to control crop pests and disease, as well as weeds or "competition" for food-bearing plants. If not mentioned, suggest that improving nutrition, though not usually considered in the U.S., is the major reason for food production. Play ***"Rice and Vitamin A,"*** in which Dr. Ronald extends her discussion to the value of transgenic Golden Rice in underdeveloped countries. Review the numbers of people (below right) affected by vitamin A deficiency, and inform students the project never really materialized. Pause before asking what they think about this.

**Claims suggest that:**

- *Vitamin A deficiencies cause 500,000 children to go blind each year and are associated with 1-2 million deaths each year.*

**9)** Discuss Golden Rice using the information provided in "Rice and Reality." Tell students there are many opposing views on the potential of Golden Rice, and some claim companies producing transgenic crops overplayed their value in order to promote their agenda. Ask, however, if this necessarily means there was *not* value in Golden Rice. Recall the criticism provided near the end of the above segment that the product would only supply 10% of the required amount of vitamin A, but ask students if 10% is better than nothing. Read the comments in "Golden Statements," and follow by explaining another type of rice—Bt rice, from a plant modified by a gene of the bacterium *Bacillus thuringiensis*—is being grown and eaten regularly. Recall the advantage of insect-resistant crops and weed prevention. Ask students to note the advantages of these new modifications as you play ***"Toward Insect and Weed-free Crops."***

**10)** Review the claims by Dr. Harvey Glick, director of scientific affairs for Monsanto. Suggest that based on his statements we now know that modified herbicide-resistant soybeans have been studied and found safe by 31 regulatory agencies in 17 countries. Pause to allow discussion, then ask which countries and agencies these might be—they are not mentioned. Suggest again, however, since a scientist assures us they are safe then it must be so. Students will question this; if not, ask if we are ready to accept that. Distribute "Something Old, Something New" and contrast claims related to use of genes from the bacterium *Bacillus thuringiensis.*

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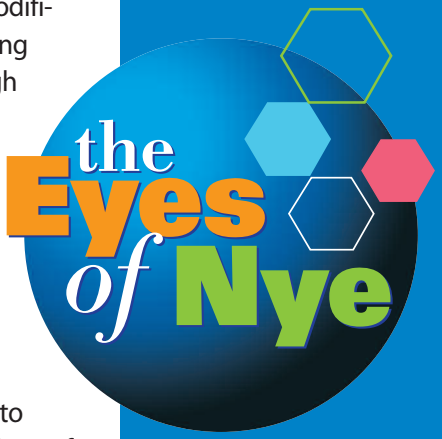


*See* ***The Eyes of Nye*** *Issue Support* ***Rice and Reality*** *and* ***Golden Statements***

*Check out opposing claims.*
*See* ***The Eyes of Nye*** *Issue Support* ***Something Old, Something New***

**11)** Ask students if this means that information provided regarding the countries and regulatory agencies are just made up by Monsanto. Some will say "yes," some "no," but most will say we do not know. Explain that much of this information is available, just difficult to verify given the range of opinions and the stakes—environmental and financial. Tell students we have explored just a few of the many things that can happen—good and bad—due to the use of transgenic plants for food production. Ask them how we can possibly address the social question posed in the first section (What *should* happen in order to gain the most benefit *and* protection?) when there are such oppositional views, and when even the research often seems designed to coerce? Suggest it is too easy to disregard claims, and bias does not necessarily mean evil intent.

*Potential social question:*

- *Does a governmental "okay" ensure safety?*

*Encourage students to locate information on Professor Ingo Potrykus (Swiss Federal Institute of Technology, Zurich) and Dr. Peter Beyer (University of Freiburg, Germany), the original inventors of Golden Rice (for instance, Dr. Beyer's interview with* The Hindu *in 2002 "Can Golden Rice Keep Vitamin A Deficiency at Bay?") for a check on potential assumptions that things are never done to help people.*

***For more on exploring claims and claimants, go to eyesofnye.org.***

## *Procedure: Propose Phase*

**12)** Tell students as we discovered earlier, we *have* and *eat* genetically modified foods every day. Suggest what we believe *should* happen—what we *can* still influence—depends largely on our own circumstances. Recall the countering views in "Something Old, Something New." Ask them if this is the way things should be (not necessarily), and tell them because of this you would like for each of them to play an unusual role in an imaginary scenario, because it is important for each of them to have an opportunity to think about this situation from another point of view.

**13)** Introduce Shady Acres. Use the following scenario.

**Situation in Shady Acres:** Shady Acres is a medium-sized, semi-rural town with beautiful weather and a long growing season. It is called Shady Acres partly because it is a stress-free place to live. Recently, the citizens of Shady Acres have been notified that ModGrow Foods, Inc., a large corporation that produces genetically engineered foods, has acquired a large area of farmland in surrounding Sunnyville County. Their farms will begin just outside the boundary of Shady Acres.

**14)** Distribute "Welcome to Shady Acres!" and discuss each possible role— Shady Acres resident, ModGrow scientist, and independent Sunnyville farmer. Ask students not to choose a stance. Tell them they will have a chance afterward to suggest courses of action, but first they are to describe their character and his/her view of the situation, including concerns or opportunities this character may consider most heavily. They should each select and build a character they think is very different from what they would consider their normal personality or role.

*See* ***The Eyes of Nye*** *Issue Support* ***Welcome to Shady Acres!***

***Teacher Note:*** *General roles are provided, but students should decide on their character's traits and views. For instance, an "independent Sunnyville farmer" may or may not be successful using past techniques, male or female, older or younger, close or far from ModGrow, and either interested, or not, in working with them in the farm business.*

*Check the support for student role cards that can be printed, cut out, and laminated.*

**15)** Ask students to discuss the concerns and/or opportunities they saw for their character, and discuss the feeling of being in an unfamiliar role or considering viewpoints from a perspective not their own. Ask about actions students may have already considered, even if not yet required. Explain many very thoughtful viewpoints come from people who have faced real situations—some like Shady Acres. Ask them to consider how they might feel if they were an employee with a food-producing biotech firm as you play ***"Labeling and Mislabeling"*** in which Dr. Sarah Hake, director of the USDA Plant Gene Expression Center at Berkeley, discusses her view of requiring labels for genetically modified foods as well as her reaction to the destruction of her fields. Ask students if there are times we can be the most helpful when we understand others' views.

**16)** Ask for volunteers to describe their concerns or possible opportunities they saw as farmers, and ask everyone what they thought about the patent issue and potential for loss of seed crops due to lack of containment. Play ***"This Land is My Land"*** in which Dr. Steven Jones, introduced in step 5, discusses his view on the topic.

**17)** Ask each student to find one or two other students who have worked in a similar role. Ask each new partnership to combine their considerations together and create two questions they would like answered, one by each of the other characters. Announce that Shady Acres is holding a town meeting—the recent furor over ModGrow's arrival has been overwhelming. Shady Acres' officials have decided therefore to hold a panel question-and-answer session. Ask for two representatives from each role to sit on the panel, and devise a brief set of town meeting rules (how students with questions will be recognized, if other panel members can answer a question should the member addressed not respond, how long the meeting will be, how many questions students in the "town audience" may ask, and so forth). Allow students to have a large role in determining these rules, and be sure to consider how to make certain all students have the opportunity to fully participate. At the completion of the meeting, charge the panel with the responsibility of proposing a plan of action. It should contain at least three points, and may include such items as making requests of state or federal government officials, further studying a certain issue, scheduling another meeting, and so forth.

*Explain to students that expressing views and deciding on courses of action can be tough, even if some amount to "wait and see" or "study this further."*

**18)** Review and discuss the action items that emerged during the meeting. Tell students to consider for a moment the scenario is real. Ask them what types of information they need to propose a plan of action a government—national, state, or local—could consider regarding production of genetically modified foods. Discuss as well what sources they may look toward to acquire this information. Ask them if they think they are ready—one day they may need to do just that.

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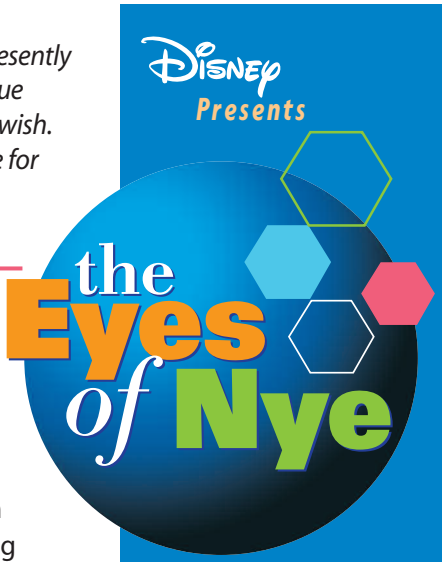
*Read on responsible action in the "propose" phase of MAP Framework*

***Final Teacher Note:*** *The Shady Acres scenario is based on numerous situations that are presently taking place across the United States. The social complexities of the issue create a unique opportunity for students to delve as deeply into the role of economics and politics as you wish. The investigation of claimants can be engrossing, emotional, and an excellent challenge for students as they attempt to learn to look past the rhetoric and the "blame game."*

***For more, go to eyesofnye.org.***




## *Further Research*

### *Investigating the Issue: GM Foods*

The issue of genetically modified foods represents a heated example of the difficulties posed by issues in which social aspects overwhelm and even cloud the science. As with most issues, much of the science is fairly new—frontier science or science-in-the-making as compared to accepted and consensual (agreed upon) science. It experiences enough difficulties in its normal progression toward consensual science without the deep shadows of distrust cast by opponents on both sides of the issue. Nevertheless, this is also part of the power of this issue for student learning—the difficult but necessary struggle that must sometimes take place to reach the stage where real decisions can be made and action proposed as a result of those decisions.

The information and claims presented in *The Eyes of Nye - Genetically Modified Foods* represent a sampling of both sides of the issue, in the science as well as the social aspects involved. Teachers may encourage students to access information on these aspects, but may also wish to encourage critique of the veracity of the information, even more so than may be required with other emotionally charged socio-scientific issues. The following represents a select assortment of aspects to investigate—each leads to further "trails" of enlightenment.

### *Exploring the Science of Genetically Modified Foods*

The "assess" phase of The Eyes of Nye - Genetically Modified Foods focuses on understanding the basic science of genetically modified foods—what it means, how it differs from food developed through traditional means, and its potential benefits and costs from a scientific perspective. Students may further explore:

***Meaning and terminology:***

- genetically modified foods (food products that result from or contain some amount of a genetically modified organism)
- genetically modified organisms (organisms that produce the food)
- genetic engineering (broader term, subject of debate regarding applicability to many genetically modified organisms)
- transgenic (preferred term as opposed to genetically engineered)

***Several available methods for transferring DNA into a plant:***

- Agrobacterium
- Particle bombardment
- Viral transformation

***Principal purposes, both at center of controversies surrounding potential benefits and effectiveness:***

- insect resistance
- herbicide resistance

### *Exploring Social Aspects of Genetically Modified Foods*

During the "assess" and "propose" phases students encounter questions related to ethics, regulatory requirements and patents, as well as the claimants themselves indicated in the next section.

Students should explore:

- Cartagena Protocol on Biosafety (2003)
- patents, intellectual property rights, and court suits
- labeling (requirements, and requirements in Europe vs. United States)

### *Exploring Genetically Modified Food Claims and Claimants*

An important aspect of dealing with socio-scientific issues involves looking beneath the evidence and viewpoints that are expressed by acquiring additional information on the experts themselves as well as the organizations for whom they work or with whom they are affiliated. Through such exploration, students are better able to infer social (contextual) factors that may influence the claims. This is especially revealing in *The Eyes of Nye - Genetically Modified Foods*, in the case of the principal providers of information in the program (Doctors Jones, Ronald, Glick, and Hake), but even more so from the general perspectives and opinions espoused by the various advocacy groups, corporations and governmental agencies that follow.

| | |
|---|---|
| Dr. Steven Jones, wheat breeder | School of Agriculture, Washington State University |
| Dr. Pam Ronald, scientist | Department of Plant Pathology, University of California, Davis |
| Dr. Harvey Glick, scientist | Director of Scientific Affairs, Monsanto Company |
| Dr. Sarah Hake, scientist | Director, USDA Plant Expression Center, U.C. Berkeley |

***Advocacy Groups***

- Friends of the Earth
- Greenpeace
- Organic Consumers Association

***Corporations***

- Monsanto
- Calgene
- Syngenta
- Zeneca

***U.S. Government Regulatory or Informational Agencies***

- Department of Agriculture
- Food and Drug Administration (FDA)
- Environmental Protection Agency (EPA)

ISSUES SUPPORT MATERIAL

# Genetically Modified Foods: Benefits and Risks

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## Traditional and Transgenic

***Traditional Process:***

Related species of a food-producing plant are interbred or "crossed." During the process homologous recombination occurs. This is a molecular process by which one member (allele) of a pair or series of genes at a particular location of a chromosome become separated from other members and replaced by a similar, but different, allele. It is a same-site (homologous) exchange.

***Result:***

Over many years, genetic recombination results in a different combination of genes for an organism's offspring than that of the original organism. Traits of one organism are introduced into a new genetic background (e.g., a slightly different plant) in order to obtain a plant with desired characteristics of each. For instance, an insect-resistant plant may be crossed with a plant that has high food yield but is susceptible to insects in the hope of obtaining a new variety that maintains high yield but also is more resistant to insects.

***Goal:***

To obtain new crops with certain desirable characteristics.

***Transgenic process:***

New plants are genetically engineered by adding one or more genes to a plant's genome through a process often referred to as "transformation"—the genetic alteration of a cell resulting from the introduction of new genetic material (DNA or RNA). There are many techniques for transferring, or inserting, the DNA.

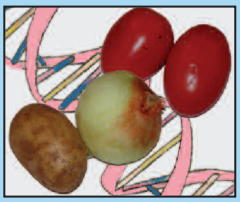
***Result:***

The new plant (the genetically modified organism, or GMO) is created by the introduction of the new genetic information into the plant's genome. For instance, a gene from a fish that does not easily freeze may be inserted into a tomato to produce a new plant that does not easily freeze. The process can produce a plant with a desired trait more rapidly than traditional processes because most of the plant's genome is not altered.

***Goal:***

To obtain new crops with certain desirable characteristics.

***Both involve the alteration of genetic patterns in order to improve a plant's value. The value of the plant is most often associated with its resistance to insects and disease, hardiness or adaptability to different climactic conditions (sometimes discussed in terms of "tolerance to environmental pressure"), and ultimately its food crop yield. The latter can be broken into categories of taste, nutritional content and value, and appearance, among others.***





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# Rice and Reality

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## *What is Golden Rice?*

Golden Rice is rice that has been genetically modified to contain pro-vitamin A in the form of beta-carotene. When a food containing beta-carotene is eaten, it is converted in the body into vitamin A. The same beta-carotene that gives carrots their color makes the rice golden.

## *How did they do that?*

Three genes were inserted—two from daffodils and one from a bacterium.

## *Why did they do that?*

The answer depends on the "camp" you ask.

***Biotech Camp:***

- The rice can provide essential vitamins to poor people in underdeveloped countries. The restricted diet of many of these people can cause death and/or blindness, especially in Asia where many diets consist mainly of rice.

***Anti-biotech Camp:***

- Large companies can make farmers and poor people dependent on them. Sterile plants mean farmers cannot grow crops from plant seed the following years, and therefore must buy new rice seed from the companies.
- Golden Rice is a method of convincing people to accept genetic engineering. With acceptance, companies can then develop many other genetically modified plants from which they can make a profit, as well as own all the food crops.

## *Who are they?*

Professor Ingo Potrykus (Swiss Federal Institute of Technology, Zurich)

Dr. Peter Beyer (University of Freiburg, Germany)

"European Community Project was one of two sponsors of this project. The first sponsor was Rockefeller Foundation. Syngenta is the industrial partner in the European Community Project. According to the agreement the company Zeneca has exclusive rights to sell the seeds in the developed countries. But the Humanitarian Board got the license back from Zeneca to give it to developing countries free of cost. The only obligation on our part is that we use it for humanitarian purposes and not make any profit from it."

- Dr. Peter Beyer, Can Golden Rice keep vitamin A deficiency at bay? *The Hindu*, November 2002 -

## Golden Statements

***"If anyone tells you that GM is going to feed the world, tell them that it is not… To feed the world takes political and financial will – it's not about production and distribution."***

- Steve Smith, former head of Novartis Seeds -

***"Biotechnology and GM crops are taking us down a dangerous road, creating the classic conditions for hunger, poverty and even famine. Ownership and control concentrated in too few hands and a food supply based on too few varieties planted widely are the worst option for food security."***

- Christian Aid Report: "Biotechnology and GMOs" -

***"…the public relations uses of Golden Rice have gone too far. The industry's advertisements and the media in general seem to forget that it is a research product that needs considerable further development before it will be available to farmers and consumers."***

- Gordon Conway, President of the Rockefeller Foundation, the chief funder of the Golden Rice project -

***"A single nutrient approach towards a nutrition-related public health problem is usually, with the exception of perhaps iodine or selenium deficiencies, neither feasible nor desirable."***

- John R. Lupien, Director, Food and Nutrition Division, Food and Agricultural Organization, United Nations -

***"Seeking a technological food fix for world hunger may be…the most commercially malevolent wild goose chase of the new century."***

- Dr. Richard Horton, editor of the British science journal The Lancet -

***"If it were not for the vast array of alternatives on offer, the arguments for the GM approach might be genuinely compelling."***

- Hugh Warwick, Splice, magazine of the Genetics Forum, March/April 2000 -

***"Golden Rice hopefully helps to achieve better acceptance of GMO technology, to encourage scientists and granting agencies to invest also into projects with no a priori guaranteed success, to motivate public research to care more for the problem of food security and less for additional funds from industry, to encourage those who have rights in key enabling technology to make free licenses available for humanitarian projects, for some scientists to consider that there can be more in a scientific career than the chance for impact factor points, and to have some GMO opponents consider whether a differentiated discussion of the GMO technology might not be the better strategy in the long run."***

- Professor Ingo Potrykus (Swiss Federal Institute of Technology, Zurich) -

Last statement made in The "Golden Rice" Tale, AgBioWorld. Other statements claimed by Friends of the Earth: The U.S. Voice of the World's Largest Network of Environmental Groups

# Something Old, Something New…

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## *Something Old*

***We have known Bt toxins to be harmful for years…***

Dozens of proteins, all Bt toxins, are produced by different strains of the soil bacterium *Bacillus thuringiensis*. Various reports have documented that bacterial spores of *B. thuringiensis,* containing a mixture of toxins have caused allergic reactions in farm workers. The protein Cry1Ac in particular has been found to produce genetic immunity in animals; cells in the small intestine in rats even have proteins that bind to it. Another Cry1Ab is 92% indigestible in pigs.

***Data has shown Bt to be safe to humans and nontarget organisms…***

We began to discover strains of Bt that were toxic to different insects over 20 years ago, and over 15 years ago we began to identify the genes responsible. These are the genes they succeeded in moving across species lines and into crops. The best indicator of the safety of a Bt transgenic crop is our experience with Bt itself. It's been used as a microbial pesticide for years. In 1998, in fact, the EPA compiled many years of data into a re-registration eligibility decision document (RED) that covers all Bt products not produced by genetic engineering. The data overwhelmingly supported the safety of Bt to humans and nontarget organisms. Also, though there are very few insecticides certified for organic agriculture, some Bt spray formulations are even among those.

## *Something New*

***C'mon, Bt crops are not even being regulated…***

Our regulatory process has completely ignored the negative findings on Bt toxins. That is dangerous because Bt genes in crops undergo changes from the naturally occurring genes. Yet, when you test for toxicity you keep testing the natural toxins, not the toxin produced in the GM crop plants. How does that tell us what we want to know? So you have it: Bt toxins in GM crops are practically untested and therefore unknown.

***Bt crops are given the same tests as every other chemical pesticide…***

We consider Bt transgenic crops to be plant pesticides, and they are given the same tests that are administered to any chemical pesticide. If it looks like the U.S. Environmental Protection Agency (EPA) gives only a glance at the seed lines of transgenic plant producers before approving their commercialization, that is because we've been dealing with assessing the risk for nearly forty years of positive experiences with commercial Bt sprays.

## Something Borrowed

***The GM toxin is not the same as the natural Bt toxin we know about…***

Again, the natural toxin is not the same as or even "substantially equivalent" to the GM toxin. Green lacewings die or experience delayed development when they eat one insect pest we know of (lepidopteran) that has eaten GM maize containing the Bt toxin Cry1Ab, but not when they eat the same pest treated with much higher levels of the natural toxin. This effect is passed on through the food chain. And further, your researchers misrepresented data when they claimed that Cry1Ab does not harm beneficial insect predators.

***The gene used is simply a truncated version of the natural gene…***

The insecticidal gene that we moved into corn (cotton and potatoes as well) is actually a truncated version of the natural gene. We borrowed it. For the gene to function in plant cells, small snippets of DNA are attached that allow the code to be read; marker genes that encode for either antibiotic or herbicide resistance are spliced onto the toxic protein gene. We know what it does and does not do.

## Something Blue

***The Bt toxins won't hurt anyone…***

The insecticidal proteins produced by the various strains of Bt are toxic only to certain species of insects—those that have the right physiology. All other organisms tolerate Bt exposure without any signs of injury. For people, and most animals in fact, the real "toxin" is in the dose. The rats you mentioned earlier? We've fed lab rats high doses of insecticidal proteins and found no measurable toxic effects. Actually, many common substances around the home (e.g., table salt, caffeine, vitamin A, and lawn herbicides) could cause illness at much lower doses than Bt proteins. How do we know you didn't just feed them so much Bt that they didn't have a chance? And as for effects from long-term exposure, when proteins are toxic, the effect is immediate (acute), never cumulative (chronic).

It is true that it *might* be argued that Bt sprays do not leave as much insecticidal protein as is present in a transgenic plant, in which every tissue makes large quantities of the protein. But we must remember that different amounts of the protein will be found in different tissues, and we should only calculate the part we eat. Take for instance the highest amount we've found in the edible portion of transgenic Bt corn. We know how much that is, and it varies widely—the amounts of Bt protein in various tissues of transgenic corn plants throughout the growing season have been measured and reported to the EPA. A two-year-old child would have to eat, for instance, 27 pounds of popcorn in order to reach the amount of toxin per unit of body weight that caused the lab rats to die. In other words, the EPA justifiably declared the risk of a toxic reaction from Bt proteins as "nil." Trust us.

# Welcome to Shady Acres!

Disney Presents

the Eyes of Nye

## *Independent Sunnyville County Farmer*

You own your farmland and all of your crops, from the plants to the seeds they produce. It has all been in your family for generations. Your plot is not huge, but it's big enough…

When you heard that ModGrow Foods, Inc. was moving in, a number of thoughts crossed your mind. Would they try to buy your land also, like they did so many of your friends' lands? If so, would they pay enough? Now, that could get interesting…

Sunnyville is windy, and you've heard these new genetically engineered crops can crossbreed just like normal crops. You've driven the distance to ModGrow's land several times, wondering just how far away is "far enough." And, what happens if you save your seed next year like you always do, then find it was some of *their* seed? You know a farmer in another state that was sued by a big modern agriculture company for doing that just last year…

Anyway, can you even compete any more? These people get so many crops, and so fast! Maybe it's better that they do it—more people can have more food then. But, you wonder, for how long?

## *Shady Acres Resident*

You saw some of their machinery arriving yesterday as you were driving back into town. And hey, who can argue with the lower prices everyone says we'll soon be seeing at the supermarket? You smile and wonder *how long* will they be lower? But no, that's no way to think…

You have two friends that have already gotten jobs there, and hundreds more are supposed to follow soon—that is good news. And the school is getting new computers and 12 new portable buildings. Better the industry tax base goes up and foots the bill than your own tax base…

You wonder how the food will taste! You heard it was fine, no different than any other food. Good thing. Turning your back yard into a mini-farm wasn't exactly what you had in mind this year…

## *ModGrow Foods, Inc. Scientist*

Well, move in and set up is almost complete. You smile when you think of all the people who have been staring at you in the supermarket lately. Shady Acres isn't tiny, but they must not get a lot of new people very often. You hope it doesn't have something to do with people worrying about ModGrow…

You had a meeting earlier today about the containment plans. The bird issue should be

taken care of—they won't get to crops to move seed, at least not this year. But this place is very windy—that's on the agenda next. It'll be done right. You'll see to it. Now if no one starts up with the labeling stuff, everything should be fine. You know they can't make you do that—they'd need approval from the FDA. But still, better if it just isn't mentioned. Add that unnecessary cost in and there goes all these folks'—and my—savings at the grocery counter, not to mention jobs lost…

At least there aren't many weeds out here—just great land. You read recently that the amount of herbicide sprayed had actually risen in the last couple years because crops like ModGrow's could withstand it. Now *that's* when there's too much of a good thing! Well, no such problem here…