

Genetically Modified Organisms

Vocabulary



Deoxyribonucleic acid (DNA) - the long, double-stranded helical molecule that contains an organism's genes. The "blueprint" or "recipe" for an organism.



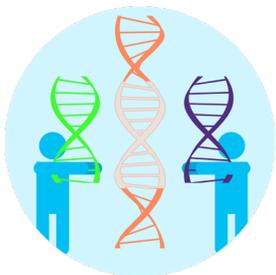
Gene - a section of DNA that codes for a specific product. Genes (and environmental factors) determine traits exhibited by an organism.



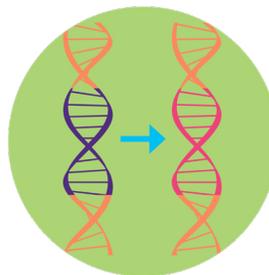
Genetically Modified Organism (GMO) - an organism whose DNA has been changed in some way. Includes alteration by genetic engineering and non-genetic engineering methods. Frequently occur in nature.



Transgenic Organism - an organism that has had genes from another species, or synthetic genes, introduced into its DNA by genetic engineering. Sometimes found in nature, most created in laboratories.



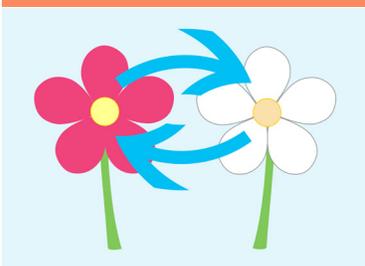
Genetic Engineering - the introduction or change of DNA, RNA, or proteins by human manipulation.



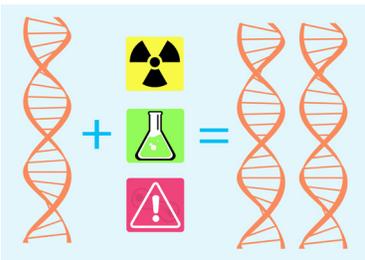
Mutation - a spontaneous or induced change in an organism's DNA. Plant "sports", like blood oranges, are common examples of mutation.

Methods Used in Plant Breeding

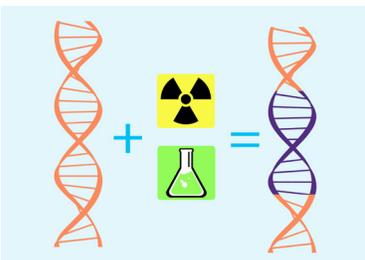
Conventional Breeding



Cross Pollination
The natural or artificial transfer of pollen from one sexually compatible partner to another. The oldest technique used in plant breeding.

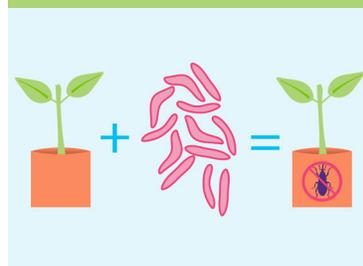


Chromosome Doubling
Inhibiting proper cell division to produce cells with twice the amount of DNA. Can be induced by radiation, chemical treatment, or natural errors in cell division.

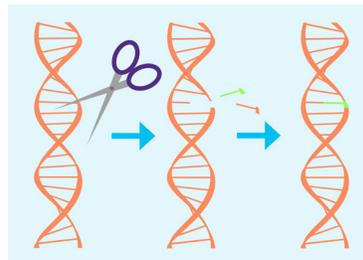


Mutation Breeding
The process of exposing seeds or cuttings to potential mutagens (radiation or chemicals) in order to generate random mutations that may lead to new traits.

Genetic Engineering



Agrobacterium-mediated Transformation
The use of the naturally occurring, soil-dwelling bacterium *Agrobacterium tumefaciens* to transfer genes into a target plant.



Gene Editing
The use of sequence-specific enzymes to alter targeted, non-random sites in the DNA. Allows for precision genetic engineering.



Particle Bombardment
"Gene gun" method. Shooting microscopic, DNA-covered particles into cells in order to introduce new genes.

Conventional Plant Breeding vs. Genetic Engineering

Conventional plant breeding includes techniques such as cross pollination, chromosome doubling, and mutation breeding. Selecting the best plants to serve as parent lines and DNA marker assisted selection (MAS) are also considered to be components of conventional breeding.

Conventionally bred plants **can be considered genetically modified**, however, they cannot be considered transgenic because conventional breeding involves sexually compatible partners rather than a transfer of DNA from two sexually-incompatible organisms.

Genetic engineering involves the insertion, deletion, or change of DNA, RNA, or proteins through human manipulation by means other than cross pollination. This includes *Agrobacterium*-mediated transformation and gene guns. Genetic engineering is used to create **both non-transgenic and transgenic** organisms. Sexual reproduction between two organisms is not necessary in genetic engineering, allowing for the movement of genes across typical barriers.

The term "GMO" is often used erroneously as a synonym for "transgenic"

"GMO" simply means a change (a modification) has occurred in the DNA, but the term doesn't describe the change in detail. Alternatively, "transgenic" *specifically* means that DNA from a sexually incompatible organism was introduced.

Not all GMOs are transgenic, but all transgenic organisms are GMOs

Facts

- Scientists began genetically engineering plants in the 1980s
- The first genetically engineered (GE) crop to be commercialized was the 'FLAVR SAVR' tomato in 1994
- In 2015, over 70 million hectares (about 173 million acres) of GE crops were grown in the United States
- Currently, the most commonly grown GE crops are cotton, maize (corn), and soybean
- Insect resistance and herbicide tolerance are the two primary traits available in commercial GE crops
- In 2016, The National Academies of Sciences, Engineering, and Medicine found no persuasive evidence of adverse health effects directly relatable to consuming GE food

GMO Labeling

The National Bioengineered Food Disclosure Standard

(S. 764), created in 2016, is an amendment to the National Sea Grant College Program Act

- Defines Bioengineered (BE) foods as "those that contain detectable genetic material that has been modified through certain lab techniques and cannot be created through conventional breeding or found in nature"
- No label required for very small food manufactures or food served in restaurants
- Foods that do not legally require a disclosure label will not be considered "non-GMO" solely because the label isn't required
- Certification under the **National Organic Program** will be sufficient to claim an absence of bioengineered food
- Bioengineered food **will not be treated safer than or not as safe as** non-bioengineered food
- Meat products from animals fed bioengineered feed will **not** be considered bioengineered
- www.ams.usda.gov/rules-regulations/be



References

clemson.edu/centers-institutes/itg/departments/apt/currentresearchbios/gmoreferences.html



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