→ Mark your confusion.
→ Purposefully annotate the article (1-2 mature, thoughtful responses per page to what the author is saying)
→ Write a 250+ word response to the article.
(If you are a teacher or student who would like to modify this Google Doc, go to File > Make a Copy. I cannot and do not respond to Share requests -- my apologies!)

Why are scientists creating genetically modified mosquitoes?

Scientists plan to release altered mosquitoes designed to sabotage the species' ability to reproduce. Is this safe? Here's everything you need to know:

By *The Week* Staff, July 26, 2020

Who's doing this?

The federal Environmental Protection Agency has approved a plan by a British biotech company called Oxitec to release about 1 billion genetically modified (GM) mosquitoes in the Florida Keys and, next year, Texas. The mosquitoes (code-named OX5034) will only be male — the gender that does not bite humans — and will carry a new gene that will be passed on to their female offspring and cause them to die while they're still larvae. Repeated releases of such "Trojan horse" mosquitoes should kill, in theory, 90 percent of the local population of the Aedes aegypti mosquito, which is capable of transmitting the Zika and West Nile viruses, as well as dengue and yellow fever. Oxitec claims it's safe and notes that the species is invasive to south Florida, anyway. But the plan has drawn protest from residents and some in the scientific community. "People here in Florida do not consent to the genetically engineered mosquitoes or to being human experiments," said Barry Wray of the Florida Keys Environmental Coalition. Henry Greely, a Stanford law professor and bioethicist, said the Oxitec plan reflects the almost limitless possibilities — and dangers — of genetic technology. "We can remake the biosphere to be what we want, from woolly mammoths to nonbiting mosquitoes," he said. "How should we feel about that? Do we want to live in nature, or in Disneyland?"

How does this technology work?

Scientists first genetically modified an animal — a mouse — in 1974. But the process remained cumbersome and slow until the development of the CRISPR technique and other "gene-editing" technology this decade. Now scientists can target exactly which genes they want to modify using RNA, break the DNA apart at the gene's location using an enzyme, and then insert a new gene. Last year, University of Georgia researchers created the first genetically modified reptile, a brown anole, and an Indiana company, AquaBounty, expects to begin harvesting tons of salmon genetically modified to grow faster at an indoor facility later this year. Critics say this is all moving too fast, without adequate study of risks and unintended consequences. Jaydee Hanson, policy director for the International Center for Technology Assessment and Center for Food Safety, calls Oxitec's project a "Jurassic Park experiment, except without the island."

Where do the plans stand?

In May, the EPA greenlighted Oxitec's plans for both Florida and Texas, issuing the company an experimental use permit. Florida state authorities followed suit with their own approval. Texas authorities and the Florida Keys Mosquito Control commission still need to sign off, and may face lawsuits. More than 31,000 people filed objections with the EPA — and only 56 expressed support — with some accusing the agency of relying solely on data supplied by Oxitec to issue permits. "What could possibly go wrong?" asked Hanson. "We don't know, because they unlawfully refused to seriously analyze environmental risks."

What could go wrong?

Some geneticists, including Dr. Ricarda Steinbrecher of EcoNexus, a public-interest research organization, have raised alarms that Oxitec's altered mosquitoes haven't been adequately studied. The researcher said "the underlying mechanism(s) leading to cell death" in the larvae aren't "fully understood" and thus can't yield "precise and predictable results." An independent group of researchers also claimed that some of the larvae produced from an earlier Oxitec field study in Brazil survived to sexual maturity and were able to reproduce — introducing the mosquitoes' modified DNA into the local population. (So

far, there is no evidence that the resulting hybrid is more robust or dangerous to humans.) Critics also warn that the potential removal of even an invasive species from the food chain and ecosystem could have profound unintentional consequences; many kinds of birds and bats, for example, eat mosquitoes. "I'm not sure I care if mosquitoes suffer, if they can suffer," Greely said. "But mammals or birds, I do care."

What's the upside?

Some see world-changing possibilities. Florida witnessed its first mosquito-to-human transmission of the Zika virus (which causes serious birth defects) in 2016, and West Nile is a perennial problem. As these diseases spread northward in a warming world, the elimination of a species that transmits them could prevent many illnesses and save lives. Meanwhile, a team of scientists led by the renowned botanist Joanne Chory is using CRISPR to create plants capable of storing extra carbon dioxide. Theoretically, if applied on a large scale, such plants could suck more greenhouse gases from the atmosphere and arrest the forces of climate change. "I feel like I have the weight of the world on my shoulders," Chory has said. In Australia, researchers are devising a genetically modified coral capable of withstanding rising sea temperatures. "The worst thing that we could do is ignore genetic engineering because it's frightening for some people," said coral geneticist Line Bay, "and then get 10 or 15 years down the road and realize it's the only option."

Oxitec's modified moths

South Florida and Texas aren't the only places that Oxitec is testing its genetically modified insects. Earlier this year, Cornell University scientists announced the results of a project they had conducted with the company involving its genetically modified diamondback moths, or Plutella xylostella. The pest reportedly wreaks between $4 billion and $5 billion a year of damage to crops like broccoli, canola, cauliflower, and cabbage. Scientists and farmers are eager to find ways of limiting the damage as well as reducing the $19 billion worth of chemical pesticides sprayed on crops each year. The modified male moths come with a self-limiting gene that causes their female progeny to die. The Cornell team declared the test a success, saying that the modified moths should "effectively suppress populations of pest P. xylostella in the field." The company is also at work developing a modified, self-limiting version of the fall armyworm, which is responsible for terrible crop losses across sub-Saharan Africa and parts of Asia. An Oxitec scientist who co-authored the Cornell report hailed the "immense potential" of protecting plants without resorting to potentially toxic pesticides.

Response option(s):

- Professor Greely in the first paragraph of the article states, “"We can remake the biosphere to be what we want, from woolly mammoths to nonbiting mosquitoes. How should we feel about that? Do we want to live in nature, or in Disneyland?" First, paraphrase what he means. Then, respond to it with your own thoughts, questions, agreements, or disagreements.
- Toward the end of the article, coral geneticist Line Bay claims, “ "The worst thing that we could do is ignore genetic engineering because it's frightening for some people, and then get 10 or 15 years down the road and realize it's the only option." What does Bay mean? How does her project connect to the mosquito project that is featured in this article? What are your thoughts on Bay’s claim?
- Summarize any point made in the article and respond.