

# Understanding Genetically Modified Organisms (GMOs)

## The Internet Exercise

In this exercise students will learn about the uses of the genetically modified organisms, their availability on the market, and will get familiar with some common issues related to the uses of these products. There are two commonly used terms for transgenic plants produced using genetic engineering: **genetically modified organism (GMO)** or **genetically engineered organism (GEO)**.

### Objectives:

Students will research the following information about GMOs:

- traits that have been bioengineered into plants
- genetically modified foods available in the market
- uses of genetically modified foods
- benefits and risks of genetically modified foods

---

### - Students Section -

---

### Introduction:

The use of GMOs in our every day life has resulted in heated public debates, scientific discussions and media coverage in the last few years. A variety of public concerns come with the new changes in plant breeding based on genetic manipulations. It is important to educate people about GMOs with the goal of improving their scientific knowledge and understanding of the advantages and potential risks of genetic engineering.

### Exercise:

For this exercise you will need access to a computer with an Internet connection, a paper and a pen to write down the answers and information required in each section. Start with exercise no.1 and follow the directions. Submit the completed exercise to your teacher.

#### 1) Terminology

**Task 1.:** Go to the Biotechnology Life Science web site <http://biotech.icmb.utexas.edu/search/dict-search.html> and find the following terms in the **Biotechnology Life Science dictionary**. Write down the definitions of each word.

Allergy	Genetic manipulation
Antibiotic	Inbreeding
Antibiotic resistance	Insulin
Antibody	Recombinant DNA
Biotechnology	Resistance
DNA (deoxyribonucleic acid)	Polygenetic trait
Enzyme	Transgenic
Gene	Transgenic plant
Gene insertion	Vaccine
Genetic engineering	

## TRANSGENIC PLANTS IN AGRICULTURE

### 2) What traits have been bioengineered into plants?

Most plants we eat today have been changed through plant breeding and bear little resemblance to their wild ancestors. Plant breeders have introduced many useful traits to crop plants, such as disease resistance, increased yield and improved nutrition to provide safe and nutritious food (that would not be safe or nutritious enough to be consumed in its wild form).

Genetic engineering uses new methods of plant breeding that allow scientists to improve plants by introducing a copy of a gene for a specific trait (or a characteristic). The gene can be copied from any organism (microbe, plant or animal). This provides an opportunity to introduce any useful trait into plants.

For example, those of you that have to eat “those Brussel sprouts every Thanksgiving”, and do not like them might wish to change their flavour to something that tastes good. Everybody likes chocolate! Would you like to be able to buy Brussels sprouts that taste like chocolate? To do this you would need to introduce **a new trait** (the chocolate flavour) into Brussel sprouts.



First, you would have to isolate **a gene in the cacao bean**, which codes for the delicious chocolate flavour. The cacao bean grows inside large pods (see picture) that sprout from the trunk of a large cacao tree. Each pod contains between 20 to 60 cacao beans. The trees grow in regions close to the equator where it is warm all year round.

Next, you could transfer the isolated gene into a Brussel sprout plant. This transfer of genes (DNA pieces) between unrelated organisms is known as **recombinant DNA technology**. There are many ways to insert a piece of DNA from one organism into the cells of another organism.

**Task 1.:** Go to the web site of Genetically Engineered Organism-Public Issues Education Project (GIE-PIE)  
<http://www.comm.cornell.edu/gmo/traits/traits.html>. Find the information about transgenic plants listed below and answer the following questions for each of the plants.

**Transgenic plants:**

- 1) tomatoes that have a longer shelf life
- 2) canola that is healthier for human consumptions
- 3) papaya that does not get infected by “bad bugs”

**Questions:**

- 1) What useful trait was introduced into the plant using genetic engineering?
- 2) What gene source did scientists use to introduce this trait into the plant?

**3) What genetically modified foods are available in the market?**

There are many GM foods that have never reached a market and you cannot buy them in the store. Some have been taken away from the market for various reasons.

**Task 1.:** Go to the web page

<http://www.comm.cornell.edu/gmo/crops/eating.html>. On this page, find articles: “The big players”, “The little guys”, “All other plants and animals”, “GE bacteria and fungi and yeast”. Read them carefully. Based on the information in these articles, write down as many food products as you can think about that might contain GMOs. Think about fruit, vegetables, processed food, food ingredients, etc. Be creative!

**Task 2.:** After you complete a list of potential products containing GMOs,



use your imagination and create a dinner menu that would contain only GM foods. Use the “Transgenic Café Dinner Menu” as a guideline (it can be downloaded from

<http://www.comm.cornell.edu/gmo/traits/traits.html> or ask your teacher for a handout.

**Task 3.:** Go back to the four articles you just read and find out how many items on your imaginary dinner menu you could actually buy in a store. Write down all the items that are available. Did you find only a small number of the items that are available on the market?

#### 4) Are bioengineered foods safe?

Have you heard that scientists can make plants that contain genes from a fish, a butterfly or a virus? What is the first thought that comes to your mind? Does this fact scare you or excite you? After completing this exercise you should be able to answer these questions rationally.

There are many people expressing concerns about bioengineered plants. Most of these concerns are results of a lack of knowledge about genetic engineering and GMOs, and awareness of the risks and benefits of genetic engineering. The knowledge of the risks and benefits involved with biotechnology as it applies to food will help people to make decisions as a consumer.

**Task 1.:** Follow the link “Risks & Benefits”

<http://www.comm.cornell.edu/gmo/issues/issues.html>. Read the information about the common issues associated with the use of GMOs. For this exercise, use two sheets of paper. On the first one, write down a list of issues that are discussed on the “Risks & Benefits” web page. On the second sheet of paper write down issues that concern you. Try to think about issues not mentioned on the web page. Separate the issues into two categories: 1) General issues concerning GM foods and 2) My personal concerns. Discuss in class.

**Task 2.:** In this part you will learn in more details about whether the GM foods could cause allergic reactions. Go to the link

<http://www.kluyver.stm.tudelft.nl/efb/TGPPB/pdf/fseng2.pdf>. The



European Federation of Biotechnology writes letters to provide the public with information and references from combined contributions of scientists, journalists, governmental, consumer and environmental organizations. Read the article carefully and answer the questions below.

Focus mainly on the sections that address the following questions: 1) What sorts of new allergens do we encounter? 2) Do transgenic crops have new allergens?

##### Questions:

- 1) In the article the author uses a kiwi fruit as an example of a food item that caused a development of an allergic reaction. Are the kiwi plants genetically modified? What was the cause of the allergenicity of kiwis?
- 2) Could GM foods cause allergic reactions? Explain why?
- 3) Are laboratory tests reliable means of testing GM products or other novel foods for potential allergenicity? What tests show that this is true?

**Task 3.:** Write down briefly your own opinion on whether GM foods can cause allergies. Do you agree or disagree?

## TRANGENIC PLANTS IN MEDICINE

Transgenic plants have been developed that hold the potential of producing important medicines and vaccines. Using transgenic plants to produce drugs is often much cheaper than other means.

### 5) Drug production

In 1982 biotechnologists produced human **insulin** from bacteria using genetic engineering. This was the first commercial use of genetic engineering. Insulin is a protein hormone that regulates blood sugar, and people with certain types of diabetes inject themselves daily with this genetically engineered product. Go to the web page <http://www.accessexcellence.org/AB/BA/aapost/firstcommerce.html> read the article and describe how did researchers make the insulin using genetic engineering technique.

### 6) Antibodies

One example is a human gene that was introduced into a plant causing it to produce **human antibodies** designed to stick to and kill tumor cells. In 1997 these antibodies entered clinical trails on cancer patients. Go to the Scientific

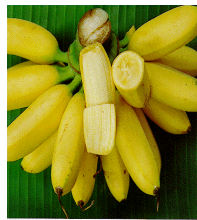


American journal web site

<http://www.sciam.com/1197issue/1197techbus1.html> and read the article. Answer the following questions:

- 1) What plant did they used to transfect with the human gene to heal cancer?
- 2) Is manufacturing of antibodies in plants a new technique? How do biotechnologists called the antibodies produced in transgenic plants?

### 7) Edible vaccines



Researchers have shown that several different vaccines can be produced in plants and that feeding such plant cells to humans can stimulate immune responses. These results show that scientists could potentially develop an edible vaccine. One of the plants used for production and delivery of edible vaccines are bananas. Vaccine-carrying bananas are being developed at the Boyce Thompson Institute for Plant Research at Cornell University, would be ideal for protecting people from hepatitis B virus, a liver disease that has infected more than two billion people worldwide. Read more at [http://www.the-scientist.com/yr1998/august/pg4\\_story2\\_980817.html](http://www.the-scientist.com/yr1998/august/pg4_story2_980817.html).

**Questions:**

- 1) What other plants did scientists use to research production of edible vaccines?
  - 2) Do you think that in the next century you will be able to have your medicine and eat it, and it will taste like a banana because it will be a banana? Write down your opinion.
-