What Is Genetically Modified Food (And Why Should You Care)?

by Martha Herbert, MD (Reprinted from the EarthSave Magazine, Spring 2002, www.earthsave.org)

All living things contain genes. Genes contain information that helps shape how each living thing works. In genetic engineering, new genes are added that come from a different kind of living thing. These new genes confer certain desired characteristics, such as resistance to frost or to pesticides. The goal is to give these new characteristics to a living thing that couldn't do those things before.

What are genes?
Genes are strings of chemicals, called "nucleic acids," in DNA. The nucleic acids are like letters in an alphabet. Three of these letters in a row makes a little "code" and the code stands for a specific amino acid.

Amino acids are the building blocks of proteins. There are about two dozen of them. Proteins are the building blocks of living organisms. Proteins form the structures of living things, and form the enzymes living things use to carry out the chemical reactions they need to stay alive.

The order of the "nucleic acids" in DNA underlies the order of amino acids in proteins. And the order of amino acids in a affects what the protein will do. Your body contains a million or more different kinds of proteins, each with different jobs.

Is genetic engineering different from other forms of breeding?
Yes, in two ways:
1) Before genetic engineering, plants and animals could only share genes through reproduction within their own species. With genetic engineering, genes from completely unrelated organisms can be introduced into our food supply. For example, moth or bacteria or fish genes can be engineered into plants. The most widely grown type of genetically engineered soybean, Monsanto's herbicide- resistant "Round Up Ready" soybean, contains genes from bacteria (Agrobacterium sp.) cauliflower virus, and petunia.[1] In experiments, technicians at the University of Illinois have inserted a cow gene into soybeans in order to alter a protein in the soy plant. This was field tested in 1998-1999.[2]
2) Foreign genes are not welcomed by plants and animals. Therefore powerful techniques have to be used to force the plant or animal to take up the foreign genes.

How is genetic engineering of food done?
1) First the engineers try to get the outside gene in: The natural defenses of plants or animals against foreign genes need to be overcome. There are two main ways of doing this: the "gene gun" and the "viral vector." The "gene gun" shoots the gene into the recipient plant or animal. The "viral vector" infects it with the foreign gene.
2) Next, the engineers have to make sure the gene actually got in: Only about one in 10,000 attempts to introduce foreign genes actually works. Therefore, attached to the foreign gene is another gene, an "antibiotic resistance marker gene." If cells from the organism are grown in a dish containing that antibiotic, and they don't die, this means that the gene "got in."
3) Finally, the engineers have to make sure the gene actually gets used: The organism that received the foreign gene may ignore the gene. Therefore, a "promoter" is included with the gene to make sure the gene becomes active.

They say that genetic engineering is more precise than traditional breeding. Is that true?
No. Although genetic engineers know what gene they are putting in, they currently have no control over where it lands in the recipient organism's genome– and the position can make a lot of difference. It can land in the middle of another gene and disrupt that gene's function. Or, the "promoter" can increase the activity of other genes that normally would be silent. Genetic engineers have no control over these effects.

Also, in order to get a genetically engineered plant good enough to market, there have to be hundreds or thousands of failures, when genes get in but the plants or animals don't do very well, when they get sick from the genetically engineered changes.

Is genetic engineering safe?
Not necessarily. Genetic engineering has potential health risks. It also has the potential to harm the environment.

Health risks of genetically engineered foods:
1) Allergy or toxicity from new proteins in the food supply: Some of the genes used in genetic engineering were never in the food supply before. There is no way to know ahead of time whether some people may become allergic to the proteins that result.
2) Allergy or toxicity from new ways of processing proteins: Plants and animals "process" proteins after they are produced by adding starch and other molecules that affect how the proteins function. Not all species do this in the same way. Different ways of processing proteins can lead to changes in function or changes in potential for allergy.
3) Allergy or toxicity or altered nutritional value from changing the way an organism functions: Genetic engineering can change the metabolism of a plant or animal. Proteins may be produced in increased quantities. Proteins that in small quantities were safe may now even exceed toxic levels. New proteins may be produced that were not produced before.
4) Antibiotic resistance genes may transfer into intestinal bacteria or other organisms and contribute to our growing public health problem of antibiotic-resistant organisms. Diseases that once could be treated by existing antibiotics may now become resistant to treatment.

Aren't these foods being tested?
Actually, not much. The U.S. regulatory agencies (USDA, FDA, EPA) rely on tests done by the companies that make these genetically engineered products. There are lots of questions that in-house testing doesn't ask. In particular, there is little to no screening for unexpected changes. No independent testing is required.

Aren't there safety standards for genetically engineered foods?
Genetically engineered foods were declared in 1992 to be "substantially equivalent" to traditional foods and therefore there is no requirement for testing. There was no scientific basis for this declaration and it is now being legally challenged. Clearly, foods that contain and were produced with viral promoters, pathogenic bacteria, and antibiotic resistant marker genes are NOT substantially equivalent to conventionally bred foods. In fact, in 1999, a major lawsuit against the FDA uncovered documents showing that the FDA's own scientists had concluded that genetically engineered foods pose unique safety hazards and had recommended that each one should be subjected to rigorous, case-by-case safety testing. These safety warnings by the FDA's best scientists were ignored and then covered up by FDA bureaucrats. Regulatory standards for testing were designed before genetic engineering existed and have not been revised.

Isn't there health monitoring for effects of genetically engineered foods?
No. Some effects may be dramatic, as in severe toxic reactions. Effects will tend to be milder, however, and more long-term, as well as difficult to distinguish from problems caused by other things. No tests are available for allergies to these substances, so who is to say whether diarrhea, runny noses, headaches, or other signs of possible mild food allergy are coming from genetically engineered food or from the many other things we are exposed to every day? Tracing health problems to genetically engineered foods is almost impossible right now, because these foods are not labeled and there is no way to keep track of them. So there is no scientific basis at this time for saying that these foods are problem-free.

They say that genetic engineering will solve world hunger.
Actually, there is enough food in the world today for every person on the planet to get 3,600 calories a day, way more than enough. The problem is distribution, and genetic engineering won't solve that. Instead, it will drive small farmers off their land and into poverty, making the distribution and hunger problems worse.

In a classic "localized irony," the two countries that lead the world in biotechnology also fare poorly in distributing wealth and food. A recent UNICEF report, Child Poverty in Rich Nations Report Card, released in June 2000, ranks Canada 17th among the 23 OECD countries, with 16% of its children living in poverty, and the USA second to last, with 22% of its children living in poverty. Both these countries with low people-to-land ratio have a sizable GMO emphasis in their agriculture.

But won't genetic engineering reduce the use of pesticides?
In some cases it may do this, but only for the short term. The pests will develop resistance very quickly, however, and this "magic bullet" approach will stop working. In addition, genetic engineering can only target a few pests at a time. Once those pests are reduced, their natural enemies can multiply. Then farmers may have to use even more pesticides than before to get rid of these "secondary" pests. This has already happened with genetically engineered cotton.

Can genetically engineered foods harm the environment?
Yes, for example: a) pesticide use may increase when pests develop resistance. b) Genes from crops resistant to herbicides may spread to weeds, and those weeds may become "superweeds" that the herbicide can no longer control. c) Non-target insects may sicken or die from exposure to pesticide-resistant crops. d) Genetically engineered plants and animals may interbreed with wild relatives, spreading novel genes into wild populations. e) Genetically engineered plants may "out-compete," driving wild varieties to extinction. They may become "bio-invaders" with a competitive advantage in an ecosystem that wasn't designed to control them. f) Genetically engineered plants may alter soil bacteria in ways that are harmful to soil health.

Then why are corporations genetically engineering our food?
The biotechnology industry has invested many billions of dollars in genetic engineering and they want to make back their investment. They also hope to control all the levels of food production, from seeds and fertilizers to food processing and supermarkets.

How can genetically engineering food increase corporate control?
Since a court decision in 1980, it has been possible to patent genes and living organisms. A company that develops a new genetically engineered plant or animal will patent it. Then no one else is allowed to breed or grow it if they don't buy it from that company. Farmers will be prohibited from saving seed and replanting it, and will have to sign contracts agreeing to buy new seed from the corporations each year

Terminator seeds and corporate control
Biotech companies have developed ways of engineering plants so that the seeds they produce will not grow. Since the dawn of farming, farmers saved some of their seed to plant in the next season. When hybrid seeds were developed early in the 20th century, farmers had to go back to the seed companies each year to buy more seed, but there were some ways around this. With terminator technology, seed company control over the seed supply will be more complete.

Risks of terminator technology
Scientists say terminator technology can help prevent spread of genetically engineered organisms into the environment. It's interesting they should say this when they just finished telling us that genetic engineering is safe. But terminator technology is not 100% effective, so it cannot be relied upon to prevent spread. There is also some question about whether the terminator gene could be spread into wild populations, and if so, what would happen.

Can corporate control endanger the world food supply?
Yes. Corporate farming and biotechnology reduce the diversity of seed varieties we plant and animals we raise. They promote monoculture –growing large areas with just one crop–rather than the traditional approach of growing many things close to each other, and preserving biodiversity. Monoculture greatly increases our vulnerability to pests, diseases, and other crises that could wipe out major portions of our food supply. The ecological risks of monoculture are great as well.

Biotechnology is also culturally destructive. It wipes out traditional farming practices and shows no respect for the complex knowledge in these practices, or in the cultures of the people who practice them.

But if you're against biotech, then aren't you against science?
Actually there are a lot of smart, sophisticated alternatives to genetic engineering. In fact, genetic engineers tend to know very little about ecology or even about farming. Organic farming, sustainable agriculture and agro-ecology require more knowledge of plants, animals, insects and soil. These high-intelligence, low-technology, lowchemical approaches work with nature instead of biotech's approach of forcing nature to do things it wouldn't ordinarily do. They can work better, and without the risks of genetic engineering. But they don't get many research dollars because they can't be patented and they aren't a good source of profit for corporations.

The truth is that biotechnology is not cutting-edge science.

Can biotech change the world?
Yes–but perhaps not in ways we'd like to see. If we want to change the world for the better, we should probably look elsewhere. Releasing genetically engineered plants, animals and even bacteria into the environment is a form of biological pollution. Like chemical toxins, you cannot call them back. But unlike chemicals, biological pollutants can multiply and spread and interbreed, and change the balance of nature on our planet. If there are better ways to solve our food problems, why should we take this path?

Reference1: GMO factsheet from Research Foundation for Science, Technology and Ecology: http://www.ipsil.com/vshiva/
Reference 2: page 4 of GE Food Alert's report, "Weird Science: The Brave New World of Genetic Engineering"; citing Permit #98-128-17N .http://www.nbiap.vt.edu/cfdocs/fieldtests1.cfm

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