Facts and Fiction About GMOs in Food

Dr. Ruth MacDonald, RD PhD
Professor and Chair, Food Science and Human Nutrition
Iowa State University

Fremont Corn Expo
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Questions about GMO

- What does genetic modification mean?
- What happens to my health when I eat GMO foods?
- Are GMO harmful for children?
- What foods have GMO?
- Who regulates GMO foods?
- What are the benefits of GMO?
- Should foods be labeled if they have GMO?
- Why are big food companies opposed to labeling GMO?

These are the result of genetic modification

Conventional agriculture

- Plant breeding and selection => hybrid seeds and crops
- Animal breeding and selection
- New varieties and characteristics
- Created current agriculture

- Limitations:
  - Time consuming
  - Not specific

Dutch Landrace	Daily gain (g/d)	Feed efficiency (kg/kg)	Backfat thickness (mm)
1930	500	3.5	45
1990	840	2.8	24

http://www.prairieswine.com/pdf/39843.pdf

Molecular biology

- Genetic code
  - DNA → RNA → protein
  - One gene → one protein
- Genomes mapped
  - Correlate genes with characteristics
  - Combined with biochemical pathways
- Technology advances
  - Tools to delete, silence, insert genes
  - Express specific traits
- RECOMBINANT HUMAN INSULIN (1980)

Molecular Structure of Nucleic Acids (1953) Nature 171; 737-738

Genomics

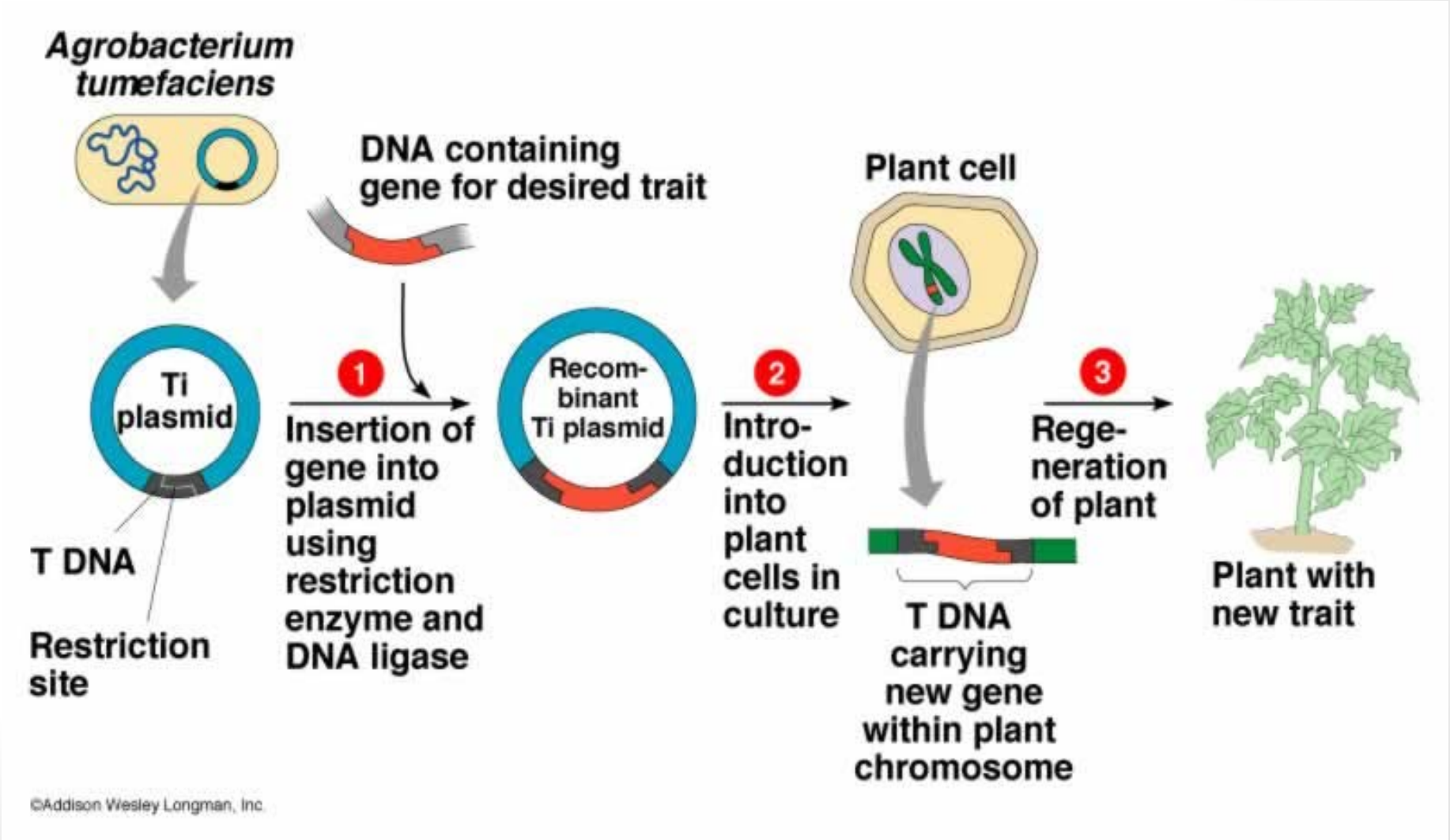
- Major effort to identify all the genes in selected plants
  - Universities
  - Research foundations
  - Agriculture industry

- Rapid advances in technology improved access

- Focus was on crops with high economic return
  - Corn, soybean, wheat, rice, bananas
- Many food crops have been mapped
  - Watermelon, cucumbers, cassava, cacao, apple

Maize Genome Mapped: The genomes of different maize plants have revealed key differences between varieties.
Science/AAAS 2009

Transgenics – how its done



http://palmer-dna-technology-wikis.wikispaces.com/file/view/transgenic_plant.JPG/197641326/transgenic_plant.JPG

Defining biotechnology in agriculture

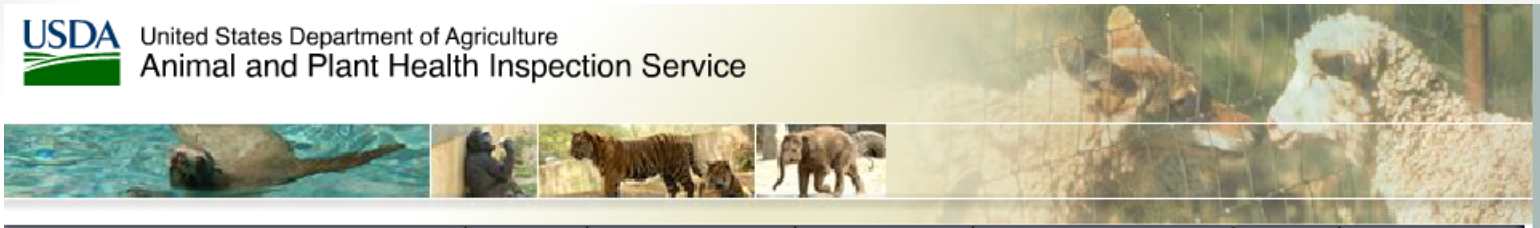
1) Any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products for special use (Convention on Biological Diversity)
2) Modern biotechnology is
   a) In vitro nucleic acid techniques, including recombinant deoxyribonucleic acid (DNA) and direct injection of nucleic acid into cells or organelles, or
   b) Fusion of cells beyond the taxonomic family, that overcome natural physiological reproduction or recombination barriers and that are not techniques used in traditional breeding and selection. (Cartagena Protocol on Biosafety)
3) Biotechnology is a range of different molecular technologies such as gene manipulation and gene transfer, DNA typing and cloning of plants and animals (FAO Glossary of Biotechnology)

What does GMO do?

- **Herbicide tolerance**
- **Insect resistance**
- **Virus resistance**
- Ripening delayed
- Amino acid composition
- Fatty acid composition
- Modified color
- Nicotine reduced
- Plant quality
- Starch hydrolysis

- Increase yield
- Increase quality
- Reduce use of chemicals
- Reduce waste
- Nutrition improvement

NONE OF THESE ARE IMPORTANT TO CONSUMERS



USDA United States Department of Agriculture
Animal and Plant Health Inspection Service

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You are here: Home > Biotechnology > Petitions Table

Biotechnology

Petitions for Determination of Nonregulated Status

The table below shows all **pending** petitions that have been deemed complete and previously made available for public comment. To view all petitions for which a **determination of nonregulated status** has been reached, click here.

Key:
Click to access documents

The following petitions are proceeding through our enhanced petition review process:

	Petition No.	Applicant	Crop	Phenotype/Event	Petition	Preliminary Assessment	Final Assessment and Decision
6	13-290-01p	Monsanto	Corn	Rootworm-Resistant/Glyphosate-Tolerant/MON-87411-9			
5	13-262-01p	Dow	Cotton	2,4-D and Glufosinate-Tolerant/DAS-8191Ø-7			
4	13-022-01p	J.R. Simplot	Potato	Low Acrylamide Potential, Reduced Black Spot Bruise/ E12, E24, F10, F37, J3, J55, J78, G11, H37, H50			
3	12-321-01p	Monsanto/ Forage Genetics	Alfalfa	Reduced Lignin/ KK179			
2	12-215-01p	Syngenta	Soybean	HPPD and Glufosinate Tolerant/ SYHT0H2			
1	10-161-01p	Okanagan	Apple	Non-Browning/ GD743, GS784			

http://www.aphis.usda.gov/biotechnology/petitions_table_pending.shtml

On the horizon

http://www.gatesfoundation.org/agriculturaldevelopment/PublishingImages/golden-rice-hero.jpg

Proven effective, but not widely accepted by developing countries

An orange from a tree infected with citrus greening, right, is stunted compared with a normal orange. Richard Perry/The New York Times

http://www.nytimes.com/2013/07/28/science/a-race-to-save-the-orange-by-altering-its-dna.html

GM banana designed to slash African infant mortality enters human trials

http://www.independent.co.uk/news/science/gm-banana-designed-to-slash-african-infant-mortality-enters-human-trials-9541380.html

WHICH ONES ARE GMO?

NONE!!

GMO in the food supply

GMO in the Grocery Store

- GE crops account for
  - Soybeans 90%
  - Corn 80%
  - Canola
  - Sugar beets

INGREDIENTS in many foods

http://www.freshthemovie.com/wp-content/uploads/2010/09AP_GE_Salmon.jpg

GMO salmon has been developed but not yet approved by FDA

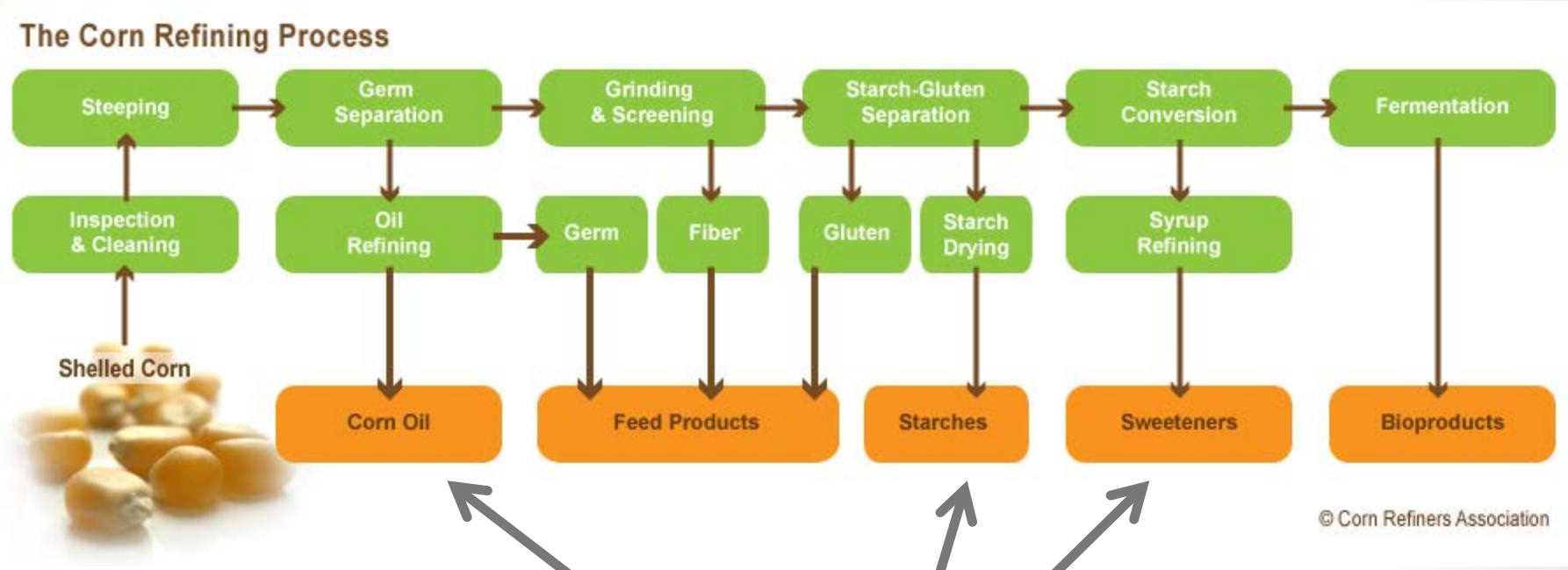
- Papaya
  - Papaya Ringspot virus in 1980
  - GE technology responsible for saving crop
- Squash

Very limited number of foods are GMO!

"70-80% of processed foods have GMO"

- Corn
  - Sweeteners (HFCS)
  - Corn oil
  - *Animal feed*
- Soybean
  - Soy flour
  - Soy oil
  - *Animal feed*
- Canola
  - Canola oil
- Sugar beets
  - Sugar
- Alfalfa
  - *Animal feed*

Where goes the GMO?

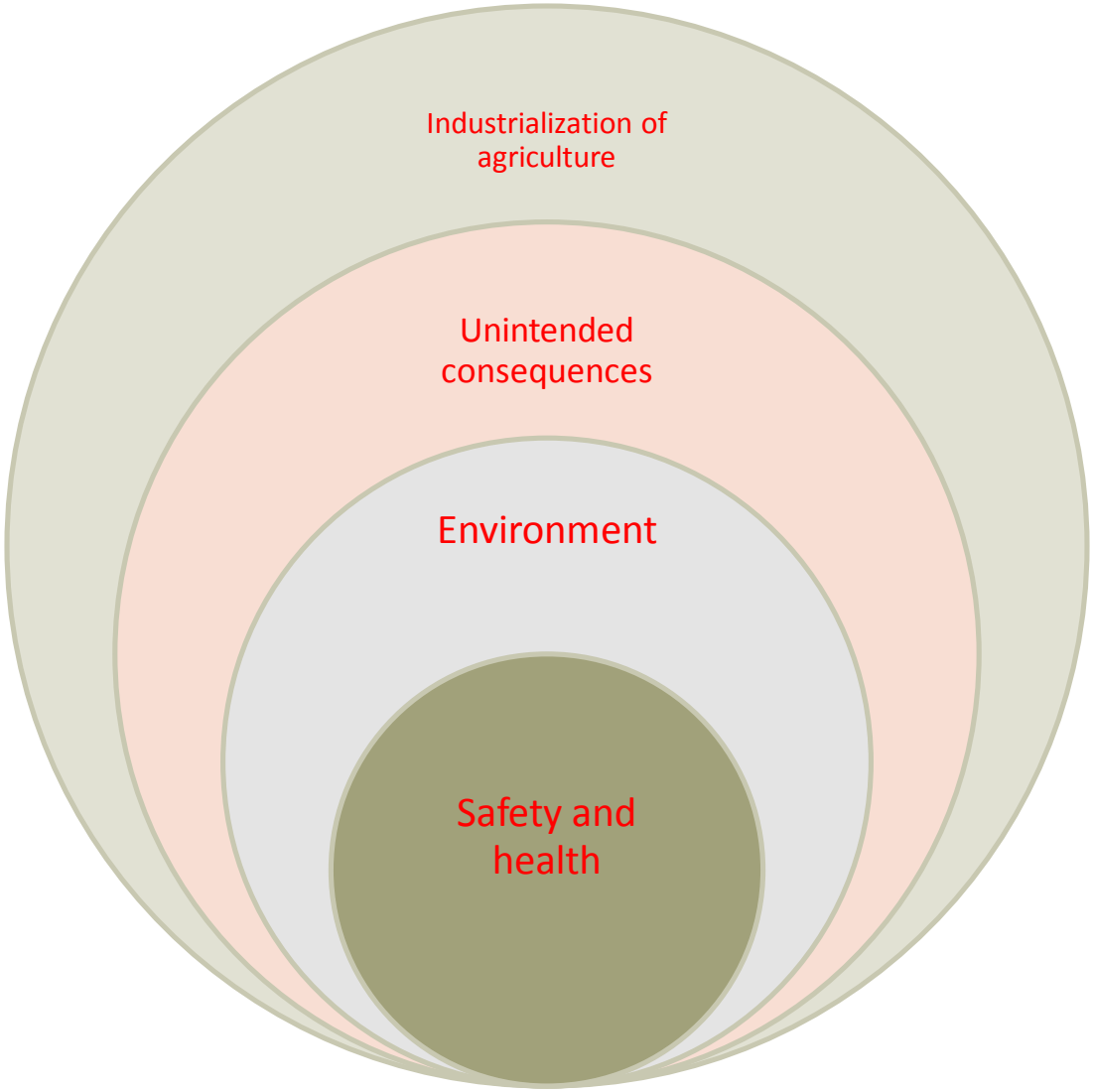


No DNA or protein
in products for human food –
so are these still GMO??

Digestion basics…

- All plant and animal foods have DNA and proteins
- Consumed food is digested into basic units:
  - DNA → nucleotides
  - Proteins → amino acids
- The basic units are absorbed into the body and used to make *human* DNA and proteins
- Intact DNA or protein from food is NOT absorbed directly into our bodies
- GMO DNA and protein is digested like all other sources

Layers of uncertainty



Government oversight

- **FDA** regulates food from GE crops in conjunction with the U.S. Department of Agriculture (USDA) and the Environmental Protection Agency (EPA).
- **USDA's** Animal and Plant Health Inspection Service is responsible for protecting agriculture from pests and disease, including making sure that all new GE plant varieties pose no pest risk to other plants.
- **EPA** regulates pesticides, including those bioengineered into food crops, to make sure that pesticides are safe for human and animal consumption and do not pose unreasonable risks of harm to human health or the environment.

http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm352067.htm

Safety testing

- 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

Human and animal safety record

- Farm animals fed GMO feed for over 30 years
  - Most carefully monitored animals on the plant
  - No changes in health, growth or reproduction

Prevalence and impacts of genetically engineered feedstuffs on livestock populations. Van Eenennaam AL, Young AE. J Anim Sci. 2014 Oct;92(10):4255-78

- Humans consuming GMO ingredients for 20 years
  - Largest epidemiological study every completed
  - Never any reported illness or negative health effect
  - No allergen risk

- Independent studies in US and Europe – found no safety concerns

A decade of EU-funded GMO research 2001-2010. http://ec.europa.eu/research

Critical Reviews in Biotechnology

http://informahealthcare.com/bty
ISSN: 0738-8551 (print), 1549-7801 (electronic)

Crit Rev Biotechnol, Early Online: 1–12
 DOI: 10.3109/07388551.2013.823595

informa
healthcare

REVIEW ARTICLE

An overview of the last 10 years of genetically engineered crop safety research

Alessandro Nicolia[1]*, Alberto Manzo[2], Fabio Veronesi[1], and Daniele Rosellini[1]

[1]*Department of Applied Biology, Faculty of Agriculture, University of Perugia, Perugia, Italy and* [2]*Ministry of Agriculture, Food and Forestry Policies (MiPAAF), Rome, Italy*

"We have reviewed the scientific literature on GE crop safety for the last 10 years that catches the scientific consensus matured since GE plants became widely cultivated worldwide, and we can conclude that the scientific research conducted so far has not detected any significant hazard directly connected with the use of GM crops."

"Every major scientific body and regulatory agency in the world has reviewed the research about GMOs and openly declared crop biotechnology and the foods currently available for sale to be safe."
John Entine, Forbes.com, 10/29/2013

- American Medical Association
- American Academy of Pediatrics
- American Association for the Advancement of Science
- Center for Science in the Public Interest
- Royal Society of Medicine
- European Commission
- Union of German Academies of Science and Humanities
- French Academy of Sciences
- World Health Organization

Credible Science

- Science Writers
  - Jon Entine, Forbes
  - Keith Kloors, Discovery
  - Tamar Haspel, Washington Post
- Genetic literacy project
- Biology Fortified
- Patrick Moore
- Mark Lynas
- Industry and foundation efforts
  - GMO Answers
  - Center for Food Integrity
  - Farmers and Ranchers Alliance
  - CommonGround

Role of celebrities

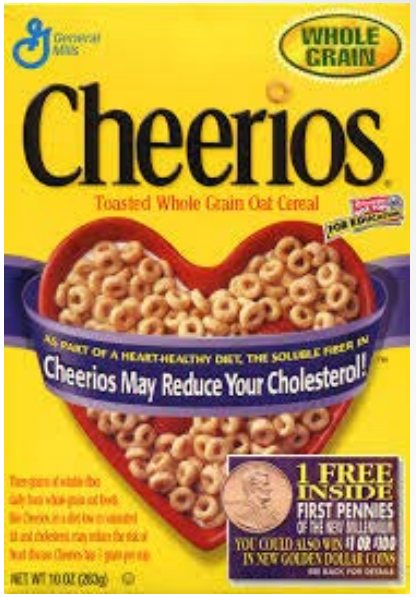
- TV chefs disparage GMO
  - Local, organic, natural
  - Unique, inaccessible, seasonal

- Dr. Oz has negative bias
  - TV show lives forever on internet

- General media writers are confused
  - Negative, uncertainty draws readers/viewers

FOOD LABELING

Purpose of food labeling



Regulated by FDA

- Standard of identity
- Quantity (weight/volume)
- Food composition and ingredients
- Manufacturer name and address
- Nutrition facts panel
- Allergens
  - (eggs, fish and seafood, milk and lactose, peanuts and tree nuts, soy, wheat and gluten)

Nutrition Facts

Serving Size 2/3 cup (55g)
Servings Per Container About 8

Amount Per Serving	
Calories 230	Calories from Fat 72
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**12%**
Dietary Fiber 4g	**16%**
Sugars 1g	
Protein 3g	
Vitamin A	10%
Vitamin C	8%
Calcium	20%
Iron	45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

FDA policy

- 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

Consumer polls

IFIC Foundation

- 74% of consumers could not think of any addition information they would like added to labels
- 63% of consumers support the FDA's current labeling policy

Center for Food Integrity

- Trust building
  - Motivation
  - Disclosure
  - Stakeholder participation
  - Relevance
  - Clarity
  - Credibility
  - Accuracy

TRANSPARENCY

Should we just label GMOs?

- FDA says **no** because there is
  - No harm from GMO foods
  - Foods are not made ‘different’ by GMO
  - No allergies or specific health risks of GMO

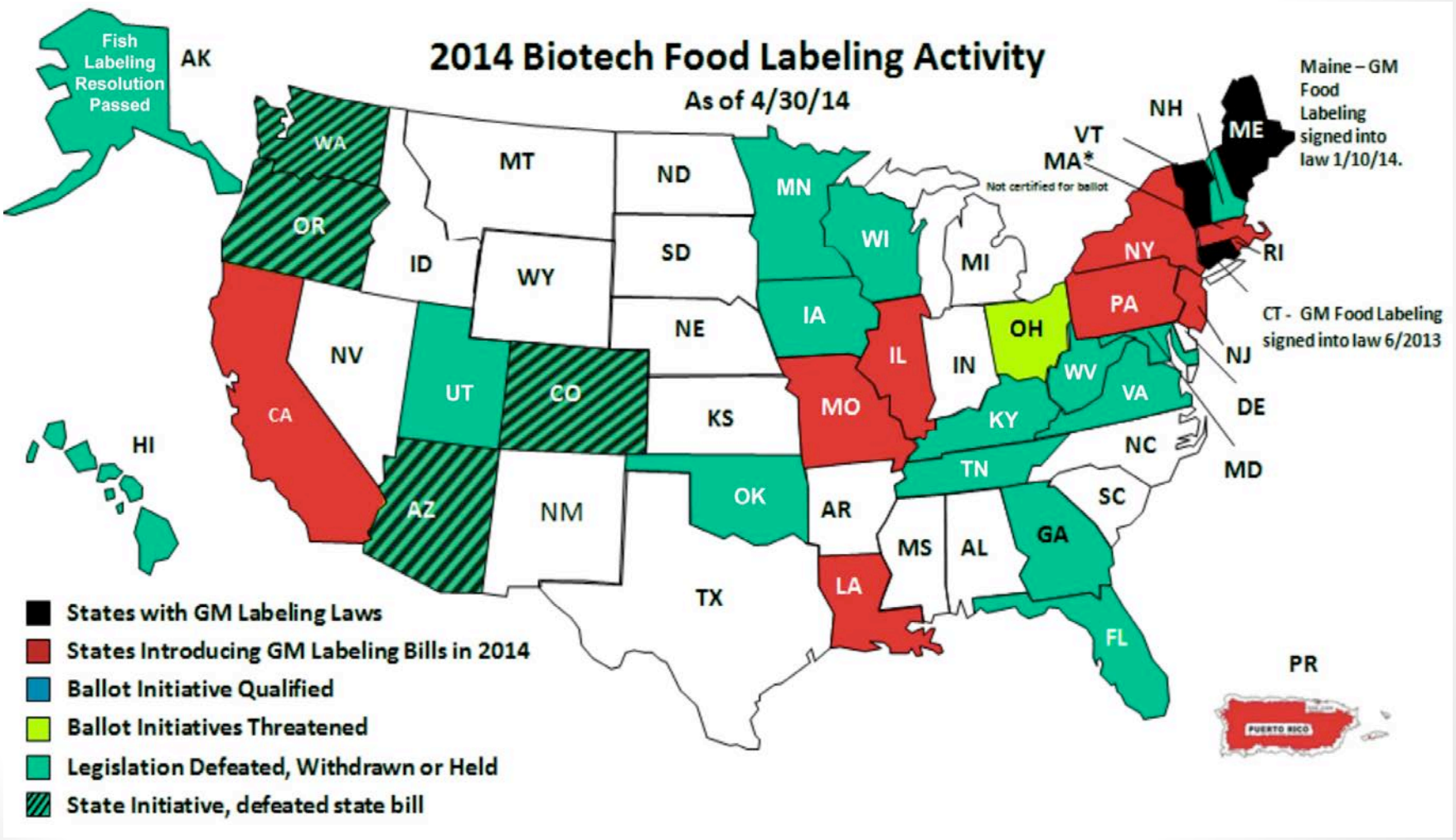
- Vocal consumer groups say **yes** - *right to know*

Labeling requires monitoring

- FDA would need to define levels of GMO, ingredient tracking and industry regulations – pass laws
- Industry tracking of ingredients and production methods would add to food costs
- More sensitive methods to detect GMO in foods and ingredients need to be developed and purchased by FDA and industry – more costs
- More FDA inspectors needed to educate and monitor industry – more costs

Funding for FDA would need to be increased (higher taxes?) and foods would cost more

Biotech Labeling: The States



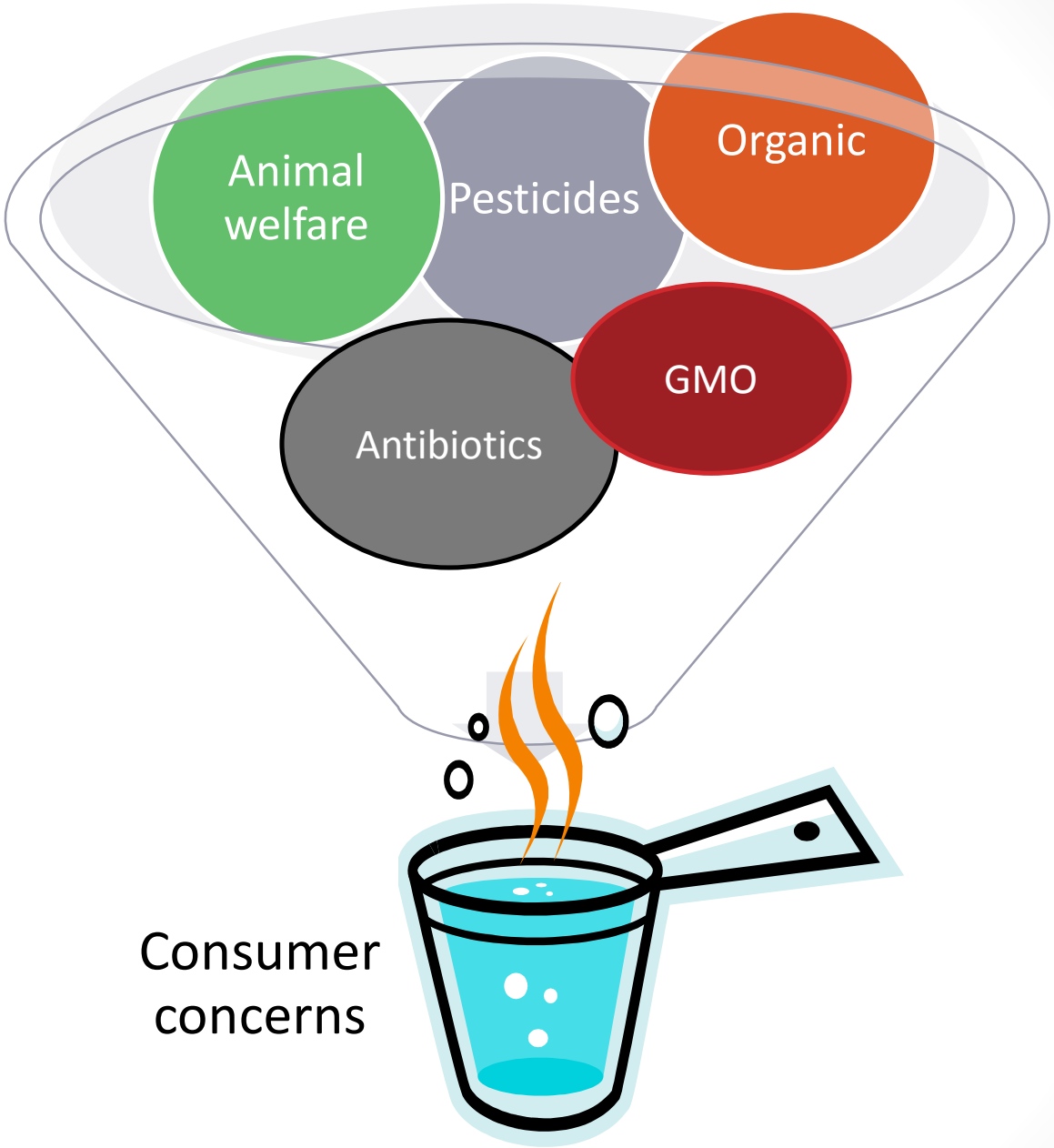
Slide provided by Dave Tierney

Deep philosophical questions

- Farming is basic to human civilization
- Farming is related to nature and wholesomeness
- Biotechnology is part of farming

- Organic farmers may be in conflict with GMO farmers – cross contamination

Is agriculture business or a way of life?

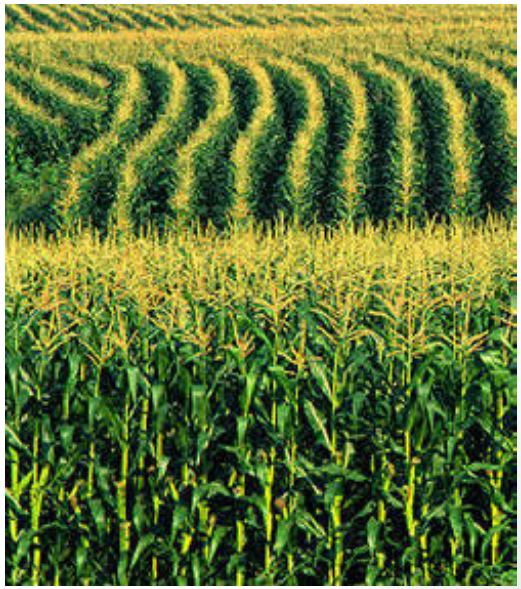


Consumer concerns

The genie is out of the bottle, let's use it wisely.....

Take home messages

- Modifying plant and animal genetics is as old as agriculture
- Modern DNA technology has made it faster and more specific
- Benefits are significant and will continue to be
- Risks to environment are low – maybe less than conventional methods
- Health risks have never been found
- Fear of GMO is unjustified
- Diligence in oversight for GMO is critical



Helpful websites

- GMO Answers www.gmoanswers.com
- Center for Food Integrity www.foodintegrity.org
- Genetic Literacy Project www.geneticliteracyproject.org
- Allow golden rice now www.allowgoldenricenow.org
- Biology fortified www.biofortified.org
- IFIC www.foodsafetynews.com