

# Genetic Technologies

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## 7.5 Genetically Engineered Mosquitoes

Mosquitoes can be very harmful to humans. They spread diseases such as malaria, dengue fever, and the more recent Zika. Malaria kills nearly half a million people every year, and Zika can cause severe birth defects when it infects pregnant women. Could genetically engineered mosquitoes finally help humans defeat or tame these insects?

Scientists are working on a variety of approaches to genetically engineered mosquitoes. Most of these aim to reduce mosquito populations, thus slowing down the spread of mosquito-borne diseases. For example, the British company Oxitec has developed genetically engineered “friendly male” mosquitoes. These males mate normally with females, but they have special genes that cause their offspring to die as larvae, so that they never grow to become biting adults (Figure 7.10). Over time, the release of enough “friendly males” causes mosquito populations to decline. In fact, field studies show that Oxitec’s “friendly males” can reduce mosquito populations by as much as 95%.



**FIGURE 7.10**

These mosquito larvae are glowing because they are genetically engineered organisms. Scientists are working on a variety of genetically engineered mosquitoes that may help prevent the spread of diseases such as malaria, dengue fever, and Zika.

Another group, based at Imperial College London, has developed a “gene drive” that spreads female infertility in mosquitoes. *Gene drives* cause certain alleles to be inherited more often than expected under Mendelian inheritance, with the result that the alleles spread very quickly. The Imperial College team’s gene drive includes three genes that prevent females from laying eggs. Again, the release of mosquitoes with the gene drive can cause mosquito populations to decline.



But what are the potential consequences of wiping out an entire insect population? How would this affect other species that interact with mosquitoes? Mosquitoes, for example, are an important source of nutrition for many bat species. And could mosquitoes end up being replaced by an even worse pest? These are important questions to be considered.

A third genetic engineering approach aims to develop mosquitoes that are themselves resistant to disease. This way, the mosquitoes will be unable to spread disease. The advantages of this approach are that wiping out mosquito populations is not necessary and unintended consequences are less likely. Groups at the University of California, Irvine, and the University of California, San Diego, are developing genetically engineered mosquitoes with high activity in the part of the immune system that fights the malaria parasite. These mosquitoes are resistant to malaria and are less likely to transmit the disease to humans.

Whether any of these strategies will defeat mosquitoes is yet to be determined. But it seems clear that genetic engineering could provide powerful tools in the battle against an age-old pest.

### READING CHECK

**How might genetically engineered “friendly male” mosquitoes help prevent the spread of mosquito-transmitted diseases?**

### CHECK YOUR ANSWER

The “friendly male” mosquitoes mate normally with females, but their offspring all die as larvae, so that they never grow to become biting adults. As a result, the release of enough “friendly males” can, over time, reduce mosquito population sizes.

You can read more about one genetically engineered mosquito, and the danger of its genes spreading into the natural population, here:

<https://www.sciencemag.org/news/2019/09/study-dna-spread-genetically-modified-mosquitoes-prompts-backlash>

