



STUDY GUIDE

SECTION I: GMOs 101

What are GMOs?

First approved by the U.S. government in 1996, genetically engineered crops, or genetically modified organisms (GMOs), have been produced through the application of a variety of laboratory techniques including in vitro nucleic acid methods (incorporating a section of DNA, or multiple sections, into a host cell) and methods of fusing cells that would not be able to occur without human manipulation in a lab. Genetic engineering is often used to add a specific trait to a plant or animal, such as resistance to treatment with herbicides or to make a plant produce its own pesticide to repel insects.

Unlike traditional plant and animal breeding, which tries to develop better varieties by selecting traits from the same species, a genetic engineering technique known as transgenesis allows scientists to insert specific genes from any plant, animal or microorganism into the DNA of an entirely different species, such as inserting fish genes into a tomato.

Haven't we always modified plants? Do you mean seedless grapes?

Biotechnology goes beyond traditional breeding methods (the things farmers have done for thousands of years, such as breed their best livestock and save seeds from their most productive crops). Selective crop breeding was accelerated by the development of crop hybridization, which crossbred plants that had desirable traits and helped reverse the stagnating corn yields of the 1930s. Breeders create hybrids by controlling the cross-pollination of two varieties that could naturally breed in the wild so that the desired traits are produced in the next generation. Hybrid seeds were bred within the same plant species until the discovery of the human genome in the 1950s. This breakthrough spurred the development of genetic engineering techniques, which allow breeders to splice genes from very different species.

Seedless watermelons, tiny oranges and many other produce items we find at the grocery store are considered hybrids. While hybrids are usually created using low-tech, natural techniques, GMOs are created by using complex technology and moving DNA in a way that could never naturally occur, usually across species.

How common are GMOs?

Since most corn, cotton and soybeans are now genetically engineered (90, 90 and 93 percent, respectively), it can be assumed that ingredients made from these crops — vegetable oils, corn starch, corn meal, corn syrup, glucose, dextrose, soy oil, soy flour, soy lecithin, cottonseed oil and protein extracts — contain GMO content. Most of the packaged foods in American grocery stores contain GMO ingredients in one form or another, and most conventional meat animals were fed GMO corn, soy or alfalfa.

Dairy products from cows treated with artificial growth hormones were the first bioengineered animal products in the food supply, and the number of GMO animals awaiting government approval, like a salmon that is supposed to grow to market size twice as fast as non-GMO salmon, has accelerated.



Other crops that have been genetically engineered include sugar beets (used to make sugar that is in many processed foods), canola, safflower, and cotton (used to make oils used in many processed foods), papaya, squash and sweet corn. Since labeling is not required, you can never be sure whether or not the food you're eating is genetically engineered unless it's certified organic (organic farmers can't use GMOs) or labeled with a verified non-GMO label.

Who makes GMOs?

Only a handful of chemical and pharmaceutical giants dominate the seed industry. The "Big 6" firms in the seed industry are Monsanto, Dupont, Syngenta, Bayer, Dow and BASF. These firms are also major chemical companies, and the companies sell both the GMO seeds and the herbicides that the seeds are engineered to tolerate (such as Roundup). In 2009, Monsanto, DuPont/Pioneer and Syngenta were the most powerful global seed companies and also ranked fifth, sixth and first in sales of crop-protection chemicals. By 2009, nearly all (93 percent) of U.S. soybeans and four-fifths (80 percent) of U.S. corn cultivated were grown from seeds covered by Monsanto patents.

Are GMOs safe to eat?

The U.S. Department of Agriculture oversees the cultivation of GMO crops, the Environmental Protection Agency regulates the pesticides and herbicides used on GMO crops, and the Food and Drug Administration is responsible for the safety of both conventional and GMO food and governs food labeling. Current laws and regulations to ensure the human health and environmental safety of GMO crops were established before genetic engineering techniques were even discovered, resulting in lax enforcement, uncoordinated agency oversight and weak monitoring after the crops are on the market.

Biotech companies submit their own safety-testing data, and independent research on GMO foods is limited because of biotechnology companies' restrictive licensing agreements. GMO foods have



not been tested for long-term impacts on human and environmental health or safety, but a growing body of research shows that biotech crops can have troubling health implications including deterioration of liver and kidney function and impaired embryonic development. Additionally, the FDA has no way to track adverse health effects in people consuming GMO foods, and because there is no requirement that foods containing GMO ingredients be labeled, consumers do not know when they are eating them.

Are GMOs good for the environment?

GMO crops usually use more pesticides and herbicides than non-GMO crops, and they can easily contaminate organic and non-GMO conventional crops with unwanted genetic material. Roundup Ready crops (which are engineered to tolerate application of the weed killer Roundup) are known to increase Roundup (glyphosate) use. Now, superweeds and pests like the rootworm have become resistant to GMO-affiliated herbicides like Roundup and require many more toxic chemicals to be applied to crops.

Isn't Roundup safe to use?

Monsanto's herbicide Roundup is one of 750 U.S. products containing the active ingredient glyphosate, the safety of which has been disputed for years. Glyphosate is a non-selective herbicide used widely in large-scale agriculture, forestry and industrial weed control, and in lawn and garden care.

Glyphosate is also known as a “systemic” herbicide, meaning that it is absorbed into every part of the plant, from the roots to the leaves.

Evidence suggests that glyphosate may pose animal and human health risks. Nevertheless, glyphosate use on Roundup Ready crops has grown steadily, with application doubling between 2001 and 2007. Independent research on glyphosate has linked the chemical with cell toxicity, neurotoxicity (including Parkinson’s disease symptoms after glyphosate exposure), cancer and endocrine disruption. Glyphosate also persists in the environment for as long as a year in soil and on sprayed plants, and for more than six months in water and has been found in streams near agricultural production sites at significant levels.

Ubiquitous application of Roundup has spawned glyphosate-resistant weeds, a problem that is driving farmers to apply more toxic herbicides, like 2,4-D and Dicamba. The chemical 2,4-Dichlorophenoxyacetic acid (2,4-D) once made up half of the herbicide mix known as Agent Orange. There is concern regarding 2,4-D’s endocrine disruption potential and its effects on development. To combat weeds and to allow farmers to apply 2,4-D generously to crops, Dow AgroScience has engineered 2,4-D-resistant corn, soybeans and cotton, which will only increase the total amount of herbicides used in agriculture once weeds develop resistance to multiple herbicides.



The EPA is currently gathering data on the safety of glyphosate — the majority of which will come from a task force representing major agribusinesses — and expects to make a final decision on its registration by 2015. The potential cumulative, long-term risks of glyphosate exposure have not been studied. These considerations should be critical in determining the safety of a product prior to approval, and not left to attempt to assess once the product is on the market.

Are GMOs good for farmers?

Biotech seed companies claim that their products strengthen farm productivity by improving yields and reducing costs. Yet the cost savings are largely illusory, and the yield gains have been limited. GMO seeds and affiliated herbicides are typically more expensive than conventional products; in 2009, Roundup Ready soybean seeds cost twice as much as non-GMO seeds. Biotech corn seeds cost nearly \$40 more per acre than non-GMO seeds, and the cost of biotech corn seeds nearly tripled from \$103 per 80,000 seeds in 1998 to \$285 in 2013. By 2009, Roundup Ready soybean seeds cost twice as much as conventional seeds. A 2009 Union of Concerned Scientists analysis found that herbicide-tolerant corn and soybeans showed no yield increase over non-GMO crops, and insect-resistant corn had only a slight advantage over conventional corn.

Additionally, organic and non-GMO farmers face the threat of contamination of their fields with GMO content. Because using GMO seeds is an excluded method under the USDA’s organic standards, organic farmers are responsible for making certain that they do not grow genetically engineered crops. With the proliferation of these crops, however, coexistence between organic, non-GMO and GMO farmers has become more and more difficult, due to the potential for gene flow and commingling of crops at both the planting and harvesting levels and in the distribution chain. GMO crops can contaminate non-GMO and organic crops through cross-pollination on the field or through seed or grain mixing post-harvest.

Biotech companies also zealously pursue farmers that allegedly violate their patents via unintended contamination. By 2007, Monsanto had filed 112 lawsuits against U.S. farmers for patent infringement, recovering between \$85.7 million and \$160.6 million. In the developing world, patented GMO seeds threaten the traditional practice of saving and sharing seeds from harvested crops to plant the next season. The prestigious 2009 International Assessment of Agriculture Knowledge, Science and Technology for Development, a report written by more than 400 scientists and sponsored by the United Nations and World Bank, concluded that the high costs for seeds and chemicals, uncertain yields and potential to undermine local food security makes biotechnology a poor choice for farmers in the developing world.

How do I know if I'm eating GMOs?

The FDA does not require the labeling of GMO food products because the agency views GMO foods as no different from conventional foods. The FDA does permit voluntary GMO labeling as long as the information is not false or misleading. Food manufacturers are allowed to affirmatively label GMO food or indicate that the food item does not contain GMO ingredients (known as "absence labeling"). But virtually no companies disclose that they are using GMO ingredients under this voluntary scheme. This means that consumers in the United States regularly consume foods that contain GMO ingredients without knowing it.

There are food industry-led efforts to promote absence ("non-GMO") labeling, but this is no substitute for requiring food companies to disclose GMO ingredients.

Do other countries use GMOs as much as the U.S.?

The majority (77 percent) of genetically engineered crops are grown by just three countries: the United States, Brazil and Argentina. Although there are 27 countries that grow GMO crops, only 14 grow more than a million acres, with 13 countries producing only minimal amounts of GMO material. Putting this into perspective, only 14 percent of the world's countries are actually growing GMO crops. Currently, nearly a quarter of EU Member States have bans on GM products.



SECTION 2: Discussion Questions

Check out these links for information you can use to have a discussion about the issues covered in the movie.

Do we need GMOs to feed the world?

- Union of Concerned Scientists – “Failure to Yield”
http://www.ucsusa.org/assets/documents/food_and_agriculture/failure-to-yeild.pdf
- Food & Water Watch – “Greenwashing GE Crops”
<http://documents.foodandwaterwatch.org/doc/GEGreenwashing.pdf>

Do you think GMOs should be labeled?

- Food & Water Watch – “The Case for GE Labeling”
<http://documents.foodandwaterwatch.org/doc/CaseForGELabeling.pdf>

Is this technology good for farmers in the United States?

What about farmers in other countries?

- Center for Food Safety – “Seed Giants vs. U.S. Farmers”
http://www.centerforfoodsafety.org/files/seed-giants_final_04424.pdf
- Food & Water Watch – “How GE Crops Hurt Farmers”
<http://documents.foodandwaterwatch.org/doc/HowGECropsHurtFarmers.pdf>



Should the government promote this technology to farmers here in the United States or in other countries?

- Food & Water Watch – “Biotech Ambassadors: How the U.S. State Department Promotes the Seed Industry’s Global Agenda”
http://documents.foodandwaterwatch.org/doc/Biotech_Report_US.pdf

Do you think the regulation of GMOs is good enough to protect human health? The environment? Farmers?

- Food & Water Watch – “Genetically Engineered Food: An Overview”
http://documents.foodandwaterwatch.org/doc/Genetically_Engineered_Food_2014.pdf
- Food & Water Watch – “Superweeds: How Biotech Crops Bolster the Pesticide Industry”
<http://documents.foodandwaterwatch.org/doc/Superweeds.pdf>
- Union of Concerned Scientists – “The Rise of Superweeds and What to Do About It”
http://www.ucsusa.org/assets/documents/food_and_agriculture/rise-of-superweeds.pdf

The movie discusses how a few large companies dominate the GMO seed market. Does this worry you? Can you think of other industries where this trend happens?

- Food & Water Watch – “Monsanto: A Corporate Profile”
<http://documents.foodandwaterwatch.org/doc/MonsantoReport.pdf>
- Wenonah Hauter – “Foodopoly: The Battle Over the Future of Food and Farming in America”
<http://www.amazon.com/Foodopoly-Battle-Future-Farming-America/dp/159558790X>

Organic farmers are very worried about GMO contamination. Who do you think should be responsible for making sure this contamination doesn’t happen, or for paying for it if it does happen?

- Food & Water Watch – “Organic Farmers Pay for GMO Contamination”
http://documents.foodandwaterwatch.org/doc/GMO_contamination.pdf



SECTION 3: What You Can Do

If you want to avoid GMOs, there are several things you can do:

Look for certified organic or Non-GMO Project verified products. The USDA organic standards (<http://blogs.usda.gov/2013/05/17/organic-101-can-gmos-be-used-in-organic-products>) do not allow the use of GMOs or synthetic pesticides or fertilizers, sewage sludge or irradiation. The Non-GMO Project (<http://www.nongmoproject.org>) is a third-party labeling program that verifies products that do not use GMOs.

Avoid heavily processed foods. Many GMO ingredients are hidden in things like corn syrup, sugar made from sugar beets, and other chemicals in processed food that are derived from soy.

Buy direct from a farmer. Buying at a farmers market or from a Community Supported Agriculture (CSA) program lets you ask the farmer directly if they use GMOs and other questions about their farming practices. (<http://www.eatwellguide.org>)

Grow your own organic food. But before you plant, know your seeds! Check out non-GMO seed suppliers like Seed Savers Exchange (<http://www.seedsavers.org>). And to find out which seed companies are now owned by Monsanto, check out <http://www.foodandwaterwatch.org/factsheet/monsantos-seed-company-subidiaries>.

Beyond shopping wisely, there are lots of things we need to do to fix our food system:

Check out groups like Food & Water Watch (<http://www.foodandwaterwatch.org>) to find ways to get involved in the fight to label GMOs and other food issues.

Ask your elected officials at the state or federal level to support labeling of GMOs.

If you see them in person in your community, mention how important this issue is to you and urge them to take action. Or call their office or write them a letter to let them know you expect them to take action to require labeling of GMOs. You can find your members of Congress at www.house.gov and www.senate.gov, and your state legislature's website should help you find out how to contact your state legislators.

For more information, links and movie clips, visit www.gmoong.com.



SECTION 4: Resources

Books and Reports

- *The Unsettling of America*, Wendell Berry
- *Uncertain Peril*, Claire Hope Cummings
- *Shattering*, Cary Fowler
- *The One-Straw Revolution*, Masanobu Fukuoka
- *Foodopoly*, Wenonah Hauter
- *Enough*, Bill McKibben
- *Where Our Food Comes From*, Gary Paul Nabhan
- *The Omnivore's Dilemma*, Michael Pollan
- "Agriculture at a Crossroads," International Assessment of Agricultural Knowledge, Science and Technology for Development
<http://www.unep.org/dewa/assessments/ecosystems/iaastd/tabid/105853/default.aspx>
- Rodale Institute Farming Systems Trial
<http://rodaleinstitute.org/our-work/farming-systems-trial>

Organizations

- Food & Water Watch • www.foodandwaterwatch.org
- Center for Food Safety • www.centerforfoodsafety.org
- Food Democracy Now! • www.fooddemocracynow.org
- Organic Consumers Association • www.organicconsumers.org
- Right to Know GMO – A Coalition of States • www.righttoknow-gmo.org
- Just Label It campaign • www.justlabelit.org