

# Engineered Mosquito

These male engineered mosquitoes carry a gene that means their offspring will die during development unless they are fed a necessary chemical that is only available in the lab. The engineered male mosquitoes are released to mate with wild females. The offspring inherit the lethal gene from the engineered male. It is the males who are engineered because they don't bite humans. The next generation of mosquitoes dies before they are mature enough to mate. This reduces the number of mosquitoes in the following generation because only females that mated with wild males will produce fertile offspring.

## **PROS:**

Fewer mosquitoes in the area means less transmission of malaria.

If the mosquito population gets low enough, it becomes practically impossible to transmit malaria, even if the population isn't zero.

Genetically engineered mosquitoes reduce the need for insecticides, bed nets, and malaria drugs, which are becoming less effective as mosquitoes and the malaria parasite adapt to them.

## **CONS:**

Mosquitoes can evolve resistance to the lethal gene, so population reduction might not go as planned. Modified female offspring might also bite humans.

In the lab, a small percentage of mosquitoes with the lethal gene were still able to survive, even without the necessary chemical.

In some places, the chemical that keeps the GE mosquitoes alive might be present in the environment, so they might be able to survive and reproduce.

Engineered males are not yet good enough at mating to reduce the mosquito population.

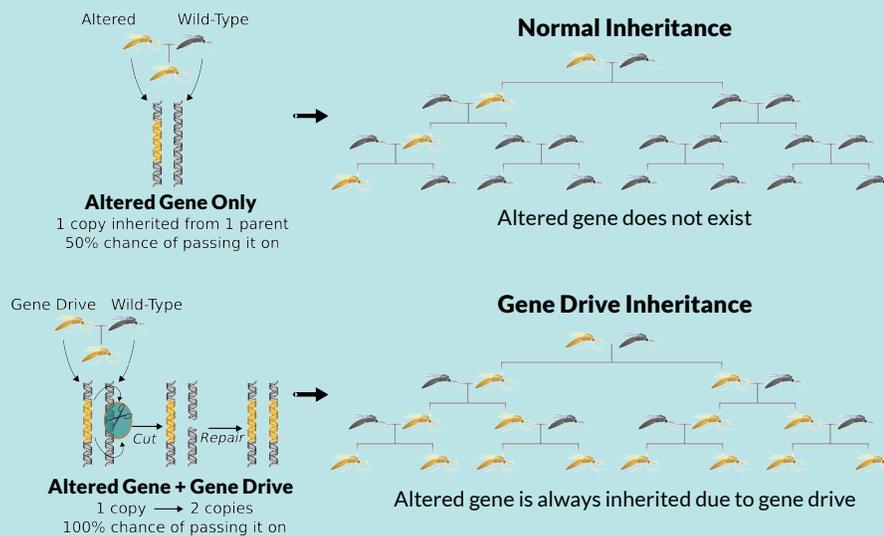
*For more information, see the Supplemental Information Sheet on Engineered Mosquitoes.*



# Gene Drive

## Part 1: Overview

Some genes found in nature are more likely to be passed on to offspring. By using elements of these genes, engineers have developed gene drive systems. Genes with gene drives spread through a population quickly over just a few generations.



### CONSIDERATIONS:

Some scientists suggest that we could release a second gene drive that would reverse the first gene drive if something went wrong. This strategy would not completely return the population to “normal” because the genes from the second gene drive would still be present.

Gene drives have been tested successfully in the lab but no mosquitoes with gene drives have ever been released in the wild.

### OPTIONS:

One possible gene drive could target the malaria parasite that can live inside mosquitoes.

Another gene drive could target the mosquito itself.

For more information, see the Supplemental Information Sheet on Engineered Mosquitoes.



# Gene Drive

## Part 2: Targets



### **TARGET: Malaria Parasite**

The gene drive targeting the malaria parasite makes mosquitoes unable to carry the malaria parasite.

#### **PROS:**

This is not likely to have many unexpected effects on animals besides mosquitoes.

The mosquitoes would still be present in the ecosystem.

#### **CONS:**

The malaria parasite might evolve resistance and return in a few years.

Scientists do not know whether the altered gene might spread to other related species of mosquitoes.



### **TARGET: Mosquito**

The gene drive targeting mosquitoes causes sterility to spread through the mosquito population, which reduces the number of mosquitoes.

#### **PROS:**

This is likely to permanently reduce the mosquito population. With a small enough mosquito population, malaria cannot be transmitted.

#### **CONS:**

This might affect species that eat or interact with that species of mosquito.

This might wipe out Mombasa's entire population of this species of mosquito, which might impact the ecosystem and food chain.

*For more information, see the Supplemental Information Sheets on Engineered Mosquitoes and Malaria and Traditional Control Methods.*



# Release Options

**Who should release the GE mosquitoes?**

**A. Local Mombasa government**

**B. Governmental authorities** such as the Kenyan Ministry of Health

**C. Companies** who developed the mosquitoes

**D. A nonprofit/NGO** that developed the mosquitoes in collaboration with academics and government

**E. Other**

**At what scale?**

**A. Group releasing the mosquitoes determines** the scale

**B. Limited local release** followed by a one year study period (*if using gene drives, this is only possible for the technique targeting mosquitoes*)

**C. Large scale release**

**D. Other**



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