Biotechnology Information

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Frequently Asked Questions about Biotechnology

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What is biotechnology?

The term "biotechnology" was coined in 1917, and was defined as "using organisms or their products for commercial purposes." Using this definition, baking bread, making beer and wine, selectively breeding for desired traits in plants and animals, and using antibiotics and vaccines to fight disease are all examples of traditional forms of biotechnology.

Advances in scientific discovery and laboratory techniques during the last half of the twentieth century resulted in an updated definition that reflects the ability to modify the deoxyribonucleic acid (DNA) in organisms to produce new products and technologies for human use. These advanced techniques have surpassed traditional biotechnology methods and have brought about countless new opportunities in medicine, agriculture, and industry.

What products have been generated using biotechnology?

- Biotechnology, combined with advances in scientific understanding, has yielded new medicines for certain human diseases and health conditions such as cancer, heart disease, stroke, diabetes, arthritis, obesity, and AIDS.
- Improved pharmaceuticals and vaccines for both people and animals are being produced using modern biotechnology.
- Agricultural products produced through biotechnology include: insect and herbicide resistant crops; plants that are able to withstand environmental stresses such as heat, cold, drought, and high salt concentration; and fruits and vegetables with delayed ripening characteristics and enhanced nutritional properties.
- Enzymes produced by biotechnology are currently used in many diverse applications including: detergents, textile manufacturing, paper production, leather processing, food processing, and in contact lens and denture cleaning solutions.

What is genetic engineering / genetic modification (GM)?

This is the process of transferring a gene (a piece of DNA) from one organism to another. The result is commonly described as a "genetically modified organism" (GMO).

What is a "transgenic" organism?

A transgenic organism has been genetically modified to contain DNA from another source.

Does biotechnology put DNA in our food? Is that safe?

DNA is present in all living things. So, humans eat DNA every day! The carrots, potatoes, fish and chicken on the dinner table contain miles of DNA. Consequently, food products that contain new pieces of DNA are not inherently dangerous.

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What United States government agencies regulate biotechnology and its products?

The Food and Drug Administration, the Environmental Protection Agency, and the Department of Agriculture provide regulatory oversight to biotechnology research, product development, and approval.

What are genetically modified foods tested for?

Just like traditional foods, genetically modified foods must be safe for human consumption. Extensive testing is done to ensure that any new proteins in the food are non-toxic and non-allergenic to people. There have been no confirmed adverse health effects from products derived from agricultural biotechnology.

Why aren't products of biotechnology labeled?

Because the regulation of biotechnology products in the United States is based on the end product and not on the method used to create it, genetically modified foods must be labeled only if they differ "significantly" from their conventional counterpart. A "significant" change includes any alteration in the nutritional content or the introduction of a potential allergen. FDA does encourage voluntary labeling of biotechnology-derived products.

Why is it hard to keep genetically modified (GM) crops separate from non-GM crops throughout the manufacturing process? Does this make it hard to keep crops that are approved only for animal use out of the human food supply?

A prerequisite to mandatory labeling of GM foods is the system for "identity preservation" that would be needed to ensure that GM products are kept separate from non-GM products. Segregating crops at every step during growth, storage, transportation, processing, and exporting would be very difficult and costly to implement.

Dr. Susan Harlander, a former vice president of Pillsbury Co., illustrated the situation with the following example: a medium-sized food company can have more than 6,000 products that contain 8,000 ingredients from 1,000 suppliers that move through 30 processing plants on their way to being exported to as many as 100 countries.

Implementing a system to track all of these ingredients from the farm to their final destination would cost billions of dollars and even then it may not be infallible.

The difficulties in keeping crops segregated was highlighted in 2000 when a type of GM corn (StarLink®) that had only been approved for use in animal feeds was found in products of the human food supply. It was subsequently determined that there were no adverse health events related to this incident; however, the EPA discontinued its policy of granting so-called "split approval" for GM crops. Therefore, all GM crops must now be approved for both animal and human consumption.

What is Bt corn? Is it harmful to monarch butterflies?

"Bt" is used as an abbreviation for the bacterium *Bacillus thuringiensis*. Farmers have been using commercial Bt bacteria sprays on their crops for decades as an alternative to chemical insecticides. The bacterium produces a protein that is toxic to certain crop damaging insects, but is harmless to humans. To produce Bt corn, scientists identified the piece of DNA that directs production of the insecticidal protein and transferred it into corn plants. This allowed the corn to produce its own insecticide.

In 1999, a group of scientists reported that the Bt protein was toxic to monarch caterpillars in a contained, laboratory setting after it had already been approved for commercial use. In the wake of the report, the United States Department of Agriculture organized a large investigation, funded by both government and industry, to address the effects of Bt corn on the monarch butterfly. The conclusion from that study was that Bt corn posed a "negligible" risk to monarch caterpillars under field conditions. However, most scientists agree that continued monitoring of these plants is prudent to determine their long-term environmental effects.

Can pests become resistant to Bt crops?

Insect resistance to traditional chemical insecticides and Bt sprays is well documented, so there is potential for resistance to Bt crops to develop as well.

To ensure that the Bt crops and traditional Bt sprays will continue to be effective, EPA has requested that companies who market insecticide-producing crops develop and promote scientifically founded strategies to manage insect resistance. These plans call for the use of Bt crops to be combined with refuge plots of non-Bt plants. Refuge plots are to constitute 20% of the total acreage planted and serve as an area where susceptible insects can live. This increases the likelihood that susceptible and resistant insects would mate, thereby keeping the population of resistant insects to a minimum.

What are Roundup Ready® crops?

These crops are tolerant to the popular herbicide, Roundup®. Herbicide tolerant (HT) crops are the most frequently used types of genetically modified plants and make it easier for farmers to manage weeds and also facilitate the practice of "no-till" agriculture. Glyphosate (e.g. Roundup®) and glufosinate (e.g. Liberty®) are the two most common herbicides to which plants have been made tolerant. One of the concerns with the use of HT crops is the potential for the unintentional development of herbicide-resistant weeds.

What effects do genetically modified (GM) products have on the environment?

It is hoped that GM products, and GM plants in particular, will have a positive impact on the environment by reducing agricultural chemical use and by promoting good agricultural practices such as no-till agriculture.

The realization of this goal is still being determined, but in 2001 the American Soybean Association conducted a Conservation Tillage Study. Results showed that 73% of soybean growers were leaving more crop residue on the soil surface than they did in 1996, meaning that there was an increase in no-till agriculture. More than half of the 452 growers surveyed attributed this increase to the use of herbicide-tolerant soybeans, a type of GM soybean.

Alternatively, there are concerns that these crops could adversely impact the environment through: 1) transfer of the GM traits to other plants; 2) harm to non-target species; or 3) increased resistance to commonly used insecticides and herbicides. Some of these problems are also encountered when using traditional agricultural practices and can be addressed by thorough pre-approval testing and implementation of sound management practices.

Can biotechnology help fight hunger that is associated with the growing world population?

The most recent figures show the world population to be 6.1 billion; twice what it was in 1960. It is estimated that the world population will be 9.3 billion by 2050, with the 49 least-developed countries nearly tripling in size. Currently, 1.1 billion people do not have access to clean water, 800 million people are chronically malnourished, and 2 billion people lack physical and economic access to sufficient food to meet their dietary needs. World hunger is a complex social and economic issue that cannot be solved by simply producing more food. However, it is clear that in the future more food will be needed and it will have to be produced using the same or even less farm acreage if the world's forests and wetlands are to be preserved.

Agricultural biotechnology may help meet the world's food and nutritional needs through the development of crops that are: higher yielding, enhanced to supply essential nutrients, resistant to pests and diseases, and able to grow on land that is currently deemed marginal to unusable.