



GENETICALLY MODIFIED FOODS

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Before Reading Any Further...

What is the first impression
you get when you hear
“genetically modified” foods?



Is it...



1

? or



2

What's scarier is not knowing the facts!

Which of these might be genetically engineered?

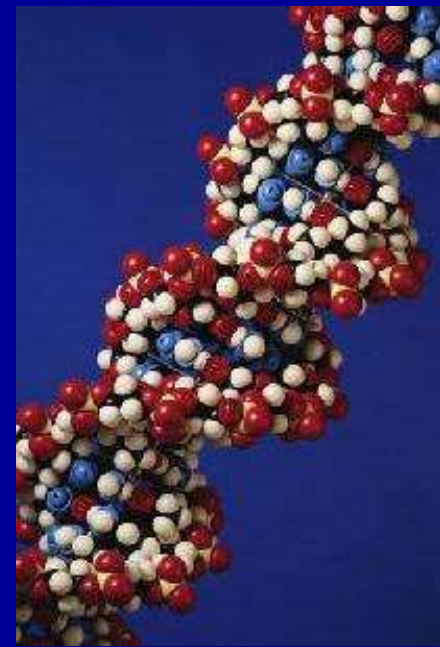
Answer: only the yellow squash (front right).





What is DNA?

- DNA is molecule of life.
- It contains all of instructions (genes) required to make an organism.





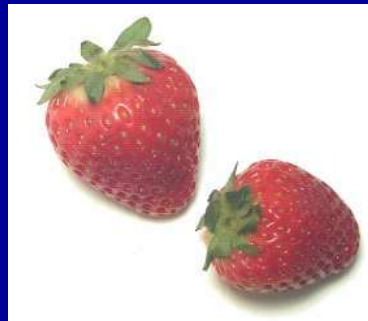
What are genetically modified foods?

- 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.



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A strawberry
resistant to frost

Arctic fish DNA

strawberry



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.**



Trait

Modified Plants

- **Insect Resistance** corn, cotton, potato, tomato
(first type of modification)
- **Herbicide Resistance** corn, soybeans, cotton, canola,
sugar beets, rice
- **Virus Resistance** squash/zucchini, papaya,
- **Delayed Fruit Rot** tomato
- **Altered Oil Content** canola, soybeans
- **Pollen Control** corn, chicory





History:

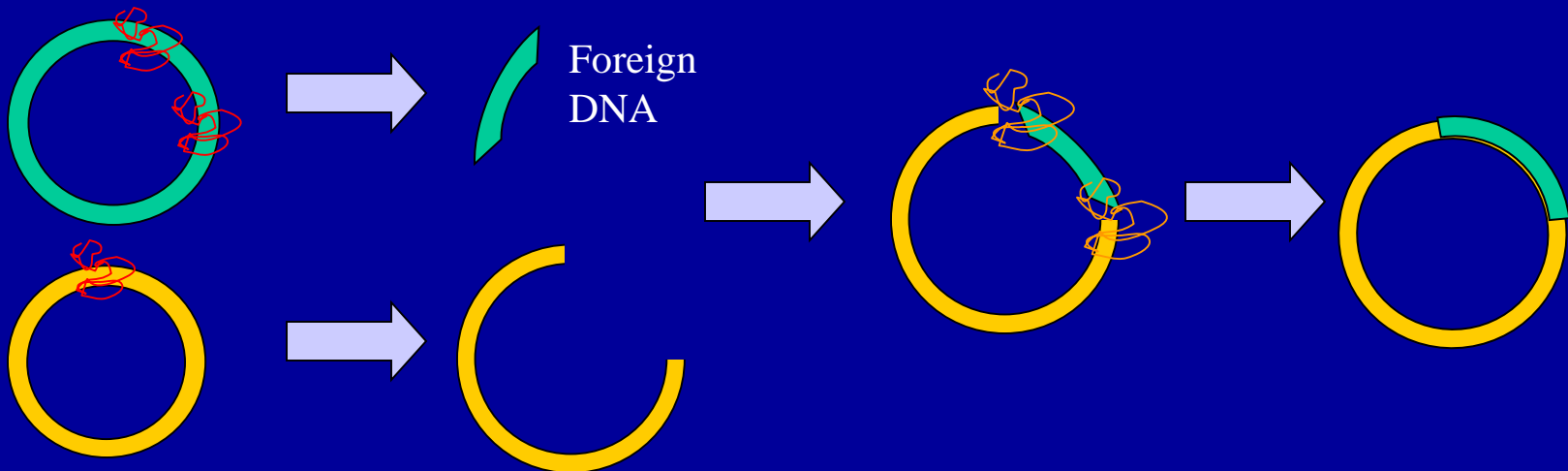
- The first GM food crop, a tomato developed by Monsanto was submitted for approval to the US FDA in August 1994 and came into market in the same year.
- As of September 2008, a total of 111 bioengineered food products have completed the US FDA "consultation procedures" on bioengineered foods.
- According to estimates by the Grocery food research center of America, "between 70 percent and 75 percent of all processed foods available in U.S. grocery stores may contain ingredients from genetically engineered plants. Breads, cereal, frozen pizzas, hot dogs and soda are just a few of them."





Modifying Genes

- 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 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.





How common are GM foods?

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

Products

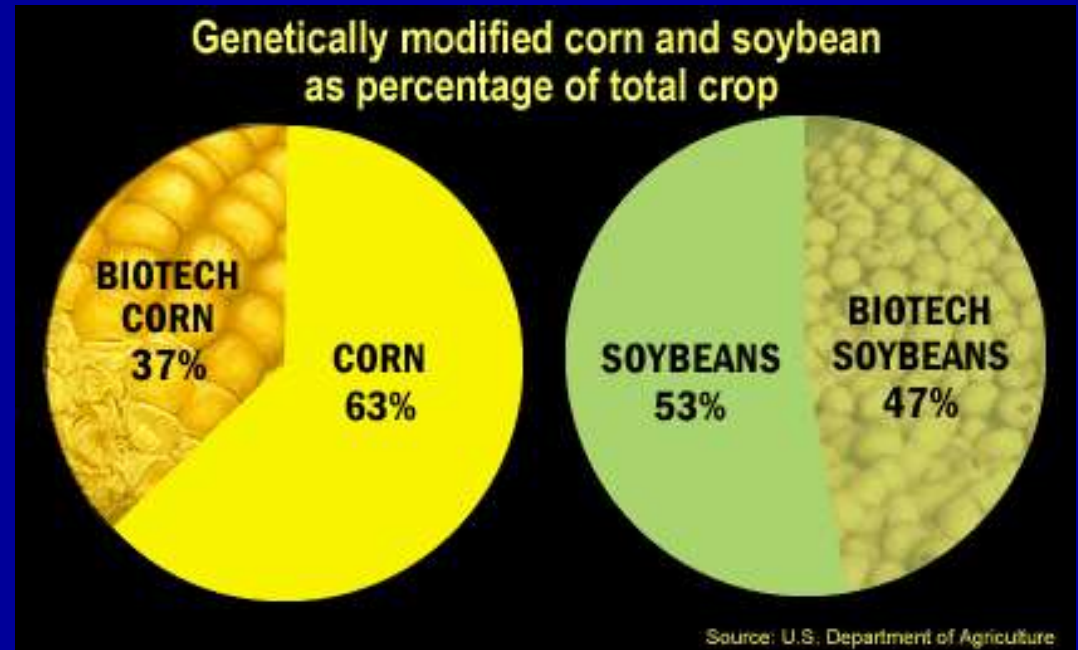
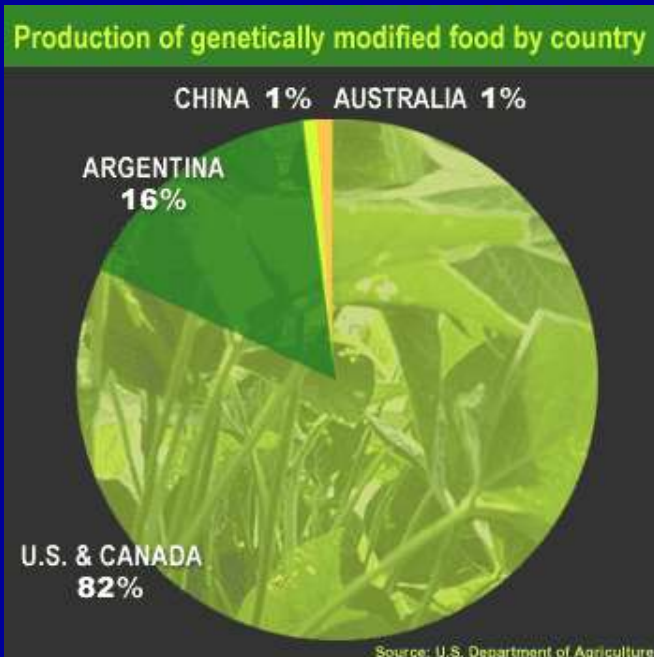
Corn
Canola
Potatoes
Tomatoes
Squash
Soybeans
Flax
Cottonseed oil
Sugarbeets

Derived Products

Corn syrup
Tofu
Canned foods
Soya sauce
Animals that feed on GMOs...
....
AND MORE



How common are GMO foods?



8

Labeling of GM foods is not mandatory unless *if there is a health or safety concern* (Health Canada/Canadian Food Inspection Agency)



The benefits of GM foods

- Support for GM foods come from different sectors: scientists, economists, and understandably from the agricultural and food industries.
- GM foods can fight world hunger.
- GM foods supposedly are easier to grow and bring higher yields
- They are meant to be resistant to drought, diseases, and pests
- GM foods can fight malnutrition.
- To cite an example, Swiss research strove to create rice strains that contain large amounts of beta-carotene and iron to counteract vitamin A and iron deficiency
- FLORA purple tomatoes have three times the amount of the antioxidant anthocyanins compared to normal tomatoes



GM foods can help medicine

- GM foods can be used in producing pharmacological products in the so-called medical molecular farming: production of antibodies, biopharmaceuticals and edible vaccines in plants.
- In 2005, Indian researchers reported the potential use of transgenic bananas in carrying vaccines against hepatitis B.
- In the same year, the biotech company GTC Biotherapeutics based in Framingham, Massachusetts has developed a herd of genetically modified goats that produce milk which contains a human anticoagulant called anti-thrombin



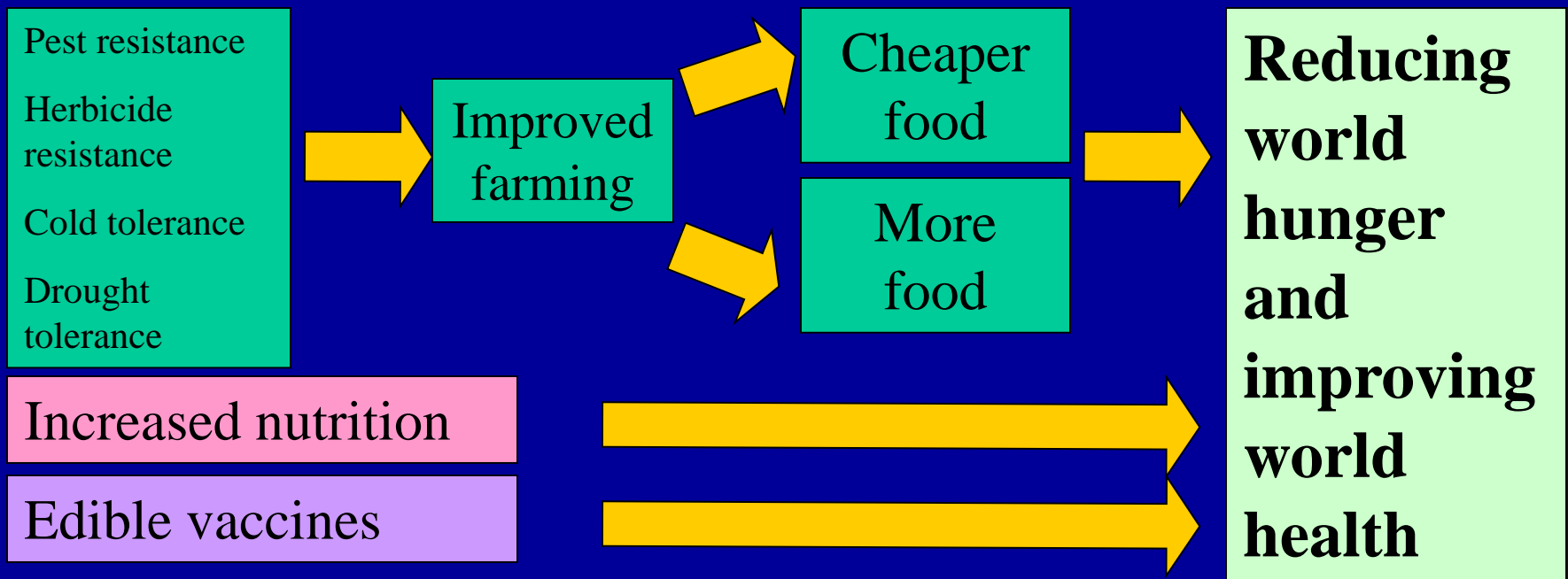
GM foods are safe

- GM crops are regulated by three agencies:
- The US Department of Agriculture (USDA)
- Environmental Protection Agency (EPA)
- US FDA
- The FDA ensures that foods made from these plants are safe for humans and animals to eat
- The USDA makes sure the plants are safe to grow
- According to the US FDA, "bioengineered foods do not pose any risks for consumers"



Potential Benefits

Humanitarian:



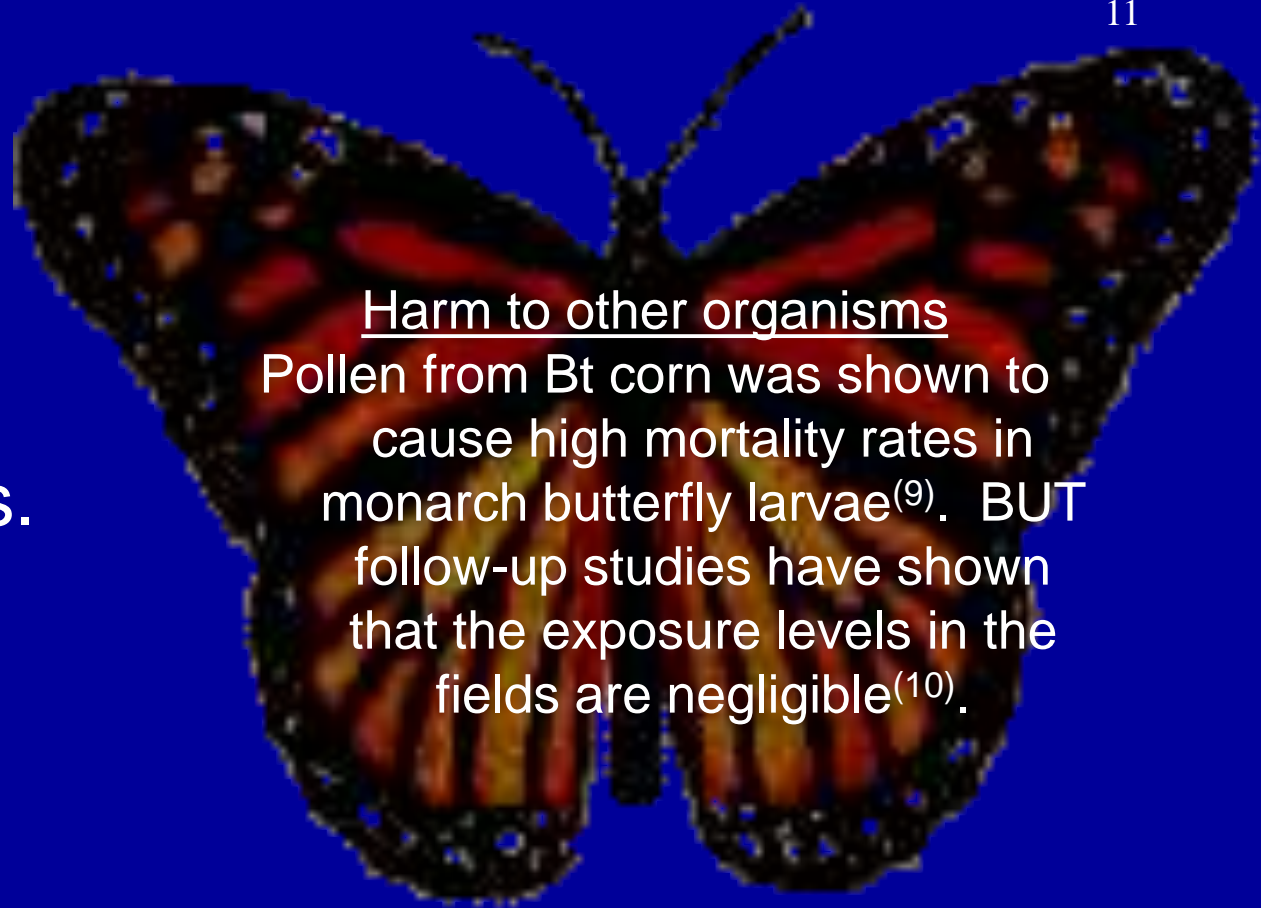
Environmental: reduced use of herbicides and chemicals in farming.



Potential Environmental Hazards

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

Loss of biodiversity



Harm to other organisms

Pollen from Bt corn was shown to cause high mortality rates in monarch butterfly larvae⁽⁹⁾. BUT follow-up studies have shown that the exposure levels in the fields are negligible⁽¹⁰⁾.



Potential Environmental Hazards

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

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.



**Labeling of GM foods and
food products is also
necessary**



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.





Conclusion

- **Genetically-modified foods have the potential to solve many of the world's hunger and malnutrition problems, and to help protect and preserve the environment by increasing yield and reducing reliance upon chemical pesticides and herbicide**



Thank you for your attention