

# FOOD FOR THOUGHT



## AN OVERVIEW OF KEY THEMES IN FOOD EVOLUTION

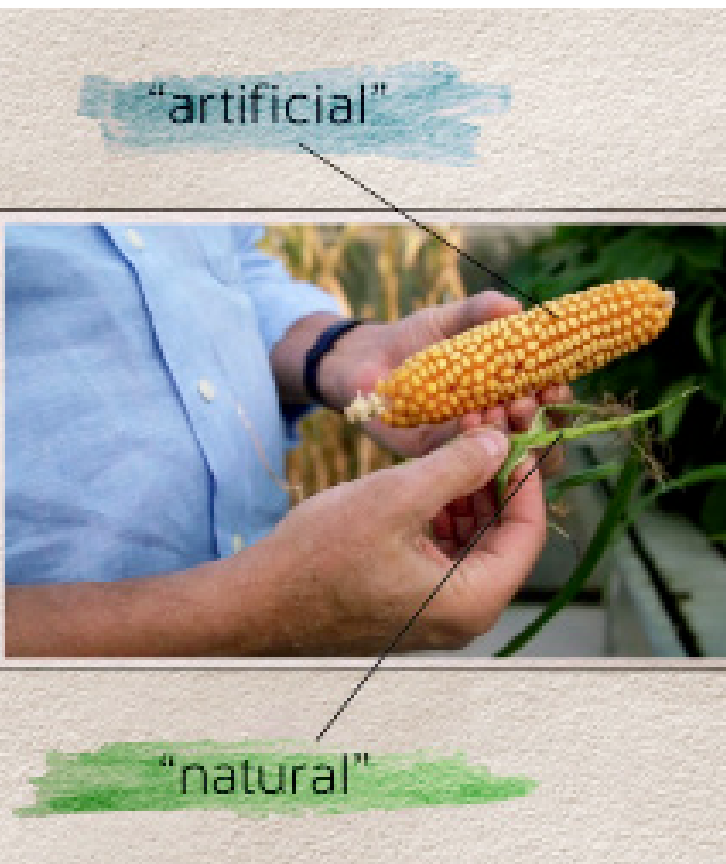
### UNPACKING THE PUBLIC DISCOURSE AROUND ADVANCES IN FOOD AND AGRICULTURE

The survival of our species has always depended on advances in food and agriculture. If few people dispute this statement, then why do we have so much conflict, confusion, and distrust in discussions around food and agriculture? The answer to that is complex, but let's begin with what most people can agree upon: Everyone wants safe, nutritious, affordable, and sustainable food for the entire planet. We also know that, as Dr. Neil deGrasse Tyson states in the film, "The profit motive is a double-edged sword. It can lead to innovation, as well as temptation." So the trick is to find the balance between promoting innovation and technology, while also checking and curbing the temptations of greed and power.

The good news is our global food and agricultural systems are the best they have been in the history of humanity. More people have access to safe and nutritious food than ever before. But at the same time, there are still huge problems: Too many people go hungry every day, and issues like obesity are real and daunting.

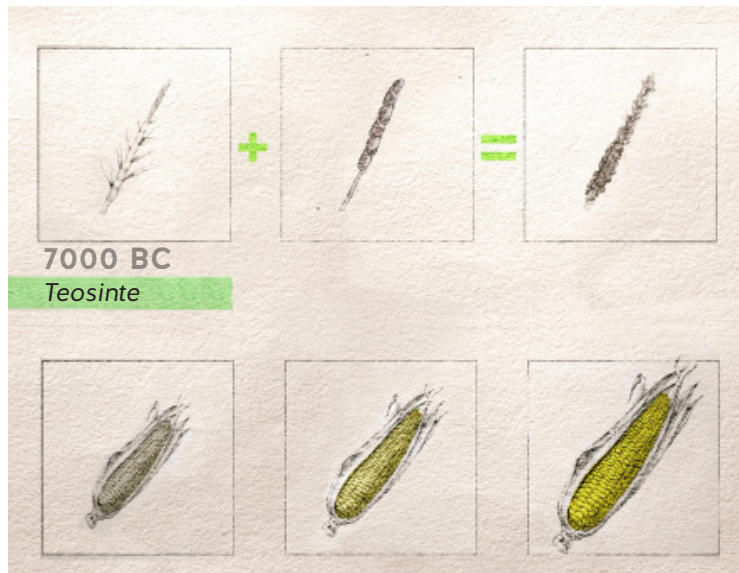
While it is healthy to be skeptical, if people are presented with overwhelming evidence that should alleviate that skepticism and they still don't change their minds, then they are no longer skeptics; they have become denialists. And that is not a helpful position.

We are witnessing the rise of a "post-truth" era where "alternative facts" may threaten our ability to innovate and thus survive one of the biggest challenges humans have ever faced: How are we going to feed over nine billion people by 2050? And while there isn't one perfect road that will get us there, the rigorous application of science is the best tool we have to help us chart a safe course through an uncertain future.





## SELECTIVE BREEDING: A HISTORY OF CORN



**HUMANS HAVE BRED *TEOSINTE* FOR THOUSANDS OF YEARS**, turning a wild grass with only a few edible kernels into the modern, abundant corn we enjoy today.

**“I might argue that a Chihuahua and a Great Dane are genetically modified relative to their ancestor, the wolf.”**

—Alison Van Eenennaam, Ph.D.,  
University of California, Davis

## GENETIC ENGINEERING IS A MODERN FORM OF PLANT BREEDING.

**A**lmost all major food crops today are the products of human intervention or what Charles Darwin called *artificial selection*. The tasty corn, watermelons, and peaches we gobble up on a summer picnic are nearly unrecognizable from their wild ancestors. This is because humans have bred plants by selecting those with the most desirable traits since the beginning of modern agriculture, about 10,000 years ago. By the 19th century, Gregor Mendel’s research on the hybridization of pea plants found inheritance patterns that further targeted results and led to the field of genetics. But since scientists did not yet know

how to find the genetic needle in the haystack, mixing different kinds of plants together could produce negative unintended consequences like toxins or allergens. Conventional plant breeding methods remain a hit-or-miss process that is usually untested and unregulated for safety or environmental effects.

We can breed plants with more precision with a technique called *genetic engineering* (GE). In 1973, scientists inserted a gene from one bacterium to another, conferring that trait to the recipient organism, creating the first genetically engineered organism, often called a genetically modified organism or GMO in popular culture.

As agriculture is one of the world’s most environmentally intense practices, producing greenhouse gases, depleting water supplies, polluting ecosystems with chemicals from pesticides and fertilizers, and clear-cutting forests for farms that lead to the loss of biodiversity, GE can also serve as an essential tool to address climate change. By inserting, silencing, or altering a gene or gene sequence, GE can protect crops from disease, pests, weeds, and drought, potentially reducing pesticide, fertilizer, and water use, increasing yield and income, improving nutrition and food safety, and contributing to a more sustainable environment.



## THE SCIENTIFIC METHOD VS. THE SINGLE-STUDY SYNDROME

**T**he Royal Society is the world's oldest scientific society in continuous existence. Formed in the 1660s and now comprising some 1,600 eminent scientists across the globe, their motto is *nullius in verba*, which means to take no one's word. Rather than being swayed by special interests who make up stories about the world around us to secure power, scientists arrive at facts by a systematic process called the *scientific method*. By making detailed observations of natural phenomena and using experimentation to test hypotheses, scientists draw conclusions based on the evidence. The scientific method is used in everyday life as well. Outside of scientific settings, it

is often referred to as critical thinking, troubleshooting, or problem solving. With greater access to conflicting information at our fingertips, however, it can be difficult to uncover the truth about a complex scientific topic. It is much easier to find one simple, absolute explanation that does not require deciphering a lot of data, especially if the study confirms what you already decided to believe in the first place. Once we take part in this "confirmation bias" with a community of support around the idea, it becomes harder to change our positions later.

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**"I TRUST SOCIAL MEDIA like blogs like Vani Hari's or other moms that even just do a post. I trust what they say more than most medical doctors, more than the CDC, more than the FDA, more than the USDA, more than the EPA. That's real, I don't need a scientific study."**

**—Zen Honeycutt, Moms Across America**

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PHOTO: BLACK VALLEY FILMS

When some anti-GMO activists cherry-pick evidence in this way, they are engaging in what science journalist Andrew Revkin calls the "single-study syndrome": selecting only the studies that appear to support a position, while ignoring all scientific evidence to the contrary.



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**“AS A SCIENTIST, when nothing seems to be working, you have to think of alternative solutions.”**

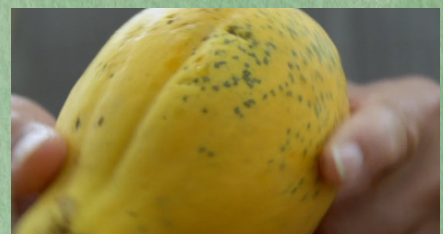
**—Dennis Gonsalves,  
Ph.D., Cornell University**

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## THE SCIENTIFIC METHOD AND SCIENTIFIC CONSENSUS

**“YOU NEVER TRUST ONE SCIENTIST OR ONE OPINION,”** says Dr. Pamela Ronald in the film. “You look at the consensus of experts in the field.” Scientists are skeptics who challenge each other with great rigor in the quest for truth. Scientific consensus is achieved when most scientists, who are experts in their fields after many years of study, come to the same conclusion. Scientific consensus is a combination of the depth of knowledge, repeatability of the results, and conversation among scientists over time. As Dr. John Swartzberg says in the film, there are no absolute answers, and consensus is neither unanimous nor definitive forever. But science provides the best information we have to make the most informed decisions we can regarding the critical issues that affect our health and the planet. The scientific consensus is that GMOs currently on the market have no known negative health or environmental consequences. This consensus is based on over 2,000 peer-reviewed scientific studies conducted over 30 years by the world’s leading scientific institutions. Over one hundred Nobel Laureate scientists agree.

GMOs continue to be the “most extensively tested crops ever added to our food supply,” vetted by the Food and Drug Administration (FDA), the United States Department of Agriculture (USDA), and the Environmental Protection Agency (EPA) in the U.S. Even in Europe, where there are bans in place on GMOs, the European Commission concluded that GMOs are no more likely to produce unintended consequences than traditional plant breeding.



In the 1990s, the **PAPAYA RINGSPOT VIRUS** nearly destroyed this popular fruit crop in Hawaii. Scientist Dennis Gonsalves wondered if it would be possible to “vaccinate” the plant against this disease by using a gene from the virus itself. With the new technology of genetic engineering, Dr. Gonsalves and his colleagues saved both the fruit and an essential industry to the Hawaii economy.







## WHAT IS SCIENTIFIC CONSENSUS?



Please click on the play button above to view the clip or go to [bit.ly/2F9xNRL](http://bit.ly/2F9xNRL)



ADVANCING SCIENCE, SERVING SOCIETY

“(T)he science is quite clear: crop improvement by the modern molecular techniques of biotechnology is safe.”



NATIONAL ACADEMY OF SCIENCES

“To date, no adverse health effects attributed to genetic engineering have been documented in the human population.”



AMERICAN MEDICAL ASSOCIATION

“There is no evidence that unique hazards exist either in the use of rDNA (GE) techniques or in the movement of genes between unrelated organisms.”



INSTITUT DE FRANCE  
Académie des sciences

“All criticisms against GMOs can be largely rejected on strictly scientific criteria.”



World Health Organization

“In addition, no effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved.”



## WHAT DOES IT MEAN TO BE “ORGANIC”?

**A**s we learn from two organic farmers in the film, Emma Naluyima Mugerwa in Uganda and Raoul Adamchak at the University of California, Davis, organic farming practices have made people think about agricultural solutions in new ways, from lowering the toxicity and negative environmental impacts of farming inputs (insecticides, herbicides, and fertilizers) to finding ways to conserve to understanding how food is grown and brought to our tables. But both Emma and Raoul also know that there is no one perfect method of farming. It is important to note that while some try to make the conversations around farming and food very binary (right vs. wrong, good vs. bad, GMO vs. organic), FOOD EVOLUTION looks at the data and embraces the nuances of “yes, and,” “it depends,” and the right of farmers to decide what is best for their particular situations.

Many pro-GMO and pro-organic farmers are using science-based thinking to find solutions. So let’s get past misinformation and remind ourselves that if we must see two sides, they aren’t organic vs. GMOs; they’re science-based thinking vs. marketing misinformation. One aim of the film is to identify when some organic and natural food companies use misinformation and fear-mongering to sell their products. When they attempt to convince customers that buying organic is a safer and more nutritious choice, that is not only scientifically false; it is also unethical, especially when it makes people who can’t afford organic products question their food choices.





## HOW WILL WE ENSURE FOOD SECURITY FOR FUTURE GENERATIONS?

If the scientific consensus says GMOs are safe, why does the debate continue? Much of the reason is that the term GMO means something different to each person. Concern around GMOs may not be with science but with politics, perception, and the profit motive.

**“We should have been much more transparent in reaching the public. You know as I look back, I wished that was something that we would have done earlier.”**

**—Robert Fraley, Ph.D., Monsanto**

Given the corporate track record, from tobacco companies hiding the health effects of smoking to oil companies denying climate change, to quote Dr. Neil deGrasse Tyson in the film: “Corporate greed and bias have broken the public’s trust.”

In the end, however, it is science-based thinking and repeatable data that confirmed the dangers of tobacco, the existence of climate change, and the safety of genetic engineering, as well as hundreds of things we take for granted every day of our lives.

The validity of the underlying science behind genetic engineering is separate from the uses

it is put toward in society. Several different avenues can address concerns about how any technology may be employed. One way would be to increase transparency and accountability from the private sector and government around scientific and technological advances. Additional investment in science education can help the public become better informed.

Finally, in one of the most comprehensive studies ever produced on GMOs, the National Academy of Sciences concluded that one area of concern is the domination of the industry by large corporations, which could restrict access to the new technology for small farmers. Efforts to democratize our food system, putting power, knowledge, and resources into the hands of small farmers as well as consumers, can help strengthen our food system and generate confidence in it.



**THE PROFIT MOTIVE IS A DOUBLE-EDGED SWORD**



**VIDEO CLIP**

Please click on the play button above to view the clip or go to [bit.ly/2odifEq](http://bit.ly/2odifEq)



## HOW WILL WE ENSURE FOOD SECURITY FOR FUTURE GENERATIONS? (cont.)

Another way to build trust in GE may be more user-friendly applications. GMOs are ubiquitous in our food supply but one reason the public may be skeptical is because they have yet to directly see the effects of the technology. Future GMOs are entering an exciting new phase that some refer to as GMO 2.0, where the benefits to consumers are much more evident. In FOOD EVOLUTION, we learn that scientists are working on non-allergenic peanuts and mosquitoes that can stop malaria, dengue, and even the Zika virus.

There are also more efforts to produce food for human consumption rather than commodity crops, from drought-tolerant maize and sugarcane to disease-resistant bananas, wheat, and potatoes. Scientists are looking at increasing the nutritional potential of food, including carrots that help people absorb more calcium or tomatoes with greater antioxidant properties.

Due to a deadly disease called *trypanosomiasis*, livestock cannot be raised on a third of the African continent, but GE cows could survive the disease, providing food and tilling fields for poor farmers.

Scientists are also finding ways to bring nearly extinct heirloom species, such as the American chestnut tree, back to life. Even further afield is the possibility of self-fertilizing crops, which pull nitrogen out of the atmosphere, increasing crop yield without pollution. Someday we may be able to grow biodegradable plastics, which would eliminate the need to use petroleum or coal to produce our current plastics that are damaging to our health and the environment.

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**“So, while we may have had a crisis of trust, when we come to our next evolutionary fork in the road, how do we decide which way to go? What kind of a future will we have if we turn our backs on credible evidence, sound science and repeatable studies? What impact will that have on ourselves, our planet and our future?”**

**—Dr. Neil deGrasse Tyson,  
FOOD EVOLUTION**

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There is no question that human activity has had an increasing impact on the planet and concerns about the effects of technology on our health and environment will persist as we enter a dangerous and uncertain future. While we can't return to the Garden of Eden, socially responsible science and technology can help us identify the problems and come up with answers. If we pursue solutions from a position of knowledge and reason, rather than misinformation and fear, the possibilities that science offers us are infinite.