

# Genetically Modified Food

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- GM food on the market
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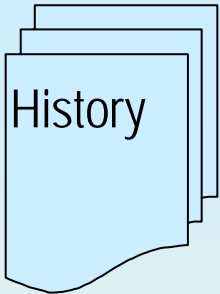


# Key terms



- **GMO** = genetically modified organism  
„Organisms in which the genetic material (DNA) has been altered.“
- **GEO** = genetically engineered organism
- **Genetic engineering** uses the techniques of molecular cloning and transformation.
- Term was coined in Jack Williamson's science fiction novel *Dragon's Island* (1951), two years before Watson and Crick showed that DNA could be the medium of transmission of genetic information.

# Development & techniques



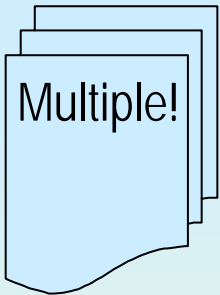
- GM food introduced 19 years ago
- Improve crop protection
- Resistance against plant diseases (insect, virus, herbicide tolerance)
- E.g. isolation of gene responsible for draught tolerance → insert into a different plant → GM plant gains draught tolerance → higher crop yields

# Process of engineering

- Identification & isolation of genes (PCR)
- Insertion of the genes into a transfer vector
- Transformation of bacteria
- Selection of the genetically modified bacteria (GMO) using antibiotics
- Extraction of the vector from the bacteria and transfection into organism to be modified



# Applications



- Biological/ medicinal research
- Production of pharmaceutical drugs
- Experimental medicine (e.g. gene therapy)
- Agriculture (e.g. golden rice, enriched in vitamin A) → improve nutrition
- Insect-repelling crops protect the environment by minimizing pesticide use
- Improve flavor, increase hardiness and to produce allergen-free grass (hay fever)
- No-tears onion and novel caffeine-free coffee plants

# GM food

Where?  
How much?

1996	2005	Area used for GM food
17,000 km <sup>2</sup>	900,000 km <sup>2</sup>	World
Unknown	55%	US

Area of land cultivated with GMOs

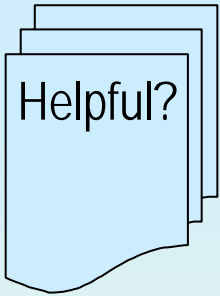


89%	Soybeans
83%	Cotton
61%	Maize

US, 2006: % of genetically modified varieties



# Controversy - Pros

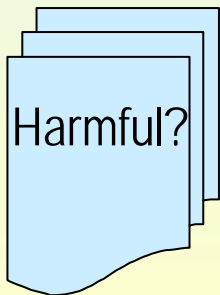


- Growing world population → GM food allows better food supply
- Pest resistance
- Herbicide tolerance
- Disease resistance
- Cold tolerance
- Drought tolerance/salinity tolerance
- Pharmaceuticals Medicines: vaccines in tomatoes/potatoes
- Phytoremediation of soil and organic compounds

# Controversy – Cons I



- Environmental hazards:
  - ◆ Agribusiness pursues profit without concern for potential hazards
  - ◆ Unintended harm to other organisms
  - ◆ Reduced effectiveness of pesticides
  - ◆ Gen transfer to non-target species
  - ◆ Loss of biodiversity
- Human health risks:
  - ◆ Allergies
  - ◆ Unkonwn effects?

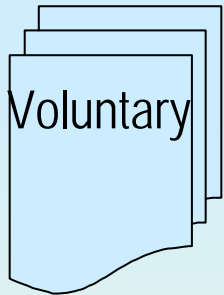


# Controversy – Cons II

- Economic concerns:
  - ◆ Agriculture-biotech companies wish a profitable return on their investment
  - ◆ Patent infringement
  - ◆ Patenting varieties, raise prices of the seeds
  - ◆ Gap between wealthy and poor grows
  - ◆ *Suicide gene technology* – should be abandoned? (plants are viable for one growing season)

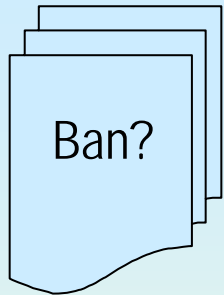


# Labeling of GM foods



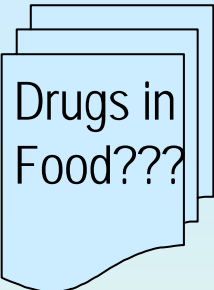
- OECD has introduced a “unique identifier”
- Countries establish labeling regulations and guidelines on co-existence and traceability
- Higher costs → two separate processing streams; Who pays? The consumer?
- Monitoring system for 0% GM contamination don't exist
- Detectability with existing methodologies not possible
- International trade agreement for labeling GM food (Jan. 2000; signed by 130 countries)
- Exporters have to label all GM food; products could be rejected

# Policy around the world



- Australia: banned planting GM food crops (2003-2008)
- Canada: ban did not pass; one of the world's largest producers of GM canola
- Europe: mandatory food labeling of GM foods
- New Zealand: no GM food is grown
- US: depends on the states/counties
- Japan: testing of GM food is mandatory (April 2001)
- Brazil: entire ban of GM crops

# Future Developments

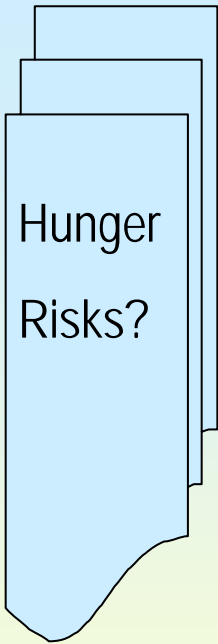


Drugs in  
Food???

- Bananas that produce human vaccines against infectious diseases such as Hepatitis B
- Metabolically engineered fish that mature quicker
- Fruit and nut trees that carry fruits years earlier
- Plants that produce new natural materials with unique properties
- Nutrition-rich maize for animal feeding
- Plants which tolerate non-biological stress (e.g. limitation of water and nitrogen, survival of extreme growing conditions, high-salinity, drought and acidic soils)

# Conclusion

- ◆ Solution to world's hunger and malnutrition problems
- ◆ Protect & preserve the environment  
→ increased yields; reduced chemical pesticides/herbicides
- ◆ Challenges: safety testing, regulation, international policy, food labeling
- ◆ Long-term health risks have to be investigated



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# Thank you for your attention!

