

# GENE EDITING FAQ



## What is gene editing?

Gene editing is the general term for methods that enable scientists to make accurate modifications to the genetic code of many organisms. These methods include Zinc-Finger nucleases, TALENs, and CRISPR/Cas.



## What is CRISPR?

CRISPR stands for clustered regularly interspaced short palindromic repeats. This acronym is used to describe the CRISPR/Cas system that allows researchers to make gene edits. This technology is comprised of a Cas protein and a guide RNA. The RNA helps direct the Cas protein to a particular region of the genome. The Cas protein will then make a cut to the DNA. After the DNA is cut, cells will initiate a repair process that can introduce modifications to the DNA.



## What other names are used to describe gene editing?

Gene editing is also sometimes referred to as genome editing, CRISPR, and GE and included in the broader terms of genetic engineering and biotechnology.



## What is the difference between gene editing and GMOs?

GMO stands for genetically modified organisms. This term is usually applied to describe an organism that contains arrangements of genetic material that aren't typically present. This newly inserted DNA can be derived from a different, sexually incompatible organism or a sexually compatible organism. Sometimes researchers even create GMOs with DNA derived from the very same organism, just in new arrangements. Though the term is most often used to describe plants, GMO bacteria, fungi, and other organisms exist.

Gene editing allows researchers to make highly targeted changes to an organism's genetic code. Sometimes these modifications can result in changes that are beneficial for agriculture, the environment, or for understanding biology. Most gene edits do not introduce new genetic code, but rather make changes to existing DNA. Gene editing has recently been used as a tool to precisely insert genetic code of interest into specific locations in an organism's DNA. In this case, gene editing is used to generate GMOs.



## Why do scientists use gene editing in agriculture?

Gene editing is an advanced breeding tool that enables rapid and accurate modifications to the genomes of crop, livestock, and microbial organisms important in agriculture. Gene editing as a tool allows scientists to make tweaks to the already existing genetic code of an organism. Sometimes these changes have the capacity to make important improvements like increasing yields, enhancing drought tolerance, or reducing methane emissions. Gene editing allows researchers to meet emerging demands in agriculture, as do conventional methods like standard breeding.





## Are gene-edited foods safe to eat?

There is currently no evidence to suggest that any gene-edited food product is any less safe than un-edited foods.



## Can farmers replant the seeds from gene-edited crops?

Growers can save seeds from gene-edited crop varieties just as they save seeds from other crops. In the case of hybrid varieties, growers typically return to seed suppliers each year to purchase new seed to ensure that the traits remain true. If gene editing is eventually applied to hybrid crop varieties, farmers would likely want to purchase seed each year.



## Is gene editing a natural process?

Gene editing using CRISPR/Cas9 is a process that was originally derived from bacteria. Bacteria make use of these molecular scissors to protect themselves from invading viruses. Scientists learned how to use this bacterial machinery to guide the same molecular scissors from bacteria to the DNA of organisms they are interested in studying.



## Are gene-edited crops climate-smart?

Many emerging gene-edited crops are adapted for resiliency in a changing climate. From increased salt-tolerance to improved disease-resistance, gene editing is facilitating the rapid improvement of climate-smart crops.



## Are gene-edited plants patented?

Some gene-edited plants will be patented, but others will not. It depends on who is developing the plant and the intended beneficiaries of the crop.



## How can you tell if a plant or animal is gene-edited?

Gene-editing generates changes to DNA in specific, pre-selected regions. One could determine if an organism is gene-edited by screening the genetic code of a region that may have been edited. However, gene-edits are sometimes identical to changes that can occur naturally or through other processes. Therefore, it may sometimes be impossible to tell if a plant or animal has been gene-edited.



## Are gene-edited foods regulated?

Each country sets its own regulations for gene-edited foods. New regulatory schemes for gene-edited foods are constantly emerging. In all cases, some regulation exists before gene-edited foods reach consumers.





## Who makes gene-edited organisms?

Gene-edited organisms can be developed by scientists at universities, public-research centers, within industry, and at other institutions where there is capacity for molecular biology. An increasing number of research institutions are participating in the generation of gene-edited organisms on a global scale.



## Does gene editing affect the environment or biodiversity?

Gene-edited organisms have the capacity to affect the environment and biodiversity in positive, negative, or neutral ways. Gene editing is a method to produce a change in a precise location of an organism's genome. Ultimately, the effects of these changes on the environment will be determined by what genetic element was changed, rather than the process of gene-editing itself. There are many examples to date that show how gene editing has been leveraged to protect the environment and safeguard biodiversity. Gene editing can also offer unprecedented solutions for improving environmental stewardship.



## Can gene editing help promote global equity?

The efficacy of gene editing technology for addressing disparities is affected by how technology is distributed and made available to stakeholders. Beyond the technology itself, socio-political considerations of distribution and equal access must be thoroughly addressed for gene editing to serve as a means for equity. The relatively low regulatory costs associated with gene editing may make it possible for this technology to benefit farmers and consumers in ways that previous biotechnological approaches could not.



## Are gene-edited foods being sold to consumers?

Gene-edited foods are starting to make their way to market. Gene-edited vegetables, fish, grains, oils, and other products are either currently available or may soon become available at a store near you.



## Is gene editing used in medicine?

Gene editing, especially CRISPR-Cas9, is becoming an increasingly important therapeutic tool. For example, it has recently been used in clinical trials to cure sickle-cell anemia, a debilitating blood disorder, and Leber congenital amaurosis, a disease causing near blindness. It is anticipated that gene editing will continue to be used to treat diseases with a genetic basis.

