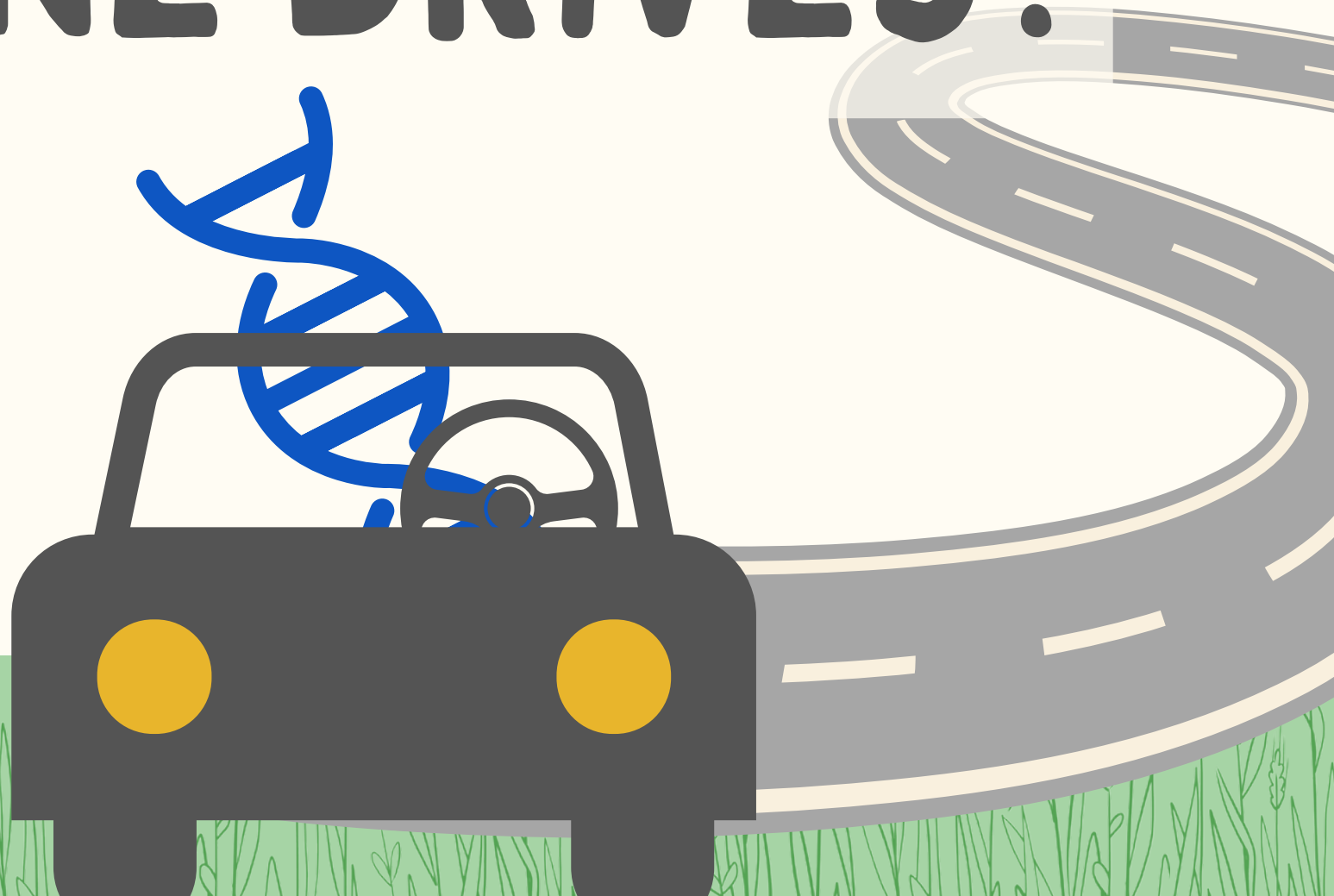
Plantastic Discoveries

YOU ASKED...

WHAT ARE GENE DRIVES?



AND WE ANSWER!

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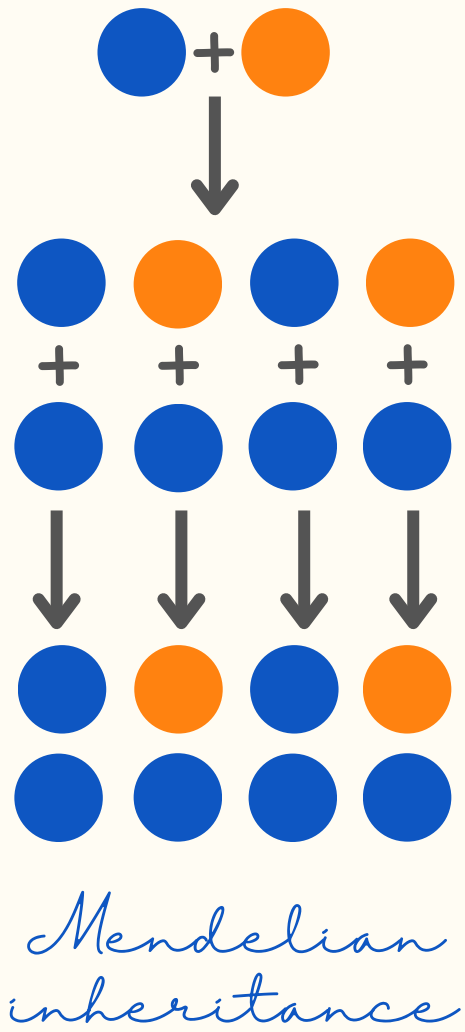
WHAT ARE GENE DRIVES?

Gene drives are a natural phenomenon that boosts the chances of a specific gene being inherited by offspring at rates higher than the usual 50% expected in typical Mendelian inheritance.



This means it promotes the biased inheritance of certain genes over generations, “driving” the gene to steadily increase its presence in the population.

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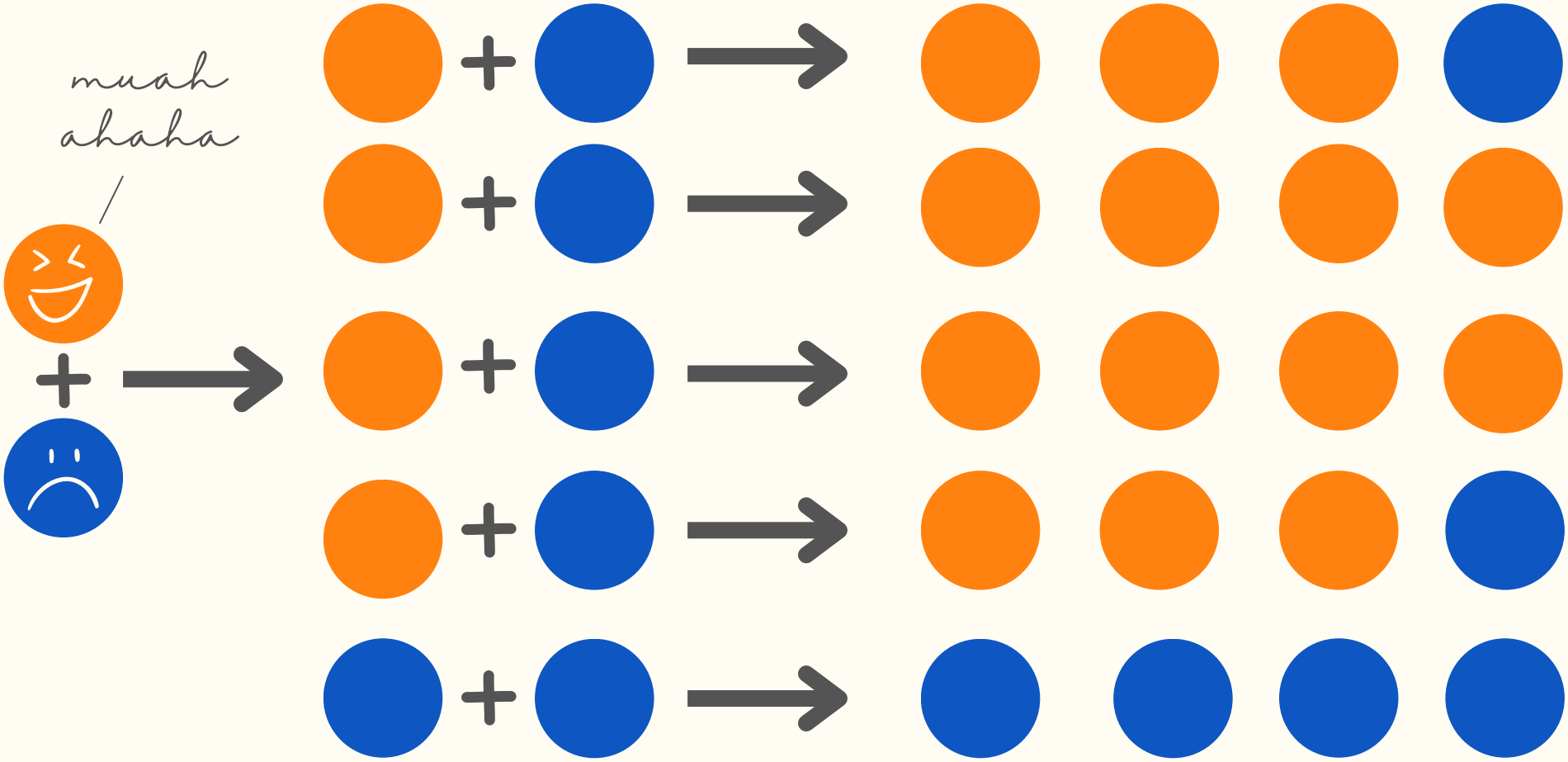
WHY DOES IT HAPPEN?

Gene drives occur naturally because some genes have evolved strategies to increase their chances of being passed on to offspring! Typically, during reproduction, each gene has a 50% chance of being inherited, but gene drives can manipulate this process to get passed on more frequently.



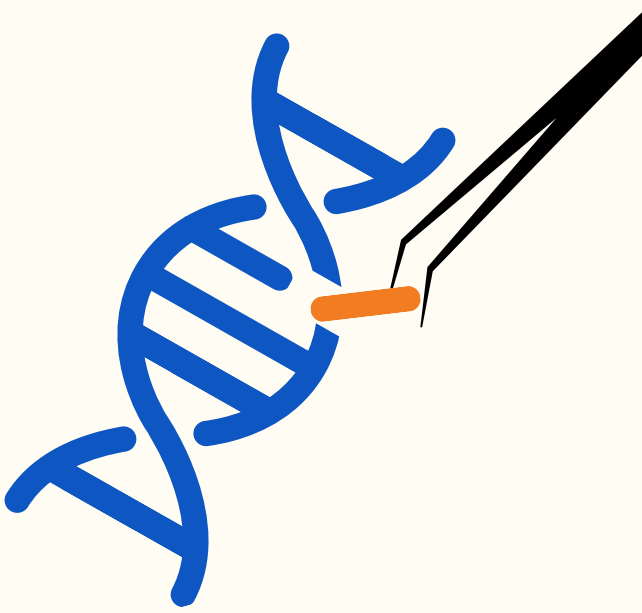
Selfish Genes: Some genes act "selfishly," meaning their primary goal is to spread themselves. They've developed mechanisms to make sure they get passed on to more offspring, even if this doesn't necessarily benefit the living organism overall.

Meiotic Drive: Normally, genes are divided equally when reproductive cells (like sperm or eggs) are formed. But some gene drives interfere with this process, giving themselves a higher chance of being included in those cells, so they get inherited more often than usual.

Segregation Distortion: In some cases, gene drives can actively disable or destroy the reproductive cells that don't carry them, ensuring that only the cells "driving" the gene survive and are passed on.

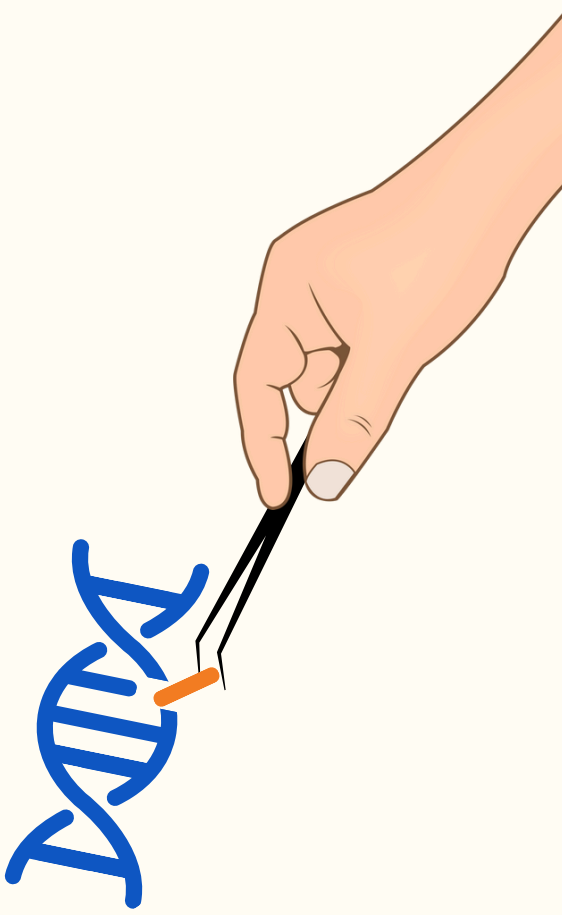
Evolutionary Strategy: While not all gene drives offer a direct benefit to the living organism, they've evolved because they can spread rapidly through populations. However, in certain situations, gene drives can help a species adapt to challenges, like fighting off diseases.

Research in molecular biology allows scientists to recreate natural gene drives in the lab through recombinant DNA techniques, resulting in what are known as "synthetic" gene drives. While this field of research is still evolving, these systems offer exciting potential by leveraging natural mechanisms to address significant challenges in health and the environment.



HOW ARE GENE DRIVES USED

Gene drives represent a powerful tool in breeding and genetics, offering new ways to address complex challenges in health, conservation, and agriculture. By encouraging certain genes to spread rapidly through a population, gene drives can help us influence characteristics in a targeted manner.



Applying gene drives is one of the many ways we can leverage natural processes to achieve specific goals, such as reducing the spread of diseases, protecting endangered species, or managing harmful pests.

GENE DRIVES TO FIGHT MOSQUITO BORNE DISEASES

One of the most promising and carefully implemented methods of leveraging gene drives is in the fight against mosquito-borne diseases. Mosquitoes are responsible for transmitting deadly illnesses like malaria, dengue, and Zika, which together affect millions of people each year. Traditional mosquito control methods, such as insecticides and repellents, often face challenges like accessibility and resistance. Gene drives offer an innovative approach that could complement these efforts.

MALARIA

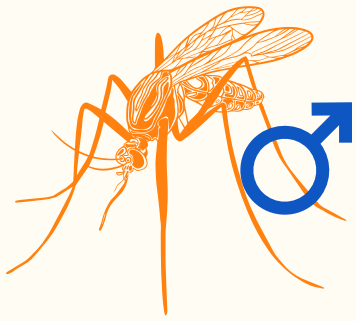
Case example

Malaria is a life-threatening disease caused by Plasmodium parasites, which are transmitted to humans through the bites of infected female Anopheles mosquitoes. Controlling mosquito populations is crucial for reducing malaria transmission. Previous experiments have been carried out where male mosquitoes were bred to be sterile. But not yet using gene drive.

Researchers are now exploring innovative gene drive technology to help combat the disease.Their strategies focus on **two key approaches**:

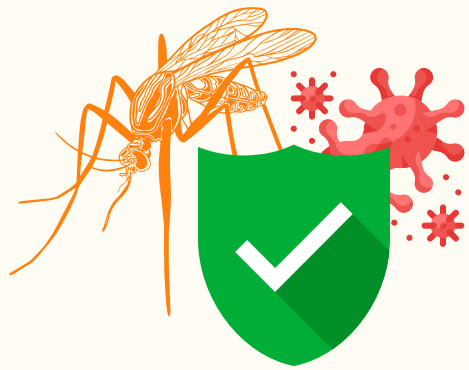
Reducing Mosquito Populations

By breeding mosquitoes to produce mainly male offspring, researchers aim to decrease the number of female mosquitoes—the ones that bite and transmit malaria. This reduction in females has been shown to significantly lower malaria transmission rates in the short to medium term. It's important to note that this approach does not offer a permanent solution. The effectiveness of the reduction does not last indefinitely, as the population will eventually rebound. To maintain control, it is necessary to regularly release specially bred mosquitoes, typically every couple of years, depending on various factors such as the local mosquito population dynamics and environmental conditions.



Making Mosquitoes Resistant to Malaria

Another strategy involves breeding mosquitoes that are resistant to the Plasmodium parasite, which causes malaria. If mosquitoes can't harbor the parasite, they can't spread malaria, disrupting the transmission cycle.



LABORATORY TESTING

Gene drive systems have been developed and tested extensively in controlled laboratory environments. These tests have demonstrated the potential of gene drives to modify mosquito populations effectively.

UPCOMING FIELD TRIALS

Trials for gene drive technology in Anopheles mosquitoes, the primary vectors of malaria, are currently in the development and preparatory phases. These trials are crucial for advancing strategies to combat malaria and assessing the feasibility of gene drives in real-world settings. Field trials utilising gene drive technology have already been successfully carried out for Ae. aegypti mosquitoes, which spread diseases like dengue and Zika, demonstrating the potential of gene drives for controlling mosquito populations and reducing the transmission of various vector-borne diseases.

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