Objective: GMO Review

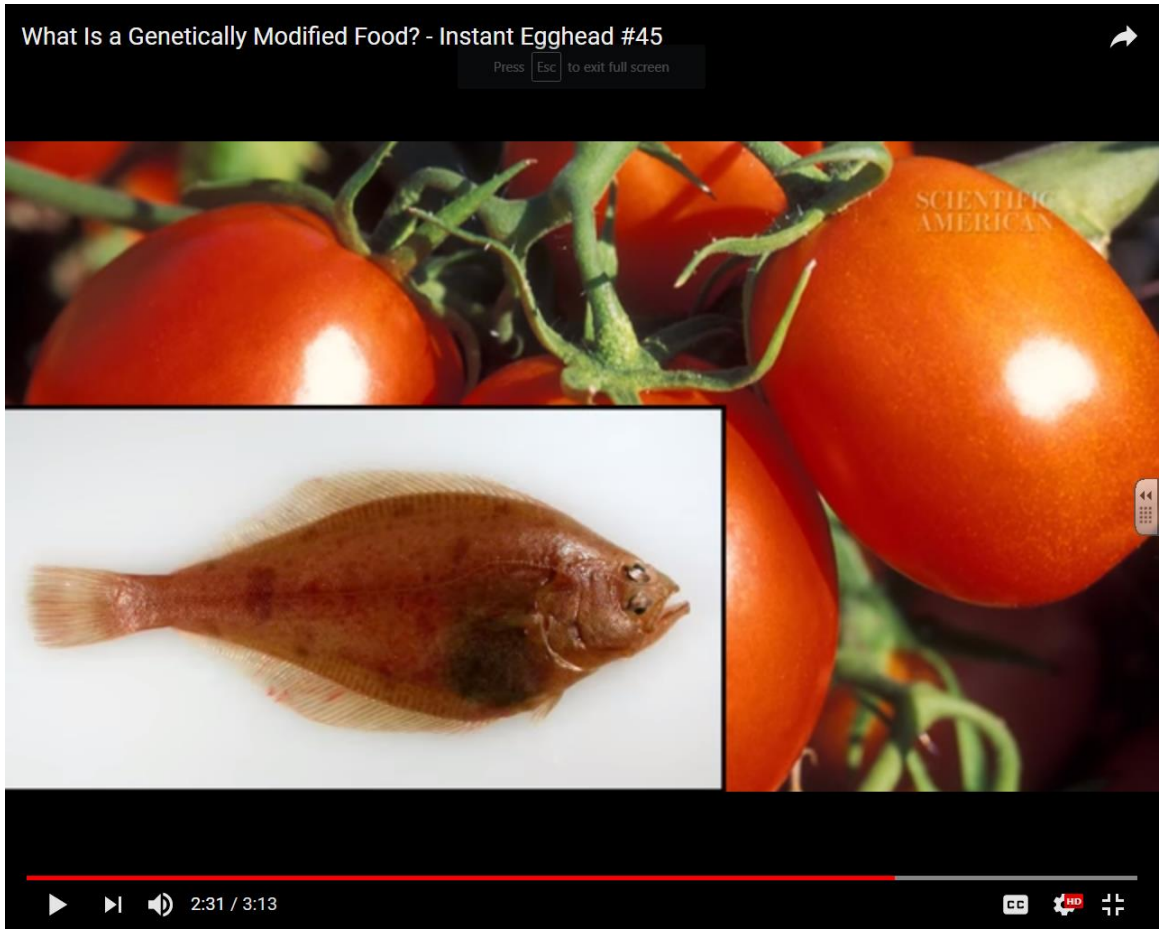
1. GMOs can be **cisgenic** or **transgenic**. Explain.
2. How was corn originally cultivated?
3. How many genes were “changed” in the original plant **genome**?
4. Explain two benefits and 2 costs of genetically modifying crops/foods?
5. When listening to someone’s point of view, claim, or proposal about a scientific issue – what should you consider?

Genetically Modified Organisms

- Organisms that have had their DNA modified
- Commonly engineered traits include rapid growth, pest resistance, and frost tolerance.
- In the United States, 85% of corn and 90% of soybean, cotton, and canola crops come from GM strains.

Video: What Is a Genetically Modified Food? - Instant Egghead #45

- https://www.youtube.com/watch?v=JMPE5wlB3Zk



Selective Breeding/Artificial Selection

- Choosing individuals with desired traits
- **Natural selection** – individuals best adapted to an environment survive best and pass on their traits
- Teosinte – grass from which corn was cultivated - in Mexico
- 5 changes made in the **genome** of the grass, a form of **selective breeding**

GM Food

- Genes moved directly into the DNA and transplanted into another organism
- **Cisgenic**: from same species
- **Transgenic**: from different species
- Examples:

  corn that produces bacterial proteins against pests

  tomatoes that produce fish “antifreeze”

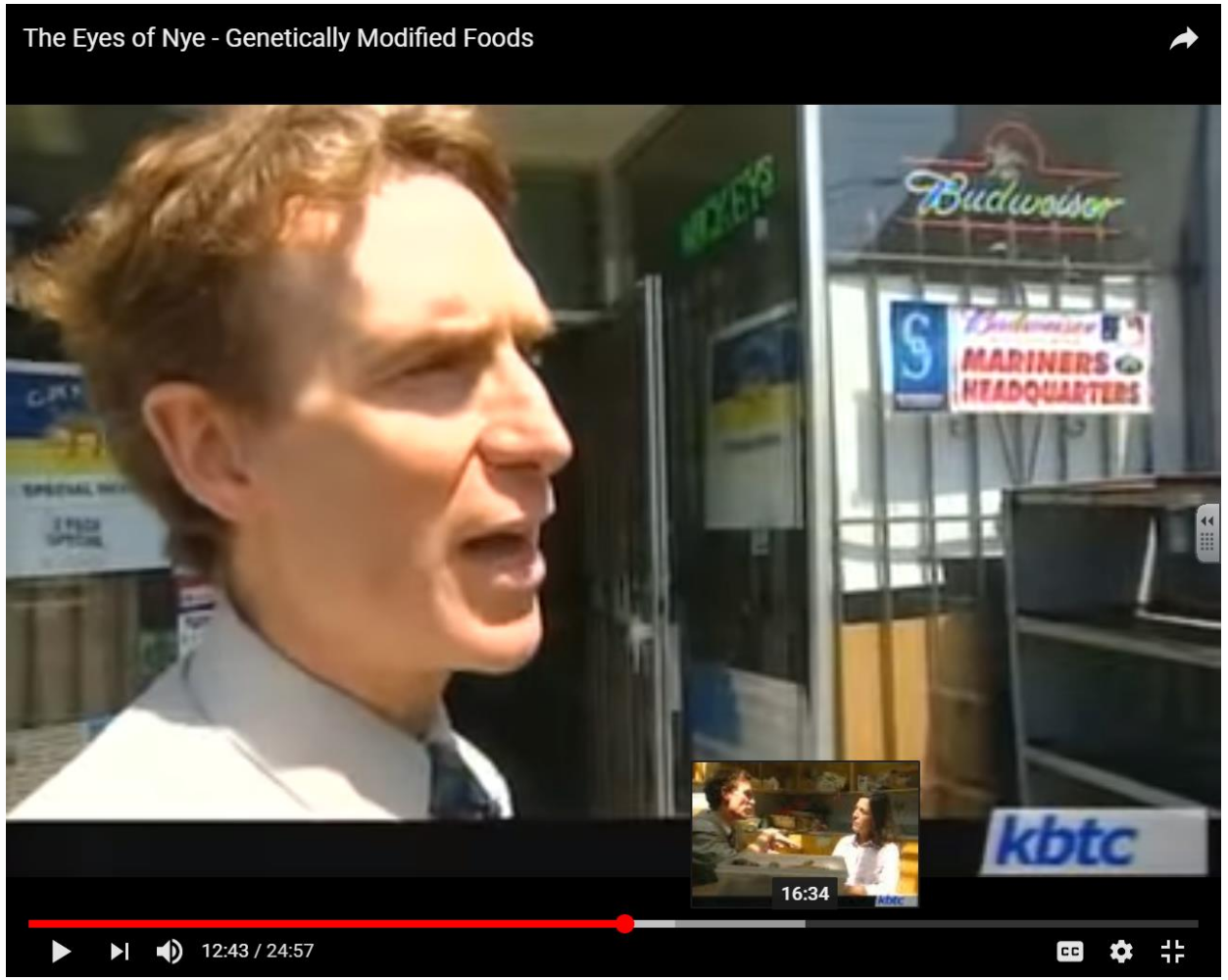
  cows that produce human milk

Risks and Benefits of GM Crops

- **Risks:**
  - Potential for "superpests" that are resistant to pest-resistant crops
  - Contamination of non-GM plants → example contamination of native Mexican corn.
- **Benefits:**
  - Insect-resistant crops reduce the need for insecticides.
  - Herbicide-resistant crops encourage tillage conservation.

Video: The Eyes of Nye - Genetically Modified Foods

https://www.youtube.com/watch?v=GKm2Ch3-Myg



Eyes of Nye – GMO Foods

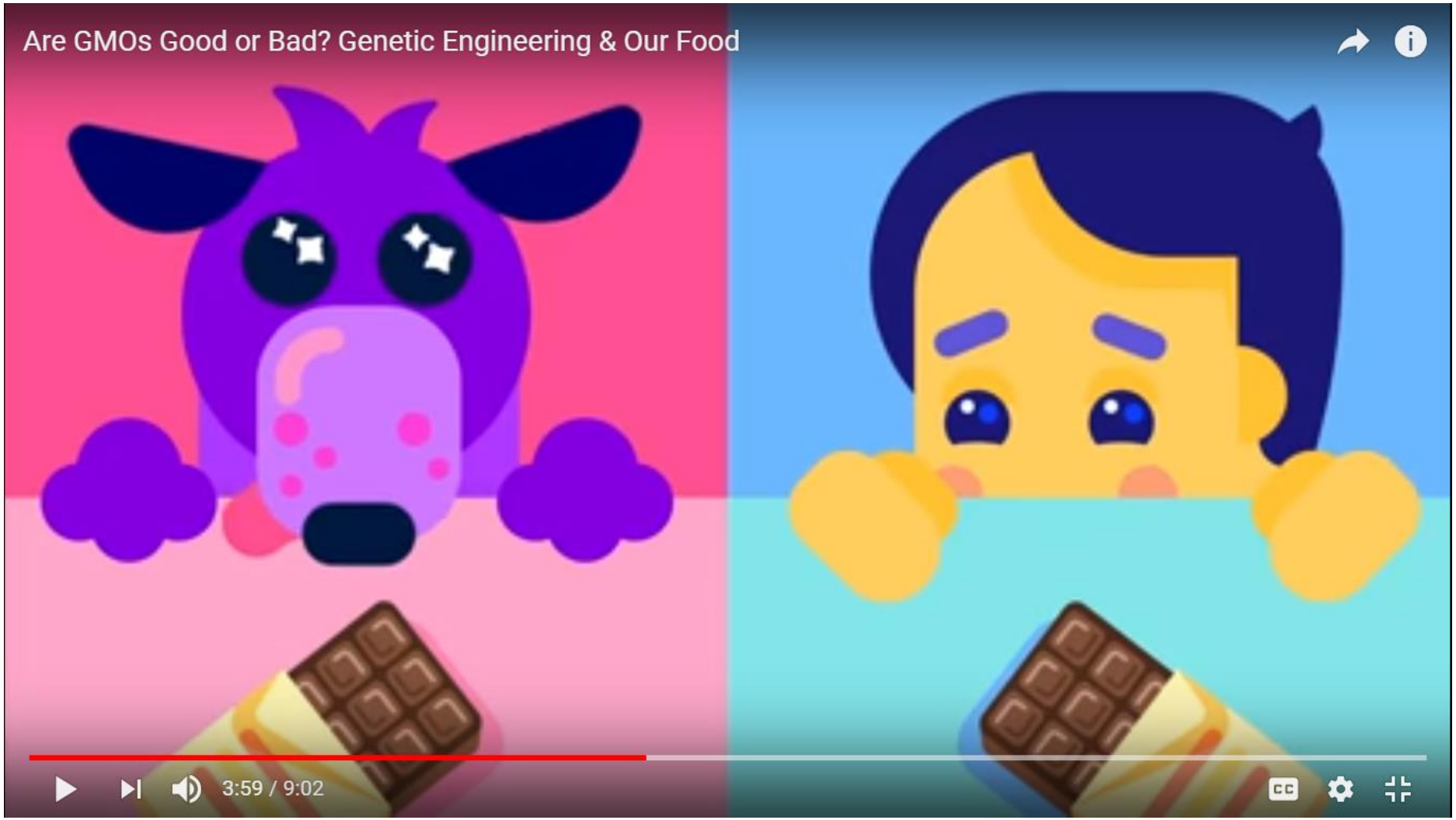
- European Law: GM Food must be labeled
- Today's foods derived from agricultural breeding over 1000's of years.
- Viral DNA in the papaya – small part of its genome, both contain the viral DNA
- GM crop lands – development of disease resistant crops

Eyes of Nye – GMO Foods

- Most soybean is GM – ingredient in many of our foods
- Canola oil and corn is found in many processed foods
- GM coffee beans – already decaffeinated
- **Concerns**: potential impacts on biodiversity and disease transmission

Are GMOs Good or Bad? Genetic Engineering & Our Food

https://www.youtube.com/watch?v=7TmcXYp8xu4



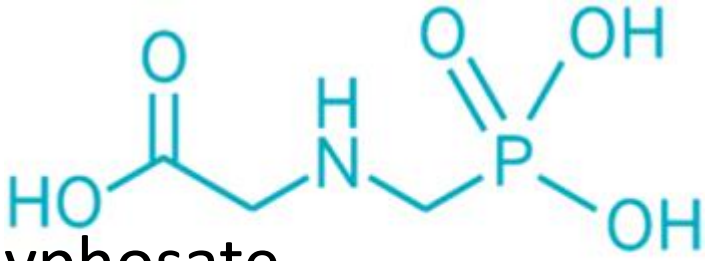
Are GMOs Good or Bad? Genetic Engineering & Our Food

- Natural Foods by artificial selection – selective breeding
  - Done for 1,000's of years by people
  - Specific individuals with desired traits are chosen for breeding
- Genetically Modified Organisms
  - Genes located and isolated in DNA
  - Traits are chosen by choosing specific genes
- Against GMO's –why?
  - Gene flow: mixing of DNA with traditional crops
  - Occurs by the transfer of pollen
- Terminator seeds
  - Farmers must by new seeds each year
  - Higher cost to farmers and consumers

Are GMOs Good or Bad? Genetic Engineering & Our Food

- Bt Crops
  - Bacillus thuringiensis (or **Bt**) is a Gram-positive*, soil-dwelling bacterium, commonly used as a biological pesticide.
  - Engineered plants produce protein that destroys the digestive system of specific insect pests

- Chemical resistant crops
  - 90% of U.S. crops are herbicide resistant – mostly to glyphosate
  - Much of this is tied with corporate farms, not family farms



Glyphosate

*difference in the structure of their **bacterial cell wall**. **Gram-positive bacteria** do not have an outer cell membrane found **in Gram-negative bacteria**. The cell wall of **Gram-positive bacteria** is high in peptidoglycan which is responsible for retaining the crystal violet dye.

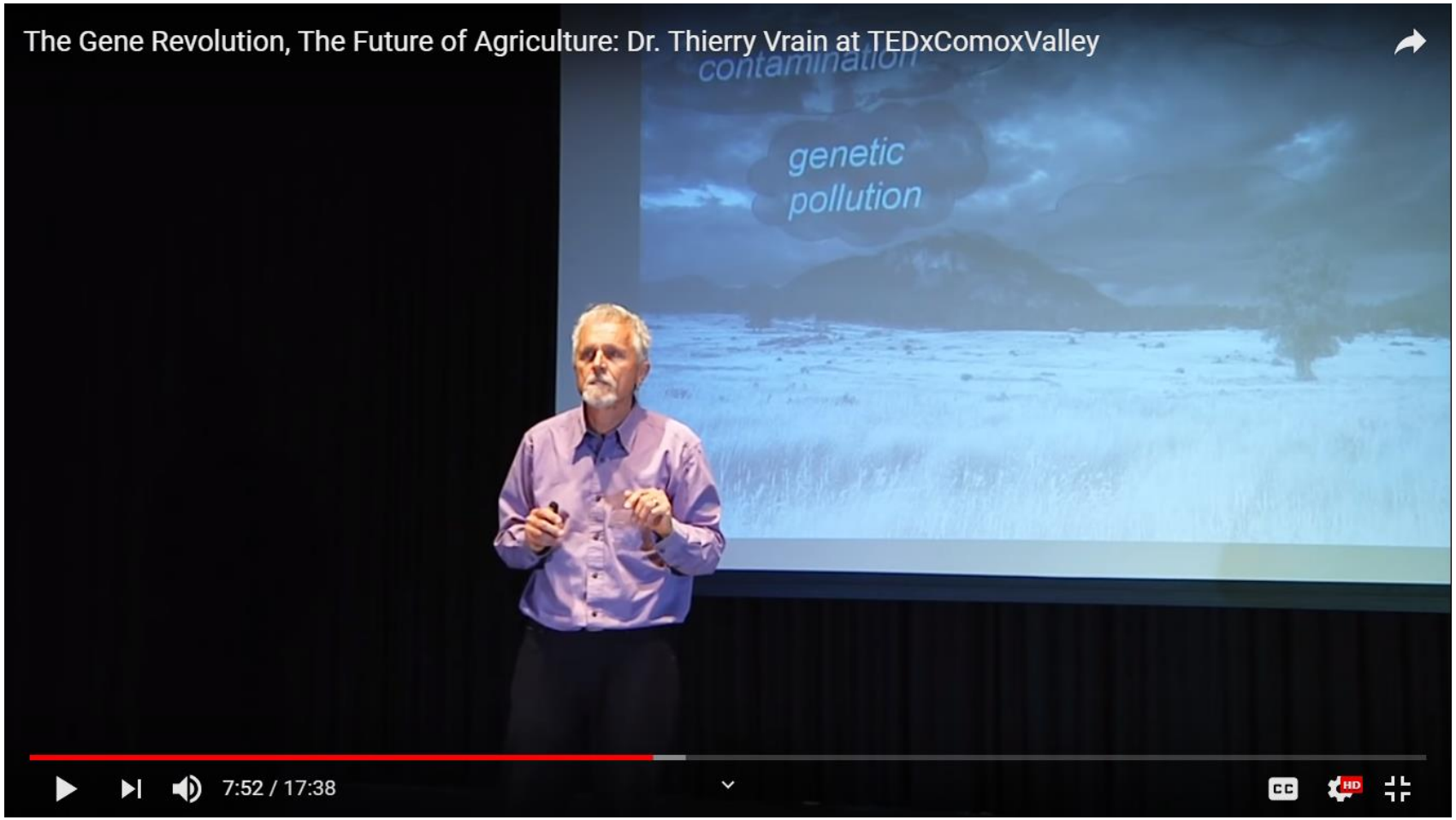
Are GMOs Good or Bad? Genetic Engineering & Our Food

- 2013 – Bt eggplant used in Bangladesh
  - Previously large amounts of pesticides used
  - Reports of farmers getting sick when exposed to the chemical
  - Farmer sickness dropped when Bt plants were used
- GM Papaya in Hawaii

- GMO research
  - Increase nutritional value of food
  - Increase resistance to climate change and soil conditions
  - Nitrogen compound producing plants – use of less fertilizer – less nitrogen in water runoff – excess nitrogen in water leads to increase in **BOD** and **hypoxia**
  - **Amount of arable land is limited:** need to increase crop yields on existing farmland

The Gene Revolution, The Future of Agriculture: Dr. Thierry Vrain at TEDxComoxValley

https://www.youtube.com/watch?v=RQkQXyiynYs



The Gene Revolution, The Future of Agriculture: Dr. Thierry Vrain at TEDxComoxValley

1. Pesticide Use
   i. 80% are herbicides
2. Big crops engineered to be HT
   i. 90% of soybean
   ii. 80% of corn
   iii. Canola and sugar beets

3. Bt modified make-up 20% of crops
4. Various pests attack and destroy crops – including some species of **nematodes**

The Gene Revolution, The Future of Agriculture: Dr. Thierry Vrain at TEDxComoxValley

5. Nobody expected problems with GM crops – **DNA is not toxic.**
6. Superweeds: resistant to the “magic herbicide”.
   i. 38 species of weeds in N.A. are herbicide resistant
   ii. ½ the acreage in the U.S. infested with these weeds
   iii. Growing insect resistance – superbugs!

The Gene Revolution, The Future of Agriculture: Dr. Thierry Vrain at TEDxComoxValley

7. Growing concerns and issues
    i. **Contamination by pollen**: canola and flax exports from Canada to the European Union have been banned
    ii. **Genetic pollution**: likely that transgenes will end up in soil and human intestinal bacteria DNA.
    iii. **Antibiotic resistant bacteria:** found in Chinese waters – from labs or GM crops? Leads to loss of antibiotic use.
    iv. **Allergens and toxic proteins**

The Gene Revolution, The Future of Agriculture: Dr. Thierry Vrain at TEDxComoxValley

8. Research on GM foods:
   i. **Biotech companies:** innocuous and safe
   ii. **Foreign government agencies (outside of U.S.):** serious problems
   iii. **1996 FDA report:** GM foods have potentially dangerous consequences
9. 2002 – Human Genome Project completed – mapping of entire sequence of human DNA
   i. 95% of DNA is regulatory – controls the functioning of other genes
   ii. 5% of DNA codes for protein production
   iii. Concern is **many allergies and organ damage** in mice to Bt proteins – based on scientific literature (published research)