What is DNA?

Gene (skin colour)

Adenine **Thymine**

Gene (iris colour)

Guanine **Cytosine**

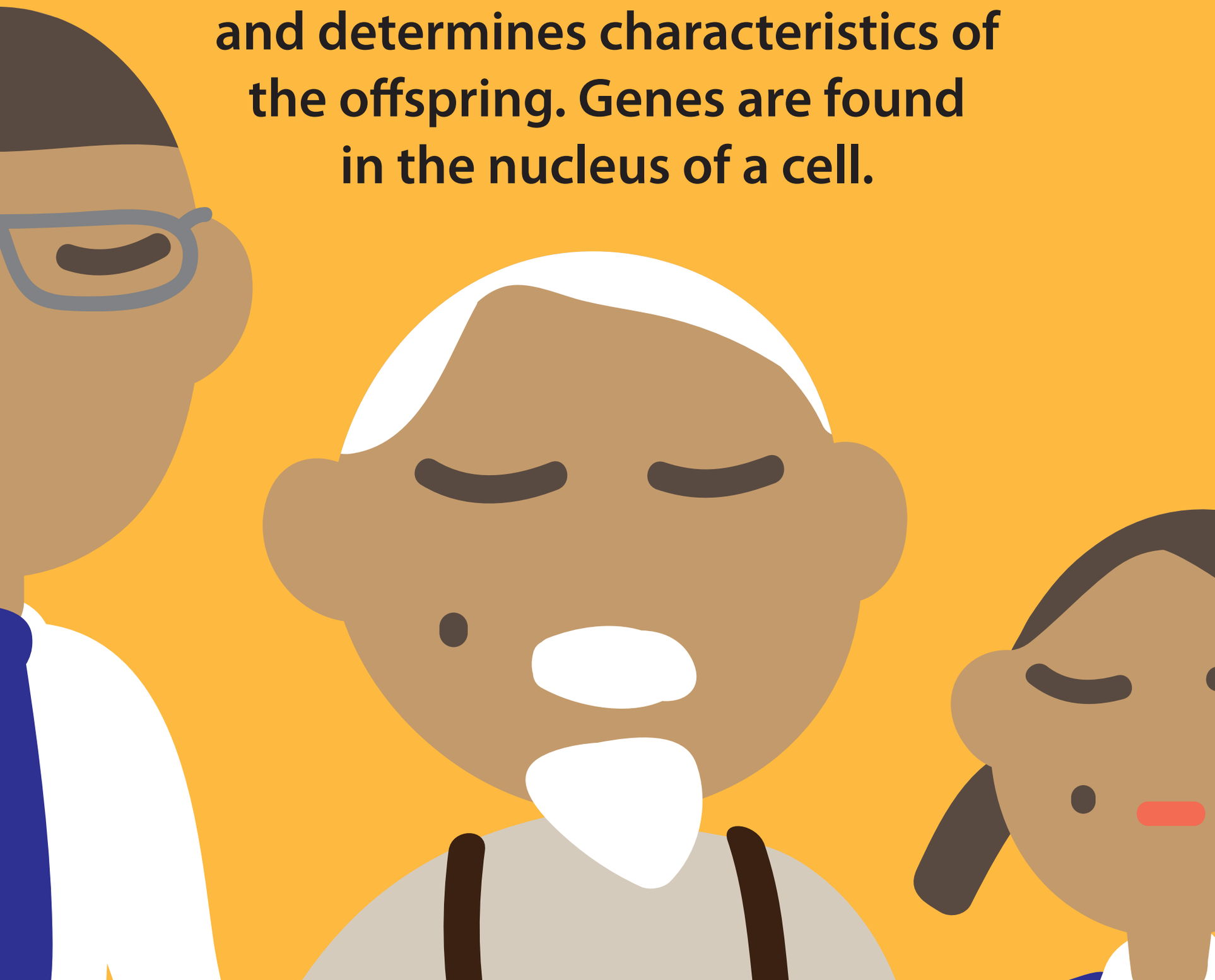
dna is deoxyribonucleic acid, a molecule found in the cells of all living organisms.

It carries the information responsible for the inheritance of characteristics such as size, shape, colour and other physical attributes of all organisms.

DNA is double stranded and wound around each other in spiral shape called the double helix.

What is a GENE?

A GENE is a unit of heredity that is transferred from a parent to offspring and determines characteristics of the offspring. Genes are found in the nucleus of a cell.



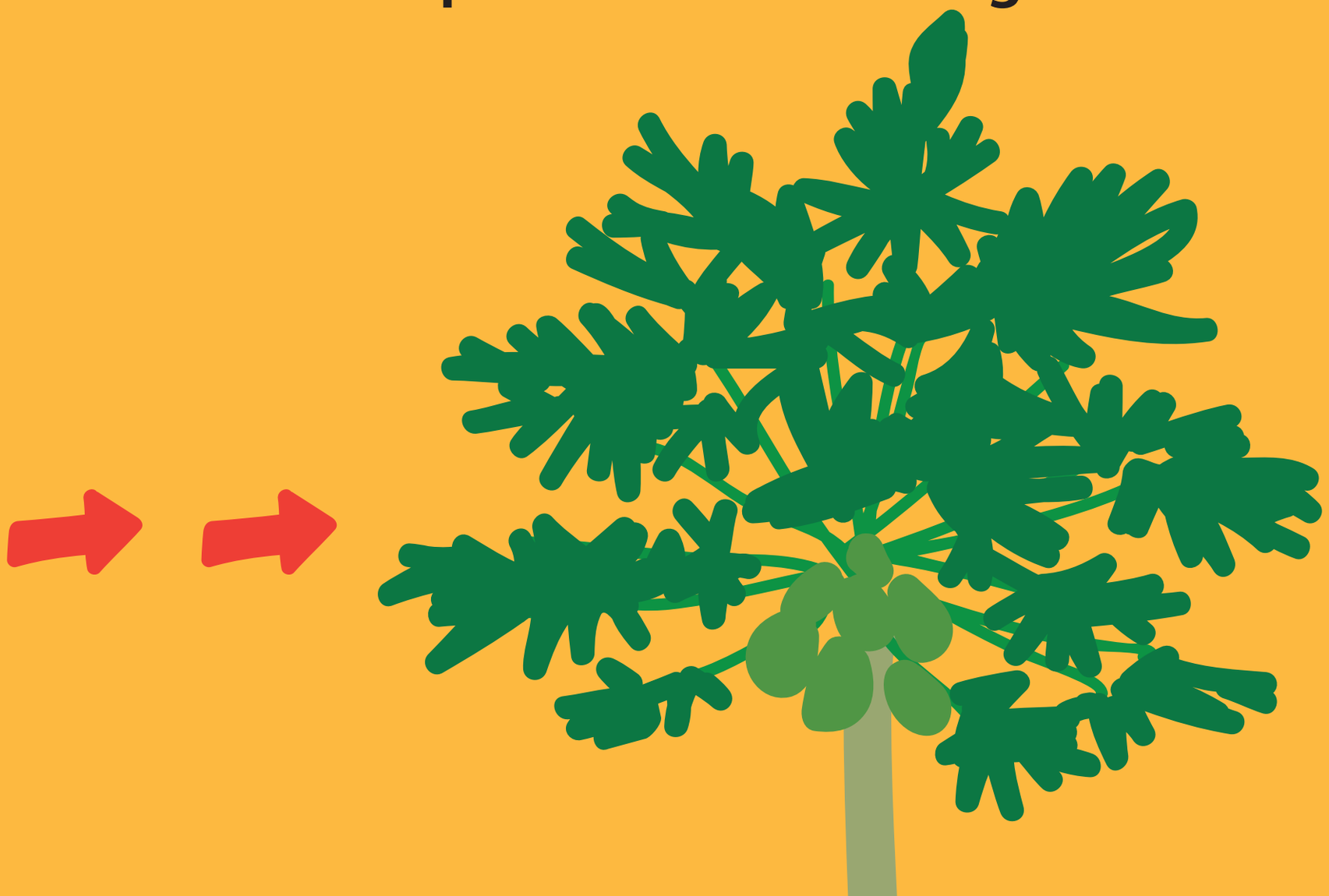
What is BIOTECHNOLOGY?

Any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use is known as BIOTECHNOLOGY.

What is MODERN BIOTECHNOLOGY?

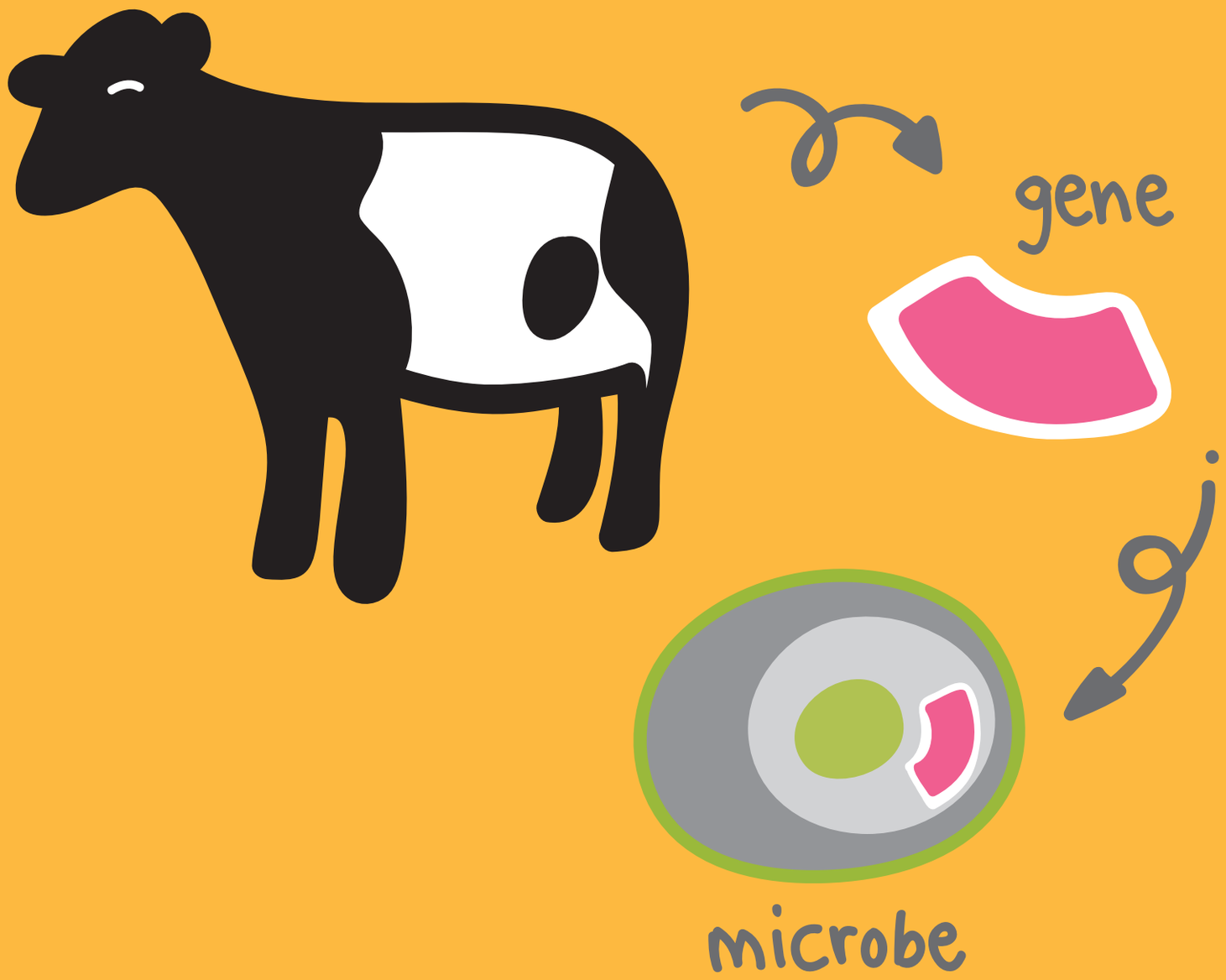
+ rdna →

Modern biotechnology involves the alteration of genetic material using recombinant DNA (rDNA) technology or other techniques not used in conventional breeding to overcome natural physiological and reproductive challenges.

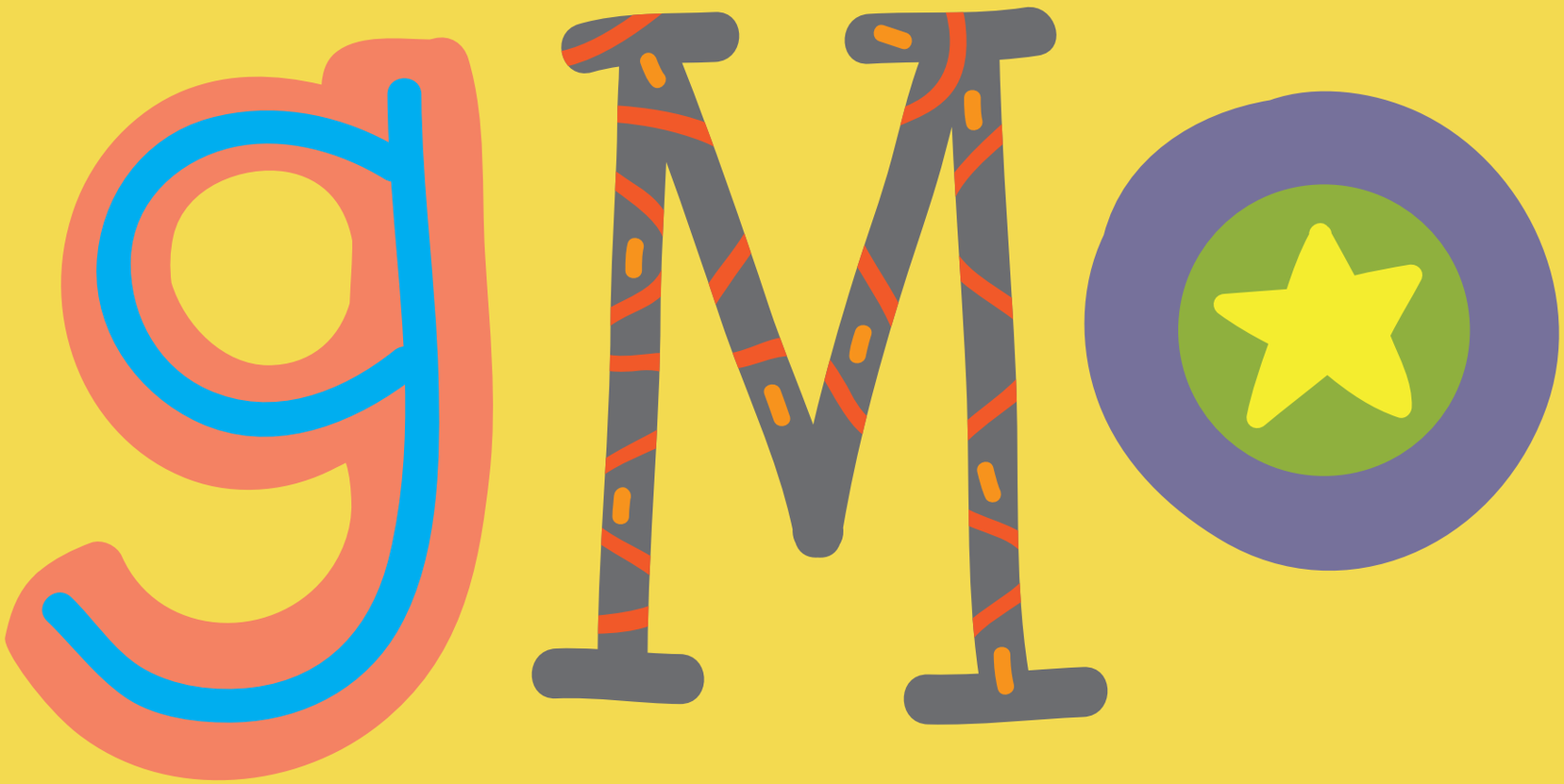


What is RECOMBINANT DNA?

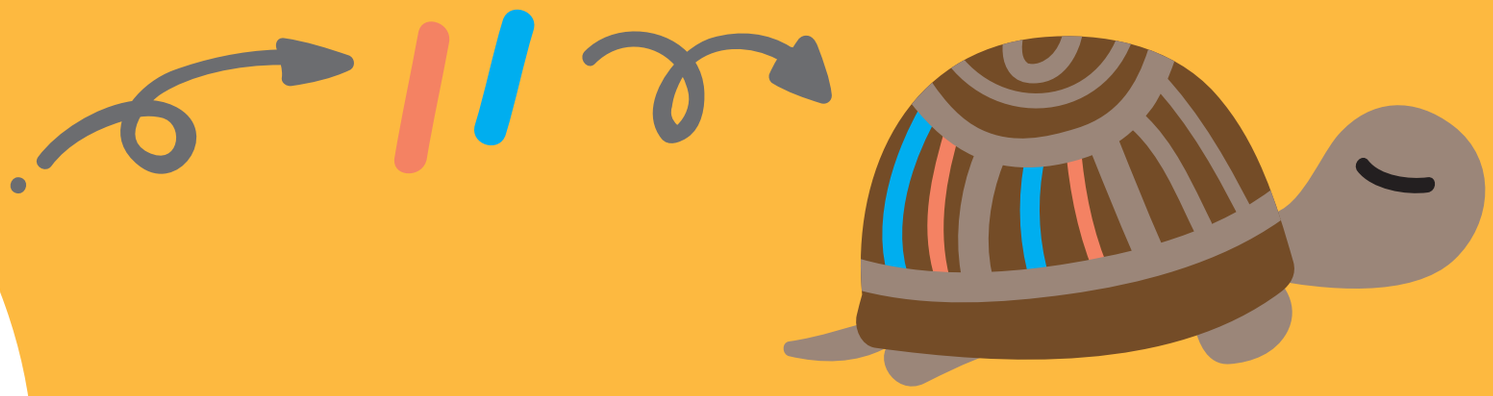
rDNA is a form of artificial DNA that is created by combining two or more sequences that would not normally occur together, using rDNA technology.



What is a GENETICALLY MODIFIED ORGANISM?

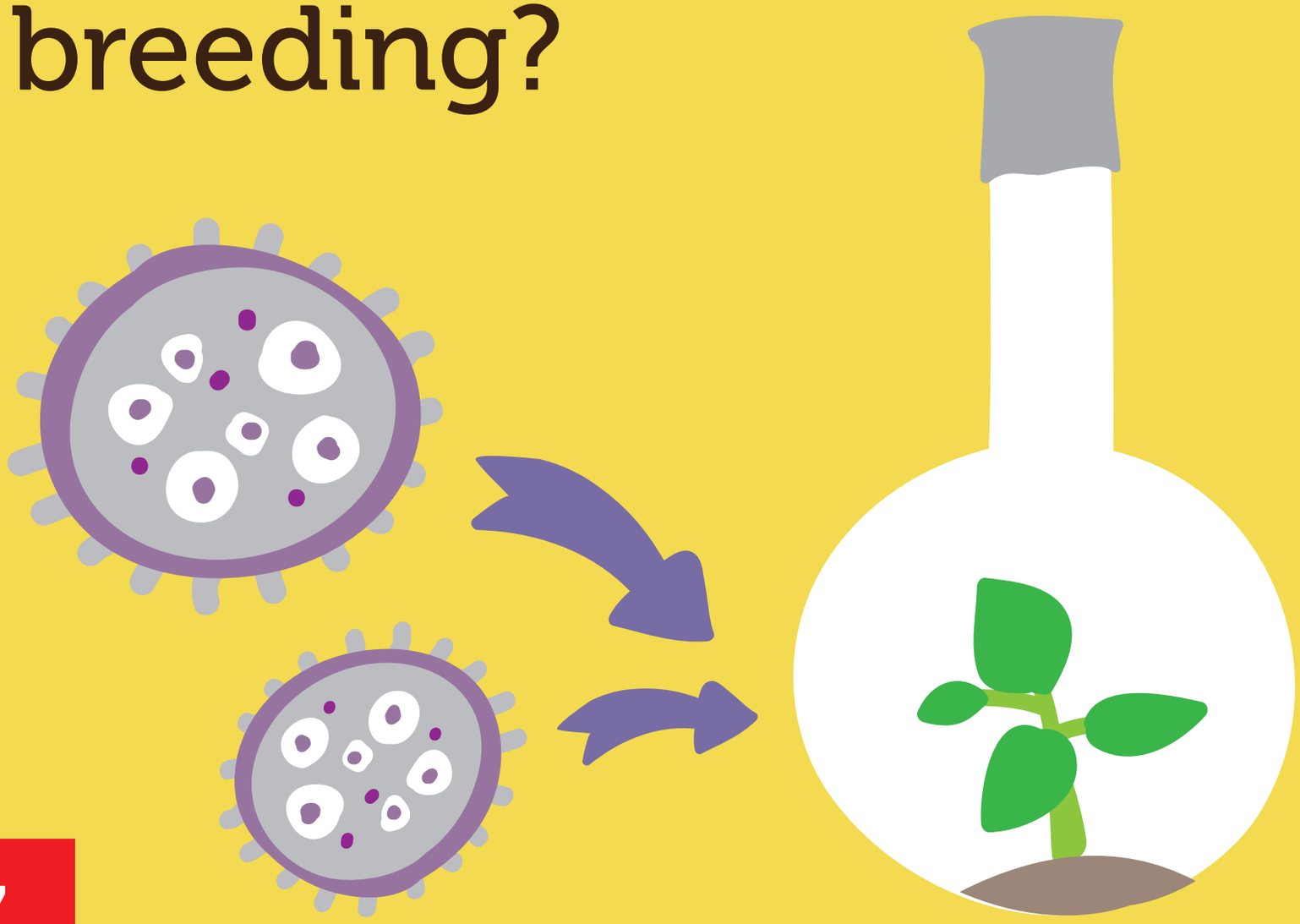


A GMO is an organism whose genetic material has been altered using modern biotechnology. A gene from an organism can be introduced into a different organism to create a new trait or to improve on existing traits.



An existing gene can also be silenced to remove an undesired trait. Living Modified Organism (LMO) is used interchangeably with GMO.

How is Modern Biotechnology different from conventional breeding?

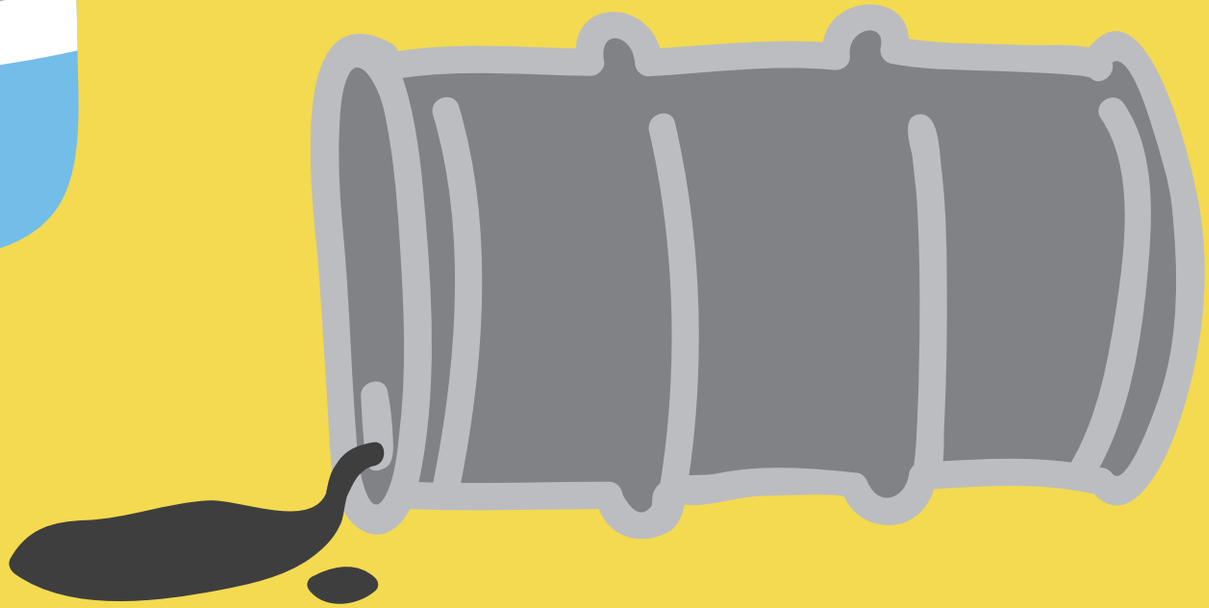


Both techniques are used for the production of more useful and productive crop varieties.

In Modern Biotechnology however, only the desired genes are added or deleted. The genes could come from diverse sources unlike in conventional breeding and may be transferred into unrelated species.

Through Modern Biotechnology, a useful gene from bacteria can be transferred into a plant, a process that can't be done in conventional breeding.

What can Modern Biotechnology do?



Modern Biotechnology produces better yield and enriches crops with vitamins and minerals.

Plants, bacteria and animals can be genetically modified to produce therapeutics, vaccine antibodies and other compounds useful in healthcare. Microorganisms can also be genetically modified to help clean up pollutants and to act as bio indicators of chemical pollutants.

What is “Bt”?

"Bt" is short for *Bacillus thuringiensis,*
a common soil bacteria
used as a biological pest control.

Bt produces a cyrstalline protein that is toxic to certain types of insects. This toxin binds to receptors in the gut of the insects and kills them.

With Modern Biotechnology, the gene encoding for this toxin can be transferred to plants, creating plants that are insect resistant. Many commercially important crops have been genetically modified this way, including Bt cotton and Bt maize.

What are the benefits of having Genetically Modified crops?

1

Higher crop yields due to reduced loss to pests and diseases

2

Reduced farm production costs due to reduced use of pesticides and labour cost

3

The availability of nutritionally enhanced food

4

Reduced use of pesticides in the environment

Are there any risks with the use of GMO/LMO and its products?

A number of potential risks exist. GMO/LMO products can be allergenic or toxic to some. When an LMO is released in the environment, imparted traits might affect other species and biodiversity in general. Insect populations might eventually develop immunity with stronger resistance to Bt toxin.

There is also the risk of unintended effects on non-targeted organisms hence the need for the Biosafety Act 2007 and its enforcement.

What will happen if the transgenic gene in a GM food item is eaten by human beings?

DNA is present in all living things such as plants, animals and microorganisms and is eaten by us in every meal.

Most of it is broken down during the digestion process and is either absorbed into the blood stream or excreted from the body.

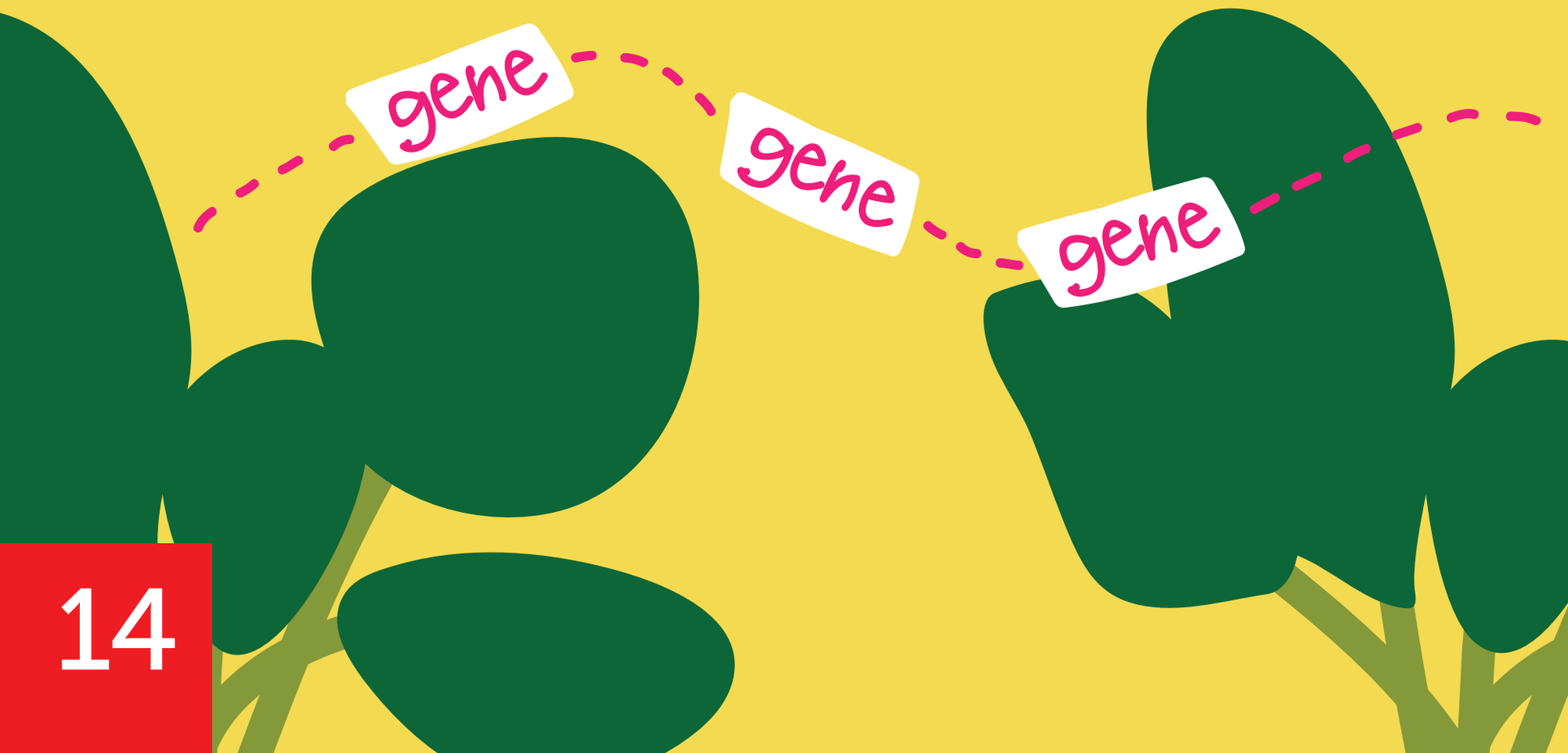
Can gene movement happen between GM and non-GM crops during pollination?

YES.

When this happens, the non-GM variety can take on GM traits.

To prevent this from happening, GM crops have to be planted away from its non-GM relatives.

Will a new species be created when transgenes from a GM crop escape to its wild relative?



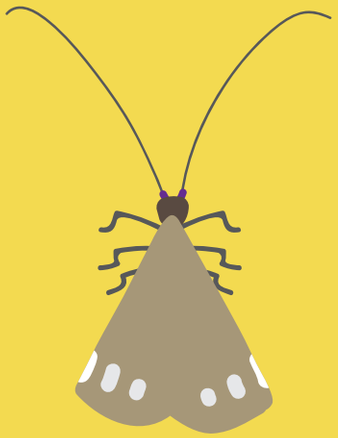
No. Cross pollination happens when GM crops and its non-GM related species are planted side by side. No new species is created this way, but the non-GM crop might attain some traits from the GM crops.

Can genetic modification cause a food item to be less nutritious?

Yes, the possibilities are there.
For this reason the GM food item has to undergo food safety analysis to be sure that the nutritional values are equal to/ better than its non-GM counterpart.

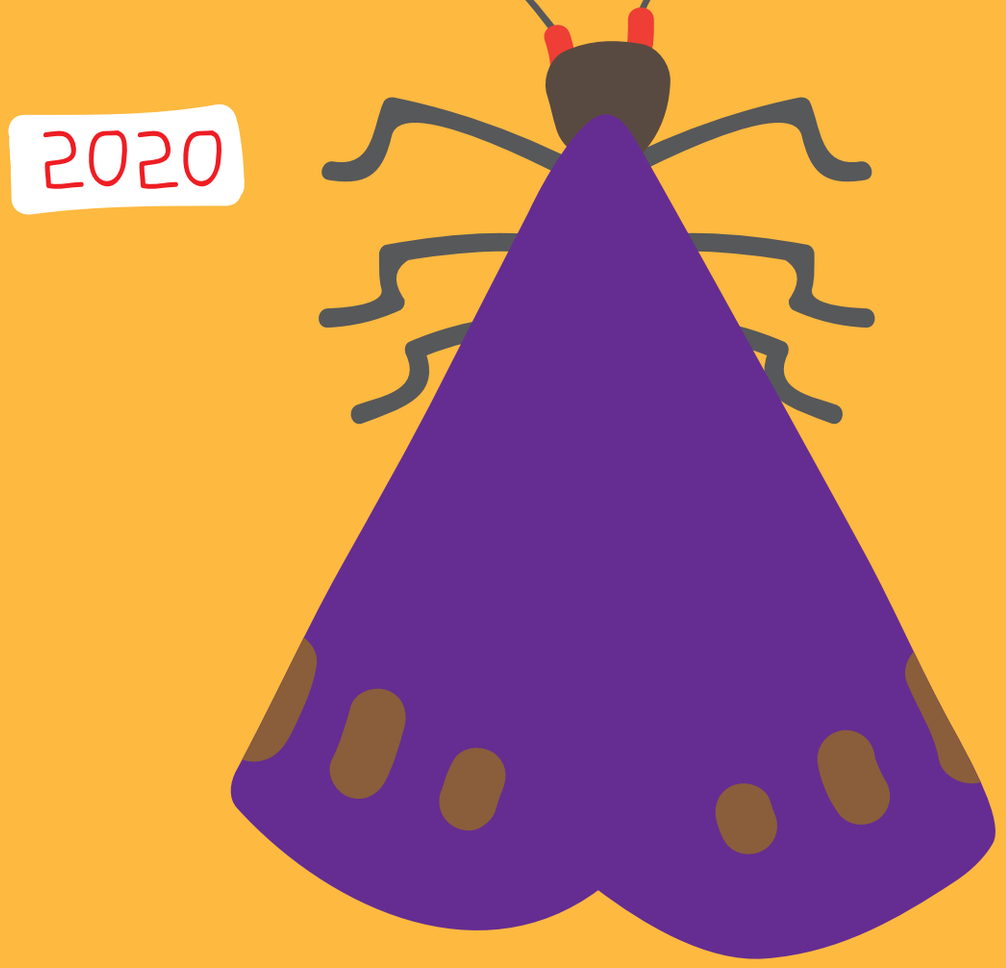
Strict regulations and enforcement is crucial to minimise these risks.

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

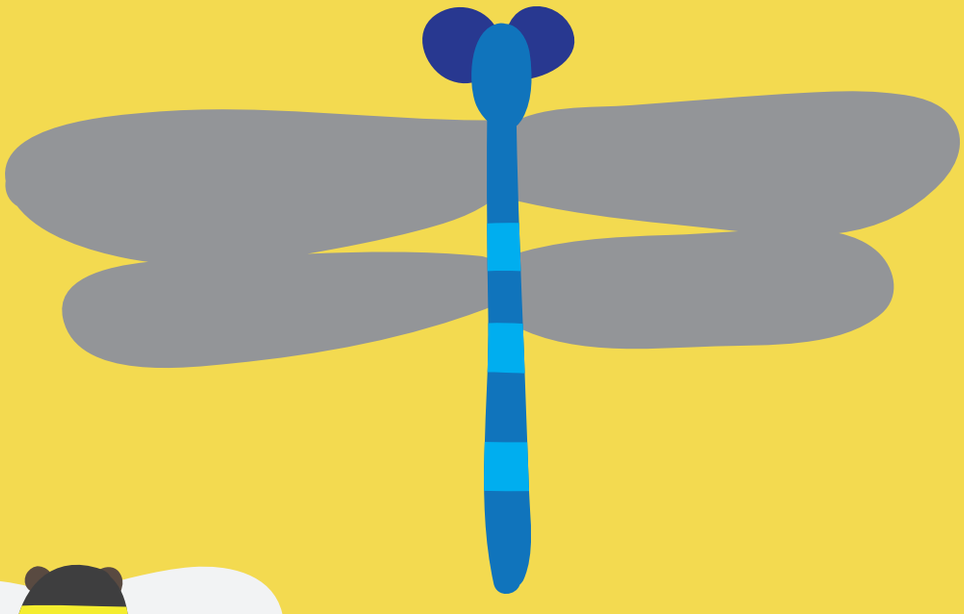


1990

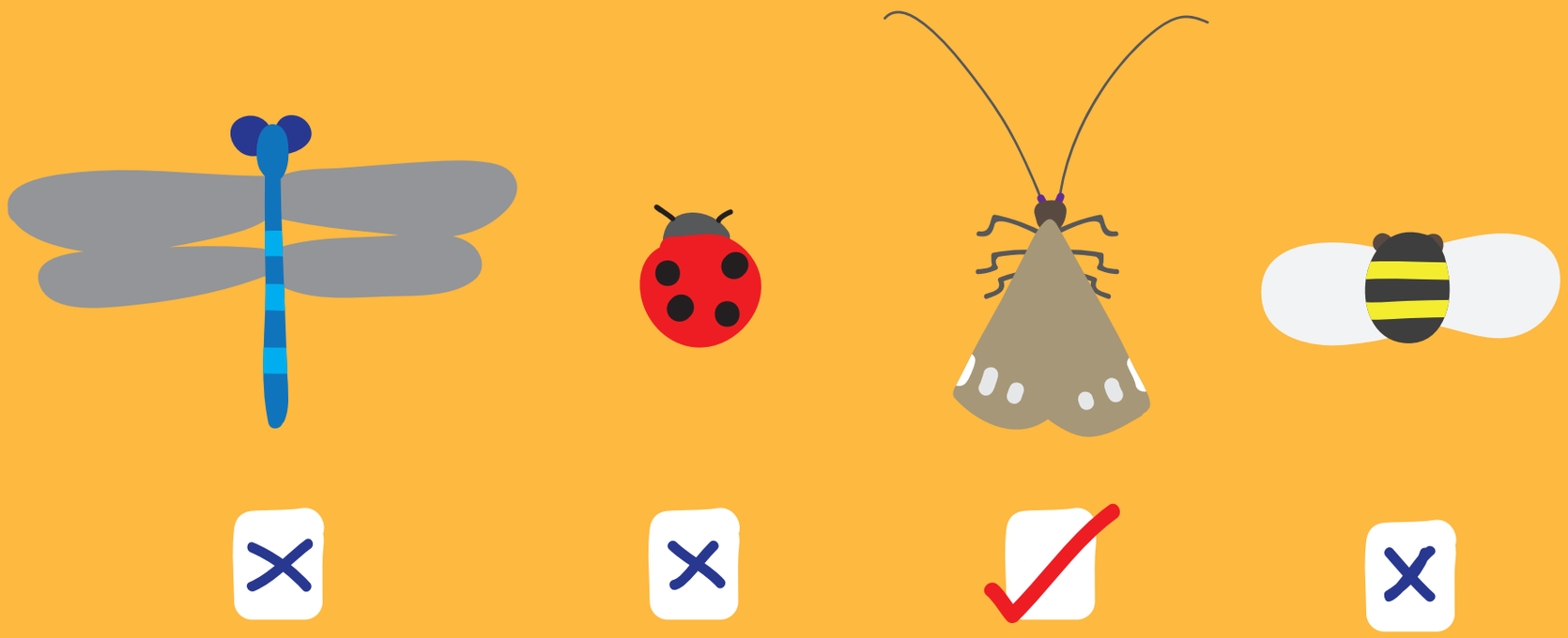
Yes. After prolonged cultivation of these crops, target pests can become resistant towards the toxins in the GM crops. However, various methods are being developed to prevent or minimise its occurence.



Are non-target organisms affected by the toxins produced by GM crops?



The toxins in GM crops are very specific to its target organisms.



Non-target organisms are usually unaffected but we cannot rule out the possibilities.

Are GM food items safe to eat?

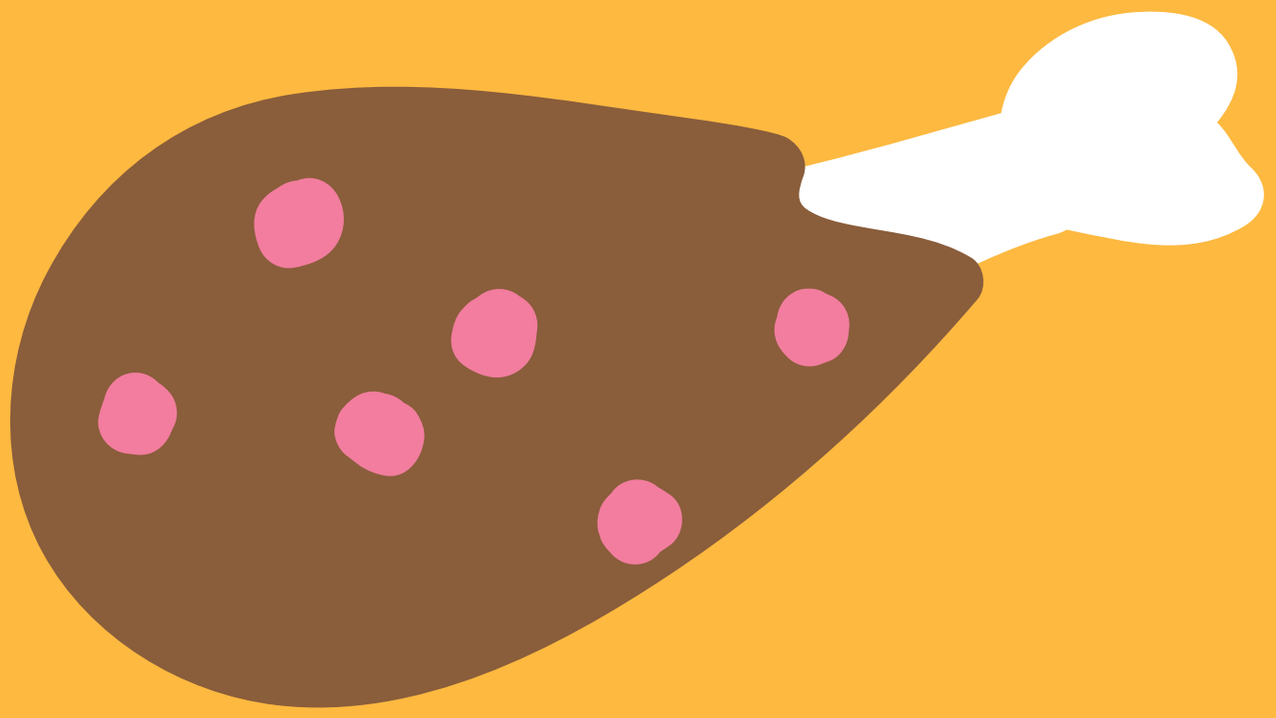
The approved GM food items have undergone extensive tests prior to approval and are safe to eat.

Can an allergen be accidentally introduced during the development of GM crops?

Yes.

Allergens can be unintentionally introduced during the genetic modification process.

For this reason the final product needs to be tested for allergenicity before it is approved for consumption.



Genes which are resistant to certain antibiotics are used as markers in the genetic modification technique.

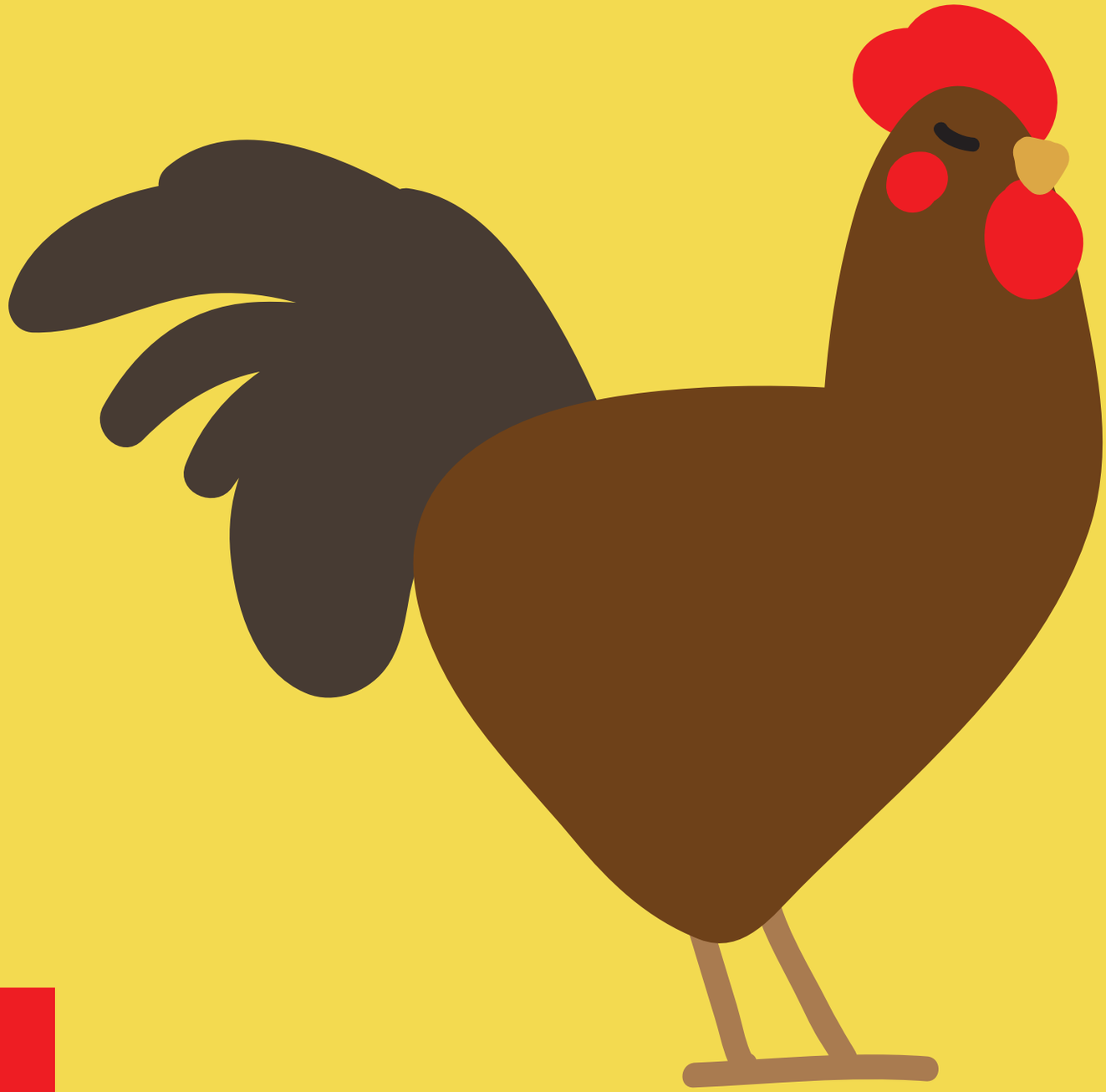
Would this make the bacteria resistant to antibiotics?

No.

These markers are used for the scientists to select only the cells that contain the transgenes.

Many of the antibiotics used in the genetic modification technique are not used in human or animal health anymore.

Can an animal gene end up in a GM crop?



Yes.

Animal genes can be transferred to a crop. Due to religious and social implications however, GM technology developers have refrained from using genes from animals or they have to label it to inform the consumer.

What are the food items that have been genetically modified?

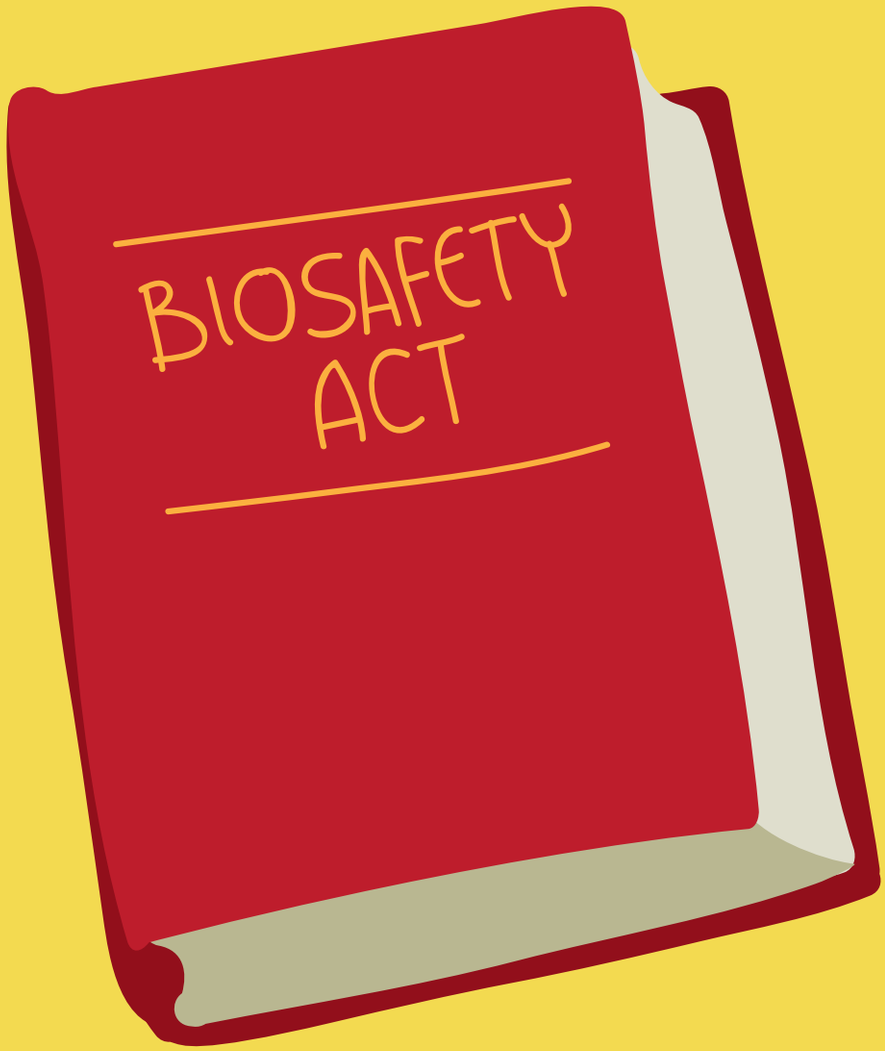
GM crops that are sold in the world are: soy, cotton, canola, corn, Hawaiian papaya, zucchini, yellow squash, tobacco and sugar beets grown for sugar.

In Malaysia, certain GM soybean and corn have been permitted to be imported for food, feed and processing.

Are GM plants cultivated in Malaysia?

Not yet, but a number of agricultural plants are in various developmental stages namely pineapple, papaya, rice, chilly, rubber, teak, oil palm and orchid.

Has Malaysia taken any steps to protect consumers from the risks of GMO/LMO and its products?



Yes. The Biosafety Act was gazetted in August 2007 and came to force in December 2009. This regulates the release, importation, exportation and contained use of LMOs, and the release of the products of such organisms. The Act aims to protect human, plant and animal health, the environment and biological diversity.

How are GMO/LMOs regulated under the Biosafety Act?

Any new GMO/LMOs intended for cultivation, contained use, field trials, and consumption must be approved by the National Biosafety Board (NBB) on the advice of the Genetic Modification Advisory Committee (GMAC).

NBB gmac

Applicants are required to submit their applications to the Department of Biosafety.

On what basis is a GMO/LMO approved?

The approval of a GMO/LMO is done after careful assessment of its impact on human and animal health, and the environment.

The applicant must submit relevant information such as toxicity, allergenicity and environmental impact reports.

How is risk assessment for the environment done?

Tests are carried out on the GMO/LMO itself and its effects to the potential receiving environment. Ecological factors are also taken into consideration.

The assessment includes unintended effects which could result from the introduction of the new gene into the area.

How do we manage GMO/LMOs after their release in the environment?

All GMO/LMOs released require close monitoring.

Any new information or evidence regarding potential risks post to the environment or to human health must be reported immediately to the NBB which reserves the right to recall any GMO/LMO based on the updated information or evidence.

Are drugs developed using GM technology regulated under the Biosafety Act?

NO.

Drugs are not regulated under the Biosafety Act. They are regulated under the Pharmaceutical Act.

However, crops and microorganisms that are genetically modified to produce drugs will be regulated under the Biosafety Act.

Who is in charge of the Biosafety Act?

The Biosafety Act comes under the purview of the Ministry of Natural Resources and Environment (NRE).

The Department of Biosafety under NRE functions as a one-stop centre for all the activities related to biosafety and is responsible for the implementation of the act.

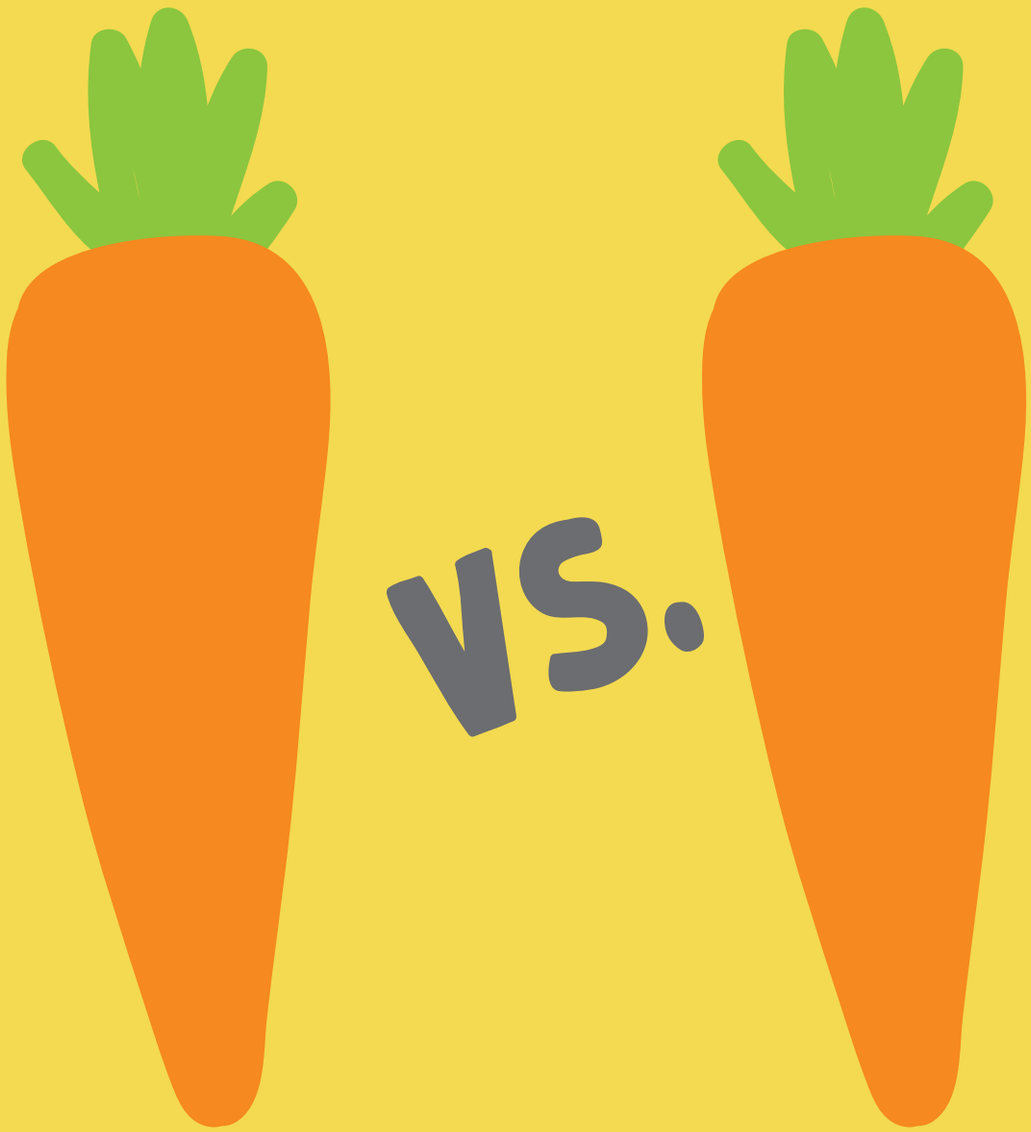
Do GM products need to be labelled in Malaysia?

YES.

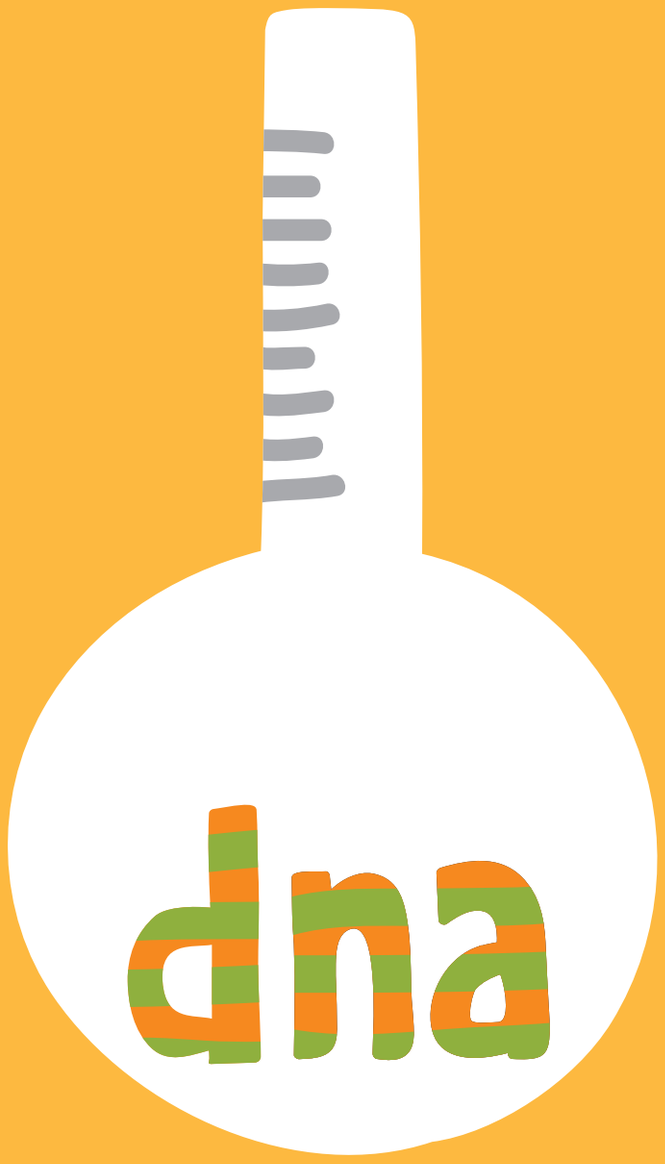
The Biosafety Act requires mandatory labelling for GM products.

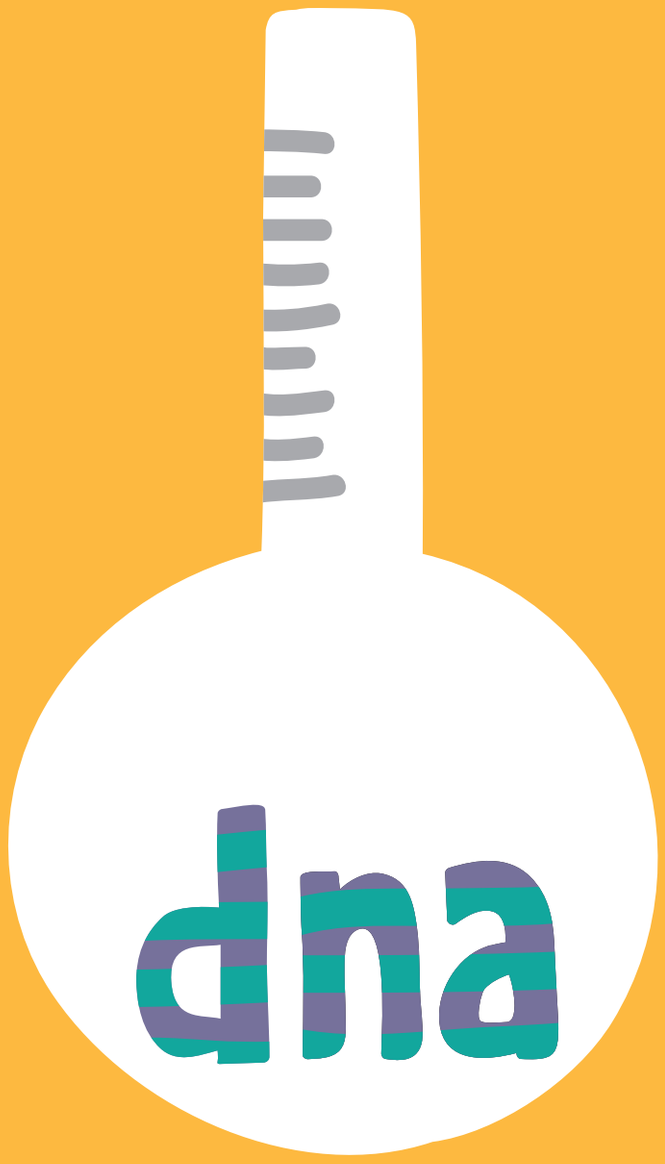
Also, the Food (Amendment) Regulations 2010 has a provision for mandatory labelling of food and food ingredients obtained from Modern Biotechnology.

How can we differentiate GM food items from conventional food?



As long as there is detectable foreign DNA in the GM food, analytical methods are available to detect them.





Since when have GM food items been in the market?

The first GM food ingredient approved in the market was GM chymosin in 1990, an enzyme used in cheese making.

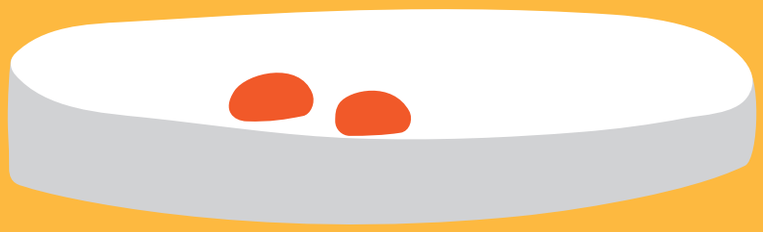
The first GM food that was released for sale in the market was the Flavr-Savr tomato in 1994.

Are GM food items subject to more tests than non-GM food products?

YES.

Under international safety assessment, standard tests on the quality, allergenicity, toxicity, composition and nutritional value of food derived from GMOs are performed by the producer before they are released.

If there are new substances being introduced as a consequence of genetic modification, the resulting food products will be subjected to additional safety tests.



Are GM food items more nutritious?

GM food items are generally equal to or better than conventional food products in terms of nutrition.

Grains, fruits and vegetables can be made to provide higher levels of nutrients such as protein, vitamins and minerals or can be modified to contain less fat or having lower levels of saturated fats.

Where can I get more information on biosafety?

Ministry of Natural Resources and Environment
Department of Biosafety

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