

What is a GMO?

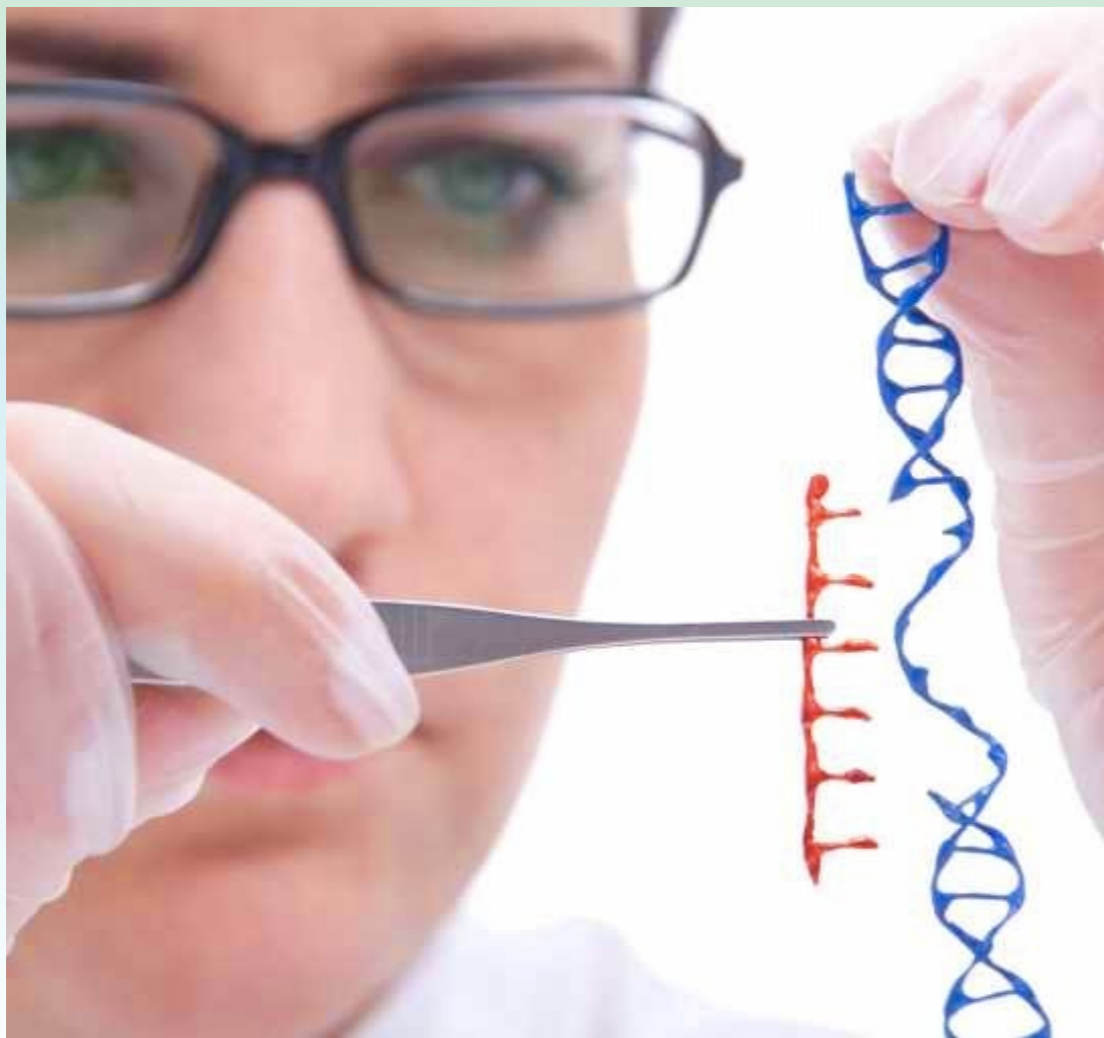
Let's see what people think...



Jimmy Kimmel interview

Critics of genetically modified organisms or GMOs claim that they pose health risks to the public. Jimmy is always interested in people who have strong opinions, so we sent a crew to one of our local farmers markets to ask people why they avoid GMOs and, more specifically, what the letters GMO stand for.

youtube.com/watch?v=EzEr23XJwFY



What makes something genetically modified?

That is a tough question... Humans have been selectively breeding for over 2000 years. Look at the many breeds of dogs, horses, and the variety of crops. Are these genetically modified?

What is a GMO?

A GMO is an organism whose DNA has been changed through any one or more of a variety of processes.

- **Selective breeding** (i.e. creating hybrids with genes for soybean aphid resistance)
- **Experimentally controlled mutation** (using chemicals to cause specific changes in DNA-has been used in cancer research)
- **Insertion of a gene from a different organism** (usually using a bacterium or virus as a carrier) Example: Round-up Ready soybeans
- **Silencing** or “turning off” a gene that creates a less desirable trait (i.e. high oleic soybean oil)

How long have we been doing this?

Timeline Activity

- You have a card that has an event or person on it, or one that has the date and a description.
- Find your match-if you have the date and description, find the person or event...
- Line up in order of the event dates, oldest to newest.
- Read off your event and description.

Case Study

- Soybean aphids are an invasive species that can impact yield.
- It is estimated that the combined loss of yield and cost of fighting soybean aphids is **\$2-\$5 billion each year.**
- Soybeans have some natural resistance to these pests, but farmers want to improve the chances that their beans will be protected.
- Breeders (seed companies) work to create “stacked” genes that will help to protect the yield using selective breeding.
- The genes that determine resistance are *Rag* genes.
We will use two forms: *Rag* 1 and *Rag* 2.

Selective Breeding Activity

- You have three Starburst candies. These candies represent the traits that determine resistance to soybean aphids.
- Stack your three starburst and determine your trait combinations using the following table...
- Red is *Rag 1*
- Orange is *Rag 2*
- Yellow is no resistance

Table of traits for soybean aphid resistance

R	R	R	R	R	R	O	O	O	Y
R	R	Y	R	O	O	O	Y	O	Y
R	Y	Y	O	O	Y	Y	Y	O	Y
<i>Rag1</i>	<i>Rag1</i>	<i>Rag1</i>	<i>Rag1&2</i>	<i>Rag1&2</i>	<i>Rag1&2</i>	<i>Rag2</i>	<i>Rag2</i>	<i>Rag2</i>	None

Find another person at your table and combine your starbursts.

Offspring results

- Place your six traits in the cup
- Shake the cup
- Draw out three Starbursts (traits)
- This represents the offspring from your cross



Table of traits for soybean aphid resistance

R	R	R	R	R	R	O	O	O	Y
R	R	Y	R	O	O	O	Y	O	Y
R	Y	Y	O	O	Y	Y	Y	O	Y
<i>Rag1</i>	<i>Rag1</i>	<i>Rag1</i>	<i>Rag1&2</i>	<i>Rag1&2</i>	<i>Rag1&2</i>	<i>Rag2</i>	<i>Rag2</i>	<i>Rag2</i>	None

Rag1 and *Rag2* together are most resistant. *Rag1* and *Rag2* are dominant to plants with no resistance, so if your stack has either *Rag*, the offspring will have resistance.

Create a new cross that has the maximum resistance to soybean aphids.



Using your offspring, find another offspring who will increase your plant's resistance to aphids.
No shaking necessary!

Reflection

- How did the offspring from your cross differ from the “parents”?
- What traits do your offspring have?
- The first process we used is random and the offspring are not predictable. However, scientists can select for traits they desire and there are predictable results, but the ratios of offspring do not always produce 100% what we want each time. The second time, we were more selective...selective breeding!
- These traits (soybean aphid resistance) are controlled by many genes on different areas of several chromosomes.
- Seed researchers can selectively breed for resistance.

What is the advantage of advanced biotechniques (such as selective breeding or genetic engineering)?

- What did you discover?
- What is the advantage of advanced biotechniques (such as selective breeding or genetic engineering)?
- Why does it matter?

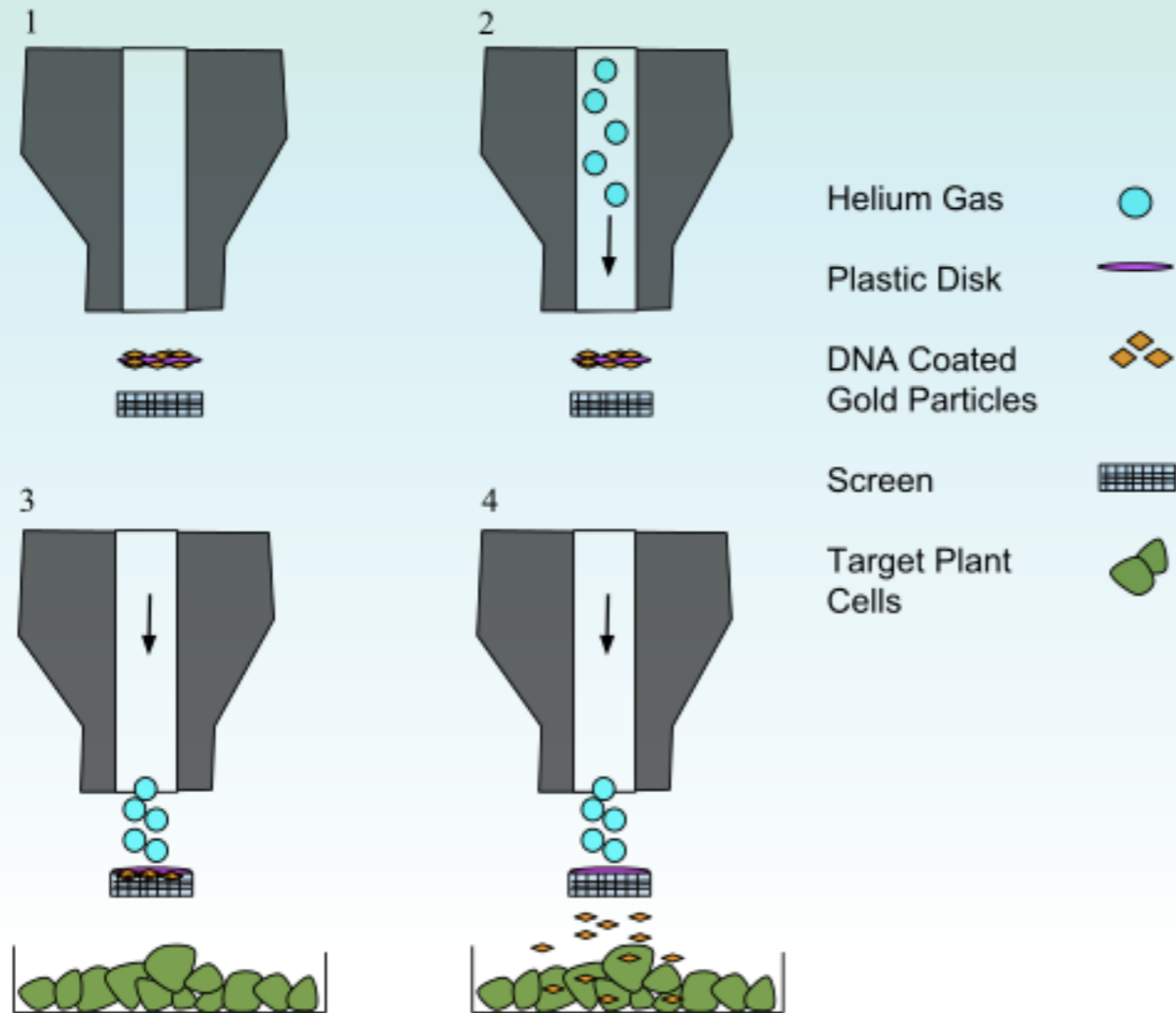
There are estimated to be over 9 billion people by 2050.

They all need a safe and steady food supply. GMOs can help meet that need.

Another example

- RoundUp Ready beans
- These beans are herbicide resistant, so RoundUp (glyphosate) can be sprayed on the field and the soybeans are not affected.
- Nearly 90% of soybeans grown in the United States carry the gene for resistance to glyphosate.

Gene Gun and Gene Insertion



The gene for glyphosate resistance was discovered in a bacterium in a pond.

The gene was isolated then transferred into the soybean plant via a “gene gun.”

Which crops are GMO? (Only 10!)

- Corn (field and sweet)
- Alfalfa
- Canola
- Cotton
- Soybeans—herbicide resistant and high oleic oil
- Sugar beets
- Papayas
- Potatoes
- Summer squash (some)
- Apples (approved, but coming in 3–4 years)

What's happening now?

- We are using both traditional methods of breeding and other techniques (gene insertion, gene silencing) to boost yield in both corn and soybeans.
- As a leader in agriculture, you can make a difference!
- Learn more about GMOs: visit **GMOanswers.com**
- Learn more about careers in agriculture: visit **grownextgen.org/careers**

