BMEG 3140 Final Presentation

Are genetically modified food safe for human consumption?

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Group 1

Table of Content

What is GM food?

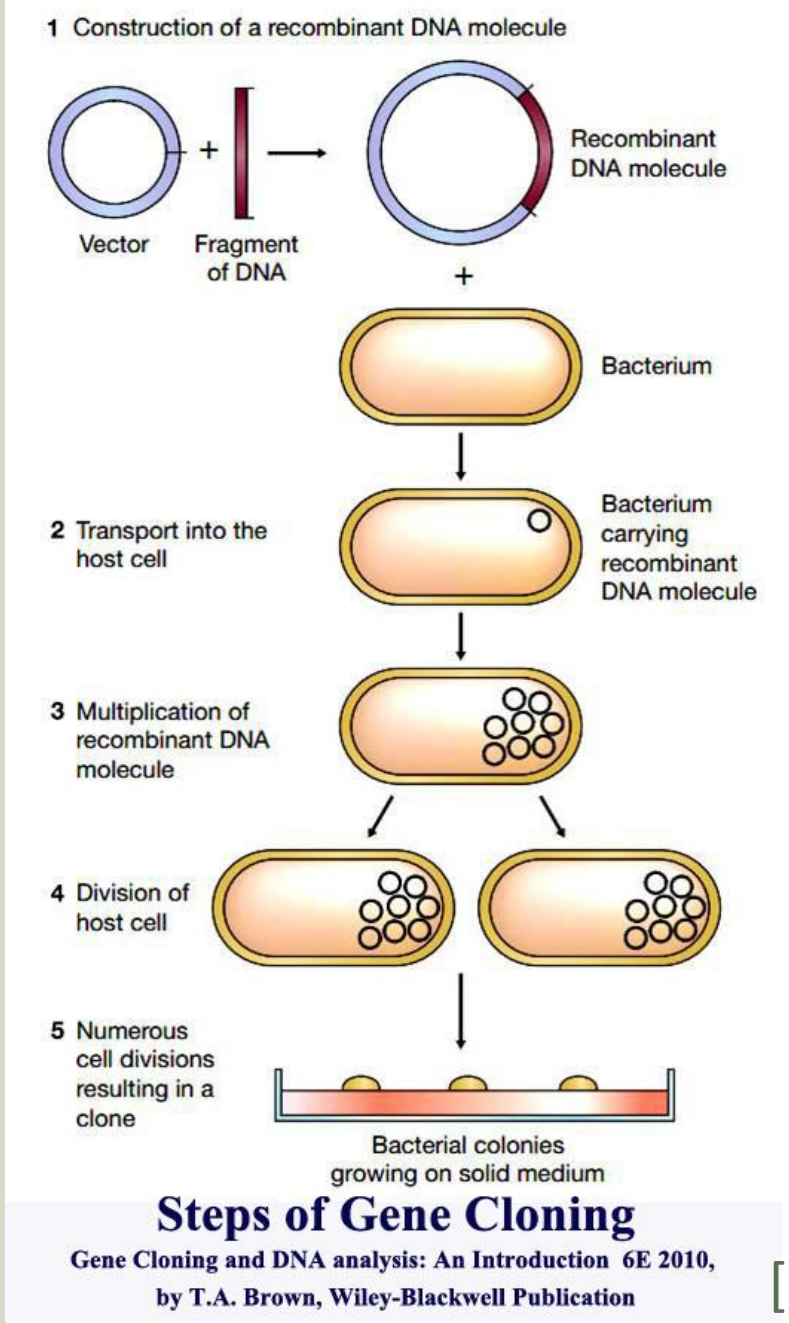
[1]

What is GM food

According to the WHO, foods produced from or using genetically modified organisms (GMOs) are GM foods.

In GMOs,
DNA is changed unnaturally by "recombinant DNA technology" or "genetic engineering".

It is also possible to create genes that cannot be found in nature from scratch



[2]

What is GM food?

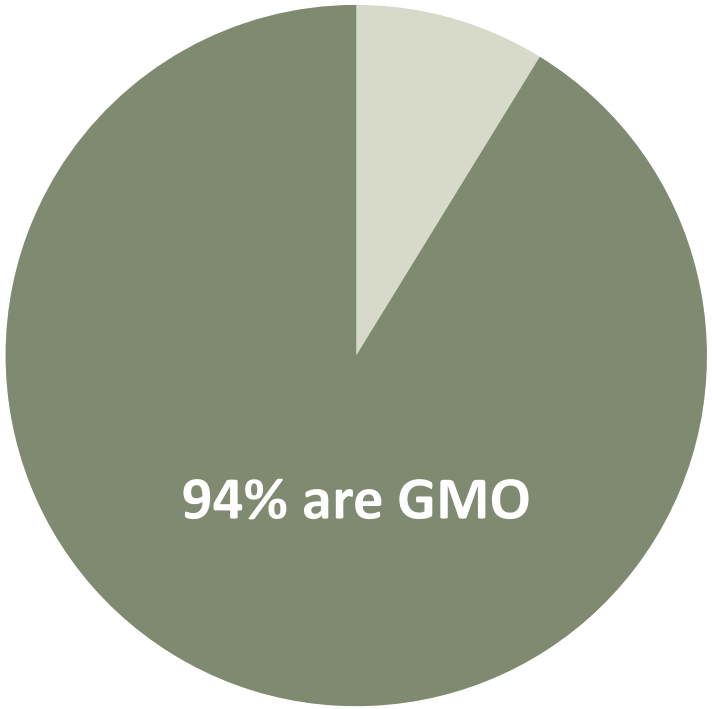
Any food items with **5% or more GM materials** in their respective food ingredient(s) [3]

It depends on:

1. Composition
2. Anti-nutritional factors or natural toxicants
3. Presence of an allergen
4. Intended use of the food product
5. Gene with animal origin in plants

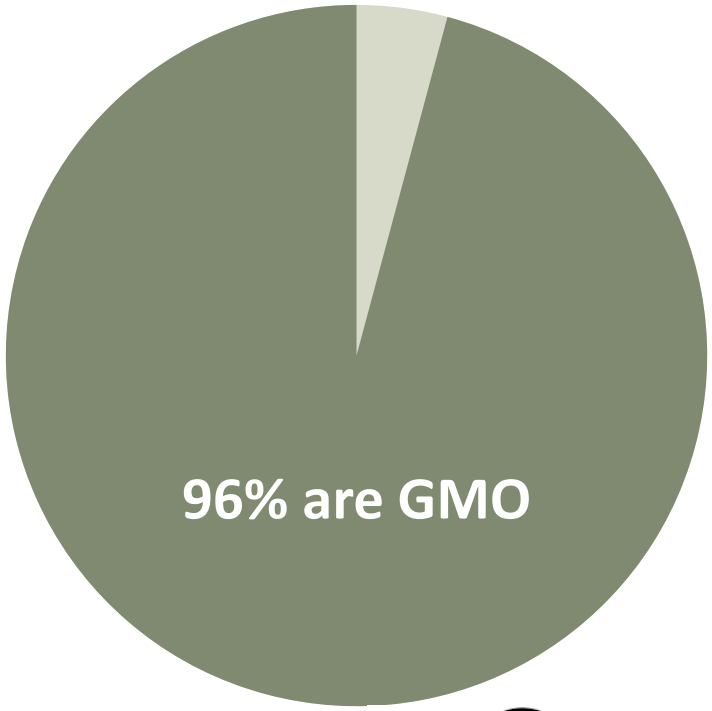
Current Situation of GM Food [4]

6% are non-GMO



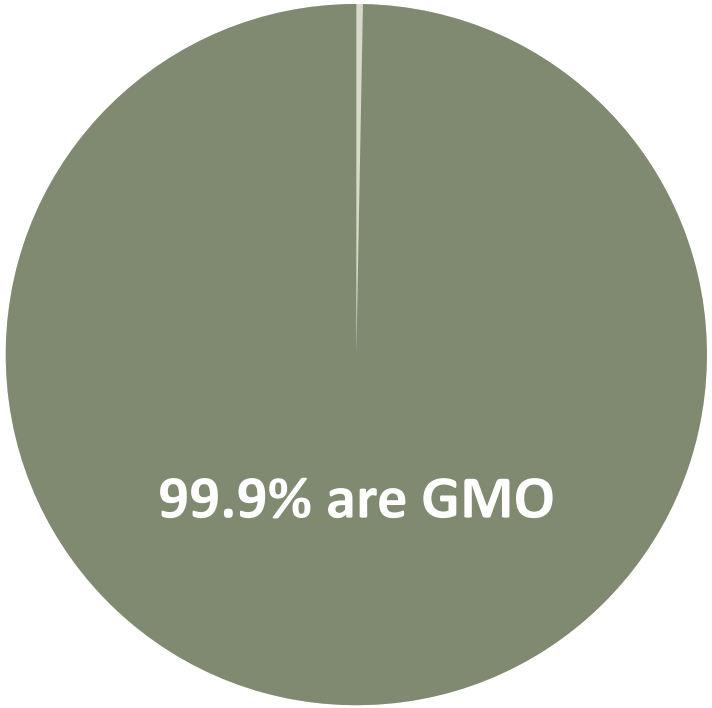
Soybeans

4% are non-GMO



Cotton

0.1% are non-GMO



Sugars beets

GMO Foods

For more information go to
olmag.co/gmo-foods

Tomato

Tomatoes have been genetically modified, but they are not being grown commerically at thia time

Rice

GMO rice has been approved but is not yet being used commercially

Sweet Corn

More than 70 percent of corn grown in the United States has been genetically engineered

Summer Squash

Farmers don't like GMO squash but some experts say GM squash have blended with wild squash

Canola Oil

87% of canola grown commercially, and 80% of wild canlola is GMO

Yeast

GMO yeast for wine has been approved

Salmon

GMO salmon has not been approved by the FDA, but it will be very soon

Alfalfa

GMO alfalfa is contaminating non GMO alfalfa crops at a rapid rate

Wheat

Unapproved GMO has contaminated wheat fields, and we don't yet know the extent of it

Sugar Beets

90% of Sugar Beets (used to make 50% of our sugar) are GMO

Soy

More than 93% of soybeans the United States produces are genetically modified

Peas

Peas have been genetically modified but are not approved or availlable

Cotton

At least half of cotton grown in the world is GMO

Hawaiian Papaya

Most Hawaiian papaya is GMO, even many organic crops are contaminated

organic lifestyle MAGAZINE

Common Reasons for GM

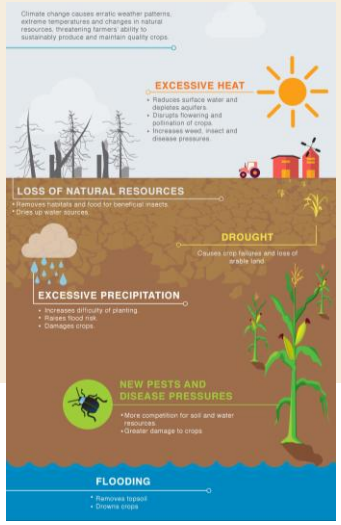
Climate Resilience [6]

Drought-tolerance:

- DroughtGard® corn have increased hydroefficiency[7]

Flood-tolerance:

- FR13A rice have increased submergence tolerance [8]

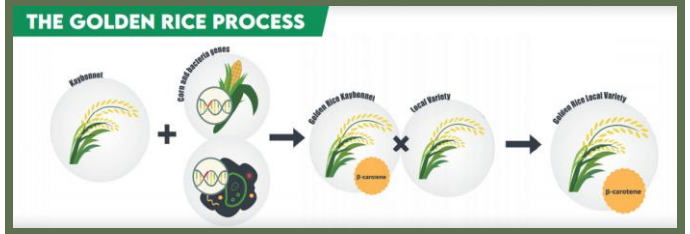


[9]

Nutrition Fortification

Vitamin A:

- Golden rice is fortified to have **23 times more beta-carotene** Poorer countries commonly suffer from hypovitaminosis A due to lack of food variety [10]



[11]

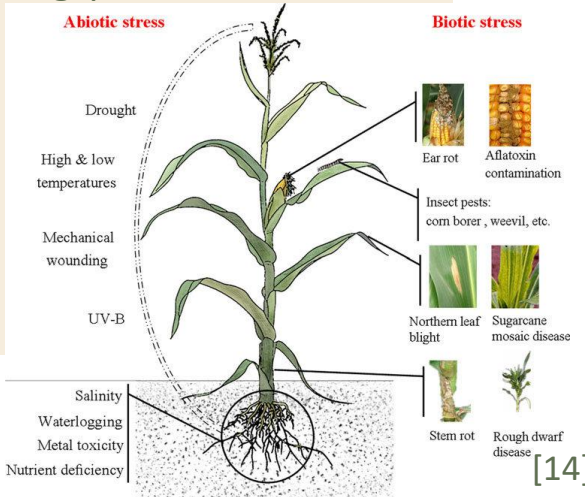
Biotic Stress Resistance

Insect resistance:

- The plants synthesis Bacillus thuringiensis (Bt) toxin which is a natural pesticide[12]

Virus resistance:

- Make papaya resistant to papaya ringspot virus[13]



[14]

Benefits for GM food

1

More nutritious foods

Less global malnutrition

2

More resilient crops

Higher crop yield → More global food supply

3

More aesthetic and desirable foods

Fewer food waste

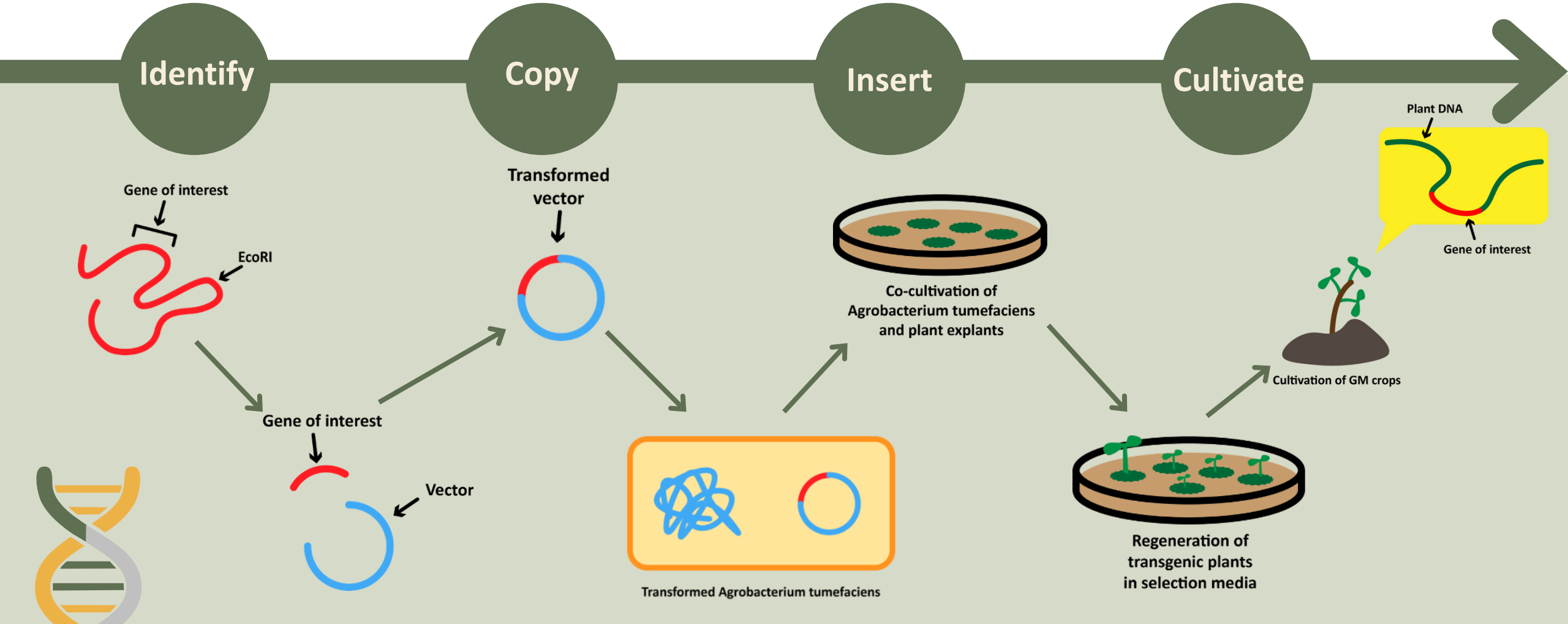
4

Less environmental resource required

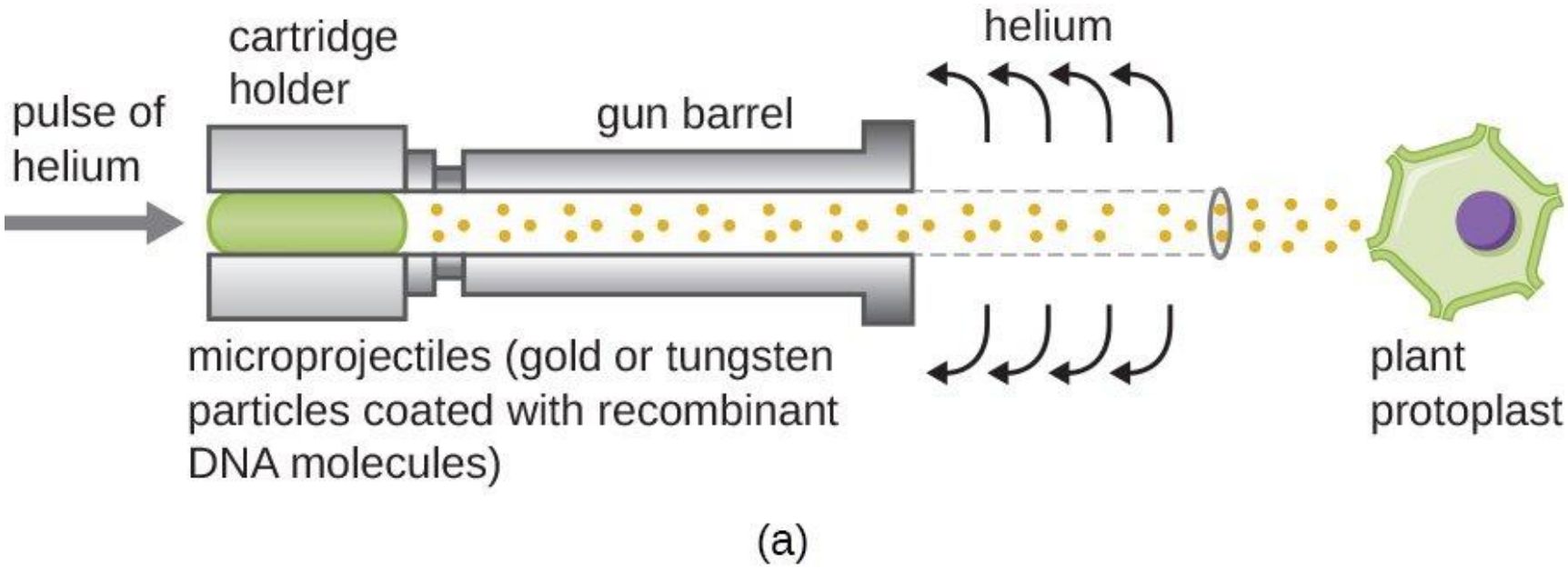
Increase global food access

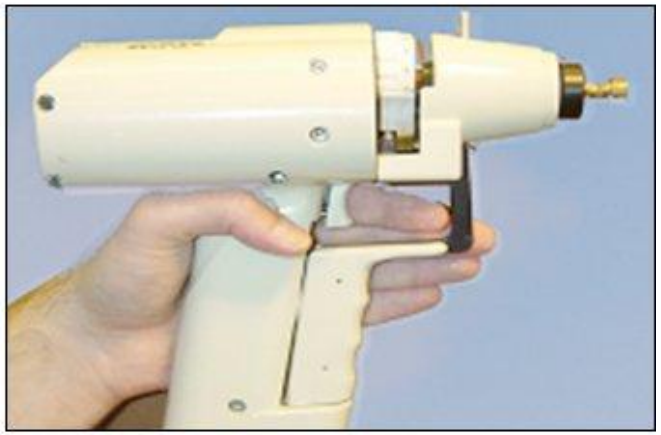
Process of GMOs Production

How to make a GMO [15]



How to make a GMO





(b)

[16]

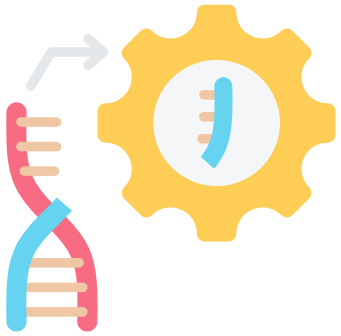
Is GM food safe?

Public Concern for GM food

1. Allergic or Toxic Reactions

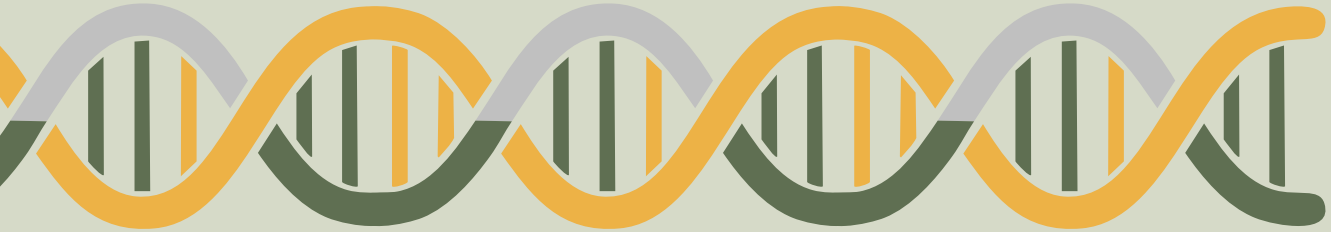
2. Unexpected or harmful genetic changes

3. Long-term cancer risk



1

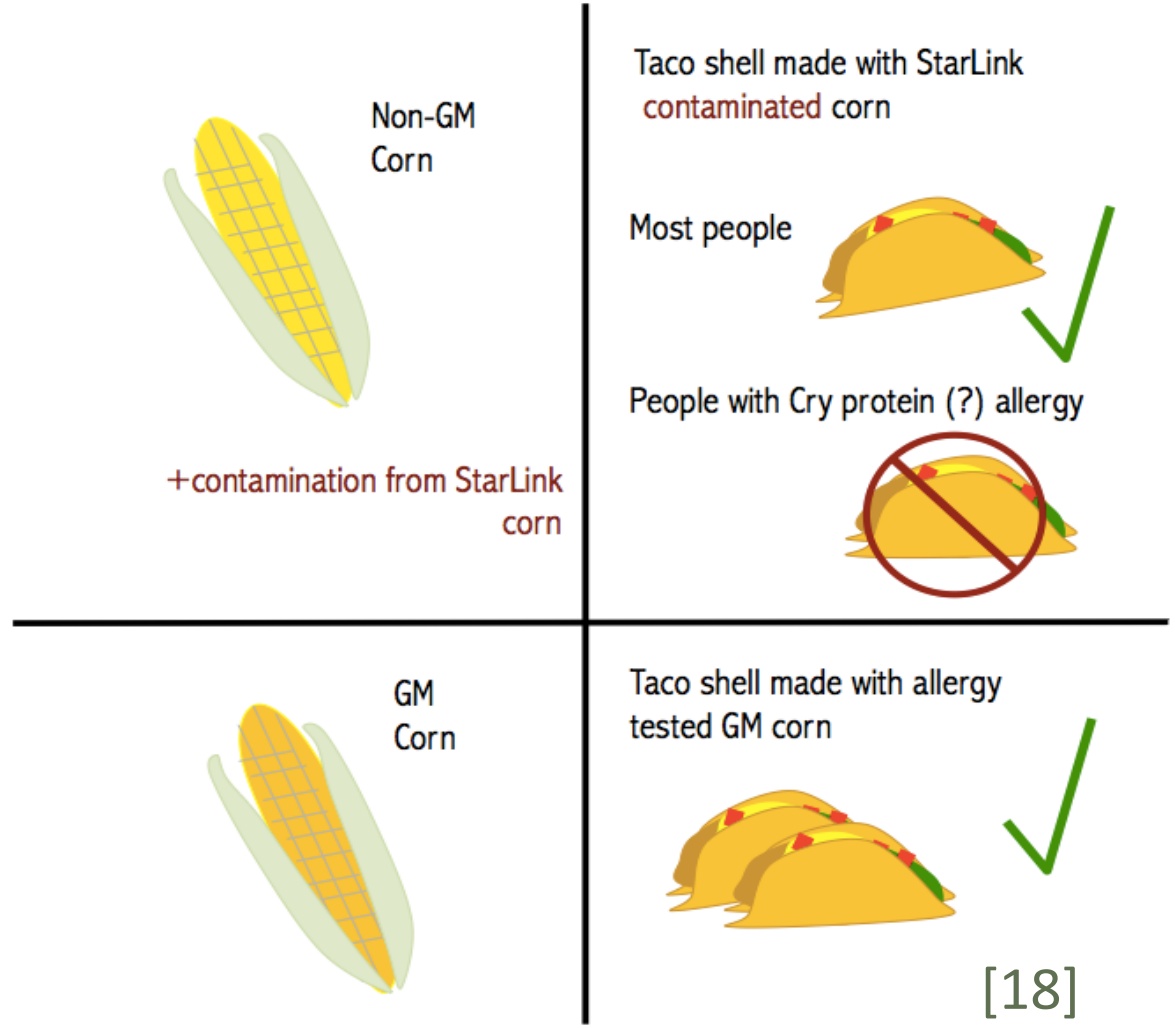
Allergic or Toxic Reactions



Allergic Example

2000 StarLink allergy scare [17]

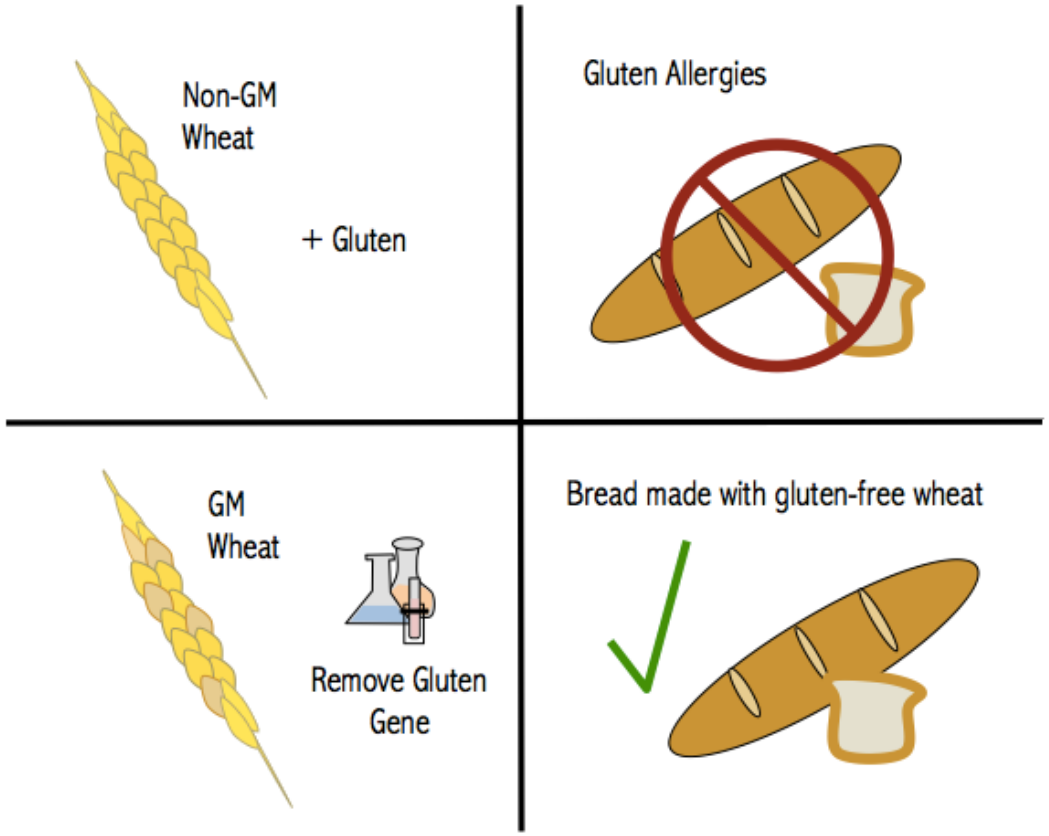
28 cases of allergy were possibly related to StarLink. The CDC studied the blood of these 28 individuals and concluded there was no evidence the reactions these people experienced were associated with hypersensitivity to the StarLink Bt protein.



[18]

Allergen Removal Example

Peanut Allergy
Cow's Milk
Gluten-free Wheat*



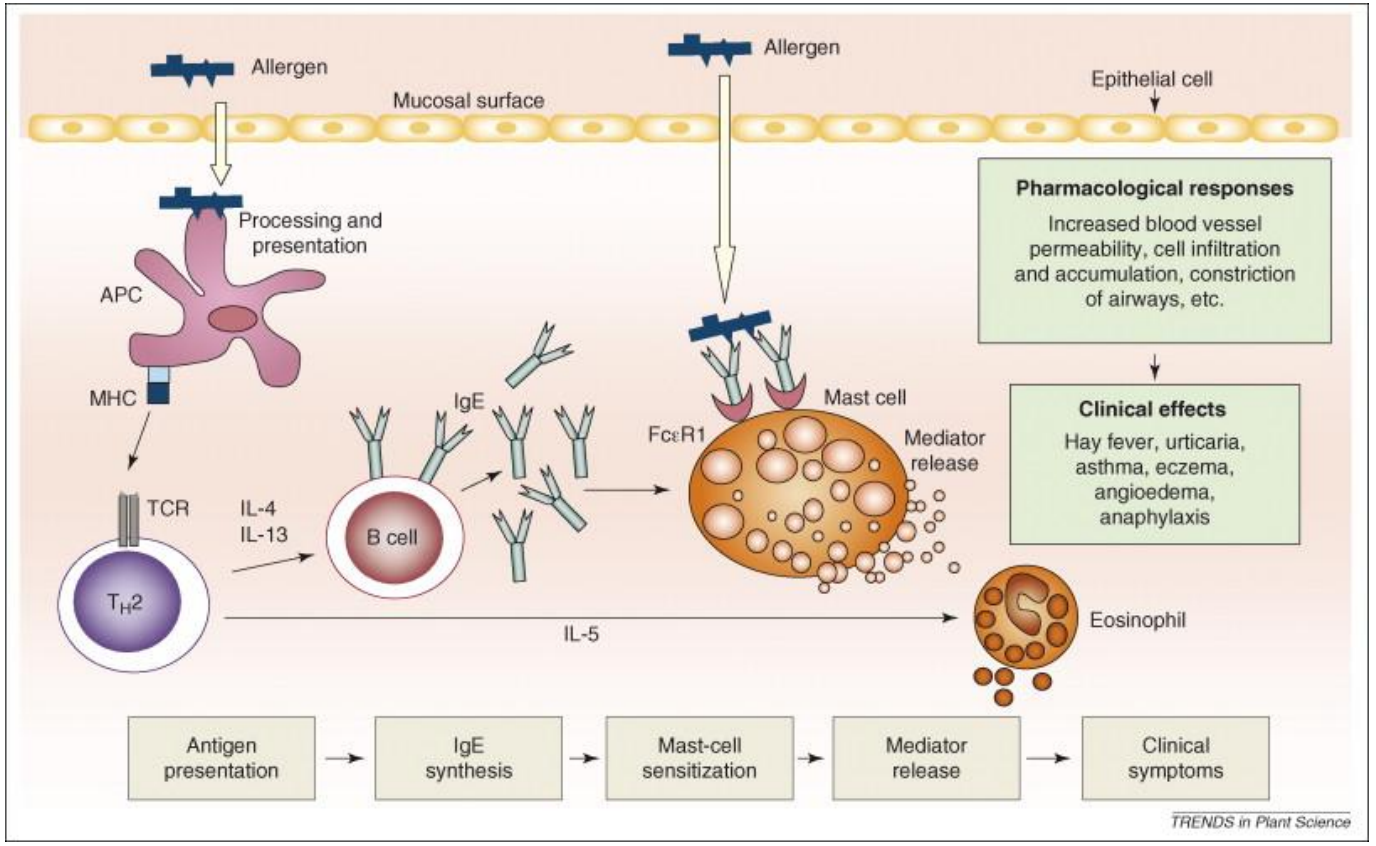
* Note that gluten sensitivity is associated with Coeliac Disease, which is not technically an allergic reaction

Allergen Removal Example

These proteins considered as important **peanut allergens** belong to legume seed-storage protein families.

- Ara h 1
- Ara h 2
- Ara h 3
- Ara h 6

These are the peanut allergens GM can remove to avoid triggering an immune response



[19]

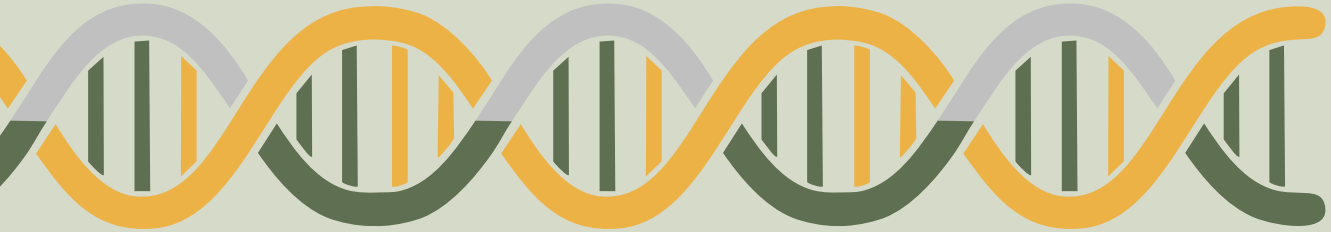
Tests

It is relatively easy to assess whether genetic engineering affected the potency of endogenous allergens using *in vitro* tests.

1. **Radioallergosorbent test (RAST)** [20]
2. **Immunoblotting (Western blotting)** [20]
3. **Pepsin Digestion test** [21]

2

Unexpected Genetic Changes



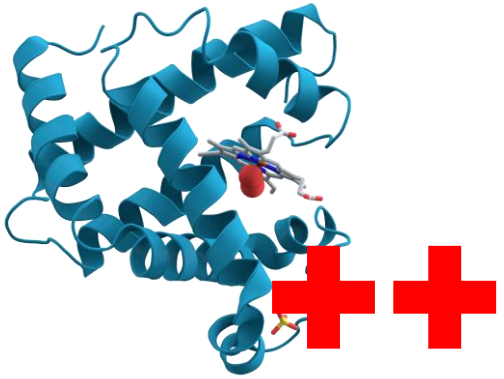
Unexpected Genetic Changes

Rice

+

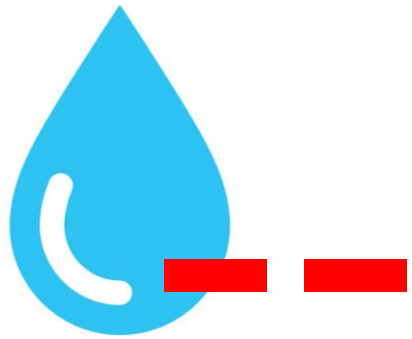
Soybean glycinin Gene

intended effect



Increase protein content

actual effect



Decrease water content

[20]

Unexpected Genetic Changes

Soybean

Agrobacterium

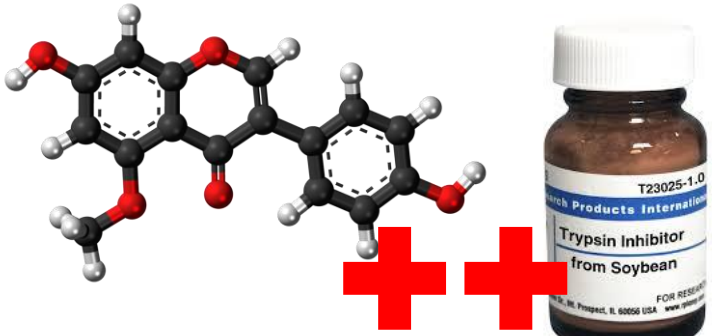
5-enolpyruvylshikimate-3-phosphate synthase

Gene

intended effect

Herbicide resistance

actual effect



Increase

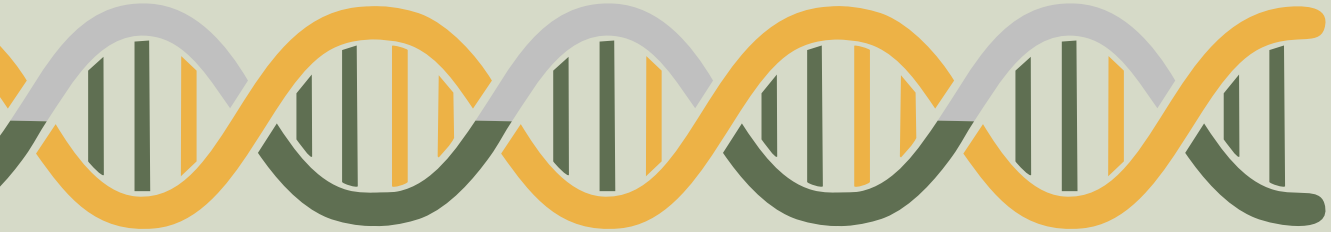
genistein (isoflavone) & trypsin inhibitor content

HEALTH CONCERN

[20]

3

Long-term Cancer Risk



Are GM foods cancerous?

There is **no correlation**
between the increase of cancer rates and consumption of GE crops. [24]

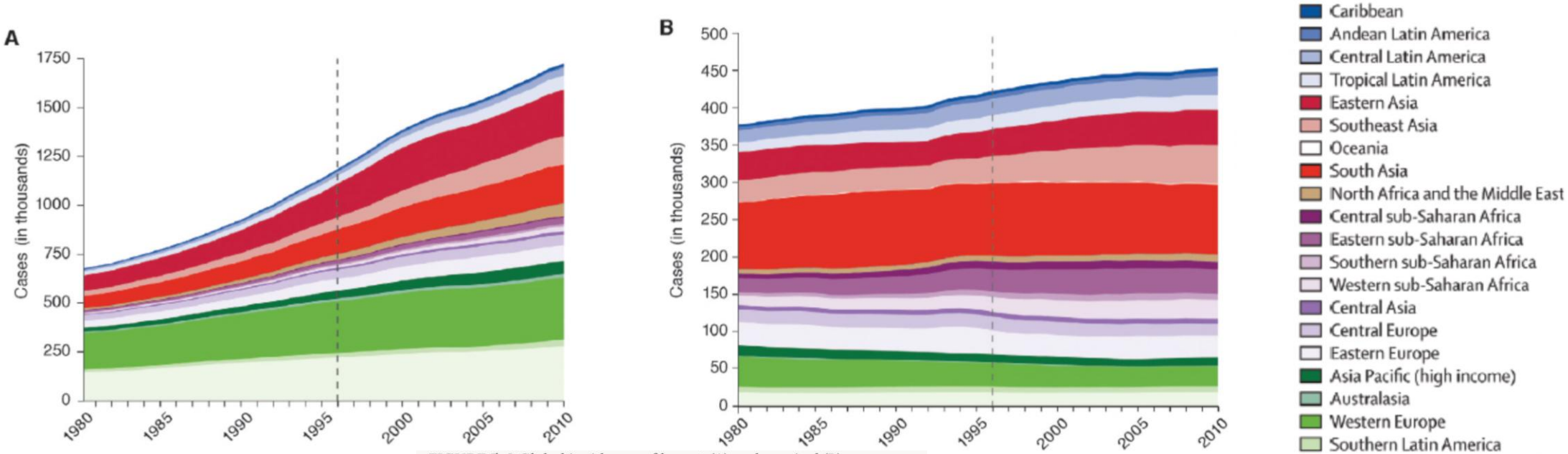
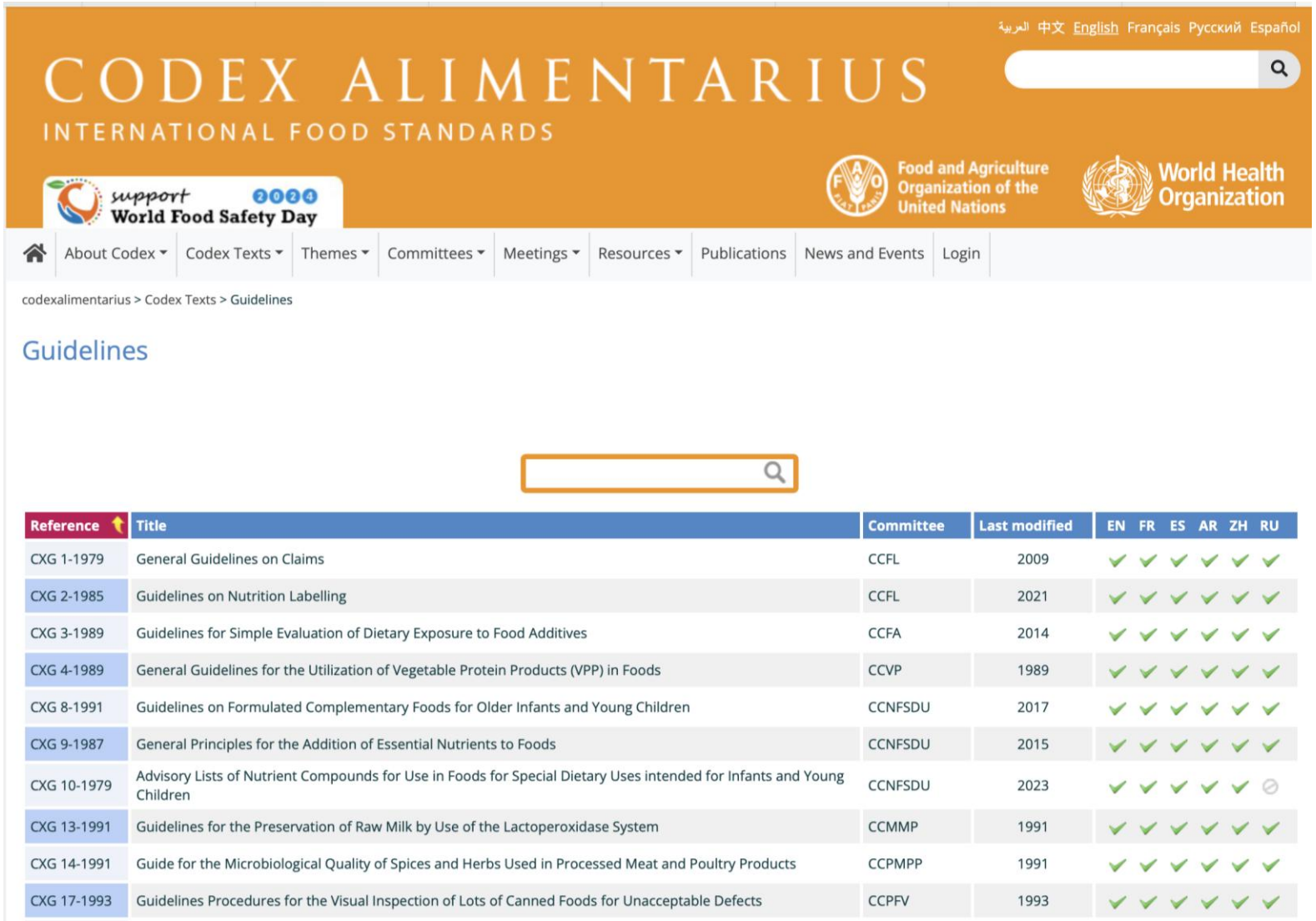


FIGURE 5-8 Global incidence of breast (A) and cervical (B) cancer.
SOURCE: Forouzanfar et al. (2011).
NOTE: North America (high income): Canada, United States; Western Europe: Andorra, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom. Dashed line at 1996 indicates year genetically engineered soybean and maize were first grown in the United States.

Who and what make GM food safe?

What make GM food safe?



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INTERNATIONAL FOOD STANDARDS

support World Food Safety Day 2024

Food and Agriculture Organization of the United Nations

World Health Organization

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Guidelines

Reference	Title	Committee	Last modified	EN	FR	ES	AR	ZH	RU
CXG 1-1979	General Guidelines on Claims	CCFL	2009	✓	✓	✓	✓	✓	✓
CXG 2-1985	Guidelines on Nutrition Labelling	CCFL	2021	✓	✓	✓	✓	✓	✓
CXG 3-1989	Guidelines for Simple Evaluation of Dietary Exposure to Food Additives	CCFA	2014	✓	✓	✓	✓	✓	✓
CXG 4-1989	General Guidelines for the Utilization of Vegetable Protein Products (VPP) in Foods	CCVP	1989	✓	✓	✓	✓	✓	✓
CXG 8-1991	Guidelines on Formulated Complementary Foods for Older Infants and Young Children	CCNFSDU	2017	✓	✓	✓	✓	✓	✓
CXG 9-1987	General Principles for the Addition of Essential Nutrients to Foods	CCNFSDU	2015	✓	✓	✓	✓	✓	✓
CXG 10-1979	Advisory Lists of Nutrient Compounds for Use in Foods for Special Dietary Uses intended for Infants and Young Children	CCNFSDU	2023	✓	✓	✓	✓	✓	⊘
CXG 13-1991	Guidelines for the Preservation of Raw Milk by Use of the Lactoperoxidase System	CCMMP	1991	✓	✓	✓	✓	✓	✓
CXG 14-1991	Guide for the Microbiological Quality of Spices and Herbs Used in Processed Meat and Poultry Products	CCPMPP	1991	✓	✓	✓	✓	✓	✓
CXG 17-1993	Guidelines Procedures for the Visual Inspection of Lots of Canned Foods for Unacceptable Defects	CCPFV	1993	✓	✓	✓	✓	✓	✓

They are based on sound scientific research conducted by **independent international risk assessment bodies** or ad-hoc consultations organised by FAO and WHO.

What make GM food safe?

The Codex Alimentarius guidelines are a collection of internationally standards, guidelines and code of practice to protect the health of consumers and ensure fair practices in the food trade. [22]

1. **International Food Standard**
2. **Protecting Consumer Health**
3. **Removing Barriers to Trade**

International Food Standard

The standard for safety assessment schemes:

1. Evaluate GM foods in their country of origin
2. Follow the principle of “substantial equivalence”
3. Endorsed by WHO, FAO and OECD

World Health Organization

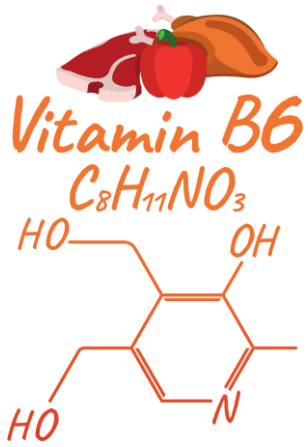
Food and Agriculture Organization of the United Nations

OECD
BETTER POLICIES FOR BETTER LIVES

International Food Standard

Safety Assessment of GM food considers:

- Characteristics of the donor and host organisms
- Composition
- Dietary intake
- Nutritional data
- Toxicological data
- Allergenic properties



To date, all GM foods put in the international market following these assessments are proven to be fit for human consumption

nutritionstudies.org

What You Should Know About

GMO REGULATION

GMOS ON THE MARKET DO NOT NEED REGULATORY APPROVAL

GMO foods enter the market without regulatory approval or consumer transparency.

NO LONG-TERM HEALTH STUDIES

There is no pre- or post-market testing of GMOs or long term consumer studies that explore GMO effects on human health.

SAFETY STUDIES ARE NOT REQUIRED AND INADEQUATE

Rat feeding experiments are not required, repeated, or long enough to rule out diseases that develop slowly, like cancer, but are used to "prove" GMO safety in humans.

BAD FINDINGS ARE HIDDEN

Biotech companies are not required to disclose all of their research and can hide bad findings from the public and regulatory agencies.

FLAWED APPROVAL PROCESS

FDA approval process is minimal and does not require peer review or additional testing for safety.

Visit nutritionstudies.org to learn more!

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How are GM crops regulated?

Research (5-7 years)

- Researchers look for solutions to a yield, stress, pest or nutrient problem by introducing beneficial traits or reducing negative characteristics in plants to produce a new and improved seed.
- Plants are tested in labs and greenhouses, and those that continue to show potential move to a field trial.

Limited and control release (2-3 years)

- Under the oversight of the Office of the Gene Technology Regulator (OGTR), plants are grown under controlled conditions to allow researchers to monitor and collect safety information to submit for evaluation.

Commercial release (1 year)

- Scientists at the Office of the Gene Technology Regulator (OGTR) carry out risk analysis to identify and manage any risks to human health and safety and the environment posed by the commercial release of new GM crops . Before a licence is granted, the Regulator prepares a risk assessment and risk management plan.
- Pre-market safety assessments may also be required by end-product regulators Food Standards Australia and New Zealand (FSANZ), the Australian Pesticides and Veterinary Medicines Authority (APVMA) and the Therapeutic Goods Administration (TGA) on a case-by-case basis depending on the GM trait.
- Approval by the OGTR does not necessarily mean that farmers have access to the new technology. State regulations sometimes ignore the science and prevent access. Click here for more (link to State Regulation page).

Product Labelling

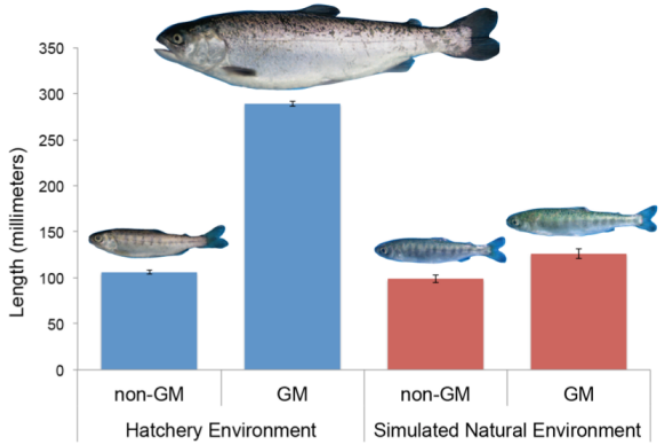
- To facilitate consumer choice, it is mandatory in Australia to label all foods and food ingredients that contain GM material. Food labelling requirements are overseen by FSANZ. End products that do not contain any genetically modified material, such as highly-refined oils, sugars and starches are exempt from the mandatory labelling regime. More on food labelling (link to labelling policy statement).

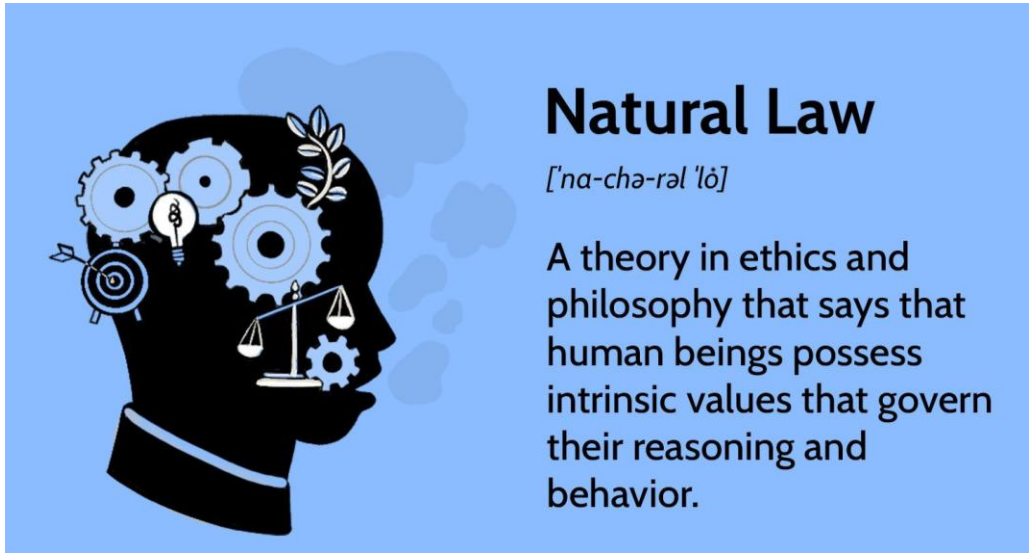
It can take up to **13 years** and **$136 million U.S.** to develop and ensure the safety of a **new plant biotech product** before bringing it to market.

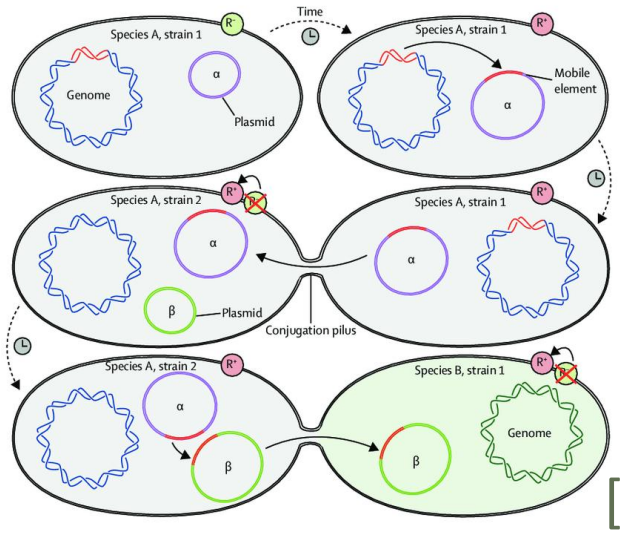
Ethical Concerns and Conclusion

Moral and Science Ethics Issue

- Violation of the Order of Nature
- Interference of Nature
- Inadvertent Gene Pool Contamination







[18]

Conclusion and Discussion

As pursuers of science, we cannot deny the benefits of genetically modified food. Based on science and scientific-based regulation, GM food is safe for us, if we are doing all the things in a transparent and honest way.

Despite safe for human consumption, we have to consider the moral and bioethics.

Thank You

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