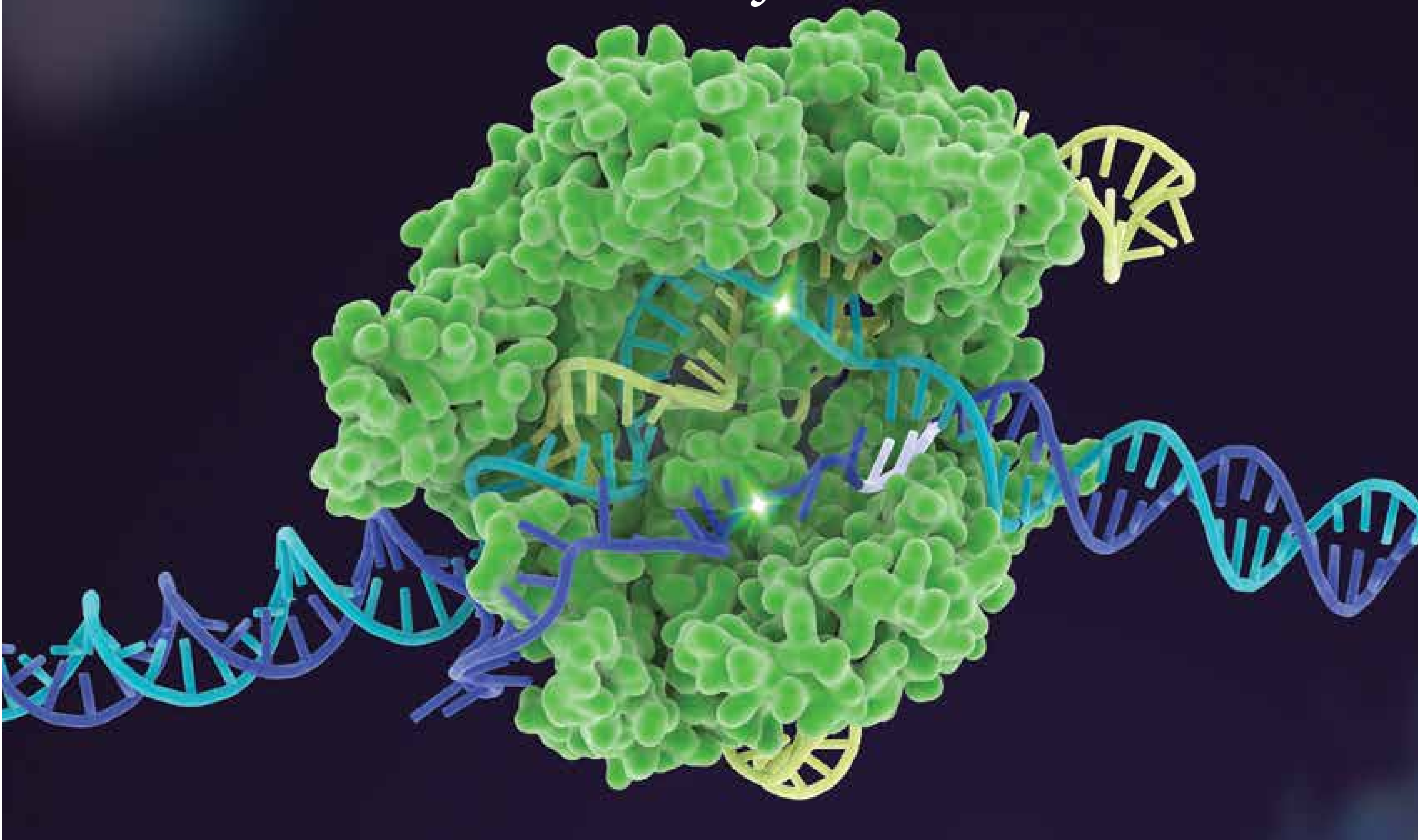
# *Article: Fighting Malaria*

*Excerpt from*

# *The Power of CRISPR*



The Lawrence Hall of Science
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Cover art: Cas9 (green) and guide RNA (gold) bound to a target DNA site (blue), making a cut in each strand (white flashes). Copyright © 2022, Janet Iwasa, for IGI.

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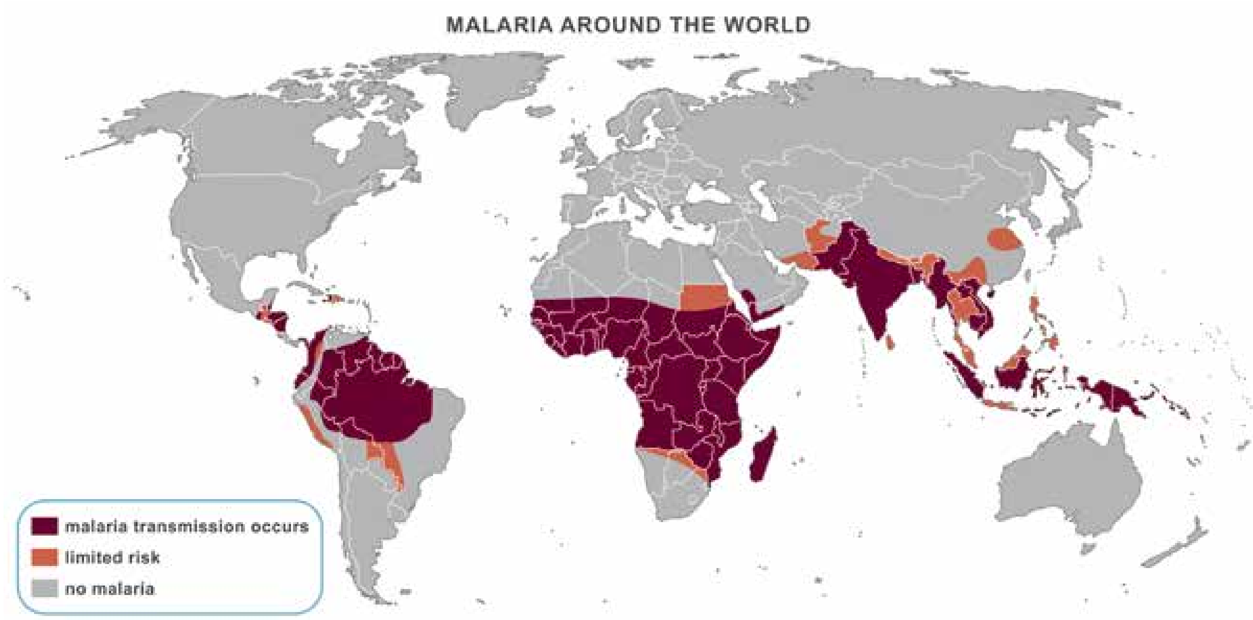
# Article Introduction: The Ethics of CRISPR

In 2012, scientists developed CRISPR, a new gene-editing technology. However, the debate around whether scientists should edit organisms' genes has been around much longer. Scientists have been manipulating genes since the 1970s. Since that time, scientists and others have debated how and when this technology should be used. As technology improves, it becomes even more necessary to ask questions like these:

- Should people be able to edit organisms' genes?
- If people are able to edit organisms' genes, who should be able to do it, which organisms' genes should be edited, and for what purpose?
- How might changing an organism's genes affect the environment and future generations?
- Will gene editing be accessible to all people or to just a select few?

# Article: Fighting Malaria

Malaria is a disease caused by a parasite that is transmitted to humans by mosquitoes. In 2019, an estimated 229 million people were infected with malaria, and approximately 409,000 died from the disease. Most of these deaths were among children. Malaria is most common in subtropical and tropical climates, and 90% of the deaths occur in Africa.



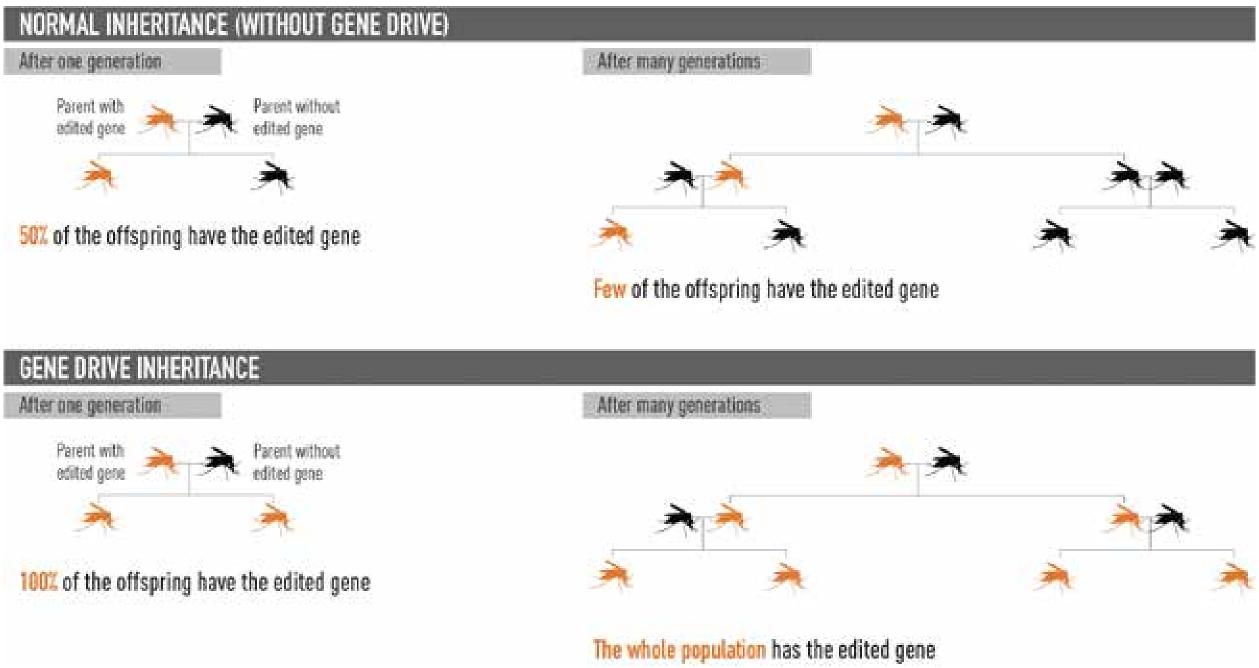

There are a few species of mosquitoes that can carry the malaria parasite and transfer it to humans. Once someone is bitten by a mosquito that carries the parasite, the parasite enters the bloodstream, eventually infecting red blood cells. This infection causes the red blood cells to die. As more red blood cells are killed, the person begins to feel the symptoms of malaria, including fever, chills, vomiting, and fatigue. If a mosquito bites a person who already has the malaria parasite in their blood, this mosquito becomes a carrier of the parasite and can infect other people.

## CRISPR and Gene Drives

One way that scientists are trying to combat malaria is by using CRISPR to edit mosquito genes. One method is to add a gene to mosquitoes to make them resistant to the malaria parasite. This means that if a mosquito were to bite someone with the malaria parasite, it would not be able to pick up and pass the parasite to anyone else. Another method is to edit mosquitoes' genes to make the females sterile, which would decrease the mosquito population—and thus reduce malaria. But neither method will work if only a few mosquitoes' genes are edited. To have the greatest impact on the number of malaria infections, the edited genes need to be passed on to as many mosquito offspring as possible so that the edited genes become part of the entire mosquito population.

# Article: Fighting Malaria (continued)

To maximize the number of mosquito offspring that get the edited genes, scientists are investigating using CRISPR to change the way that genes are passed down through generations. This method, which is called a gene drive, can be accomplished in a variety of ways, and it can lead to 100% of an organism's offspring having the edited gene instead of just 50%, which is what typically occurs. There are still some technical hurdles, but in lab experiments scientists created CRISPR gene drives in which nearly all the descendants of a particular organism inherit the edited genes. Using gene drives in the real world could solve a lot of problems, such as reducing deaths from infectious disease, producing better crop plants, eliminating invasive species, and protecting endangered species from extinction. However, there are also risks.




**A gene drive leads to all offspring inheriting the altered gene. After many generations, this can lead to nearly the whole population having the altered gene.**

One risk of creating CRISPR gene drives is the unforeseen effects they may have on an ecosystem. For example, a gene drive created to make female mosquitoes infertile would eventually lead to the collapse of an entire mosquito population. This could have unforeseen consequences for the rest of the ecosystem and be problematic for populations that depend on mosquitoes as a major food source, such as insects, spiders, amphibians, reptiles, fish, bats, and birds; mosquitoes are also pollinators for some plants. However, many species of mosquitoes do not carry the malaria parasite and would not be targeted in this effort; they might be able to take over the ecosystem role that the malaria-carrying mosquitos once played. Another risk in reducing or eliminating a mosquito population is the potential for other disease-carrying insects to take their place.

CRISPR is a powerful tool that could be used to fight malaria and other mosquito-borne diseases—such as West Nile virus, Zika virus, and dengue—that affect hundreds of millions of people every year. However, as of 2021, no organisms carrying CRISPR gene drives have been released into the wild. As societies debate whether to take this step, consideration must be taken regarding how ecosystems could be affected.