



# STUDY GUIDE

## ARE GMOS GOOD OR BAD?

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**KEY TERMS:** genes  
seeds

DNA  
Monsanto

genetically-modified

<b>NOTE-TAKING COLUMN:</b> Complete this section <i>during</i> the video. Include definitions and key terms.	<b>CUE COLUMN:</b> Complete this section <i>after</i> the video.
<p>How long have humans been modifying the genetics of plants and animals?</p> <p>Which organizations have declared genetically modified food as safe?</p> <p>What were the results of the first comprehensive study of genetically modified crop performance?</p>	<p>What is the truth about the safety of genetically modified foods?</p> <p>What does the science and data tell us in terms of how beneficial GMOs are for humanity?</p>

## DISCUSSION & REVIEW QUESTIONS:

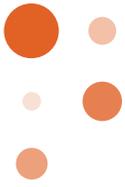
- At the beginning of the video, Dr. Moore explains that, "...'genetically modified' has become a loaded term that is misused to describe recombinant DNA biotechnology...Throw in bogus, Hollywood-inspired terms like Franken Foods, Killer Tomatoes, and Terminator Seeds, and you have the makings of one of the most groundless anti-science campaigns in the history of anti-science campaigns." Why do you think that a movement against GMOs exists? Why do you think that anti-GMO activists feel compelled to 'misuse' and manipulate such terms as scare tactics that deny naturally occurring, beneficial biological processes?
- Dr. Moore reminds us that, "Every credible science, health, and nutrition organization in the world says the genetically modified food available today is safe – without reservation. This includes the World Health Organization, the European Commission, and the Society for Toxicology." This being the case, why do you think that so many people mistakenly believe that GMOs are unhealthy? Do you think that GMOs are unhealthy? Why or why not?
- While Monsanto has done great good in genetically modifying food to be more nutritious and plentiful, has helped to increase farmer profits, and has helped to greatly reduce the use of pesticides, it has also previously produced harmful chemicals to be sprayed on crops as well. However activists tend to lump ALL of Monsanto's activities, and by extension the entire GMO industry, into one category of 'evil.' Why do you think that activists target the act of genetically modifying foods as negative rather than the completely separate act of using pesticides and herbicides that might be harmful?
- Dr. Moore informs us that, "Invented 15 years ago, Golden Rice alone has the potential to end all vitamin A deficiency. Yet the anti-GMO movement is vehemently opposed to it just because it's a GMO. As a result no country has approved Golden Rice for commercial farming. So, while children continue to go blind and die, the anti-GMO crowd celebrates a victory." Do you think that the activists who oppose the use of Golden Rice, solely on the grounds that it is genetically modified, are simply ignorant or have some other agenda that values something other than and greater than the health of poor children? Explain.
- In the video, Dr. Moore asks, "This random movement of genetic material [via bacteria from one species to another] has been one of the driving forces in the development of species... Why wouldn't we harness this naturally occurring phenomenon to improve the makeup of our food and fiber crops?" How would you answer Dr. Moore's question? Why?

## EXTEND THE LEARNING:

### CASE STUDY: GMOs

**INSTRUCTIONS:** Read the article “GMO Foods: Good or Bad?” then answer the questions that follow.

- What does the article identify as the primary sources from which people form their opinions regarding GMOs? Why do you think that people form their opinions from those sources rather than from factual science? Should they? Why or why not?
- The article states that, “...most people who avoid GMOs are doing so because they believe these foods to be unhealthy,” yet that, “To date, there is no evidence suggesting that GMOs cause harm in humans.” What do you think are the reasons that anybody thinks that genetically modified foods are unhealthy? What evidence are they going by? Why do you think that so many opponents of GMOs are so woefully ignorant of the science regarding GMOs?
- The article concludes that, “While GMO foods themselves cannot be classified as unhealthy, other related factors may cause adverse effects. The herbicide glyphosate (Roundup), which is sprayed on some GMO crops, may be harmful to health.” Do you think that people confuse and confound the clearly beneficial process of genetically modifying food with the potentially harmful spraying of some GMO crops- therefore associating both acts as negative? If yes, why do you think that some people do that? If no, why do you think that many people, on any grounds, are so against the GMO process?



# QUIZ

## ARE GMOS GOOD OR BAD?

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- 1. Which of the following organizations say the genetically modified food available today is safe – without reservation.**
  - a. The World Health Organization
  - b. The European Commission
  - c. The Society for Toxicology
  - d. All of the above.
  
- 2. The first comprehensive study of genetically modified crop performance reported which of the following:**
  - a. GM crops reduced pesticide use 37%.
  - b. GM crops were found to cause cancer.
  - c. GM crops significantly decreased farmer profits.
  - d. GM crops need to be banned.
  
- 3. Golden Rice alone has the potential to end all vitamin A deficiency.**
  - a. True
  - b. False
  
- 4. Why has no country has approved Golden Rice for commercial farming?**
  - a. It isn't profitable.
  - b. There are safety concerns.
  - c. It is approved to be commercially farmed in three countries.
  - d. It's genetically modified.
  
- 5. What is the biggest killer of children in the world today?**
  - a. Vitamin A deficiency
  - b. Vitamin B deficiency
  - c. Vitamin C deficiency
  - d. Vitamin D deficiency



# QUIZ - ANSWER KEY

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<http://authoritynutrition.com/gmos-good-or-bad/>



**AUTHORITY NUTRITION**

An Evidence-Based Approach

## **GMO Foods: Good or Bad?**

By [Atli Arnarson, PhD](#)

September, 2015



Genetically modified foods (GMOs) are highly controversial.

Yet, despite the debate, GMOs are found in all sorts of food products – often without labels.

Therefore, it's important to understand the science behind these foods.

This article explains what genetically modified foods are, and how they can affect your health.

### **What is Genetically Modified (GMO) Food?**

GMO stands for “genetically modified organism.”

The term is generally used for food that has had its genes changed using biotechnology.

Using genetic modification, scientists are able to produce new varieties of plants with certain qualities, such as being more resistant to viruses or pesticides.

To understand how this works, knowing some basic principles of genetics is required.

## Basics of Genetics

Genetics is a scientific field that studies genes and heredity.

Genes contain instructions about how to make living organisms. These instructions are basically codes consisting of [DNA](#), which is found inside cells.

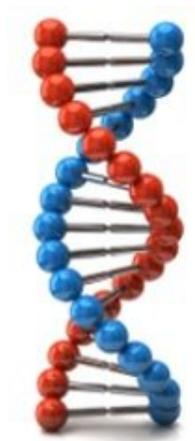
Genes tell cells what to do, ultimately determining how organisms look and function. All living things inherit genes from their ancestors, which is why we look similar to our parents.

However, genes are not entirely stable. They are prone to changes called [mutations](#).

This is part of the reason why each individual has unique physical features. The genes are slightly different between individuals of the same species.

**Bottom Line:** Genes contain information on how living organisms should look and function. Genes vary slightly among individuals of the same species.

## Evolution



Evolution is a term that describes changes in organisms over many generations.

These changes happen because genetic makeup varies between individuals, even for organisms within the same species.

Evolution is usually a very slow process, and is determined by adaptations to specific environmental conditions.

Here is a simple example:

- A species of plants is found on an island. The island has a wet climate and these plants have adapted to growing in wet conditions.
- Gradually, over thousands of years, the climate changes from wet to dry.
- Because of individual variability, some of the plants are, by chance, more tolerant to dry conditions than the others.
- These plants survive, whereas the less drought-tolerant plants are more likely to die before they can produce seeds.
- The end result is a plant population that has adapted to living in dry conditions.

This is called [natural selection](#), and is where the phrase “survival of the fittest” comes from. The genes that are best suited for survival in the environment get passed on to future generations.

**Bottom Line:** Genetic variability drives natural selection. Some individuals are more likely to survive and reproduce, which over time may change the species.

## Selective Breeding

Humans have used these natural principles to create various breeds of domesticated plants and animals. This is known as selective breeding.

Selective breeding is a faster process than evolution. It is based on choosing individuals that have desirable features and breeding them together.

For example, cows have been selectively bred to produce more [milk](#), and [apple](#) trees have been selected to produce bigger [fruit](#).

With genetic modification, this process has been made faster and more precise.

**Bottom Line:** Selective breeding involves choosing individuals with desirable features and breeding them together.

## Genetic Modification



Genetic modification is a technique that allows scientists to alter the genetic material of an organism.

This is usually done by transferring a gene from one organism to another, giving it new traits.

For example, genetic modification can be used to make plants more resistant to diseases or pesticides.

It can also be used to increase a plant’s nutritional value, allow it to grow faster or make it taste better. The possibilities are endless.

Here are some examples of genetically modified (GMO) foods:

- **Herbicide-resistant corn and soybeans:** [Corn](#) and [soybeans](#) were modified to tolerate the herbicide glyphosate, found in Roundup. This allows farmers to spray their fields with powerful herbicides to kill off weeds.
- **Virus-resistant papaya:** In Hawaii, papaya was genetically modified to be able to withstand the ringspot virus.
- **Golden rice:** Swiss scientists developed golden [rice](#), a type of yellow rice that produces beta-carotene, an antioxidant that the body can turn into vitamin A ([1](#)).

Other crops that are often genetically modified include rapeseeds (used to make canola oil) and cottonseeds.

**Bottom Line:** Genetic modification allows scientists to transfer genes between organisms. This technique is more precise than selective breeding, and offers endless possibilities.

## GMO Food is Very Common These Days

The amount of GMO food on the market is increasing worldwide.



However, the exact amount of GMOs you may be eating is difficult to estimate. This is because these foods are not always labeled as such.

In the US, GMO foods do not need to be labeled. Conversely, the European Union requires all GMOs to be labeled.

There are actually far fewer GMO foods available in Europe. These foods are much more readily available in US markets.

About 70–90% of GMO crops are used to feed livestock, and more than 95% of all food-producing animals in the US consume GMO feed.

If you eat soybeans, especially processed soy products, it is likely that they come from a GMO crop. More than 90% of all soybeans are genetically modified (2).

Keep in mind that soy, corn and canola are incredibly common in processed foods in the US. If you eat processed food, then you are almost definitely eating some genetically modified ingredients.

**Bottom Line:** GMO foods are generally not labeled in the US. Most processed foods in the US contain soy, corn or canola, so if you are eating processed foods then you are probably eating some amount of GMOs.

## The GMO Controversy



GMO food is highly controversial.

People's opinions of GMO foods are often based on ethical, philosophical or religious views.

Scientific misconceptions also frequently affect people's beliefs (3).

However, there are plenty of unanswered questions regarding large-scale genetic modification and GMO agriculture.

Some scientists are concerned about the potential environmental impact and sustainability. Meanwhile, others believe that genetic modification may have beneficial environmental effects in the larger scheme of things.

Supporters of GMO foods also argue that genetic modification may be necessary to prevent food shortages as the world's population continues to grow.

However, most people who avoid GMOs are doing so because they believe these foods to be unhealthy.

**Bottom Line:** Genetic modification is a very controversial subject and there are many unanswered questions.

# Are GMO Foods Bad For Your Health?

GMO foods cannot be generalized as either healthy or unhealthy.



It depends entirely on individual genetically modified crops, which should be assessed on a case-by-case basis (4).

Some people have pointed out that transferring a gene from an allergenic food crop, such as [peanuts](#), could make the GMO food allergenic as well. While this is a possibility, safety testing should prevent such products from going on the market (5).

That being said, the risks associated with GMO foods are considered to be very low. They are no greater than those arising from traditional genetic manipulation through selective breeding (6).

To date, there is no evidence suggesting that GMOs cause harm in humans (7).

Likewise, most animal studies suggest that GMOs are safe (2, 8, 9).

Yet, despite the general lack of evidence against GMO foods, there is considerable public opposition to them and the debate continues.

This may be partly due to general distrust of biotech companies. There is also a potential conflict of interest in many scientific studies (10, 11).

**Bottom Line:** GMO food itself cannot be generalized as unhealthy or toxic. There is no good evidence saying these foods negatively impact human health.

## The Herbicide Glyphosate (Roundup) May Cause Harm

Even though there is no good evidence showing that GMO foods themselves are unsafe, there are some other factors to consider.

A few animal studies suggest that herbicide-resistant crops sprayed with [glyphosate](#) (Monsanto's [Roundup](#) herbicide) may cause adverse effects ([12](#))

A notable study from 2012 showed that GMO corn that had been sprayed with glyphosate promoted the formation of cancerous tumors in rats.

The authors suggested that the tumors were a result of the toxic effects of glyphosate and/or the genetic modification itself ([13](#)).

The results of the study were controversial and heavily debated. In fact, the original paper was retracted, but published in a different journal later the same year ([14](#), [15](#), [16](#)).

A few other animal studies and test-tube experiments have found signs of adverse effects when testing GMO corn and soybeans sprayed with glyphosate.

These studies suggest that trace amounts of the herbicide may be causing harm, rather than the genetic modification itself ([17](#), [18](#)).

**Bottom Line:** While GMO foods themselves cannot be classified as unhealthy, other related factors may cause adverse effects. The herbicide glyphosate (Roundup), which is sprayed on some GMO crops, may be harmful to health.

## Take Home Message

The available evidence indicates that GMO food is not harmful to human health.

However, the health effects of spraying GMO crops with the herbicide glyphosate is still a matter of debate.

Nonetheless, there is no good evidence that genetic modification itself causes foods to become unhealthy or toxic.