Academy of Nutrition and Dietetics Foundation
Future of Food Initiative

The Nutrition Professional's Guide to GMOs

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Photo credit: Amy Myrdal Miller

Session objectives

1. Explain the history of GMOs in the food supply and describe the process involved in developing GM crops.
2. Identify benefits of GM foods supported by science, as well as scientific and consumer concerns with GM foods.
3. Identify sources of science-based information on GM foods.

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Speakers

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Future of Food Resources for Members

- Toolkits www.eatrightfoundation.org/toolkits-webinars
  - Hunger in Our Community. What We Can Do.
  - Smart Choices. For a Healthy Planet. (English/Spanish!)
  - Tossed Treasures. How We All Can Waste Less Food. (English/Spanish!)
- Supervised Practice Concentrations:
  - Food Insecurity and Food Banking—available now! www.healthyfoodbankhub.org
  - Food Systems—under development!
- Webinars and Infographics www.eatrightfoundation.org
- Affiliate Presentations:
  - "Changing the Way We Look at Agriculture" 32 affiliates/DPGs (2015)
  - Food waste, food additives, and GMO presentations 10 affiliates (2016)
  - Foods of future, farming tools, and food preservation presentations 10 affiliates (2017)

Last year our donors' generosity helped us award:

$446,900 in student scholarships to 194 students

$14,000 in student stipends to help 140 students attend FNCE.

$40,000 through Home Food Safety Challenge grants to dietetics students.

www.eatrightfoundation.org

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Disclosures

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- **Immediate Past President 2014-2015 Institute Food Technologists**
- DuPont 2005-2015
- Monsanto 1997-2005

What is 'Biotechnology?'[1]

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Agricultural biotechnology is a range of tools, including traditional breeding techniques, that alter living organisms, or parts of organisms, to make or modify products; improve plants or animals; or develop microorganisms for specific agricultural uses.

Modern biotechnology today includes the tools of genetic engineering.

GE & GMOs[2]

Genetic engineering (GE) is the technology that allows for selected individual genes to be transferred from one organism to another.

Genetically modified organisms (GMOs) are organisms in which the genetic material has been altered in a way that does not occur naturally.

Safety Assessment of GM Crops[3]

- Weight of evidence approach
  - GM proteins (eg. Bt gene)
    - Gene source
    - History of safe use
    - Bioinformatics
    - Digestibility/stability
    - Mechanism of action/specificity
    - Exposure
    - Mammalian toxicity testing

  - GM Crop
    - Composition assessment – Substantial equivalence
    - Animal feeding studies

International Biotech Guidance[4]

- **OECD**
  - **Substantial Equivalence (1993)**
    - Not possible to demonstrate that any food is absolutely safe
    - Composition and agronomic properties of the GM crop comparable to those in an appropriate non-GM comparator
- **Codex Alimentarius**
  - **Principles for Risk Analysis**
    - Guidelines for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Plants
      - *Allergenicity Annex*
      - *Nutritional Composition Annex*
    - Guidelines for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Microorganisms and DNA Animals
- **Cartagena Protocol on Biosafety**

US Biotech Regulatory[5,6]

Three Federal agencies review under a coordinated framework to *ensure human and environmental safety*

- **FDA**- safety and *labeling* of whole foods, food ingredients and additives
  - Once tested and approved no labeling required to differentiate GM vs. Non-GM
- **USDA/APHIS**- biotech plants; field test inspection
- **EPA**- registration of use of pesticides and herbicides

GMOs in Food[7]

- 1st trait commercialized in 1993
  - 23 years in food supply
- Primarily for animal feed
- Human foods
  - Most processed - oils
- History of safe use
- Currently 9 crops commercially
  - 1 more and 1 animal coming to market soon

20+ Years

GMO Crops Available Commercially

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- Apples
- Potatoes
- Field Corn
- Sweet Corn
- Canola
- Alfalfa
- Soybeans
- Papaya
- Cotton
- Sugar Beets
- Zucchini and Yellow Summer Squash

Global Adoption of Plant Biotech[8]

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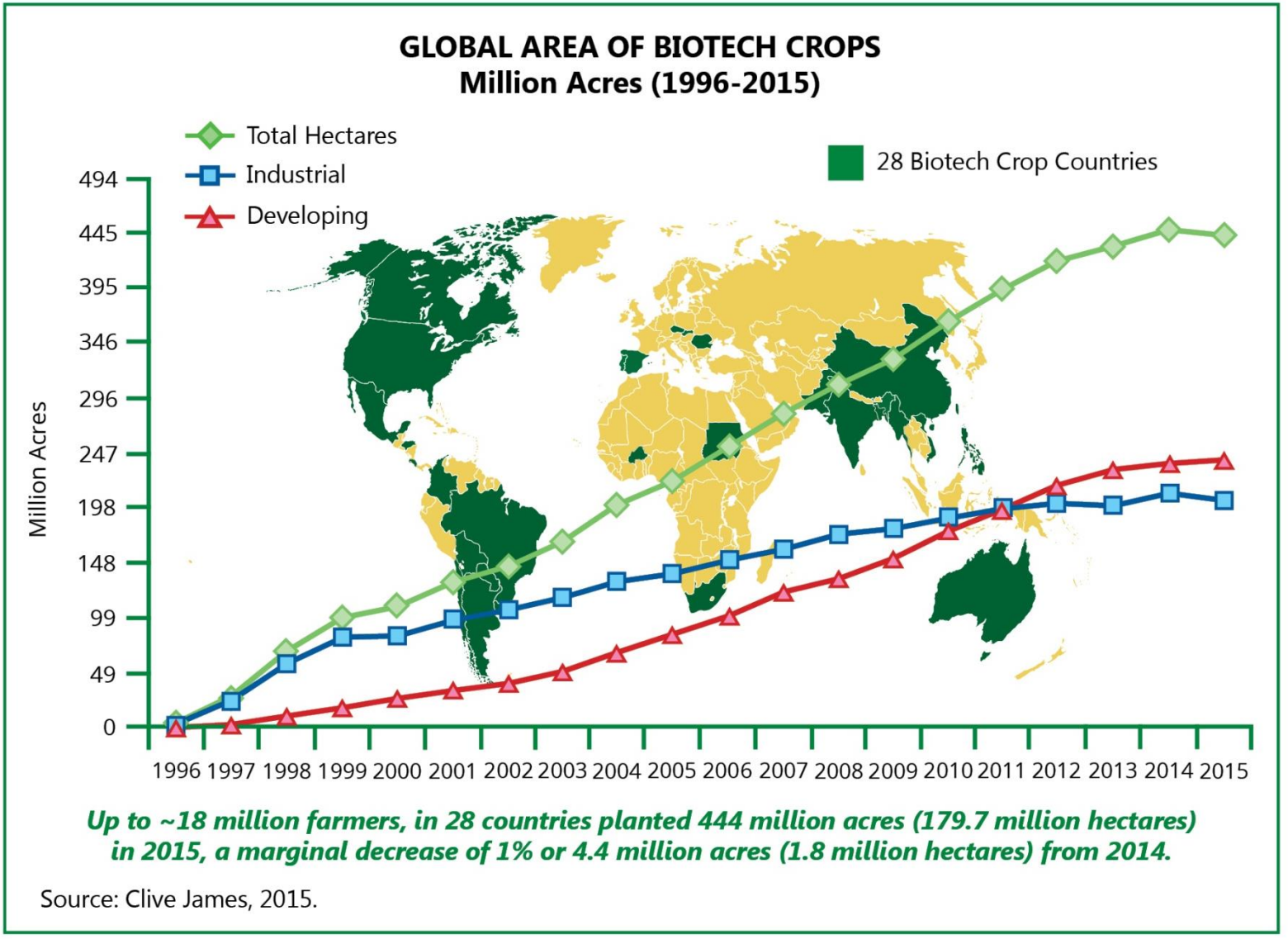


Who Says GM Foods are Safe?[9-12]

International authorities

Food and Agriculture Organization of the UN

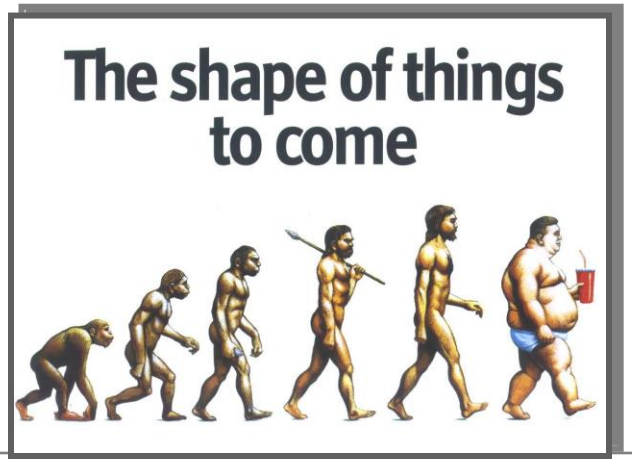
World Health Organization of the UN

Codex Alimentarius- FAO/WHO

National authorities

Summary

- GMOs produced through genetic engineering are a part of agriculture biotechnology
- GM foods are regulated
  - Robust established safety testing paradigm
- GM crops have been consumed safely for over 20 years
- GM crop adoption continues to increase



(The Economist 2003)

Thank You!

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Photo credit: Amy Myrdal Miller

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Disclosures

- American Society Nutrition, Member
- IFT, Professional Member
- GMO Answers Expert (volunteer)
- Center for Food Integrity content provider (volunteer)

Two examples of GMO crops[13-15]

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ROUNDUP® READY

RoundUp® is glyphosate

- Inhibits shikimate pathway – plant specific enzymes

Resistance gene inserted using *Agrobacterium tumefaciens* process

Allows plant to survive exposure to glyphosate

- Herbicide tolerant

BACILLUS THURINGIENSIS (Bt)

Bt is a naturally occurring pesticide

Bt toxin approved as natural pesticide since 1960s – approved for use under organic standard

Bt gene inserted into plant

Plant produces Bt pro-toxin that kills corn borer insect

- Pest resistant

Food Sources of GMO[16,17]

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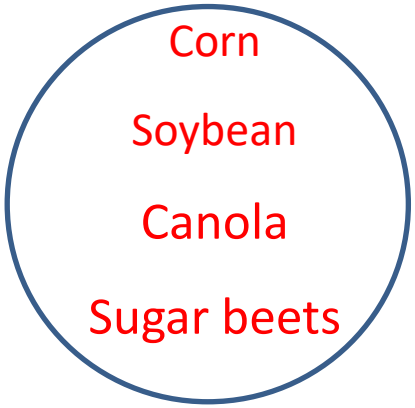
Currently in the food supply



Papaya

Squash

Approved – coming soon

Apples

Eggplant

Melon

Plum

Potato

Rice

Salmon

Sweet pepper

Tomato

Processed Foods[18]

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"70-80% of processed foods have GMO"

Corn
- Sweeteners (HFCS)
- Corn starch
- Corn oil
- *Animal feed*

Soybean
- Soy flour - proteins
- Soy oil
- *Animal feed*

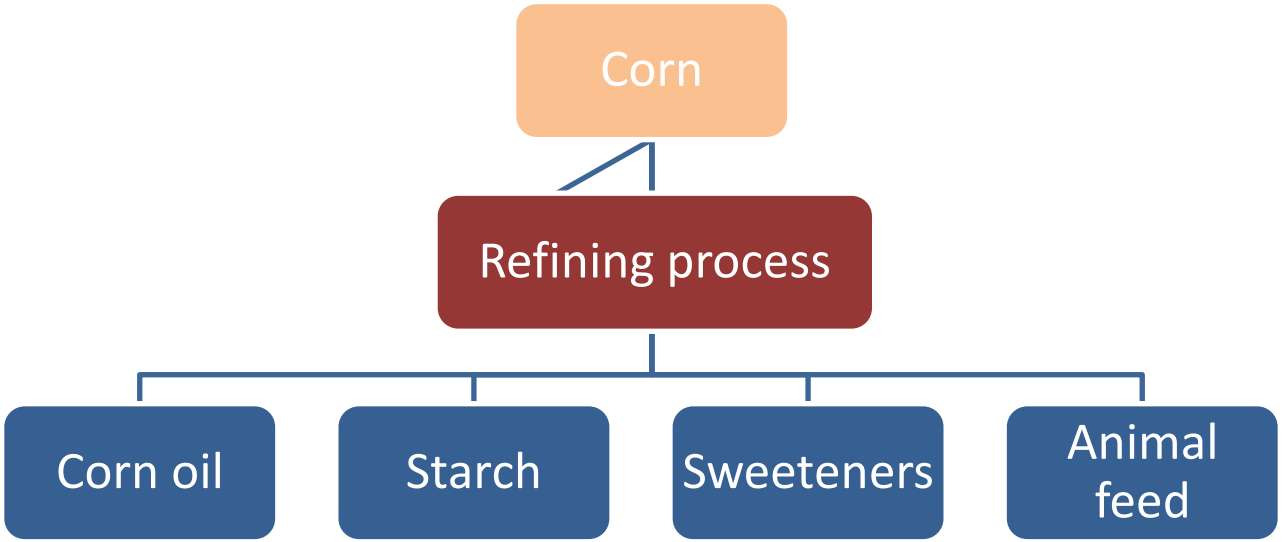
Canola
- Canola oil

Sugar beets
- Sugar

Alfalfa
- *Animal feed*

Mainly contributed by food ingredients

Processing of food ingredients[19-21]



Purified lipids and carbohydrates have no DNA or proteins therefore GMO products are not different from non-GMO products

GMO grains fed to animals do not change the composition of meat, milk or eggs

FDA Policy[22]

In the 1992 policy, FDA also addresses the labeling of foods derived from new plant varieties, including plants developed by bioengineering.

The 1992 policy does not establish special labeling requirements for bioengineered foods as a class of foods.

The policy states that FDA has no basis for concluding that bioengineered foods differ from other foods in any meaningful or uniform way, or that, as a class, foods developed by the new techniques present any different or greater safety concern than foods developed by traditional plant breeding

http://www.fda.gov/food/guidanceregulation/guidancedocumentsregulatoryinformation/ucm059098.htm

Safety Testing[1,23-25]

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Safety assessments begin with concept of product

No variety is released without substantial safety evidence

Research on safety
- Nutrient and chemistry same as non-GMO
- No inadvertent compounds – no allergens
- Transfer and/or breakdown of trait
- Environmental safety

Independent researchers
- Animal studies
- Environmental studies

- Nicolia, A. et al. Critical Reviews Biotechnology 34(1):77-88, 2014.
- Panchin, AY et al. Critical Reviews Biotechnology 37(2):213-217, 2017.
- Goldstein, DA. Journal Medical Toxicology 10(2):194-201, 2014.
- USDA: https://www.usda.gov/wps/portal/usda/usdahome?navid=AGRICULTURE&contentid=BiotechnologyFAQs.xml

Evidence of Safety[26-28]

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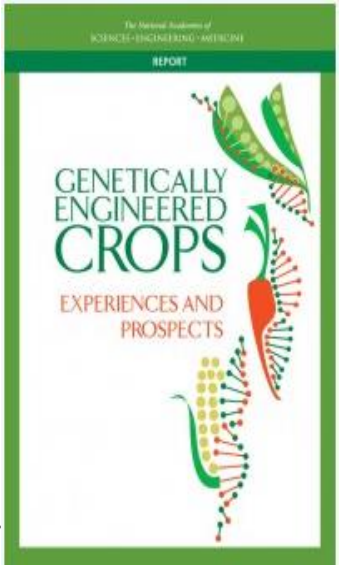
1. FDA considers technology equivalent to conventional plant breeding
2. Study of 100 billion animals fed conventional compared to GMO feed for 25 years found no health risks *(Van Eenennaam and Young, J. Animal Science 92(10):4255-78, 2014)*
3. No human disease or illness ever linked to GMO food
4. Most scientific organizations approve safety of GMO
   - American Medical Association
   - American Academy of Pediatrics
   - American Association for the Advancement of Science
   - Center for Science in the Public Interest
   - European Commission
   - Union of German Academies of Science and Humanities
   - French Academy of Sciences
   - World Health Organization
5. National Academies of Sciences, Engineering, and Medicine report *(https://nas-sites.org/ge-crops/)*

National Academies of Sciences[28]

National Academies of Sciences, Engineering, and Medicine Report 2016

"…the committee found no differences that implicate a higher risk to human health from GE foods than from their non-GE counterparts."



National Academies of Sciences, Engineering, and Medicine. 2016. Genetically Engineered Crops: Experiences and Prospects. Washington, DC: The National Academies Press. doi:10.17226/23395.

Current GMO labeling policy

Signed by President Obama in July 2016 – *National Bioengineered Food Disclosure Standard*

Requires USDA to define how the bill (S.764) will be implemented

Three options for labels

- Label on the food package
- USDA symbol on the package (to be created)
- Electronic access – either a QR code, website or toll-free phone number

Currently in rule-making phase

Defines GMO food as: "(Food) *that has been modified through in vitro recombinant deoxyribonucleic acid techniques; and for which the modification could not otherwise be obtained through conventional breeding or found in nature.*"

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Disclosures

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- Academy Foundation, RDN Farmer Expert
- Academy HOD, Dietitians in Business & Communications

- Chair, LEAD Network, Monsanto
- Nutrition Seminars, National Cattlemen's Beef Association
- Advisory Board, Ajinomoto USA

- Trustee, Denver Botanic Gardens
- Dietetics Advisory Board, Univ. Northern Colorado

Genetically Engineered Crops

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- Food Security
- Food Waste
- Health

Photo credit: Amy Myrdal Miller

Food Security:

Resistance to Diseases and Viruses[30-34]

Next Generation: More consumer benefits

- Banana Wilt Disease
- Virus-resistant & nutritionally enhanced cassava
- Insect resistant rice

Photo Credit: Lepoint, Pascale / Bioversity International, Source: Musarama.

Closer to Home:

Resistance to Diseases and Viruses[35,36]

Photo credit: http://www.ars.usda.gov/citrusgreening/

Citrus Greening

Citrus crop devastation

Modification through spinach gene introduction

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Food Security:
Waste, Shelf Life and More[37-40]

Phot credit: Okanagan Specialty Fruits

Arctic® Golden &
Arctic® Granny Apples
Okanagan Specialty
Fruits

Innate® Russet Burbank (left) next to conventional Russet Burbank 30 minutes after peeling

Photo credit:, Simplot Plant Sciences

Healthier Food Products[41-45]

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Soybeans

High oleic acid

Omega-3's

Photo credit:: Scott Bauer http://www.ars.usda.gov/is/graphics/photos/k4389-11.htm

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Concern

Independent Studies[28,46]

Are there studies not conducted or funded by the GMO industry?

GENERA
Genetic Engineering Risk Atlas

http://genera.biofortified.org/

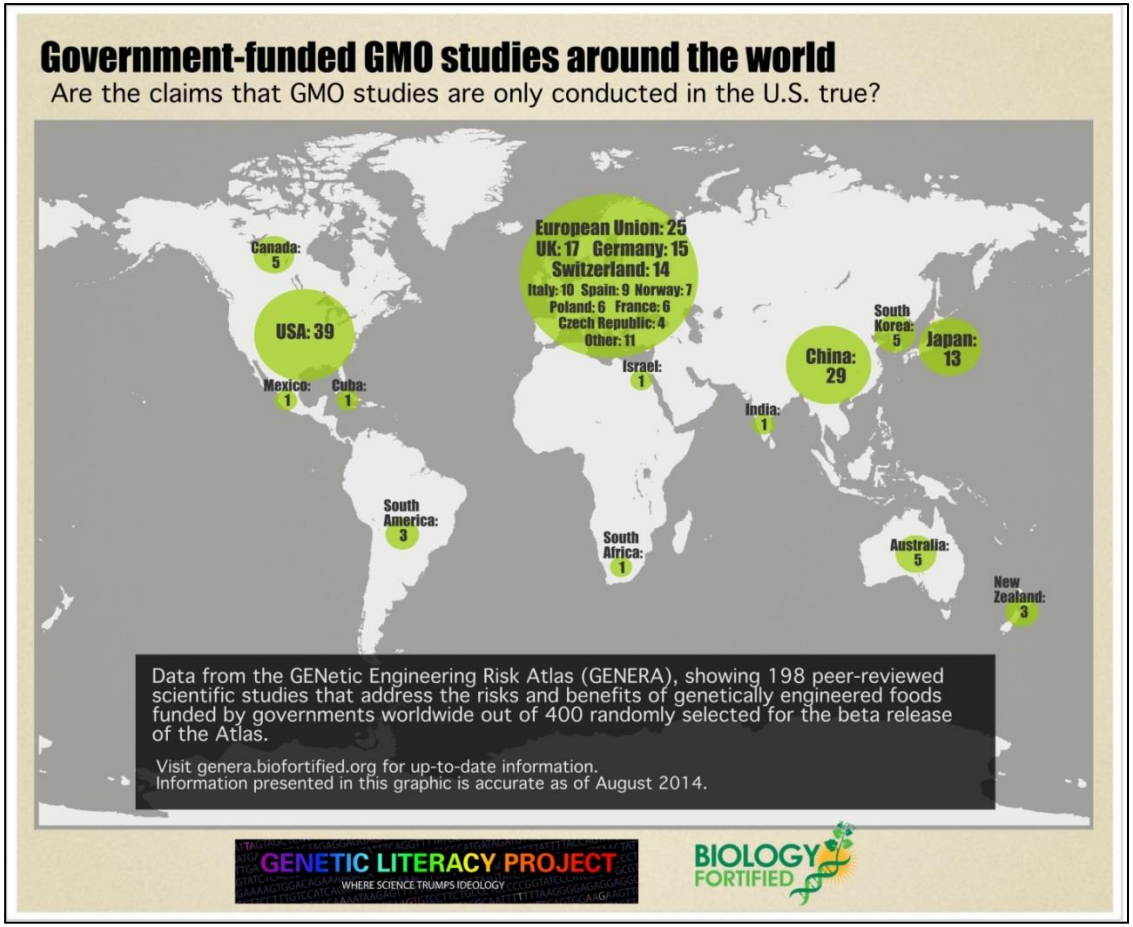
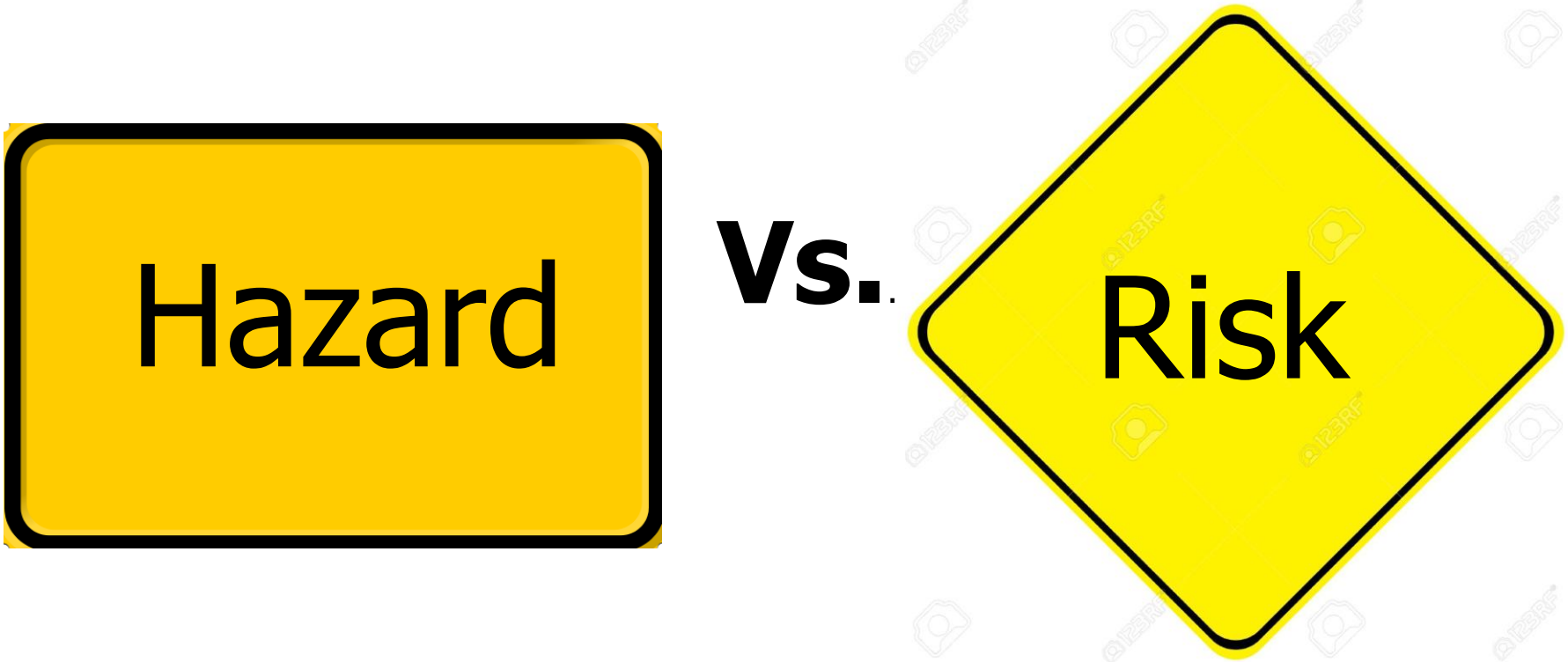


Photo credit: Genetic Literacy Project

Concern – Glyphosate[28,47-49]

Can glyphosate (Round-up) cause cancer?



Concern – Allergens[50-52]

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Can introducing new genes into foods cause allergies?

Photo credit: Ekaterina Sotova, https://www.flickr.com/photos/

Photo credit: Satendra Mhatre http://www.freepik.com/index.php?goto=41&idd=36008&url=aHR0cDovL3d3dy5zeGMuaHUvcGhvdG8vMTIzMzI5NA==

Photo credit: Dömötör Gergely FreeImages.com http://www.freeimages.com/photo/peanut-1486433

Photo credit: Leonardo Menezes FreeImages.com http://www.freeimages.com/photo/the-shrimp-1322833

Opportunities & Challenges-GMO[28,53-55]

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Enhanced nutrition quality

Increased pest & disease resistance

Greater insect biodiversity

Decreased crop losses

Conservation tillage

Reduced pesticides

Tolerance climate change

Improved farmer income[1]

Ethical or religious issues

Resistant weeds and bugs[2]

Not unique to GMO

Herbicide tolerant weeds

Corporate seed consolidation

Regulatory challenges

Labeling issues

Public Skepticism

Shared Values[56,57]

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Photo credit: Pigalle, Cambodia. Fruit And Vegetable Stall, Psah Chas, Siem Reab Creative Commons on Flickr
https://www.flickr.com/photos/pigalleworld/5195836355

Winning the science isn't the same as winning the argument

- Find shared values & common ground
- Balance interests of all sides to ensure all forms of agriculture thrive
- Build on co-existence & cooperation to grow food that is abundant, affordable, and safe
- Practice courteous discourse

Where to go for more information

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National Academies of Sciences, Engineering, and Medicine. Genetically Engineered Crops: Experiences and Prospects. National Academies Press. 2016. https://nas-sites.org/ge-crops/2016/05/17/report/

Food & Agriculture Organization of the United Nation - www.fao.org/biotech

U.S. Department of Agriculture - www.aphis-usda.org and https://www.usda.gov/wps/portal/usda/usdahome?navid=AGRICULTURE&contentid=BiotechnologyFAQs.xml

Food and Drug Administration - www.fda.gov

Environmental Protection Agency - www.epa.gov

The International Crops Research Institute for the Semi-Arid Tropics - http://www.icrisat.org

International Food Information Council - http://www.foodinsight.org/food-biotechnology-resources-gmos-agriculture-genetic-modification

AgBiosafety - http://agbiosafety.unl.edu/

Council for Agricultural Science and Technology- www.cast-science.org

The Genetic Literacy Project - http://www.geneticliteracyproject.org

Academy of Nutrition & Dietetics - www.eatright.org

Institute of Food Technologists - www.ift.org

Evidence Analysis Library (EAL)[58]

Advanced Technology in Food Production (ETFP) 2013-2015

ATFP: Human Consumption of Animal Foods Produced Using Genetic Engineering (GE) Technologies (2015)
ATFP: Human Consumption of Plant Foods Produced Using Genetic Engineering (GE) Technologies (2015)
ATFP: Human Consumption of Plant Foods with Pesticide Residues (2015)

https://www.andeal.org/topic.cfm?menu=5021

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Thank you!

Questions?

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Ruth S. MacDonald, PhD, RD

Mary Lee Chin, MS, RD

Please complete this short online feedback survey: https://www.surveymonkey.com/r/gmowebinar

Photo credit: Amy Myrdal Miller

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10. WHO. World Health Organization of the United Nations. Geneva CH. http://www.who.org.
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