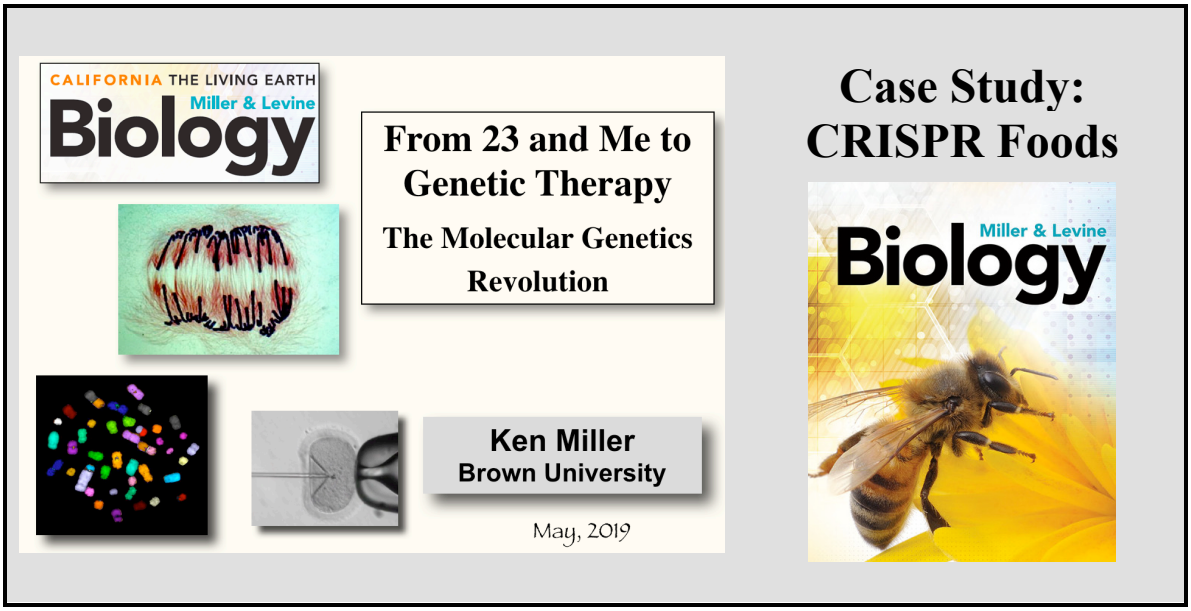
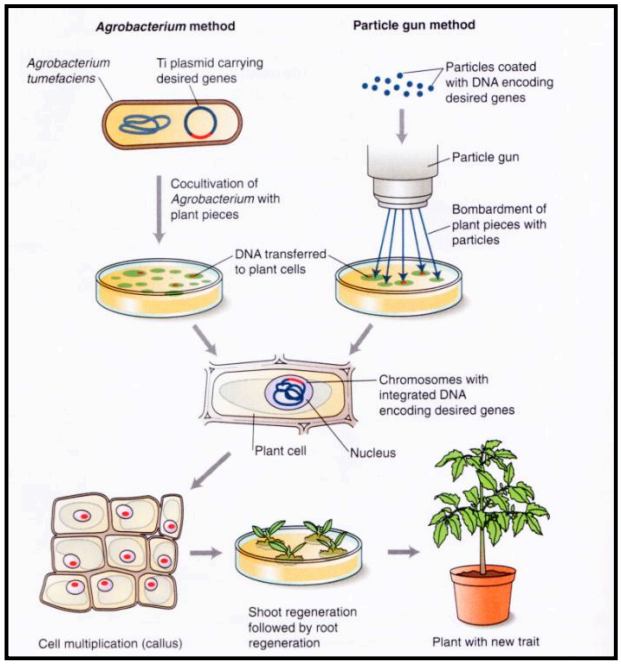


Conventional Plant Genetic Engineering



GMOs, as we have come to love (or hate) them are created by inserting a gene of choice into a single plant cell, and then regenerating a complete plant. The essence of the technique is the use of recombinant DNA inserted into the plant genome. Genetically-modified plants may display disease resistance, herbicide tolerance, or insect resistance as a result of the DNA that has been used to modify their genomes. As a result, the current legal definition of a GMO is one that has been modified by the addition of genetic material from another organism.

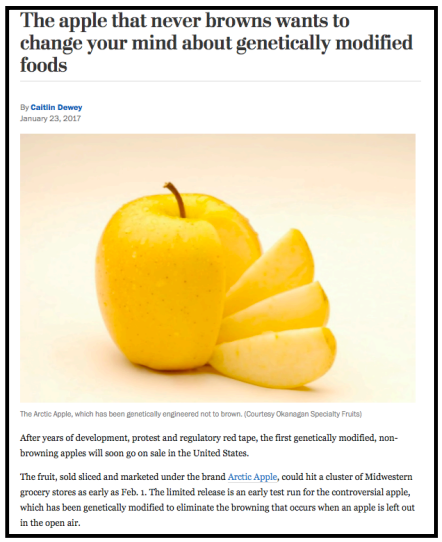
What's Different About CRISPR?

Because CRISPR is a gene-editing technique, it need not involve the insertion of foreign genes into the plant genome. In fact, once a CRISPR construct has carried out the modification or inactivation of a gene, it usually does not leave any trace of itself behind. GMOs, on the other hand, carry both the foreign gene and the

control sequences needed to ensure a high level of expression of that gene. This means that there is no straightforward way to determine whether a plant genome has been modified by CRISPR technology.

What Can Be Done with CRISPR?

The simplest way to employ CRISPR technique is to inactivate an existing gene by engineering a double-stranded break in the gene, and then allowing it to be repaired by the cell's own DNA repair mechanism. Because double-stranded breaks are repaired by the insert of random bases, this usually results in the inactivation of the gene in question. While it is also possible to insert defined DNA sequences by homologous recombination, to date most CRISPR-modified plants have involved the inactivation of certain plant enzymes.



The apple that never browns wants to change your mind about genetically modified foods

By Caitlin Dewey
January 23, 2017

The Arctic Apple, which has been genetically engineered not to brown. (Courtesy Okanagan Specialty Fruits)

After years of development, protest and regulatory red tape, the first genetically modified, non-browning apples will soon go on sale in the United States.

The fruit, sold sliced and marketed under the brand Arctic Apple, could hit a cluster of Midwestern grocery stores as early as Feb. 1. The limited release is an early test run for the controversial apple, which has been genetically modified to eliminate the browning that occurs when an apple is left out in the open air.

One product already on the market is the "Arctic® Apple," in which CRISPR has been used to reduce expression of a gene coding for polyphenol oxidase (PPO), an enzyme that causes browning when a sliced apple is exposed to air. These apples are both highly nutritious and resistant to browning.

A similar strategy has been used to produce a variety of mushrooms in which the PPO gene has been inactivated, making the mushrooms resistant to browning, increasing their shelf life and long term nutritional value. In genetic terms, unless one knew how these organisms had been produced, it would be nearly impossible to distinguish a CRISPR-modified plant from one that was the result of a naturally-occurring mutation.

Discussion: Should they be Regulated?

Because these organisms do not contain foreign DNA, they do not meet the current legal definition of GMOs. Should they?

• **Safety:** Can we be sure that foods from these gene-edited plants are safe?

• **Regulation:** What level of government regulation, if any, should be in place before such foods are made available to the public?

• **Information:** Do consumers have a right to know if their food contains CRISPR-modified organisms? If so, should they be labeled differently from conventional GMOs.