

Genetics

Biology Dep.3rd Stage

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Genetically modified foods

Genetically modified foods or **GM foods**, also known as **genetically engineered foods** or **bioengineered foods**, are foods produced from organisms that have had changes introduced into their DNA using the methods of genetic engineering. Genetic engineering techniques allow for the introduction of new traits as well as greater control over traits than previous methods such as selective breeding and mutation breeding.



Commercial sale of genetically modified foods began in 1994, when Calgene first marketed its unsuccessful Flavr Savr delayed-ripening tomato. Most food modifications have primarily focused on cash crops in high demand by farmers such as soybean, corn, canola, and cotton. Genetically modified crops have been engineered for resistance to pathogens and herbicides and for better nutrient profiles. GM livestock have been developed, although as of November 2013 none were on the market.

There is a scientific consensus that currently available food derived from GM crops poses no greater risk to human health than conventional food, but that each GM food needs to be tested on a case-by-case basis before introduction. Nonetheless,

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members of the public are much less likely than scientists to perceive GM foods as safe. The legal and regulatory status of GM foods varies by country, with some nations banning or restricting them, and others permitting them with widely differing degrees of regulation. However, there are ongoing public concerns related to food safety, regulation, labelling, environmental impact, research methods, and the fact that some GM seeds, along with all new plant varieties, are subject to plant breeders' rights owned by corporations.

Mendel: making crosses, introducing 1860

Discovery of hybrid genes 1920

Inducing vigor 1950

Tissue culture and embryo mutations 1960

Plant transformation -GMO 1980

The scientific basis of all crop improvement is the identification of the genes that encode certain phenotypic characteristics. Those genes can now be transferred more easily (via marker assisted breeding - no GM) or directly (through genetic engineering - GM)

What are genetically modified foods?

- Also called genetically modified organisms (GMO).
- Involves the insertion of DNA from one organism into another OR modification of an organism's DNA in order to achieve a desired trait.



strawberry resistant to frost

- Foods that contain an added gene sequence

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- Foods that have a deleted gene sequence
- Animal products from animals fed GM feed
- Products produced by GM organisms
- Genetic engineering offers a rapid and precise method of altering organisms as compared to traditional methods that are slow and inaccurate.

Examples of GMO's

Golden rice – rice that contains beta-carotene (Vitamin A), which is not found in regular rice.

- **Bt corn** – corn that contains a chemical normally found in a bacterium (*Bacillus thuringiensis*) that is toxic to insects but not to humans.
- **Herbicide resistant plants.**

Common GM Foods

- * Vegetables
- * Tomatoes
- * Potatoes
- * Rice
- * Cheese
- * Meat

How is genetic modification possible?

- The components of DNA are the same in all organisms.
- Sequences that code for proteins can be moved from one organism to another.
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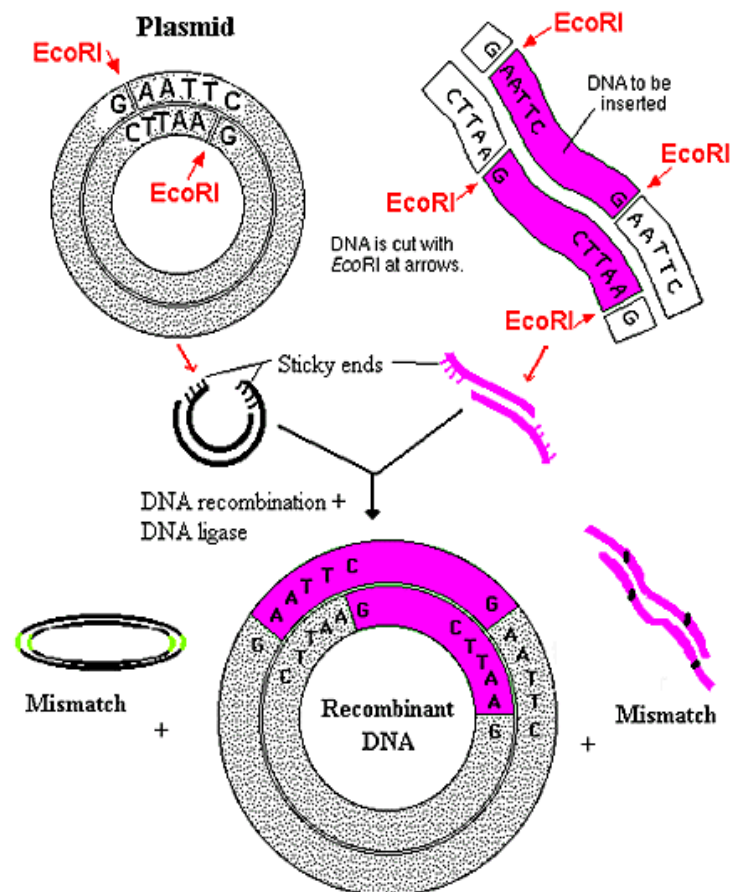
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How can DNA be moved from one organism to another?

- ▶ Find an organism with the desired trait
- ▶ Isolate the gene sequence that codes for the desired trait
- ▶ Insert the gene sequence into the genome of the plant cell
- ▶ Allow the genetically altered cell to grow into a plant
- ▶ Allow the plant to propagate
- ▶ A vector can carry DNA. The vector can be a pellet from a gene gun. Viruses and bacteria also can be utilized to transfer genes.



Modifying Genes

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- Also called recombinant DNA technology, molecular cloning, and genetic engineering.
1. Restriction enzymes are used to “cut” DNA segments from one genome.
 2. DNA ligases are used to “paste” them into another genome.

How are animals targeted?

- The microinjection method uses a fine needle to inject a solution of DNA into a developing embryo.



How are plants targeted?

- Agrobacterium that normally normally infects plants with disease is used to infect plant with gene of interests or...
- A particle gun is used to shoot small bits of metal coated with the gene into the plant.



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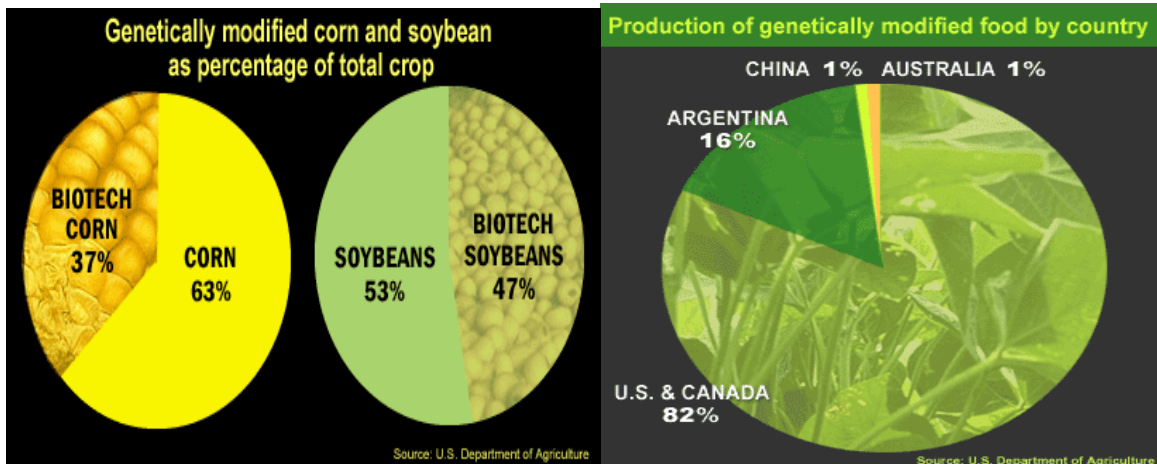
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How common are GM foods?

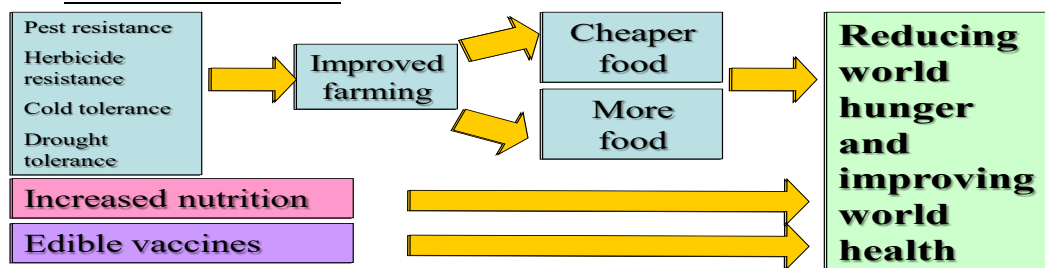
48 foods have been approved for use by the Canadian Food Inspection Agency.

Products Corn ,Canola, Potatoes, Tomatoes ,Squash Soybeans ,Cotton, seed oil ,Sugarbeets



Potential Benefits

Humanitarian:



Environmental: reduced use of herbicides and chemicals in farming.

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- Pest resistance
 - Crop loss due to insets → financial loss to farmers
 - So, farmers use tons of pesticides/fertilizers annually
 - GM eliminates pesticides and thus ↓ cost of production
- Disease resistance
 - Viruses, fungi, bacteria → plant diseases
 - GM crops resistance to these diseases
- Cold resistance
 - Frost can destroy sensitive seedlings
 - Antifreeze gene from cold fish → tobacco and potatoes
- Drought resistance
 - More population → ↑ land for housing, ↓ land for farming
 - Land unsuited for plant cultivation → Africa, desert
 - GM crops → grow in draughts or ↑ salt-content soil
- Nutrition
 - Single crop (rice) cannot give all the nutrition needed
 - Lack vitamin A → blindness → common in EMs
 - GM food: golden rice has Vitamin A (beta-carotene)
 - GM food: with enhanced iron is underway, Europe?
- Pharmaceuticals
 - Edible vaccines.

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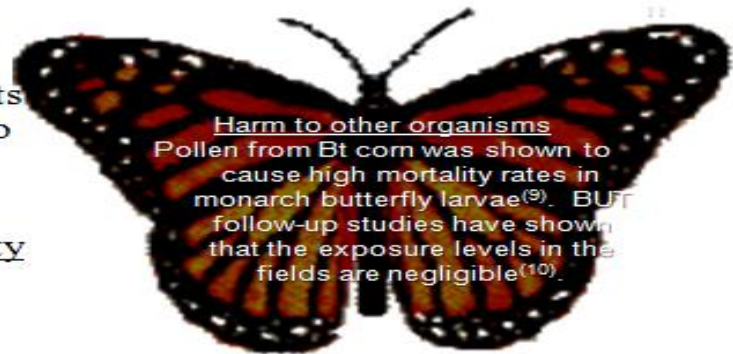
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- Easier to ship, store, administer than traditional injections

Potential Environmental Hazards

Reduced effectiveness of pesticides as insects become resistant to engineered toxins.

Loss of biodiversity



Gene Transfer to non-target species

- Herbicide resistant plants and weeds could cross breed and create “superweeds”
- To address this one could:
 - Create sterile male plants that don’t produce pollen
 - Engineer the plants so that pollen doesn’t contain the foreign genes
 - Create buffer zones of non-GM crops around GM crops. The buffer crops would not be harvested.

Potential Human Health Risks

Allergens

- Genetic engineering could potential introduce or create allergens
- For example, inserting genes from a nut into another plant could be dangerous for people who are allergic to nuts

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Unknown health risks

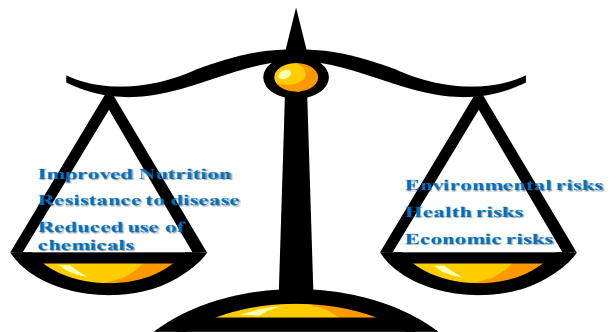
- Biological processes involve a lot of INTERACTIONS
- It is often difficult to identify every possible interaction.

Economic Hazards

- Elimination of competition
 - GM seeds are patented
- Suicide seeds
 - Plants with sterile seeds that are infertile are created
 - Farmers are forced to buy seeds every year
- However, some companies have reduced costs or donated GM seeds to impoverished nations.

Creating a balance

- So are GM foods a good or bad thing?
- It depend on each individual case.
- Consumers, the government and scientists should be responsible for weighing the benefits against the costs.



Genetics is always better than chemicals:

GM Cotton with a *Bacillus thuringiensis* Cry gene is resistant

to Cotton Bollworm. Cry encodes an insecticidal protein

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Are GM foods safe and nutritious?

1. All GM foods have been extensively tested and they are as safe as other foods in the market place.
2. GM crops can be made into convenience and “junk” food just like organic crops and other crops!
3. Nutrition depends on the food, not the method of crop breeding



How to Label ?



Conventional corn

Pesticides available



G M O

Pesticide free

Who makes sure GM foods are safe?

- Government agencies regulate GM foods
- GM foods in the United States are required to be labeled only if the nutritional value is changed or a new allergen is introduced.