

For more information on biotechnology issues, see the other publications in this Explore the Genetic Frontier series :

“Biotechnology and Cotton—Texas’ Biggest Crop”

“Developing Crops Resistant to Glyphosate Herbicide”

“Labeling of Foods Derived from Biotechnology”

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American Dietetic Association:

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Student research team at Texas A&M University under the supervision of Andy Vestal (979-458-3406, t-vestal@tamu.edu):

Steve Boecker • Carole Hawkins
Jaime Edelman • Thomas Hinnant
Timm Gergini • Kelli O’Neill

Scientific critique for this publication was provided by :

Carolyn Bednar, Ph.D.

—Texas Woman’s University

Fuller Bazer, Ph.D.

—Texas A&M University

Philip Lyons, Ph.D.

—University of Houston-Downtown

Sharon Robinson, Ph.D.

—Texas Cooperative Extension,
The Texas A&M University System

Akif Uzman, Ph.D.

—University of Houston-Downtown

Andy Vestal, Ph.D.

—Texas Cooperative Extension,
The Texas A&M University System

Ron Yasbin, Ph.D.

—University of Texas at Dallas

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The publications in this series describe processes and products developed through rigorous scientific research and testing. Informed citizens are knowledgeable consumers and decision makers.

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 **EXPLORE**
the genetic frontier

**What is
Biotechnology?**

B iotechnology uses scientific processes to enhance or create products to benefit people. These processes include fermentation, selection and breeding, cloning, tissue



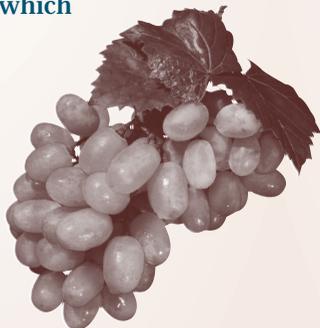
culture, genetic engineering, and DNA diagnostics (for example, studying chromosomes to diagnose diseases and find allergens or toxins in foods). Although biotechnology has existed since ancient times, some of the most dramatic developments have occurred in recent years.

Over the years, traditional breeding and selection techniques have resulted in plants and animals that are more productive and more useful to humans. Biotechnology is a tool for modifying the DNA of organisms so that they will produce safe and high quality foods, medicines, and other products. Biotechnology also may help farmers produce larger quantities of food for the world's growing population.

The origins of biotech

Humans have always altered their environment. Centuries ago, people used simple techniques that became the basis of biotechnology as we know it today. For example, microorganisms such as bacteria and yeasts have been used in the age-old arts of fermenting cheese and leavening bread, which are forms of biotechnology.

Another early form of biotechnology was the breeding of "hybrids." Farmers crossed separate strains of plants or animals to produce offspring with the best traits from the



parent strains. Farmers manipulated genes by breeding their finest animals, crosspollinating plants, and saving their best seeds to plant for the next year's crop. In 1917, the term "biotechnology" was given to those techniques.

Such selective breeding took years of trial-and-error experimentation. The outcome was uncertain because unwanted genes often were inherited along with the desired genes. Plant breeders might spend a 30- to 40-year career trying to reproduce one specific trait such as essential amino acid content in a plant. Today, with new biotechnology techniques, they can accomplish this in 3 to 5 years.

Biotech today

Although the basic idea of creating a superior plant or animal for production has not changed, the tools and techniques of biotechnology have evolved. At one time, scientists and growers produced changes in plant or animal DNA over several generations of organisms using natural reproduction. Today, however, scientists can do this in a controlled setting.



For example, in 1973, scientists learned how to identify and isolate a superior genetic trait in the DNA of a plant or animal, then introduce that trait into the genetic matter of another organism. This is known as "recombinant DNA" (rDNA). Through the use of rDNA, scientists and plant breeders can predict the outcome of a single gene replacement and produce a plant or animal with a specific trait.

What are the benefits of biotechnology?

Biotechnology is already helping people by:

- **Combating human diseases.** The field of medicine uses some of the most dramatic forms of biotechnology. In 1982, the pharma-

ceutical industry began to market recombinant insulin for diabetics. Scientists can now produce blood clot-dissolving enzymes for heart attack victims easily and cheaply.



- **Improving human nutrition.** Researchers are creating ways to boost the nutritional value of foods, such as lowering the fat content in cooking oil and enhancing the nutritional content of foods, to make foods safer to eat.

- **Combating animal diseases.** Biotechnology helped produce a vaccine to protect animals against rabies and a vaccine for upper respiratory diseases, the leading cause of death in young beef cattle.

- **Growing disease-resistant plants.** These plants enable farmers to produce more food on existing agricultural acreage. By using less land for agriculture, farmers can leave natural areas undisturbed and preserve wildlife habitat.

- **Helping the environment by reducing pesticide use.** Biotechnology allows farmers to reduce their reliance on insecticides, fungicides and herbicides. New herbicide-resistant plants enable farmers to replace traditional herbicides with environmentally friendly herbicides.

What are the concerns?

Some people are concerned about the safety or ethics of using some biotechnology practices. The National Institute of Health, the U.S. Department of Agriculture, the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) are responsible for



addressing food safety and environmental concerns. These agencies require each new product that is produced by biotechnology to clear a 10-step safety process, over a 7- to 8-year period, before being marketed. Some concerns remain, however, such as:

- **Product labeling.** The FDA requires labels on all new foods if the nutritional content is not substantially equivalent to like foods already available to consumers. Labels are also required if the new food is derived using genes from common allergens, such as peanuts or wheat.

- **Food safety.** For example, a new product might include allergens, substances that cause some people to suffer allergic reactions.

- **Long-term effects on the environment.** Some people believe that products created through biotechnology, though beneficial in some ways, may be harmful in other ways. For example, weeds that are resistant to chemicals ("super weeds") may overtake beneficial crops. Or, disease and insect organisms sometimes build resistance to substances such as insecticides.

- **Ethical implications** (for example, cloning). Some people object to any procedure that changes the genetic makeup of a living organism.

- **Food prices.** If biotechnology were to affect food production costs or cause trade restrictions on the international market of products derived from biotechnology, the farmer or consumer may experience price increases. Researchers and regulatory agencies are addressing these concerns.