Genetic Engineering Writing Prompt

Prompt:

Genetic engineering is controversial topic with strong beliefs on both sides of the argument. Some argue that genetic engineering can benefit the world with new technology to create better health and food sources. Others argue that genetic engineering is unethical and the long term consequences are still unknown.

Write an essay in which you take a position either for or against allowing genetic engineering in the United States. Use specific evidence from the articles and videos we have read in class to support your claim.

VIDEO: TED TALK

"It's Time to Question Bio-Engineering" by Paul Root Wolpe

http://www.ted.com/talks/paul_root_wolpe_it_s_time_to_question_bio_engineering

ATTACHED ARTICLES:

D.I.Y. Biology, on the Wings of the Mockingjay By James Gorman

A Dream of Trees Aglow at Night By Andrew Pollack

OPINION: Don't Be Afraid of Genetic Modification By Emily Anthes

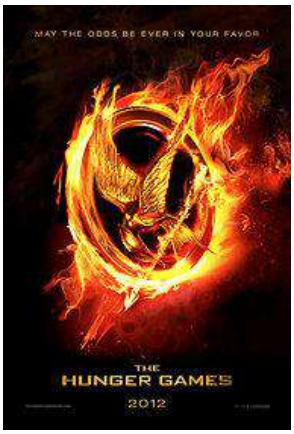
Seeking Food Ingredients That Aren't Gene-Altered By Stephanie Strom

SIDE EFFECTS

D.I.Y. Biology, on the Wings of the Mockingjay

By JAMES GORMAN

Published: May 10, 2012



Genetically modified organisms are not wildly popular these days, except one: a fictional bird that is central to the hugely popular movie and book trilogy "The Hunger Games." That's the mockingjay, a cross between a mockingbird and a genetically engineered spy bird called a jabberjay.

The action in "The Hunger Games" takes place in a fictional future in which teenagers are forced to hunt and kill one another in annual competitions designed to entertain and suppress a highly controlled population. The mockingjay first appears as a symbol, when Katniss Everdeen, the heroine, is given a pin that depicts the bird. Mockingjay pins, although not the birds, have spread to the real world.

"They're funny birds and something of a slap in the face to the Capitol," Katniss explains in the first book. And the nature of that slap in face is a new twist on the great fear about genetic engineering, that modified organisms or their genes will escape into the wild and wreak havoc. The mockingjay is just such an unintended consequence, resulting from a failed creation of the government, what Katniss means when she refers to "the Capitol." But rather than being a disaster, the bird is a much-loved reminder of the limits of totalitarian control.

The origin of the bird, Katniss explains, is that the rulers modified an unspecified species of jay to make a new creature, an animal of the state called a jabberjay. Jabberjays were intended to function as biological recording machines that no one would suspect. They would listen to conversations and then return to their masters to replay them.

The jabberjays, all male, were left to die out when the public realized what they were doing. Like genetically modified organisms today, the jabberjays were not expected to survive in the wild, but they bred with mockingbirds and produced a thriving hybrid that could mimic human sounds and songs, and lived on, to the irritation of the government and the delight of the people.

Setting aside whether jays could actually breed with mockingbirds — this is a kind of fairy tale, after all — the choice of species rings true. Jays, along with crows and ravens, belong to a highly intelligent group of birds called the corvids. And jays are naturally thieves and spies, keeping track of where other jays hide food, for example, to raid it later. Mockingbirds, of course, have a fantastic ability to mimic other birds' songs. Coincidentally, or perhaps not, Thomas Jefferson, a lover of both birds and liberty, kept a pet mockingbird in the White House.

I asked Joan Slonczewski, a microbiologist and science fiction writer at Kenyon College in Ohio, about her take on the mockingjay. Dr. Slonczewski, whose recent books include a text and a novel, "The Highest Frontier," teaches a course called "Biology in Science Fiction." The tools needed to modify organisms are already widely dispersed in industry and beyond. "Now anybody can do a start-up," she said.

That's no exaggeration. Do-it-yourself biology is growing. The technology to copy pieces of DNA can be bought on eBay for a few hundred dollars, as Carl Zimmer reported in The New York Times in March. As to where D.I.Y. biology may lead, Freeman Dyson, a thinker at the Institute for Advanced Study known for his provocative ideas, presented one view in 2007 in The New York Review of Books. He envisioned the tools of biotechnology spreading to everyone, including pet breeders and children, and leading to "an explosion of diversity of new living creatures."

Eventually, he wrote, the mixing of genes by humans will initiate a new stage in evolution. Along the way, if he is right, the world may have more than its share of do-it-yourself mockingjays.

This article has been revised to reflect the following correction:

Correction: May 14, 2012

An earlier version of this article misstated the name of the academic institution with which Freeman Dyson is affiliated. It is the Institute for Advanced Study, not Studies.

A Dream of Trees Aglow at Night

By ANDREW POLLACK

Published: May 7, 2013

Antony Evans, left, and Kyle Taylor show E. coli with jellyfish genes.

Mr. Taylor, left, is lead scientist of the glowing plant project, and Mr. Evans its manager.

Arabidopsis, the first plant test subject.

Hoping to give new meaning to the term "natural light," a small group of biotechnology hobbyists and entrepreneurs has started a project to develop plants that glow, potentially leading the way for trees that can replace electric streetlamps and potted flowers luminous enough to read by.

The project, which will use a sophisticated form of genetic engineering called synthetic biology, is attracting attention not only for its audacious goal, but for how it is being carried out.

Rather than being the work of a corporation or an academic laboratory, it will be done by a small group of hobbyist scientists in one of the growing number of communal laboratories springing up around the nation as biotechnology becomes cheap enough to give rise to a do-it-yourself movement.

The project is also being financed in a D.I.Y. sort of way: It has attracted more than $250,000 in pledges from about 4,500 donors in about two weeks on the Web site Kickstarter.

The effort is not the first of its kind. A university group created a glowing tobacco plant a few years ago by implanting genes from a marine bacterium that emits light. But the light was so dim that it could be perceived only if one observed the plant for at least five minutes in a dark room.

The new project's goals, at least initially, are similarly modest. "We hope to have a plant which you can visibly see in the dark (like glow-in-the-dark paint), but don't expect to replace your light bulbs with version 1.0," the project's Kickstarter page says.

But part of the goal is more controversial: to publicize do-it-yourself synthetic biology and to "inspire others to create new living things." As promising as that might seem to some, critics are alarmed at the idea of tinkerers creating living things in their garages. They fear that malicious organisms may be created, either intentionally or by accident.

Two environmental organizations, Friends of the Earth and the ETC Group, have written to Kickstarter and to the Agriculture Department, which regulates genetically modified crops, in an effort to shut down the glowing plant effort.

The project "will likely result in widespread, random and uncontrolled release of bioengineered seeds and plants produced through the controversial and risky techniques of synthetic biology," the two groups said in their letter demanding that Kickstarter remove the project from its Web site.

They note that the project has pledged to deliver seeds to many of its 4,000 contributors, making it perhaps the "first-ever intentional environmental release of an avowedly 'synthetic biology' organism anywhere in the world." Kickstarter told the critics to take up their concerns with the project's organizers. The Agriculture Department has not yet replied.

Antony Evans, the manager of the glowing plant project, said in an interview that the activity would be safe.

"What we are doing is very identical to what has been done in research laboratories and big institutions for 20 years," he said. Still, he added, "We are very cognizant of the precedent we are setting" with the do-it-yourself project and that some of the money raised would be used to explore public policy issues.

Synthetic biology is a nebulous term and it is difficult to say how, if at all, it differs from genetic engineering.

In its simplest form, genetic engineering involves snipping a gene out of one organism and pasting it into the DNA of another. Synthetic biology typically involves synthesizing the DNA to be inserted, providing the flexibility to go beyond the genes found in nature.

The glowing plant project is the brainchild of Mr. Evans, a technology entrepreneur in San Francisco, and Omri Amirav-Drory, a biochemist. They met at Singularity University, a program that introduces entrepreneurs to futuristic technology.

Dr. Amirav-Drory runs a company called Genome Compiler, which makes a program that can be used to design DNA sequences. When the sequence is done, it is transmitted to a mail-order foundry that synthesizes the DNA.

Kyle Taylor, who received his doctorate in molecular and cell biology at Stanford last year, will be in charge of putting the synthetic DNA into the plant. The research will be done, at least initially, at BioCurious, a communal laboratory in Silicon Valley that describes itself as a "hackerspace for biotech."

The first plant the group is modifying is Arabidopsis thaliana, part of the mustard family and the laboratory rat of the plant world. The organizers hope to move next to a glowing rose.

Scientists have long made glowing creatures for research purposes, including one or more monkeys, cats, pigs, dogs and worms. Glowing zebra fish have been sold in some aquarium shops for years.

These creatures typically have the gene for a green fluorescent protein, derived from a jellyfish, spliced into their DNA. But they glow only when ultraviolet light is shined on them.

Others going back to the 1980s have transplanted the gene for luciferase, an enzyme used by fireflies, into plants. But luciferase will not work without another chemical called luciferin. So the plants did not glow unless luciferin was constantly fed to them. In 2010, researchers at Stony Brook University reported in the journal Plos One that they had created a tobacco plant that glowed entirely on its own, however dimly. They spliced into the plant all six genes from a marine bacterium necessary to produce both luciferase and luciferin.

Alexander Krichevsky, who led that research, has started a company, BioGlow, to commercialize glowing plants, starting with ornamental ones, since it is still impractical to replace light bulbs.

"Wouldn't you like your beautiful flowers to glow in the dark?" he said, invoking the glowing foliage in the movie "Avatar."

Dr. Krichevsky declined to provide more about the products, timetables or the investors backing his company, which is based in St. Louis.

Whether it will ever be possible to replace light bulbs remains to be seen and depends to some extent on how much of the plant's energy can be devoted to light production while still allowing the plant to grow. Mr. Evans said his group calculated, albeit with many assumptions, that a tree that covers a ground area of 10 meters (nearly 33 feet) by 10 meters might be able to cast as much light as a street lamp.

While the Agriculture Department regulates genetically modified plants, it does so under a law covering plant pests.

BioGlow has already obtained a letter from the department saying that it will not need approval to release its glowing plants because they are not plant pests, and are not made using plant pests. The hobbyist project hopes to get the same exemption.

Todd Kuiken, senior research associate at the Woodrow Wilson Center in Washington, who has been studying the governance of both synthetic biology and the do-it-yourself movement, said the glowing plant project was an ideal test case.

"It exposes the gaps and holes in the regulatory structure, while it is, I would argue, a safe product in the grand scheme of things," Dr. Kuiken said. "A serious look needs to be taken at the regulatory system to see if it can handle the questions synthetic biology is going to raise."

OPINION: Don’t Be Afraid of Genetic Modification

By EMILY ANTHES

Published: March 9, 2013

IF patience is a virtue, then AquaBounty, a Massachusetts biotech company, might be the most virtuous entity on the planet.

In 1993, the company approached the Food and Drug Administration about selling a genetically modified salmon that grew faster than normal fish. In 1995, AquaBounty formally applied for approval. Last month, more than 17 years later, the public comment period, one of the last steps in the approval process, was finally supposed to conclude. But the F.D.A. has extended the deadline — members of the public now have until late April to submit their thoughts on the AquAdvantage salmon. It’s just one more delay in a process that’s dragged on far too long.

The AquAdvantage fish is an Atlantic salmon that carries two foreign bits of DNA: a growth hormone gene from the Chinook salmon that is under the control of a genetic “switch” from the ocean pout, an eel-like fish that lives in the chilly deep. Normally, Atlantic salmon produce growth hormone only in the warm summer months, but these genetic adjustments let the fish churn it out year round. As a result, the AquAdvantage salmon typically reach their adult size in a year and a half, rather than three years.

If the modified fish is approved, which could still happen later this year, it will be the first transgenic animal to officially enter the human food supply. Appropriately, it has been subjected to rigorous reviews, with scientists all over the country weighing in on whether it is fit for human consumption and what might happen if it was to make its way into the wild. Some environmentalists fear that the modified salmon might wriggle free from fish farms, start reproducing, and ultimately drive wild salmon populations to extinction.

But scientists, including the F.D.A.’s experts, have concluded that the fish is just as safe to eat as conventional salmon and that, raised in isolated tanks, it poses little risk to wild populations.

This decision isn’t meant to be made quickly; due scientific diligence requires time. But some suspect that political considerations have played a role in drawing the approval process out to tortuous lengths. Many of the members of Congress who oppose the modified fish represent states with strong salmon industries. And some nonprofit groups seem to be opposing the modified salmon reflexively, as part of an agenda to oppose all animal biotechnology, regardless of its safety or potential benefits.

Even the White House might be playing politics with the salmon. One step in the approval process is the preparation of an environmental assessment on the fish’s potential risks. In May of last year, the F.D.A. commissioner said that a draft would be released “very soon.” Months passed.

In December, Jon Entine, the executive director of the Genetic Literacy Project, a nonpartisan nonprofit group that promotes education about biotechnology issues, wrote an article in Slate suggesting that the holdup wasn’t with the F.D.A., which had completed the report, but with the Obama administration, which had just finished a re-election campaign. He wrote, “The delay, sources within the government say, came after meetings with the White House, which was debating the political implications of approving the GM salmon, a move likely to infuriate a portion of its base.” A few days after the article appeared, the F.D.A. published its assessment. The date on the report — May 4, 2012 — seemed to confirm Mr. Entine’s account that it had been ready for months.

The publication of that assessment initiated the public comment period, now extended to April. After reviewing the comments — more than 30,000, so far — the F.D.A. will be free to issue its final ruling.

WE should all be rooting for the agency to do the right thing and approve the AquAdvantage salmon. It’s a healthy and relatively cheap food source that, as global demand for fish increases, can take some pressure off our wild fish stocks. But most important, a rejection will have a chilling effect on biotechnological innovation in this country.

Some scientists may move abroad, to China, Argentina, India or another nation where the political climate is more favorable. (Indeed, some have already done so — researchers at the University of California, Davis, who have developed goats whose modified milk could be used to treat and prevent childhood diarrhea, are moving much of their operation to Brazil.) Others may decide not to pursue such research at all. If a company that has done everything right can’t get its product approved, who else will be foolish enough to embark upon this kind of research? Who will finance it?

Of course, all this would be just fine with some anti-biotech groups, which traffic in scare tactics rather than science. But it shouldn't be fine with the rest of us.

Genetically engineered animals could do real good for the world. Scientists at Cambridge University and Scotland's Roslin Institute — the facility that created Dolly, the cloned sheep, in 1996 — have been working to genetically engineer chickens that are resistant to bird flu. They haven't pulled that feat off yet, but they have managed to engineer birds that can't spread the flu to others in their flock, which is a good start. Given how hard it is to develop vaccines to combat the rapidly evolving flu virus, this genetic modification could end up saving the lives of many birds, and perhaps humans.

Then there's the Enviropig, a swine that has been genetically modified to excrete less phosphorus. Phosphorus in animal waste is a major cause of water pollution, and as the world's appetite for meat increases, it's becoming a more urgent problem. The first Enviropig, created by scientists at the University of Guelph, in Canada, was born in 1999, and researchers applied to both the F.D.A. and Health Canada for permission to sell the pigs as food.

But last spring, while the applications were still pending, the scientists lost their funding from Ontario Pork, an association of Canadian hog farmers, and couldn't find another industry partner. (It's hard to blame investors for their reluctance, given the public sentiment in Canada and the United States, as well as the uncertain regulatory landscape.) The pigs were euthanized in May.

The F.D.A. must make sure that other promising genetically modified animals don't come to the same end. Of course every application needs to be painstakingly evaluated, and not every modified animal should be approved. But in cases like AquaBounty's, where all the available evidence indicates that the animals are safe, we shouldn't let political calculations or unfounded fears keep these products off the market. If we do that, we'll be closing the door on innovations that could help us face the public health and environmental threats of the future, saving countless animals — and perhaps ourselves.

Seeking Food Ingredients That Aren't Gene-Altered

By STEPHANIE STROM

Published: May 26, 2013

Lizanne Falsetto's company, thinkThin, spent 18 months looking for nongenetically modified ingredients for its Crunch bars.

Mostly Modified

The vast majority of a number of major crops in the United States are grown from genetically engineered seeds.

- Canola (about 90% of crop)
- Corn (about 88% of crop in 2011)
- Soy (about 94% of crop in 2011)
- Sugar beets (about 95% of crop in 2010)
- Cotton (about 90% of crop in 2011)
- Papaya (most of Hawaiian crop; about 988 acres)
- Zucchini and yellow summer squash (about 25,000 acres)

Source: Non-GMO Project.

Food companies big and small are struggling to replace genetically modified ingredients with conventional ones.

Pressure is growing to label products made from genetically modified organisms, or "G.M.O." In Connecticut, Vermont and Maine, at least one chamber of the state legislature has approved bills that would require the labeling of foods that contain genetically modified ingredients, and similar legislation is pending in more than two dozen other states. This weekend, rallies were held around the globe against producers of genetically altered ingredients, and consumers are threatening to boycott products that are not labeled.

And so, for many businesses, the pressing concern is just what it will take to gain certification as non-G.M.O.

Lizanne Falsetto knew two years ago that she had to change how her company, thinkThin, made Crunch snack bars. Her largest buyer, Whole Foods Market, wanted more products without genetically engineered ingredients — and her bars had them. Ms. Falsetto did not know how difficult it would be to acquire non-G.M.O. ingredients.

ThinkThin spent 18 months just trying to find suppliers. "And then we had to work to achieve the same taste and texture we had with the old ingredients," Ms. Falsetto said. Finally, last month, the company began selling Crunch bars certified as non-G.M.O.

The Non-GMO Project was until recently the only group offering certification, and demand for its services has soared. Roughly 180 companies inquired about how to gain certification last October, when California tried to require labeling (the initiative was later voted down), according to Megan Westgate, co-founder and executive director of the Non-GMO Project.

Nearly 300 more signed up in March, after Whole Foods announced that all products sold in its stores would have to be labeled to describe genetically engineered contents, and about 300 more inquiries followed in April, she said.

"We have seen an exponential increase in the number of enrollments," Ms. Westgate said.

The shift is evident in prices of nongenetically modified crops, which have been rising as more companies seek them out. Two years ago, a bushel of non-G.M.O. soybeans cost $1 to $1.25 more than a bushel of genetically modified soybeans. Now, that premium is $2. For corn, the premium has jumped from 10 cents to as high as 75 cents.

"We've had more calls from food processors wanting to know if we can arrange for non-G.M.O. supplies," said Lynn Clarkson, founder and president of Clarkson Grain, which sells such conventional grains.

In this country, roughly 90 percent or more of four major crops — corn, soybeans, canola and sugar beets — are grown from genetically engineered seeds, creating a challenge for companies seeking to swap to ingredients sourced from conventional varieties. A portion of the conventional varieties of those crops is exported, and much of the rest of those crops is already spoken for by organic and other companies here.

Additionally, the livestock industry is increasing its demand for non-G.M.O. crops to meet growing demand among consumers for eggs and meats sourced from animals that have never eaten genetically modified feeds.

On Saturday, at least two million people in 436 cities in 52 countries rallied in protests against the seed giant Monsanto and genetically modified food, according to the organizers of the "March Against Monsanto." The company, based in St. Louis, is the largest producer of genetically engineered seeds and the pesticides used to protect them.

Farmers have long crossbred plants to improve genetics in an effort to increase productivity and resistance to pests and diseases, and decrease the need for water, among other things.

The type of genetic engineering done by Monsanto and its competitors, however, involves inserting genetic materials, sometimes from wholly different plant species and bacteria, directly into the DNA plants like corn or soybeans.

Regulators and some scientists say this poses no threat to human health, but a growing number of consumers are demanding increased information about what is in their food, whether it is gluten or genetically engineered ingredients.

Monsanto said it respected people's right to express their opinion, but maintained that its seeds improved agriculture "by helping farmers produce more from their land while conserving natural resources such as water and energy."

Mr. Clarkson said that, so far, there were more of those non-G.M.O. crops than buyers for them, and large companies like Silk and Hain Celestial that have long been users of conventional crops say they are not worried.

"I don't think you can discount the number of companies that are not in favor of labeling, which is what is driving demand right now," said Ellen Deutsch, senior vice president and chief growth officer at Hain. "But if demand does grow, we will need to maintain our longstanding relationships with our suppliers."

Errol Schweizer, national grocery buyer at Whole Foods, said he was already seeing shortages in organic and conventional seeds, as well as in commodity ingredients sourced from conventional crops.

"Suppliers are going overseas to get what they need," he said. "We know farmers need to feel secure that there's a market for what they grow, and I'm saying, please plant these crops, there is a demand."

Dealers in conventional crops say more farmers will switch to them if the demand is there, but it will take time. Most food-processing companies have an 18-month supply chain for crops like corn and soy, which means that if they begin making a switch today, the earliest they might get certification would be in 2015.

And farmers cannot simply replace genetically engineered seeds with conventional ones, because soil in which genetically modified crops have been grown may not be immediately suitable for conventional crops.

"There's a transition period required," said Richard Kamolvathin, senior vice president at Verity Farms, which sells meats, grains and other products derived from conventional crops, as well as natural soil amendments. "You don't just stop growing G.M.O. seed and then start growing non-G.M.O. seed."

Nor can companies simply replace, say, corn flour from genetically engineered corn with its non-G.M.O. cousin without wreaking havoc on things like taste, consistency and mouth feel.

Every ingredient in a product must be verified by affidavit, and storage and processing facilities, as well as transportation equipment, must be scrubbed of all traces of genetically modified supplies.

Those requirements may be too high a hurdle for some food processors. Big makers of pivotal ingredients like corn and soy oil, for instance, cannot easily switch back and forth between genetically engineered and conventional sources.

Even companies that use conventional crops in production have to work hard to get certified. Silk, a large maker of soy and nut "milks," has used soy beans from plants that are not genetically modified since its founding.

But it took the company some eight months to gather and compile lists of all its ingredients, affidavits from suppliers, test records and other information, then go through independent testing for confirmation, before its products gained non-G.M.O. certification — and it helps underwrite the Non-GMO Project.

"It's a pretty significant undertaking," said Craig Shiesley, senior vice president for plant-based beverages at WhiteWave Foods, the parent company of Silk. "We make 100 million gallons of soy milk using one million bushels of soy beans, and this affects not only all those bushels of soy beans and other ingredients like vitamins and flavorings, but also all of our manufacturing and distribution."

While Whole Foods tries to help suppliers procure non-G.M.O. ingredients, its labeling initiative is causing headaches.

"Whole Foods has come in the back door and inadvertently created something of a crisis," said Reuven Flamer, the founder of Natural Food Certifiers, which certifies foods as organic or kosher and is now adding non-G.M.O. certification to its list of services. "People who make organic products support non-G.M.O. standards, but they are already paying a premium for their supplies and certification."

Based on the demand he is seeing for non-G.M.O. certification, Mr. Flamer says it is almost certain the supply of conventional seeds and crops, and derivatives of those crops, is going to become an issue.

That worries Manuel Lopez, whose family owns El Milagro, a tortilla and tortilla products company in Chicago. "We've always used non-G.M.O. corn," he said, "and our concern is about our supply."

The cost of the corn El Milagro uses is roughly 1.7 times the cost of genetically engineered corn, he said, and the company cannot pass on all the additional cost to customers.

Mr. Lopez is hopeful, though. "I believe there are a lot of farmers who want to get away from G.M.O.," he said. "If they see more demand, I think they will respond."