

LEVELED BOOK • Z²

Are GMOs Safe?



MULTI
level
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Focus Question

Why is agriculture being altered with GMOs?

Words to Know

agriculture	deficiencies	mandatory
altered	genetically	monoculture
assess	herbicides	pesticides
bestow	impartial	proponents
biased	ingest	splicing
consumers	intermingle	vulnerable

Title page: A lab worker at the Monsanto company maintains GMO corn specimens.

Page 3: Demonstrators in Tucson, Arizona, protest GMO foods and the Monsanto company.

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Correlation

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Fountas & Pinnell	Y-Z
Reading Recovery	N/A
DRA	70+



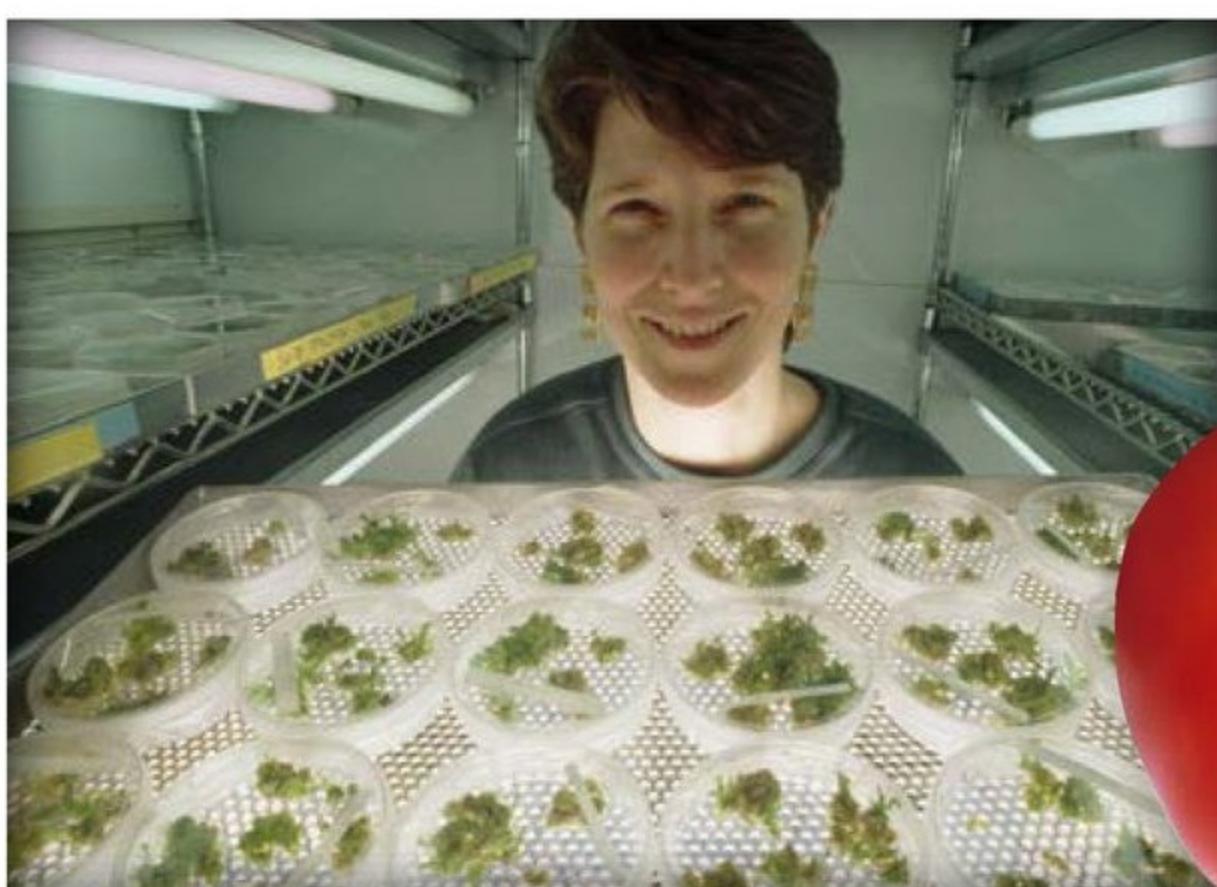
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The Birth of GMOs

In 1994, the Food and Drug Administration (FDA) approved a new kind of tomato for sale in the United States. Called the Flavr Savr, the tomato was grown from seeds that researchers had **altered** in a laboratory. Unlike traditional tomatoes, this new variety stayed firm long after ripening. This feature allowed growers to let the tomatoes ripen longer on the vine before they were picked and sent to market, which gave them more flavor.

Flavr Savr tomatoes were clearly labeled as being grown from seeds that had been **genetically modified**. Initially, they sold very well. Within two years, however, concerns over safety had turned public opinion strongly against them, and they were removed from sale. The argument over genetically modified organisms (GMOs) had begun. It's been going on ever since.

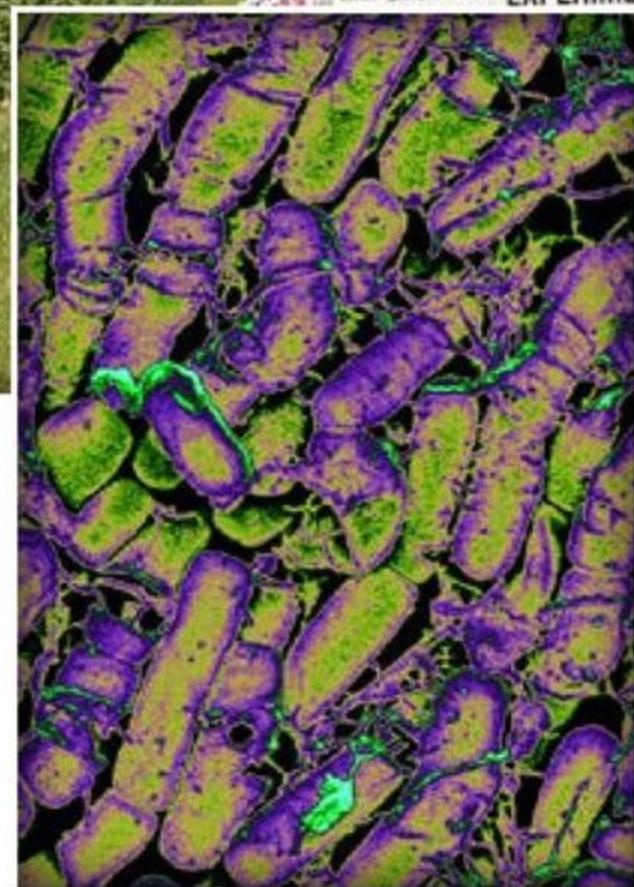


Dr. Virginia Ursin (main) worked on the first genetically modified tomatoes (inset).





Genetically modified cornfields (main) look exactly like those that have not been modified with the Bt soil bacterium (inset).



Since the start of **agriculture** almost ten thousand years ago, people have bred plants to grow food crops not found in the wild. For example, corn as it is known today never grew wild. Instead, farmers developed it from a wild grass called *teosinte* by saving and replanting only the seeds of plants that had certain traits they desired.

Farmers still use those methods—known as *conventional breeding*—to improve the crops they grow in their fields. However, over the past few decades, scientists have used technology to invent new kinds of foods that never existed before. Scientists can create a new crop variety in a laboratory by taking genes from one organism and putting them into a plant they want to improve or change.

Instead of slowly breeding generations of plants to make them look, taste, or behave differently, scientists can **bestow** a desired trait simply by giving a seed a gene from a completely different plant or other organism. For example, in 2014, the United States Department of Agriculture (USDA) stated that 80 percent of the corn grown in the United States had been changed to include genes from a soil bacterium called *Bt*, which creates a protein that kills insects that **ingest** it. The percentage was up from 29 percent in 2003. Those borrowed genes give the new corn the ability to kill insects that try to feed on it.

Creating a brand-new organism by **splicing** together genes of existing, unrelated organisms is known as *genetic engineering* or *genetic modification*, and the new varieties are known as GMOs. Some GMOs are now common among the foods people in the United States buy and consume every day.

What—and Where—Are GMO Foods?

The USDA says that about 40 percent of all crops grown in the United States are genetically modified. The most common crops currently grown with GMO technology are alfalfa, cotton, canola, corn, sugar beets, soy, papaya, zucchini, and yellow squash. In fact, about 90 percent of the corn, cotton, and soybeans grown in the United

States are GMOs. It is surprising to learn about all the places these modified foods turn up.

After all, corn isn't just that familiar treat roasted on the cob or popped to eat at the movies. The kernels are also processed into products like corn meal and corn syrup, which in turn become ingredients in cereal, cookies, pet foods, and countless other foods. Similarly, soy is an ingredient in many of the foods in the average person's kitchen pantry. In all, it's estimated that between 60 and 80 percent of processed foods in the United States contain GMOs.

In other words, most Americans have eaten GMO foods of some kind without knowing it. Even when reading every ingredient on food labels, it can be difficult to know which of those ingredients may have been genetically modified.

Some concerned citizens are working to change that by asking the U.S. government to require manufacturers to label all food products containing GMO ingredients.



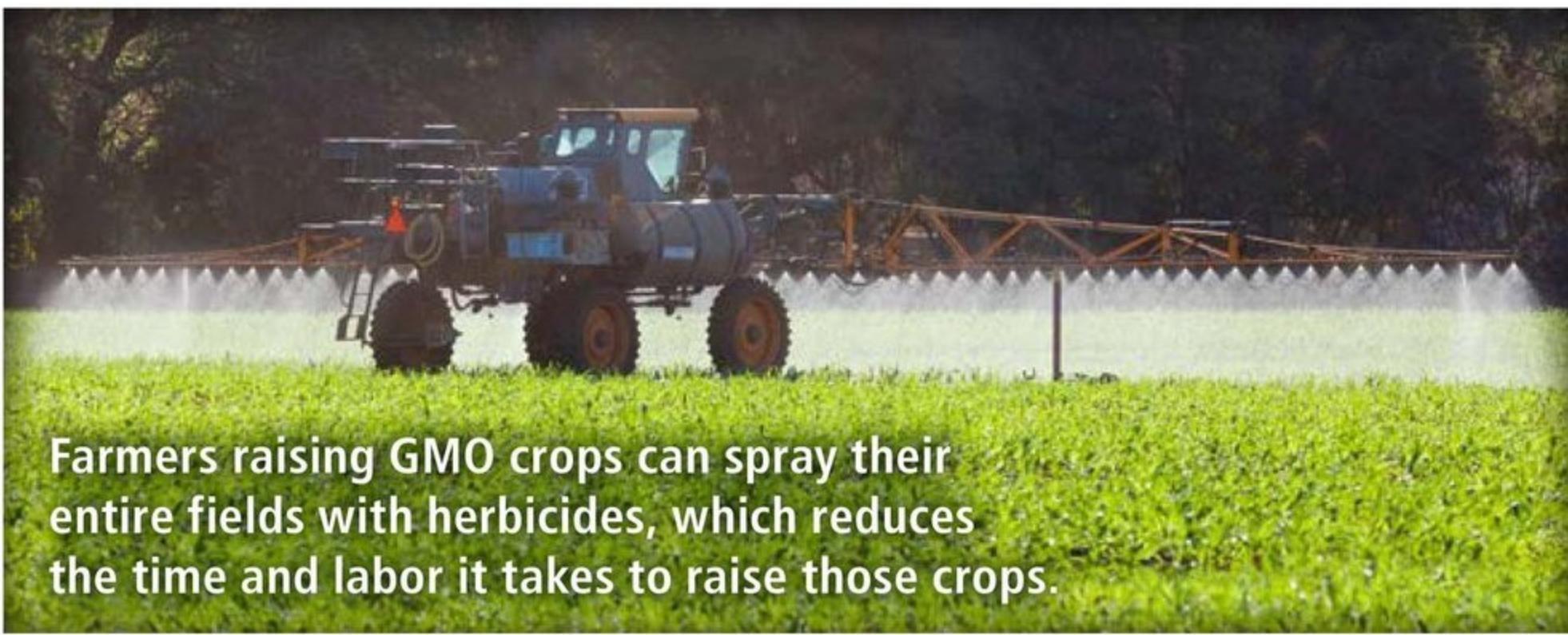
All the foods pictured above are made with corn.

They believe that just as labels show **consumers** the ingredients and nutritional information for the foods they buy and eat, people also have a right to know whether they're eating food grown by conventional methods or with GMO technology.

The Benefits and Risks of GMOs

GMO food products became part of the U.S. diet in the mid-1990s. Supporters of the new technology cited many benefits of GMO foods for world agriculture, including positive effects on human health and the environment. However, many people are concerned about possible risks to their families and the environment from growing and eating genetically modified foods.

The vast majority of GMO crops on the market today have been modified by adding genes to make them more resistant to crop-eating pests or **herbicides**. The Bt corn produces an insect-killing toxin, which some experts say allows farmers to spray fewer **pesticides** on their fields. Because many GMO crops are modified to survive the use of weed-killing herbicides, farmers can apply those herbicides across entire fields instead of spending time and labor spraying or pulling individual weeds.



Farmers raising GMO crops can spray their entire fields with herbicides, which reduces the time and labor it takes to raise those crops.

Some scientists and businesspeople who support the use of GMO crops say these advantages can increase crop yields, making agriculture more profitable. They also say that crops can be produced more efficiently with fewer chemicals, making agriculture less harmful to the environment and food safer for human consumption.

The opponents of GMOs say that, as a whole, farmers have increased their use of chemical weed killers since they started planting herbicide-resistant GMO crops. They think that GMO plants may make some crop-damaging pests stronger in the long run, as targeted insects and weeds adapt to the new crops' built-in insecticides and farmers' more liberal use of herbicides. As a result, they fear that farmers will eventually need to use more or stronger chemicals to battle these new breeds of "superbugs" and "superweeds." As nature and science take turns upping the ante, the escalating cycle could increase safety risks for humans as well as the environment.

People who advocate for more GMO crops say that any unknown risks are outweighed by the potential for genetically engineered crops to solve world hunger. They say GMOs' larger, more efficient crop yields will be necessary to supply food to people as Earth's human population grows exponentially. Researcher David Weisser says that when people place limitations on GMOs, they "only hurt the world's starving population."

But some opponents say that as more farmers plant the same few varieties of GMO crops, the world's food supply becomes more **vulnerable**. Experts at Princeton University caution that planting fewer varieties of crops "can lead to the

Who Profits from GMO Crops?

The broad shift to an industry dominated by GMO crops has had mixed consequences for small-scale farmers. Pollen can drift from a GMO farm to a neighboring non-GMO farm, and a farmer may wind up growing a crop he or she didn't plant. This situation can be a problem for organic farms that don't buy GMO seeds. In addition, the GMO seeds are owned by the company that developed them, not the farmers, so saving seeds for the next year is illegal.



quicker spread of diseases” in plants and reduce their production overall. For example, if everyone grows the same GMO corn seeds and a disease comes along that wipes out that corn, it could also wipe out an entire key food source in one fell swoop.

Monoculture has led to such a disaster before. Millions of people starved to death or were forced to leave Ireland in the mid-nineteenth century after a fungus destroyed the country’s potato crop, which was primarily grown from one popular variety.

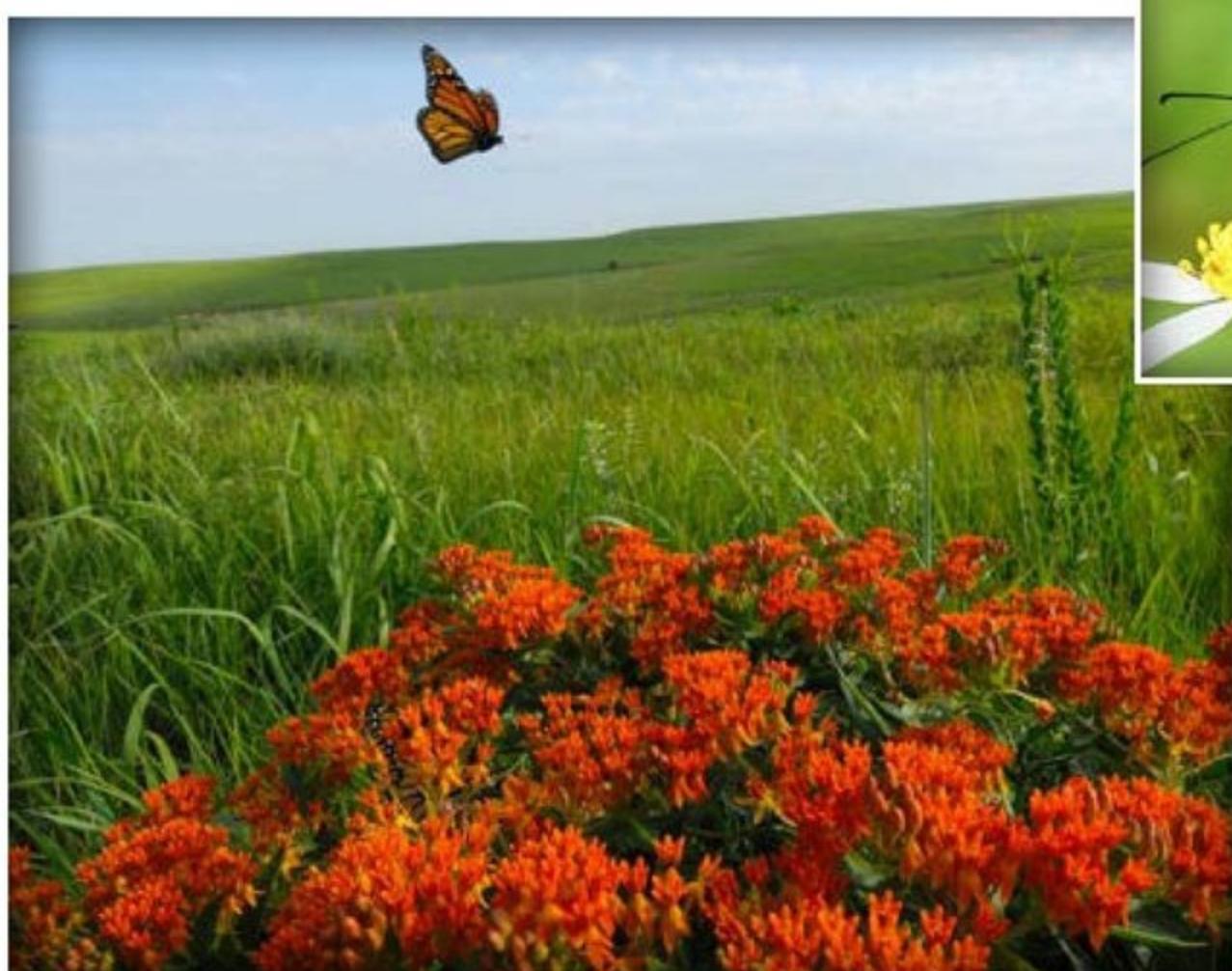
GMOs in the Environment

Scientists develop the seeds for GMO crops in laboratories. But part of the GMO experiment is growing those crops on a wide scale in real life to discover how GMO seeds **intermingle** with the surrounding environment and the wild plants and animals that live there.

For example, if wind carries pollen from a field of GMO crops to a neighboring field of wildflowers, some of those wildflowers might cross-pollinate with the GMO crop. The wildflowers might then take on genetically engineered traits bred into the crop. Insects and other animals that carry pollen might also be affected. Studies need to be done to determine

the effects that GMOs might have on beneficial insects such as ladybugs, which eat insects that can harm crops, and bees and butterflies, which play an important role in pollinating crops people depend on for food. Some consumers fear that crops engineered to contain insect-killing toxins will also kill these beneficial, “nontarget” insects, but that has not been proved.

The monarch butterfly is one of those nontarget insects that pollinate crops. Populations of monarch butterflies have declined dramatically over the past twenty years, with the number of butterflies dropping by as much as 90 percent. However, scientists haven’t determined whether or not ingesting Bt toxins harms monarch larvae that hatch and feed on GMO plants. Some experts say that too much spraying of weed killer on



The amount of milkweed (main), the main food source for monarch butterflies (inset), is being reduced due to herbicides being sprayed on neighboring GMO fields.

herbicide-resistant crops is killing off other plants that monarchs need in order to survive. Other experts say that the reduction of open areas that monarchs call home is the reason for the reduction in monarch populations, meaning GMOs might not be to blame.

Are GMO Foods Good for People's Health?

In some cases, people who support widely growing and marketing GMO foods say that those foods can solve serious human health problems. In addition to producing more food for people in the world's poorest areas, some GMO crops have been developed to help solve nutritional **deficiencies** in those areas. For example, scientists are experimenting with growing rice that has been modified to produce beta carotene, the source of vitamin A. Those who are developing the rice hope it might help people in areas where a lack of vitamin A in the diet contributes to widespread blindness.

However, some people question whether humans should eat genetically modified food before more studies have been done to investigate its long-term effects on health. They are concerned that GMO crops designed to kill insects or crops that have been heavily sprayed with herbicides

may play a role in causing diseases such as cancer. Another concern is the rise of new food allergies, as people eat GMO foods containing new proteins that people have never before encountered in the foods they eat.

Though many studies have been done over the past twenty years to **assess** the health risks of eating GMO foods, much debate still exists about whether these questions have been answered. **Proponents** of GMO foods frequently cite the conclusion of a 2013 review of nearly eighteen hundred published papers, which found no significant evidence that GMOs are harmful to human health.



Soy, eggs, milk, and peanuts are common food allergens.

However, that same year, nearly three hundred scientists and other experts signed a statement concluding that science has not yet reached a consensus declaring GMOs safe. Opponents have also put together studies that they say do show that GMOs are harmful to human health and the environment, citing increases in depression, weight gain, and Alzheimer's disease since the advent of GMO production.

One reason people on both sides of the issue can't agree on the conclusion is that they can't agree on the evidence. Each side questions whether the other side's research is truly **impartial**. GMO opponents say that the studies showing the safety of GMO crops aren't reliable because they are funded and carried out by the same companies that profit from those crops.

Conversely, advocates for the industry say that studies cited by anti-GMO activists are **biased**. Furthermore, because most genetically engineered crops are patented by large seed companies, independent researchers have reportedly faced challenges obtaining seeds to conduct strict, unbiased studies. The positive or negative effects of any new technology cannot be fully understood without long-term study.

To Label or Not to Label?

The ongoing debate about the benefits versus the risks of GMO foods has met with a different reaction in the United States than in many other countries around the world.



In the United Kingdom, items that contain GMO foods must be labeled (right). In the United States, some non-GMO foods carry labels (left).

In more than sixty countries, GMOs have either been banned until further study can prove them safe, or foods containing GMOs must be labeled. In the United States, GMO foods are allowed on the market unless they can be proved to be harmful, and the federal government does not require special labels for foods that contain ingredients made from GMOs.

Yet public opinion polls show that most consumers in the United States want to see labels on foods containing genetically modified ingredients. Many people believe that by clearly labeling products containing GMO ingredients, they can choose for themselves whether they want to consume GMO foods.

Some advocates for labels on GMO foods are working to get new laws passed that require labeling in the individual states where they live. So far, most of those efforts have been unsuccessful. In 2014, Vermont became the first state to require labels on GMO foods sold within its boundaries. Some businesses across the country, such as specialty grocery stores, have also pledged to label any GMO foods they sell.



Despite protests, in 2013 Oregon passed legislation that prevents the banning of GMO crops within the state.

People who want widespread labeling for GMO foods face considerable opposition. The companies that develop, grow, and market genetically modified foods say that requiring GMO labels on their products will unfairly hurt their business.

Advocates for the GMO industry argue that the negative perceptions about GMO foods are based in controversy, not information, and that labels won't help educate the public with the facts about GMOs. Some argue that due to public fears about the risks of GMO foods, any label that says "GMO" will automatically keep people from buying a product—whether that product is good or bad. Many industry insiders fear that **mandatory** labels will lump all GMO products into one category, regardless of how and why each product is manufactured and which GMO ingredients are used.

Industry advocates warn that labels will only promote more fear, resulting in decreased funding and support to develop new GMO products that might benefit people in the future. Finally, they say that labeling every product will be expensive and complicated, especially if different states or stores each have their own laws requiring labeling.



Scientists at Cornell University document growth rates of genetically modified plants on the lids of petri dishes.

The Future of GMOs

People have been eating foods grown from laboratory-altered seeds for only the past two decades. While hundreds of reports have been published exploring the benefits and risks of GMO foods, many people believe the jury is still out on whether or not GMO foods are safe.

Saving Seeds for a Rainy Day

A century ago, farmers could buy seeds for more than three hundred unique varieties of corn. Today, most commercially grown corn comes from hybrid seeds from the same few varieties of corn. Meanwhile, many of the world's historic and traditional foods have gone extinct—including 90 percent of historic fruit and vegetable varieties in the United States.

To address this problem, people have started seed banks around the world to save seeds from traditional, or "heirloom," crops. By preserving a diverse array of crops—as well as the knowledge of the people who grew them—they hope to ensure more food choices for future generations.



Glossary

agriculture (<i>n.</i>)	the science or practice of farming and raising livestock (p. 5)
altered (<i>v.</i>)	made different; changed (p. 4)
assess (<i>v.</i>)	to evaluate or measure something (p. 14)
bestow (<i>v.</i>)	to give or present something, often as an honor (p. 6)
biased (<i>adj.</i>)	having or showing unfair support for one opinion, group, or set of beliefs over another (p. 15)
consumers (<i>n.</i>)	people who buy or rent goods or services and use them (p. 8)
deficiencies (<i>n.</i>)	shortages or lack of something necessary; flaws or shortcomings (p. 13)
genetically (<i>adv.</i>)	in a manner having to do with heredity and variation in living things (p. 4)
herbicides (<i>n.</i>)	biological or chemical agents that kill unwanted plants (p. 8)

impartial (<i>adj.</i>)	treating people, groups, or situations with fairness and objectivity; without bias (p. 15)
ingest (<i>v.</i>)	to take in food or some other substance (p. 6)
intermingle (<i>v.</i>)	to mix together (p. 11)
mandatory (<i>adj.</i>)	required; related to something a person must do (p. 17)
monoculture (<i>n.</i>)	a method of farming in which only one type of crop is grown; a crop grown using such a method (p. 11)
pesticides (<i>n.</i>)	chemical or biological substances that kill harmful animals or plants (p. 8)
proponents (<i>n.</i>)	people who support or argue in favor of something; advocates (p. 14)
splicing (<i>v.</i>)	interweaving or joining together two or more strands to make a single piece (p. 6)
vulnerable (<i>adj.</i>)	able to be hurt easily (p. 10)

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Word Count: 2,264

Connections

Writing

Are GMOs safe? Take a stand. Write an article supporting or opposing the use of GMOs. Use information from the text to support your position.

Health

What food-labeling regulations has the U.S. Food and Drug Administration (FDA) established? Use the information in the book and your research to write food-label regulations based on what you think every consumer should know.



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