

Genetically Modified Organisms



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Introduction

“Any organism created by gene splicing techniques – often merging DNA from different species, scientists directly manipulate an organism's genome” (1,2)

History (1, 4-7)

30,000 BC -
First evidence



1973 - Invention
of genetic
engineering



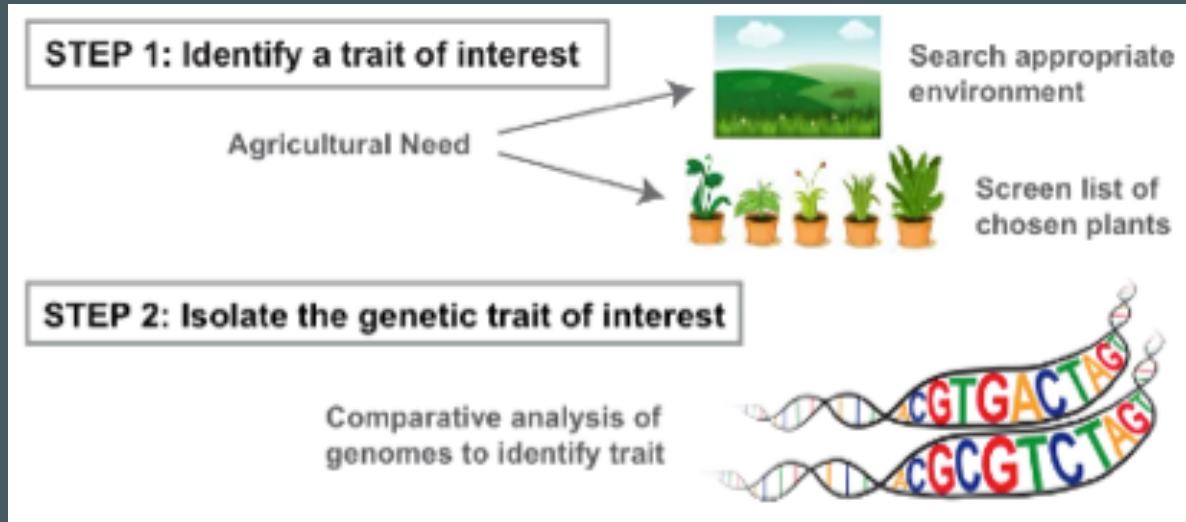
1982 - GM
Pharmaceuticals
manufactured



1992 - GM Food
consumed

Procedure Steps 1 - 2

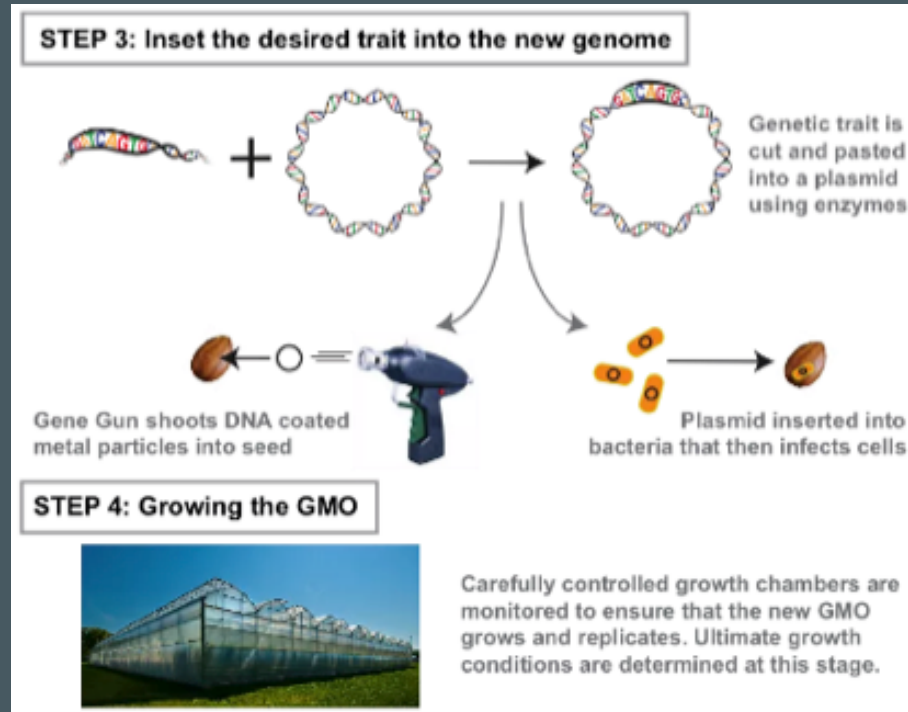
(2-3)



Retrieved from <http://sitn.hms.harvard.edu/flash/2015/how-to-make-a-gmo/>

Procedure Steps 3 - 4

(2-3)



Biological Effects of GMOs

Biological Benefit #1: Consumerism (12,13)

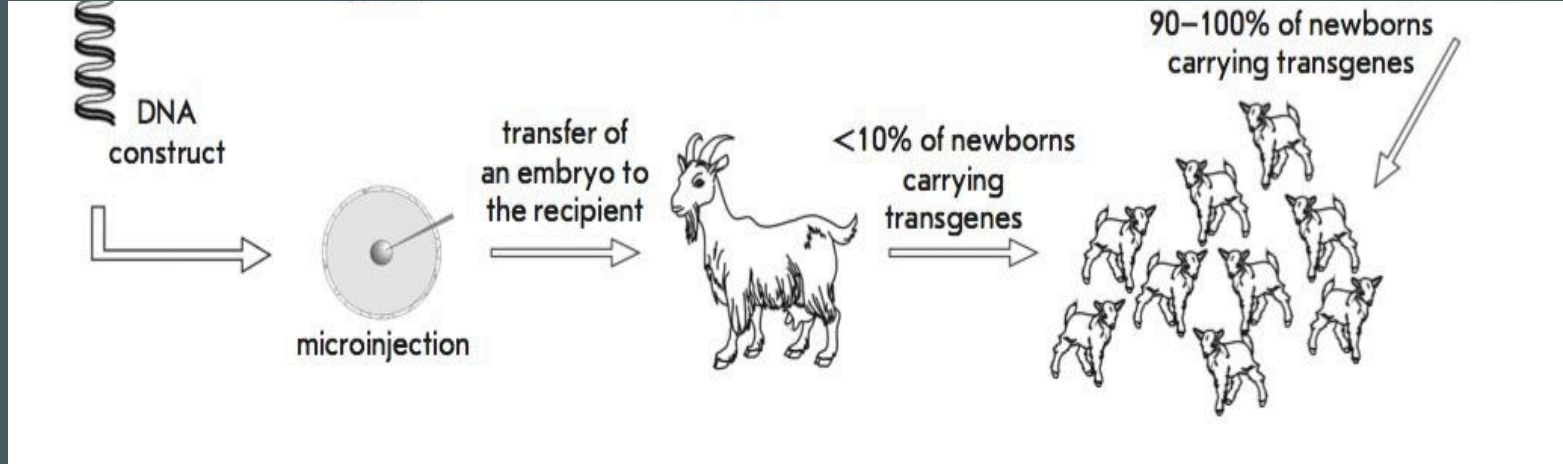
Increased efficiency

Example - Bovine Somatotropin (bST)/
Recombinant Bovine Growth Hormone
(rbGH)



Biological Benefit #2: Pharming (14,15)

- Pharming = “Pharmaceuticals”+ “Farming”
- Branch of biotechnology
- Example- Antithrombin produced by goats for human consumption

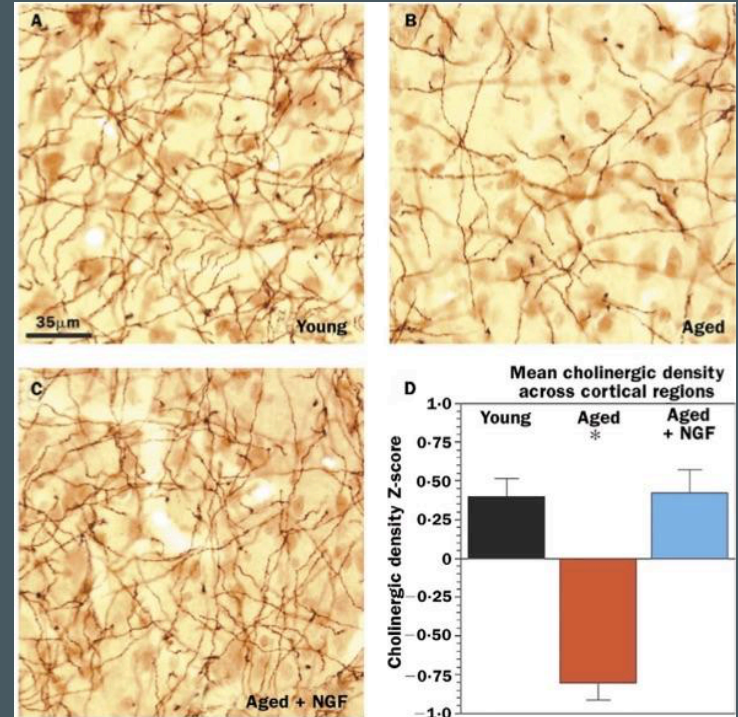


Biological Benefit #3: Gene Therapy (16)

Example- CNS diseases

Tuszynski's (2002) work with primates

Aging model



Retrieved from: Tuszynski, M. H. (2002, May). Growth-factor gene therapy for neurodegenerative disorders. *The Lancet Neurology*, 1(1), 51-57. doi:10.1016/s1474-4422(02)00006-6

Biological Risk #1:

Detection of GMO Toxins in Maternal and Fetal Blood (17)

Study identified pesticides associated with GMO foods in maternal, fetal and non-pregnant women's blood

Thirty pregnant and thirty non-pregnant women



Biological Risk #2: Study links GMOs to Gluten Disorders

(18)

Systematic Review Study released by the Institute for Responsible Technology (IRT) used data from US Dept. of Agriculture and US Environmental Protection Agency

“Bt-toxin and glyphosate are linked to five conditions that may either initiate or exacerbate gluten-related disorders,” according to Smith

GMO-relate



Biological Risk #3: DNA from GM Crops can be Transferred into Humans (19)

Peer reviewed study by PLOS emphasized sufficient evidence that meal-derived DNA fragments carry complete genes that can enter the human circulation system.

Based on the analysis of over 1000 human samples.

“...one of the blood samples had a higher relative concentration of plant DNA than human DNA”

Concluded that this could be affecting the human genome

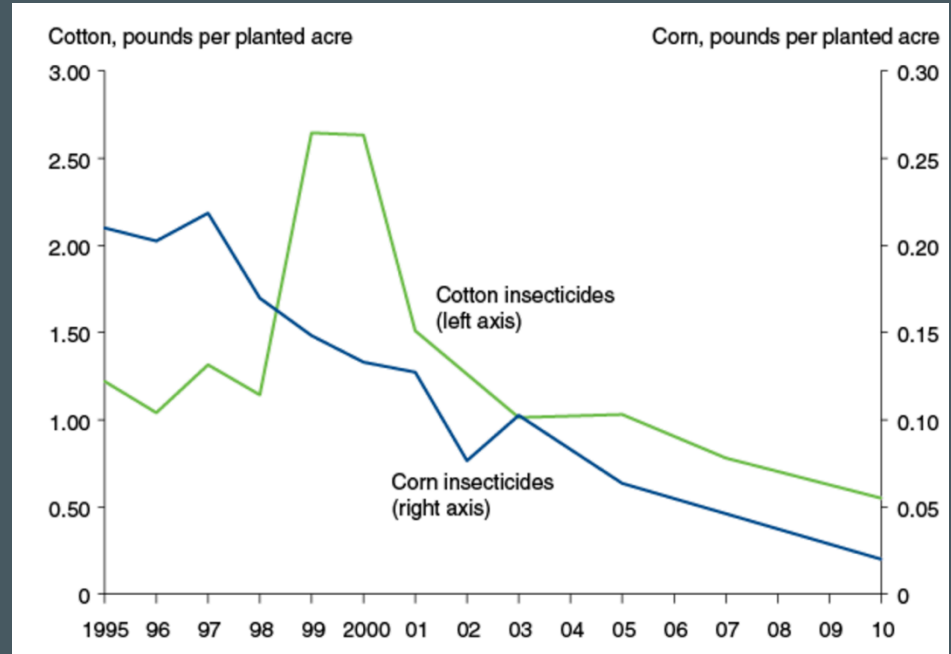


Environmental Effects of GMOs

Environmental Benefit #1: Decrease in insecticide and herbicide usage (20,21,22)

Decrease in harmful chemicals used on crops and soils

Leads to decrease in toxic chemicals in groundwater



Retrieved from:

http://www.ers.usda.gov/amber-waves/2014-march/adoption-of-genetically-engineered-crops-by-us-farmers-has-increased-steadily-for-over-15-years.aspx#_V-QyAZMrd_Vo

Example: Bt Corn

How does it work? (20,23)



Retrieved from:
<http://www.ers.usda.gov/amber-waves/2013-february/ht-corn-adoption-by-us-farmers-increases-yields-and-profits.aspx>

Environmental Benefit #2: Increase crop yield (20,24)

See significant increases in yield in *developing countries*

Have the most pests with the least amount of chemicals to use

Better crop yield= less land converted for agricultural usage

Region	Pest pressure	Availability of chemical alternatives	Adoption of chemical alternatives	Yield effect of GM crops
Developed countries	Low to medium	High	High	Low
Latin America (commercial)	Medium	Medium	High	Low to medium
China	Medium	Medium	High	Low to medium
Latin America (noncommercial)	Medium	Low to medium	Low	Medium to high
South and Southeast Asia	High	Low to medium	Low to medium	High
Africa	High	Low	Low	High

Environmental Benefit #3: Improving soil integrity

(25,26,27)
Phytoremediation

Process of plants detoxify soils and sediments

Plants absorb pollutants through roots and leaves → convert them into non-phytotoxic metabolites

Less expensive and des

mediation

Herbicides and
pollutants in soil



Non-harmful
metabolites out, clean
soil

GM plant with overexpression
of metabolism enzymes

Retrieved from: <https://slwablog.com/2014/06/23/drought-season-brings-thirsty-roots/>

Environmental Benefit #3: Improving soil integrity

(20,28,29)

Soil conservation

Herbicides can be applied after herbicide-resistant crops emerge

Shift away from mechanical weed control (tillage)

Decrease soil erosion and conserve soil moisture



Retrieved from:

https://www.google.ca/imgres?imgurl=http%3A%2F%2Fwww.e-shamba.com%2Fland_preparation%2FPrimary_Cultivation%2FImages%2FPrimary_Cultivation_Disc.jpg&imgrefurl=http%3A%2F%2Fwww.e-shamba.com%2Fland_preparation%2Fdefault_land_preparation.html&docid=vprqVUJhPwGjZaM&thnid=Q10qYLToSvvcKM%3A&w=360&h=360&hl=en&authuser=0&bih=634&biw=1042&ved=0ahUKFwjYx8-986XPAhUFNz4KHqCBakQxiAlAvqB&iact=c&ictx=1

Environmental Risk #1: Invasion into Ecosystems (30)

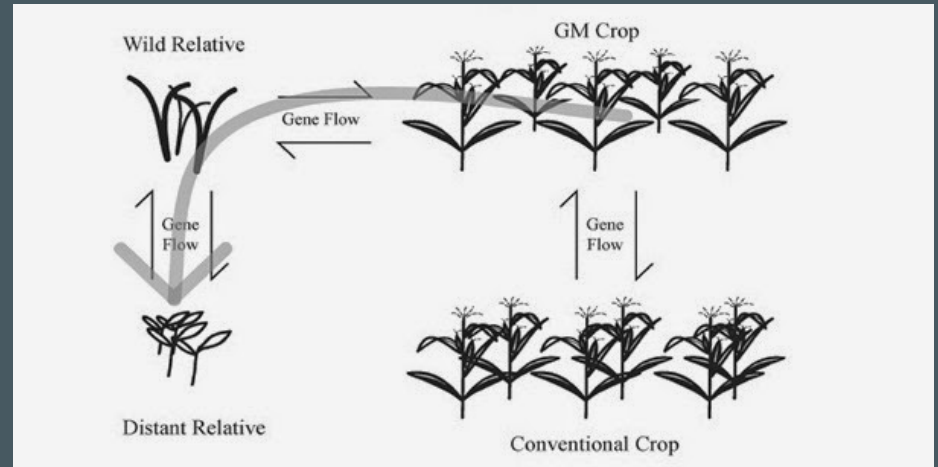
- Directly or indirectly degrading the natural structure and function of the ecosystem
- GM Atlantic Salmon



<https://www.sott.net/article/231692-First-Study-into-GM-Atlantic-Salmon-Mating-Reveals-Danger-of-Escape-to-Wild-Gene-Pool>

Environmental Risk #2: Gene Flow (31,32)

“To add genes from other plants unwittingly and randomly to native gene pools may result in phenotypic effects which could change the way entire genomes relate to their physical and biotic environments”
(32)



http://bch.cbd.int/cpb_art15/training/module3.shtml

Environmental Risk #3: Impacting Non-target Insects

(33)

- Bt corn pollen on milkweed
 - Eating less
 - Growing slower
 - Higher mortality



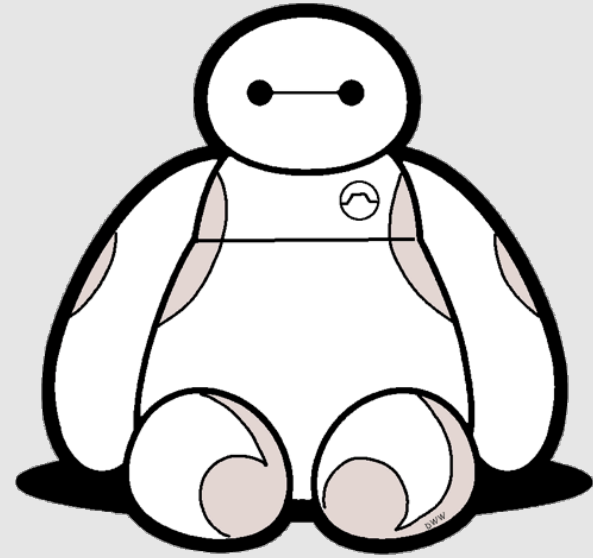
<http://www.bigblogofgardening.com/home-gardeners-can-save-the-monarch-butterfly-with-milkweed/>

Public Opinion

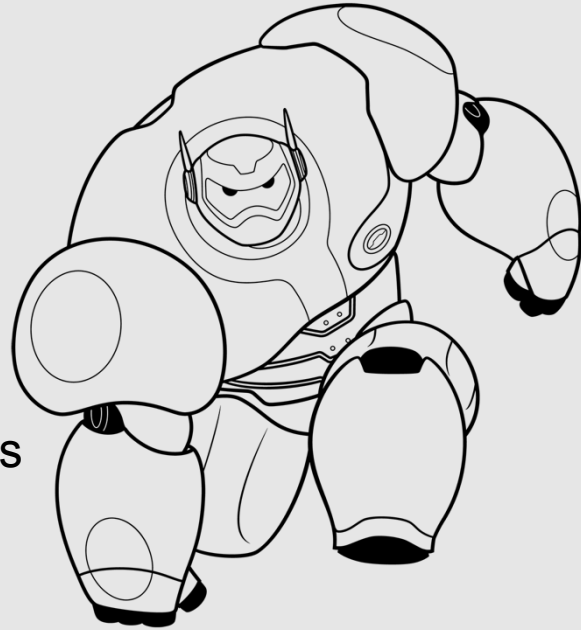


Retrieved from <http://www.dailymail.co.uk/debate/article-1283571/JOANNA-BLYTHMAN-GM-food-sinister-bid-twist-public-opinion.html>

Responsibilities and Recommendations (8-11)



1. The public must be sincerely informed of the advantages, disadvantages, and limits
2. Regulatory status must be evaluated by governing bodies
3. Risk-benefit communication must be carefully performed



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Multiple Choice Test Questions

1. What is the function of antithrombin derived from transgenic goats?
 - a. Anti inflammatory
 - b. Anticoagulant ##
 - c. Immunosuppressant
 - d. Antidiuretic
 - e. None of these

2. Which of the following is considered a benefit for using GMOs?
 - a. Opportunity to introduce new species into the ecosystem
 - b. The ability to successfully breed GM species with their wild relatives
 - c. Can reduce the use of tilling ##
 - d. DNA from GM plants have been found in human blood
 - e. None of the above is considered beneficial