

# Q & A on Biosafety & Genetically Modified Organisms (GMOs)







This material is produced through the National Biosafety Project (Implementation of the National Biosafety Framework in accordance with the Cartagena Protocol on Biosafety) implemented by the Ministry assigned the subject of environment with technical support from the Food and Agriculture Organization of the United Nations (FAO) and funding from the Global Environment Facility (GEF). The National Science Foundation, Sri Lanka, which is an implementing partner of the National Biosafety Project developed this material.







Hi Mr Doubt, Good morning to you too, Yes. I am very busy with a new project that is being implemented by the Ministry of Environment & Food and Agriculture Organization of the United Nations (FAO). The project is called "Implementation of the National Biosafety Framework (NBF) in accordance with the Cartagena Protocol on Biosafety" (known as National Biosafety Project).

This project is about strengthening regulatory, institutional & technological capacity of our country for implementation of the NBF in conformity with the Cartagena Protocol on Biosafety.

Hello Prof. Biosafety, Good Morning!  
How are you today?  
By the way I heard that you are busy with a new project, what is it about?





What is the Cartagena Protocol?

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement which aims to ensure the safe handling, transport and use of Living Modified Organisms (LMOs) or Genetically Modified Organisms (GMOs) resulting from modern biotechnology that may have adverse effects on biodiversity.

How is it relevant to Sri Lanka?

Sri Lanka has signed the Cartagena Protocol on 24th May 2000 and ratified it on 28 April 2004. The objective of this protocol is to ensure an adequate level of protection in handling, use and transfer of products of modern biotechnology commonly known as genetically modified organisms.

In order to fulfil the obligations under this protocol and to implement biosafety in the country we are working on the National Biosafety Project. A draft Act for Biosafety is being enacted and will come into effect very soon.





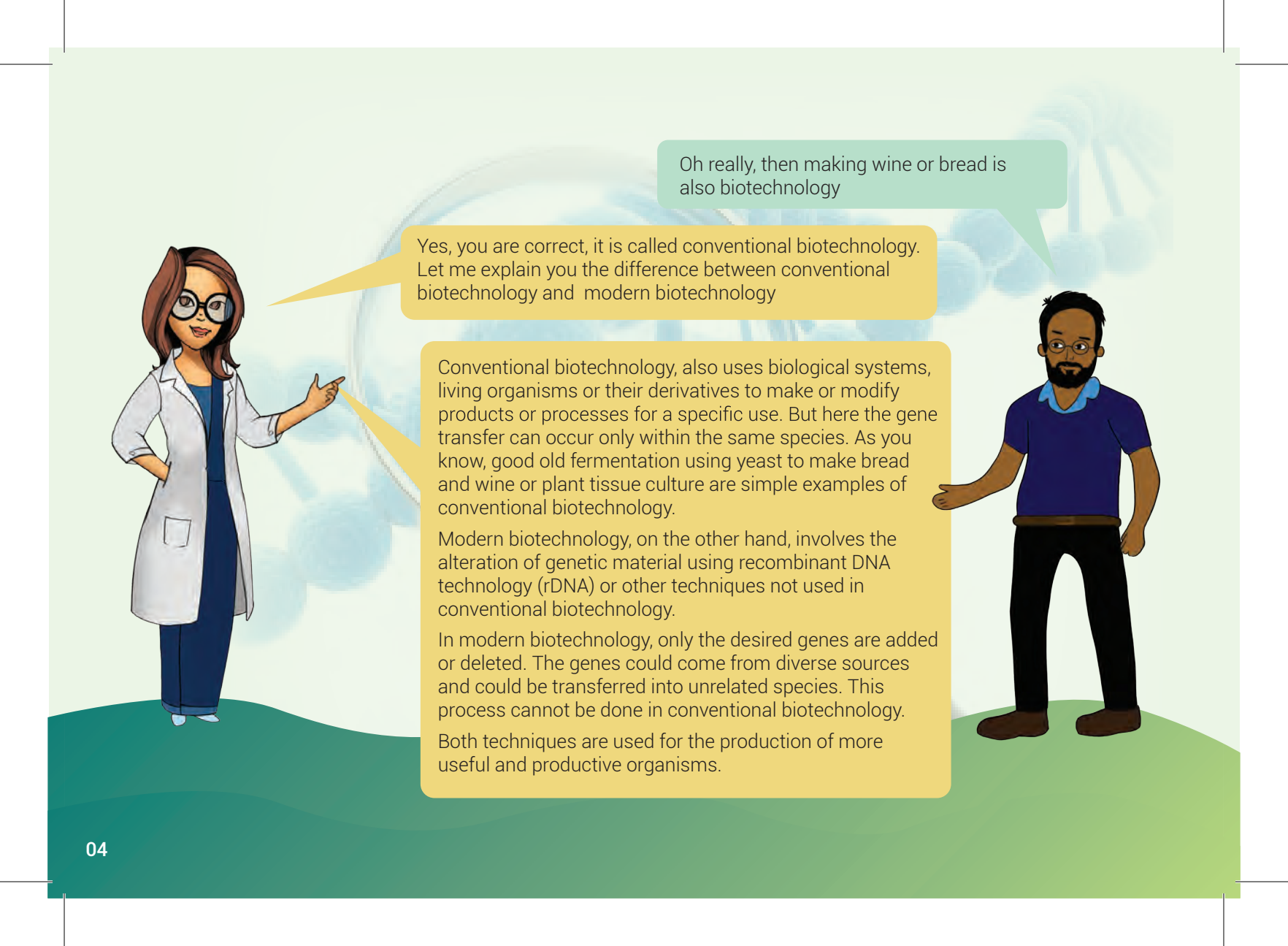
What do you mean by modern biotechnology?

Before I explain, what is modern biotechnology?  
let me tell you something about biotechnology.

Ok. then, what is biotechnology?

Biotechnology is any technological application that  
uses biological systems, living organisms or  
derivatives thereof, to make or modify products or  
processes for a specific use.





Oh really, then making wine or bread is also biotechnology

Yes, you are correct, it is called conventional biotechnology. Let me explain you the difference between conventional biotechnology and modern biotechnology

Conventional biotechnology, also uses biological systems, living organisms or their derivatives to make or modify products or processes for a specific use. But here the gene transfer can occur only within the same species. As you know, good old fermentation using yeast to make bread and wine or plant tissue culture are simple examples of conventional biotechnology.

Modern biotechnology, on the other hand, involves the alteration of genetic material using recombinant DNA technology (rDNA) or other techniques not used in conventional biotechnology.

In modern biotechnology, only the desired genes are added or deleted. The genes could come from diverse sources and could be transferred into unrelated species. This process cannot be done in conventional biotechnology.

Both techniques are used for the production of more useful and productive organisms.





What are the benefits of modern biotechnology?

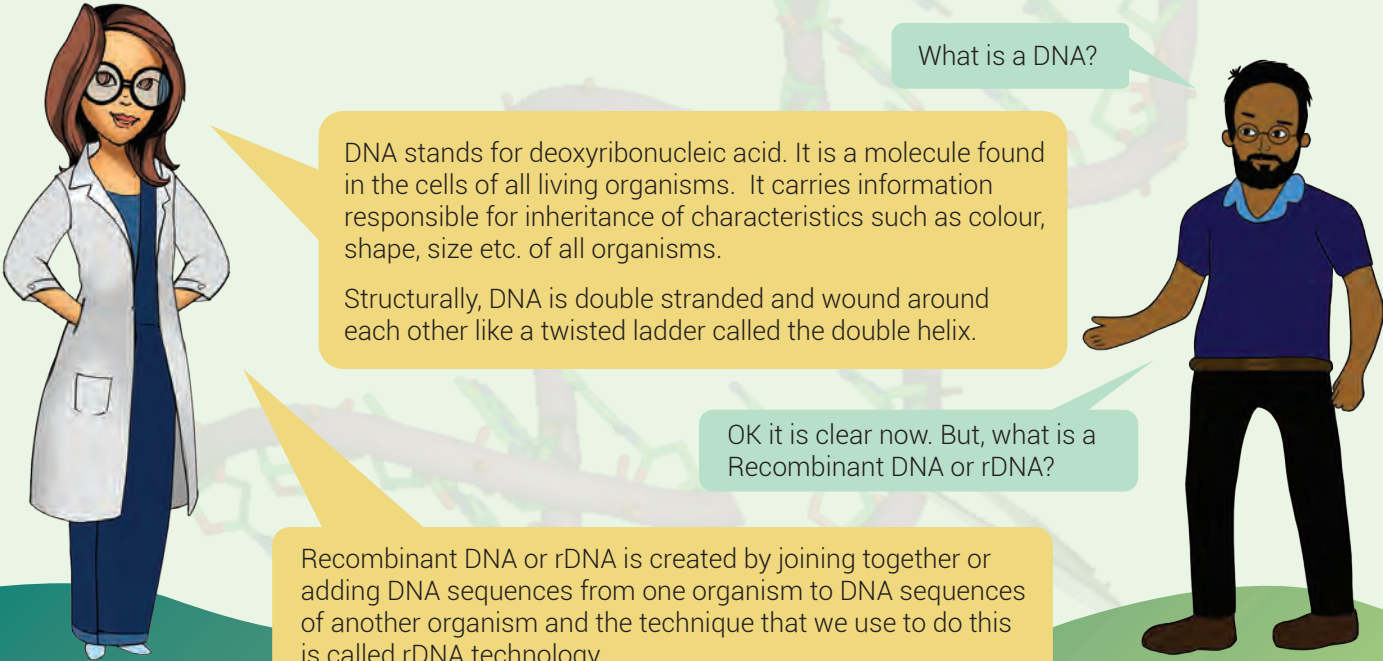
Modern Biotechnology can increase productivity of crops. It can introduce resistance to pests and diseases, tolerance to adverse weather and soil conditions, produce better yields and enrich crops with vitamins and minerals. Not only plants, but also animals and bacteria can be modified through modern biotechnology to produce pharmaceuticals, edible vaccines (for eg. in milk and eggs) and other compounds useful in healthcare. Microorganisms can be genetically modified to help in bioremediation (cleaning up pollutants) and as bioindicators of chemical pollutants



Prof. you mentioned about rDNA technology, what is that?

In order to explain this technology, you need to know about the molecules involved in it like gene, DNA etc.

What is a gene?



A Gene is a unit of heredity that is transferred from parent to offspring and determines characteristics of the offspring. Genes are made up of DNA and each chromosome contains many genes, which is found in the nucleus of a cell.

What is a DNA?

DNA stands for deoxyribonucleic acid. It is a molecule found in the cells of all living organisms. It carries information responsible for inheritance of characteristics such as colour, shape, size etc. of all organisms.

Structurally, DNA is double stranded and wound around each other like a twisted ladder called the double helix.

OK it is clear now. But, what is a Recombinant DNA or rDNA?

Recombinant DNA or rDNA is created by joining together or adding DNA sequences from one organism to DNA sequences of another organism and the technique that we use to do this is called rDNA technology.



What is a GENETICALLY MODIFIED ORGANISM or GMO?

How it is related to what you have been talking about right now?

A Genetically Modified Organism (GMO) is a living organism or part thereof, whose genetic material has been modified using modern biotechnology in a way not occurring naturally by mating or natural recombination. You should also know that the term Living Modified Organism (LMO) is interchangeably used with GMO

How are they modified?

- A gene from an organism can be introduced into a different organism to create a new trait or improve an existing trait.
- An existing gene can also be silenced to remove or suppress an undesired trait.
- Genes can also be edited by making a small and specific change to acquire the required useful traits



How can we differentiate between GM and non-GM foods?

We cannot differentiate by appearance (Phenotypically). But analytical methods are available to detect foreign DNA sequences in a GM food.

It is mandatory to label all GM foods available in the market in Sri Lanka. Therefore, the consumer is informed and the choice is given to choose between GM and non-GM foods.



Are GM foods safe to eat?

The GM foods available in the market have gone through safety assessment and considered to be safe.



What about the inserted DNA? Is it safe to eat?

Any inserted DNA is composed of same material as the natural DNA found in all living things (vegetables, meat etc.) that we eat. Therefore, it is safe to eat.

DNA is digested and absorbed into the blood stream or excreted from the body.



Are GM food items more nutritious?

If they have been modified to provide higher levels of nutrients such as proteins or vitamins, then they are more nutritious. (Eg: Golden rice rich with vitamin A) Not all GMOs are modified to be more nutritious. However, all GMOs must be as safe as non-GMOs before they are approved.



Can genetic modification make food items less nutritious?

Yes, this is possible. That is why GM food items have to undergo food safety analysis to make sure that they are equal to or better than their non-GM counterparts.

Since when, have GM food items been in the market?

The first approved GM food ingredient seen in the market was GM chymosin in 1990, an enzyme used in cheese making. The first GM food that was released for sale in the market was Flavr-Savr tomato in 1994.

May I know the food items that have been genetically modified?

Some of the GM crops that are available globally are: soybean, canola, corn, Hawaiian papaya, zucchini, yellow squash, tomato, potato, rice, tobacco and sugar beet grown for sugar production.





On what basis is a GMO/LMO approved?

It is done, after careful assessment of its impact on human health and the environment.

Are there any GM food items available in the Sri Lankan market?

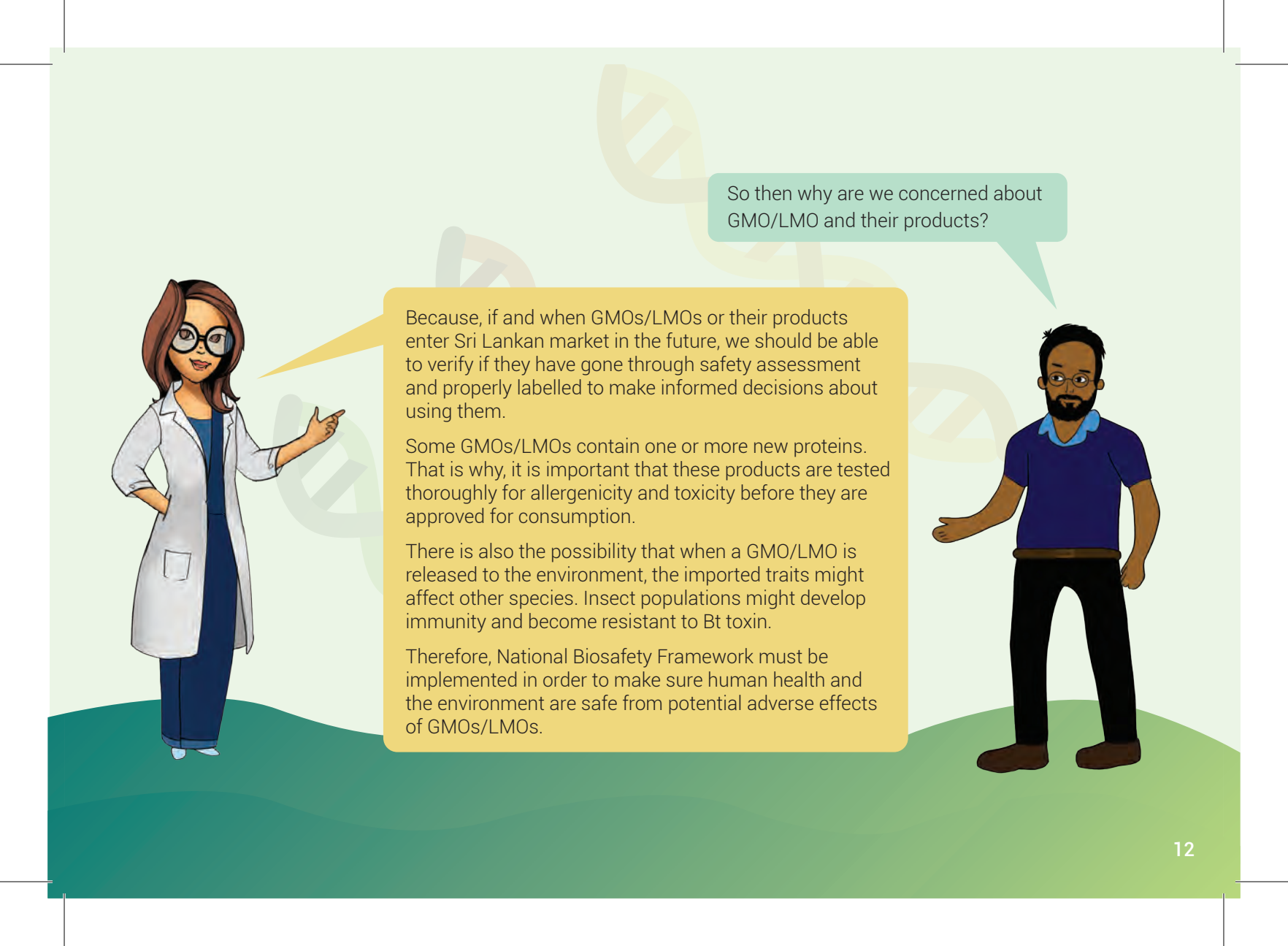
No. So far, no GM food items are available in Sri Lankan market. However, if they are to be available in the future, they will be labelled, so that the consumer has the choice to decide between GM and non-GM foods.

But I have seen big Mangos and Guavas in the market, what are they? Are they not GM fruits?

Those are not GM fruits, but they are hybrid fruits produced from plants through cross pollination between two varieties of the same species.







So then why are we concerned about GMO/LMO and their products?

Because, if and when GMOs/LMOs or their products enter Sri Lankan market in the future, we should be able to verify if they have gone through safety assessment and properly labelled to make informed decisions about using them.

Some GMOs/LMOs contain one or more new proteins. That is why, it is important that these products are tested thoroughly for allergenicity and toxicity before they are approved for consumption.

There is also the possibility that when a GMO/LMO is released to the environment, the imported traits might affect other species. Insect populations might develop immunity and become resistant to Bt toxin.

Therefore, National Biosafety Framework must be implemented in order to make sure human health and the environment are safe from potential adverse effects of GMOs/LMOs.





Are there GM foods sold in other countries?

Yes, there are some vegetables available in the market of certain countries like USA, Brazil, and China.

Can an animal gene end up in a GM crop?

Yes. An animal gene can be transferred to a crop.  
Eg: Leech's hirudin gene in *Brassica napus*

Genes which are resistant to certain antibiotics are used as markers in the genetic modification process. Would this make the bacteria in our body resistant to antibiotics?

No. These markers are used by scientists to select only the cells that contain the transgenes. Some of the antibiotics used in the genetic modification processes are not used for humans or animals.





"Bt" is in short for *Bacillus thuringiensis*, a common bacterium found in the soil and used in biological pest control.

Bt produces a protein that is toxic to certain types of insects that kills them. Using modern biotechnology, the gene (Cry gene) that encodes this toxin can be transferred to plants making them insect resistant. Bt Cotton and Bt corn are two commercially important crops that have been genetically modified using this gene.

What is "Bt"?



Can other organisms be affected by toxins produced by GM crops?

Non-target organisms are usually unaffected by GM toxins because toxins in GM crops are very specific to its target organisms. However, this should be considered during the risk assessment.



Will the target pests develop resistance towards toxins produced by GM crops?

Yes. This is possible after prolonged cultivation of these crops. However, various strategies are being developed to prevent or minimize resistance development. Among them most applicable one is special refuge strategy.

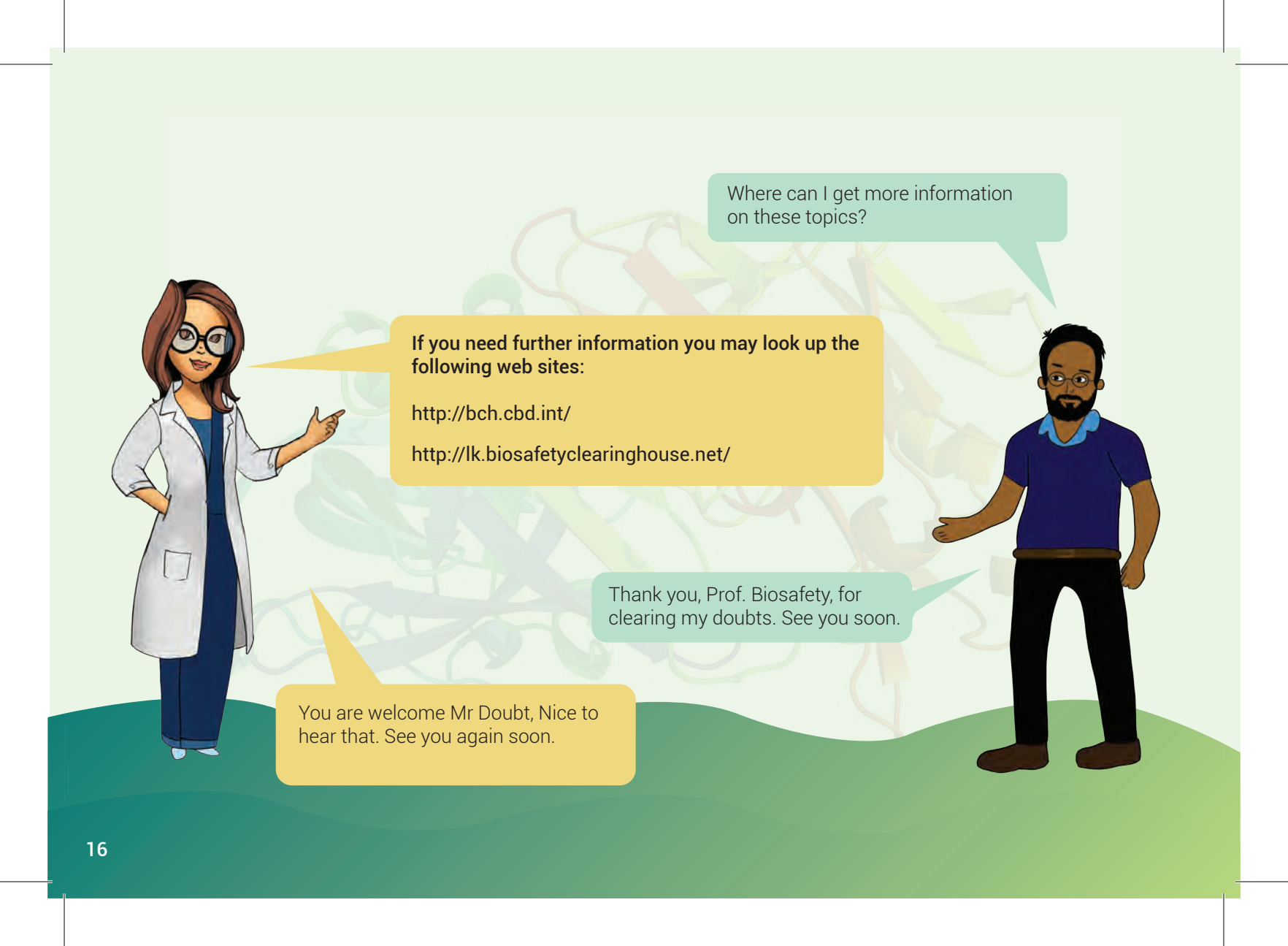
Can gene movement occur between GM and non-GM crops during pollination?

Yes. This can happen. However, to prevent this from happening GM food crops have to be planted away from its non-GM relatives or should be grown in a contained facility.

Can new species be created if transgenes from a GM crop escapes to its wild relatives?

No. New species cannot be created this way. But cross pollination may occur if GM and its non-GM relatives are planted side by side. If planted close to each other the non-GM crop might get some traits from the GM crop.





Where can I get more information on these topics?

If you need further information you may look up the following web sites:

<http://bch.cbd.int/>

<http://lk.biosafetyclearinghouse.net/>

Thank you, Prof. Biosafety, for clearing my doubts. See you soon.

You are welcome Mr Doubt, Nice to hear that. See you again soon.

# SAFETY ASSESSMENTS OF GENETICALLY ENGINEERED PLANTS



Prof. Biosafety, what type of information is required for safety assessment of Genetically Engineered plants?



Mr Doubt, information required is segregated into three categories, as mentioned below

## Factors relevant for Safety Assessment

### Gene & Plant Characterization

#### Description on:

- GM crop
- Biology of the non-modified host plant
- Gene modification
- Inheritance and stability of inserted gene(s)
- Molecular characterization
- Level of protein expression

### Safety of Food & Feed

#### Assessment on:

- Toxicity and Allergenicity
- Heat stability of the expressed protein
- Susceptibility of the expressed protein to pepsin digestion
- Composition of the feed
- Effect on Livestock
- Effect on Processing

### Safety of Environment

#### Confirmation on:

- Level of expression of the new protein
- Location and methods used for field trials
- Phenotype of the new plant

#### We also have to record:

- Growth of the plants
- Any specific changes taking place in the plant
- Susceptibility for diseases and pests
- Impact on non-targeted plants
- Changes in gene flow pattern



This awareness material is produced through the National Biosafety Project (Implementation of the National Biosafety Framework in accordance with the Cartagena Protocol on Biosafety) that was implemented by the Ministry of Environment (MoE) and the Food and Agriculture Organization of the United Nations (FAO) with funding from the Global Environment Facility (GEF).

The National Science Foundation (NSF), which was an implementing partner of the Biosafety Project provided technical support for developing this material. Their contribution and those of many entities and experts who are too numerous to be mentioned individually, are gratefully acknowledged as critical to the production of this material.

The names and characters portrayed in this material are fictitious and have no bearing on any person, place or an institution.

The designations employed and the presentation of material throughout this publication do not imply the expression of any opinion whatsoever on the part of the GEF, FAO, MoE or the NSF.

This work is made available under the Creative Commons Attribution-Noncommercial-Share Alike 3.0 IGO license (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo/legalcode>). Under the terms of this license, this work may be copied, redistributed and adapted only for non-commercial purposes, provided that the work is appropriately cited.

