

Biotechnology and Daily Life

7.05



Getting the Idea

Key Words.....

microbiologist
biotechnology
killer T-cells

A **microbiologist** studies microbes. A microbiologist may work as a research scientist who studies microbes in a laboratory. Microbiologists also work in the food industry to ensure that the proper procedures and sanitary conditions are in place to prevent contamination. Many microbiologists also work in technological fields. In these fields, microbiologists look for ways that microbes can be used to benefit medicine, agriculture, and other industries.

Biotechnology and Medicine

Biotechnology is the use of living organisms, or parts of organisms, to produce products used by people. Some products resulting from biotechnology include medications and foods.

Bacteria multiply very rapidly. Scientists have found ways to use this rapid reproduction ability to produce drugs that treat various diseases. The first step in using bacteria to produce drugs is to identify and isolate the gene that controls the production of a particular protein. Once isolated, the gene is then inserted into the single chromosome of a bacterial cell. This chromosome and its corresponding gene is duplicated when the bacterial cell divides. Because bacteria produce so many cells in a short time, many copies of the inserted gene are made. The protein made by the inserted gene is then removed from the bacterium and purified for use in other organisms.

Bacteria have been used to make several substances that are used to treat diseases in humans. For example, bacteria help to make human insulin that is used in the treatment of diabetes. Bacteria also help make a hormone that is used to stimulate growth and substances that are used in the treatment of high blood pressure, strokes, and kidney failure.

Drug companies have also developed ways to use bacteria to make products that can treat diseases caused by viruses. An example is the drug interferon. Interferon is used to treat viral diseases such as life-threatening cases of influenza. Interferon works by stimulating body cells to secrete substances that prevent the production of new viruses in infected cells.

Biotechnology and Vaccine Production

Like bacteria, viruses also can be used to make substances used in medicine. For example, viruses have been manipulated to get them to make vaccines known as piggyback vaccines. A piggyback vaccine is made by using a harmless virus to carry a specific gene from another source.

Scientists have modified the smallpox virus to allow it to be used as a vector for the gene that makes the capsid of a herpes virus. The modified smallpox virus with the herpes capsid gene is injected into cells that are growing in laboratory cultures. In the lab, the virus quickly makes large numbers of smallpox viruses that are enclosed within capsids of the herpes virus. These viruses are then collected and injected into animals such as mice and rabbits. This causes these animals to produce antibodies against the herpes virus. The antibodies might then be used to develop a herpes vaccine for use in humans.

Scientists hope that biotechnology can be used to develop piggyback vaccines for many human diseases. In late 2005, a pharmaceutical company announced plans to develop a piggyback vaccine to prevent HIV. This vaccine would use the measles virus as a vector. However, the vaccine will not be ready for testing for several years.

Scientists are also testing another type of vaccine, known as a DNA vaccine. A DNA vaccine does not promote the production of antibodies. DNA vaccines are designed to stimulate the production of a type of white blood cell known as killer T-cells. **Killer-T cells** are white blood cells that attack and destroy invading microbes. The first DNA vaccine was developed by inserting a gene from the influenza virus into bacteria. The bacteria were then injected into mice, which produced T-cells against the influenza virus.

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Test Tips . . . 

If your teacher approves, write relevant information such as formulas and facts on a reference sheet to use during the test.

Biotechnology in Agriculture

Biotechnology is also used in agriculture. Scientists are seeking ways to alter crops to make them resistant to disease, herbicides, and frost. In addition, food crops are manipulated so that they taste better and are more nutritious. The most successful results have been obtained using a bacterium that infects broadleaf plants such as soybean, tobacco, and tomato.

To reach market before they rot, most tomatoes must be picked before they ripen on the vine. The tomatoes then continue to ripen as they are processed and shipped to market. However, tomatoes that ripen off the vine are less flavorful than those that ripen on the vine. Using biotechnology, scientists developed a type of tomato that can remain on its vine longer to ripen without rotting before it can be sent to market. In 1994, the USDA approved the sale of these "Flavr Savr" tomatoes.

Biotechnology in North Carolina

North Carolina has a number of biotechnology firms. Biotechnology firms in North Carolina include the state-funded North Carolina Biotechnology Center in Research Triangle Park. Biotechnology firms provide many economic benefits to the state by generating jobs and conducting research that enables farmers to improve their crop yields.

Ethics and Biotechnology

The use of biotechnology presents ethical issues that the scientific community and society must face. For example, concerns have been expressed about the safety of genetically manipulated food crops.

Another ethical issue raised by biotechnology concerns whether it is appropriate to alter the genetic material of living things to produce substances for human use. Because the use of biotechnology has saved many human lives, there are no easy answers to these questions. Scientists and society must decide which forms of biotechnology are appropriate and which forms are not appropriate.

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