QUESTION FOR READING ACTIVELY

1. The editors of *Scientific American* are extremely concerned that, because agritech companies such as Monsanto, Pioneer, and Syngenta control research on the efficacy and dangers of GMOs, they alone decide who can do the research, the nature of the research, and the publication of the research findings. Why do the editors feel this is a practice of grave concern?

QUESTIONS FOR THINKING CRITICALLY

1. The editors declare, "It would be chilling enough if any other type of company were able to prevent independent researchers from testing its wares and reporting what they find—imagine car companies trying to quash head-to-head model comparisons done by Consumer Reports." Given the recent and growing uproar over genetically modified crops and the dangers they present to our health and environment, do you think agritech companies will be forced to become more forthright and transparent with their reporting and business practices? Explain your thoughts.
2. Seed companies contend that these GMOs increase crop yield and reduce the use of pesticides. Has that proved to be the case? Why or why not? Refer to at least two sources to support your ideas.

QUESTION FOR WRITING THOUGHTFULLY

1. Are you concerned about the findings and assertions in this and the previous article regarding the risks of the food we are eating? If so, what steps might you take to address this risk?

Eating the Genes: What the Green Revolution Did for Grain, Biotechnology May Do for Protein

by Richard Manning

Fears that genetically engineered foods will damage the environment have fueled controversy in the developed world. The debate looks very different when framed not by corporations and food activists but by three middle-aged women in saris working in a Spartan lab in Pune, India. The three, each with a doctoral degree and a full career in biological research, are studying the genes of chickpeas, but they begin their conversation by speaking of suicides.

The villain in their discussion is an insidious little worm, a pod borer, which makes its way unseen into the ripening chickpea pods and eats the peas. It comes every year, laying waste to some fields while sparing others. Subsistence farmers expecting a bumper crop instead find the fat pods hollow at harvest. Dozens will then kill themselves rather than face the looming hunger of their families. So while the battle

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wages over "frankenfood" in the well-fed countries of the world, here in this Pune lab the arguments quietly disappear.

A generation ago the world faced starvation, and India served as the poster child for the coming plague, occupying roughly the same position in international consciousness then that sub-Saharan Africa does today. The Green Revolution of the 1960s changed all that, with massive increases in grain production, especially in India, a country that now produces enough wheat, rice, sorghum, and maize to feed its people. Green Revolution methods, however, concentrated on grains, ignoring such crops as chickpeas and lentils, the primary sources of protein in the country's vegetarian diet. As a consequence, per capita production of carbohydrates from grain in India tripled. At the same time, largely because of population growth, per capita protein production halved.

The gains in grain yield came largely from breeding plants with shorter stems, which could support heavier and more bountiful seed heads. To realize this opportunity, farmers poured on nitrogen and water: globally, there was a sevenfold increase in fertilizer use between 1950 and 1990. Now, artificial sources of nitrogen, mostly from fertilizer, add more to the planet's nitrogen cycle than natural sources, contributing to global warming, ozone depletion, and smog. Add to this the massive loads of pesticides used against insects drawn to this bulging monoculture of grain, and one begins to see the rough outlines of environmental damage the globe cannot sustain.

During this same revolutionary period, India and other countries, including Mexico, Brazil, Chile, and Cuba, developed scientific communities capable of addressing many of their own food problems. High on their list is the promise of genetic engineering (see "New Markets for Biotech"). In India, researchers have found a natural resistance to pod borers in two other crops, the Asian bean and peanuts, and are trying to transfer the responsible gene to chickpeas. If they are successful, farmers will not only get more protein; they will also avoid insecticides. "The farmer has not to spray anything, has not to dust anything," D. R. Bapat, a retired plant breeder, told me. He need only plant a new seed.

This is the simple fact that makes genetic modification so attractive in the developing world. Seeds are packages of genes and genes are information—exceedingly valuable and powerful information. Biotech corporations can translate that information into profits. Yet when those same packets of power are developed by public-sector scientists in places like India, they become a tool, not for profit, but for quickly distributing important information. There is no more efficient means of spreading information than a seed.

The above argument built only slowly in my mind in the course of researching a book (*Food's Frontier: The Next Green Revolution*) that profiled nine food projects in the developing world, all of which were carried out largely by scientists native to the countries I visited. I expected to encounter low-technology projects appropriate for the primitive conditions of subsistence agriculture in the developing world—and I did. But I also found, in all nine cases, a sophisticated and equally appropriate use of genetic research or genetic engineering.

A lab in Uganda, for example, could not regularly flush its toilets for lack of running water, but could tag DNA. This tagging ability, used in six of the projects I studied, allows researchers to understand and accelerate the breeding of new strains. Typically, an effort to breed a disease- or pest-resistant strain of a crop can involve ten years of testing to verify the trait. Using genetic markers cuts that time in half—a difference that gains urgency in countries where test plots are surrounded by poor farmers whose crops are failing for want of that very trait.

In this manner, by allowing researchers to accelerate the development of new, pest-resistant sources of protein, genetic engineering can help fulfill the decades-old promise of the Green Revolution. Our last revolution created a world awash in grain. But if Uganda is to get better sweet potatoes, Peru better mashua, and India better chickpeas, then research on those orphan crops will have to catch up rapidly. Biotechnology can help.

Food researchers in developing countries are understandably worried they will be hampered by the controversy over genetically modified foods. Meanwhile, they have a hard time understanding why genetic engineering is the focus of such concern. The gains of the Green Revolution, after all—and for that matter the gains of 10,000 years of agriculture—have in many cases come from mating unrelated species of plants to create something new and better. Every new strain has brought with it the potential dangers now being ascribed with apparent exclusivity to genetic engineering, such as the creation of superresistant pests. Genetic engineering merely refines the tools.

When viewed from labs surrounded by subsistence farmers, where food research is a matter of life and death rather than an intellectual debate, genetic engineering is a qualified good—not without problems and dangers, but still of great promise. Genetic modification of foods becomes a natural extension of the millennia-old practice of plant breeding, less environmentally damaging than many modern alternatives. In the end, DNA is knowledge, which we can hope will build to wisdom, from which we may one day create an agriculture that both supports our population and coexists peacefully with our planet.

QUESTION FOR READING ACTIVELY

1. Richard Manning's perspective in "Eating the Genes" is quite different from the perspectives presented in the two previous essays. Describe some of the differences, and identify any causal relationships you observed while reading.

QUESTIONS FOR THINKING CRITICALLY

1. Manning claims that in developing countries, the risks to the environment or people posed by genetically engineered foods are of much less consequence than the reality of starvation and suicides by farmers whose crops are ruined by insects. Do you agree with the point he is making? Why or why not?
2. In contrast to developed countries like the United States and those in Europe where biotechnology is controlled by large, profit-oriented biotech corporations, in developing countries sophisticated native public-sector scientists are developing new disease-resistant and pest-resistant biotech crops for their countries. Which approach to biotechnology is better? Why?

QUESTION FOR WRITING THOUGHTFULLY

1. Given what you have learned about genetically modified crops and foods so far, define and describe your perspective on the issue (whether you are in favor of genetically modified crops and foods or against them), and justify your claims.