

PLOS Science Wednesday: Hi reddit, I'm Jackson and I identified an important barrier to the practical application of gene drives using CRISPR/Cas9 technology, which could be used to fight vector-borne diseases like malaria – Ask Me Anything!

PLOSScienceWednesday<sup>1</sup> and r/Science AMAs<sup>1</sup>

<sup>1</sup>Affiliation not available

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### Abstract

Hello Reddit, My name is Jackson Champer and I am postdoc at Cornell. My research focuses on gene drives, which are genes designed to spread rapidly through populations. A successful gene drive in mosquitoes could help fight vector borne diseases such as malaria and dengue. Together with my coauthors, I recently published a study titled “Novel CRISPR/Cas9 gene drive constructs reveal insights into mechanisms of resistance allele formation and drive efficiency in genetically diverse populations” in PLOS Genetics. We found that resistance alleles, which prevent the spread of the gene drive, can form in both the germline and in the embryo stages in fruit flies. We utilized the nanos promoter for better gene drive performance, and we also found that gene drive could produce greater or smaller numbers of resistance alleles, depending on the genetic background of the insect. Since our PLOS Genetics article was submitted, we have taken the first steps towards reducing resistance allele formation. A preprint of our new results is available on bioRxiv I will be answering your questions at 1pm ET – Ask me Anything! I also post occasional research updates and links to gene drive papers on Twitter, follow me @Jackson\_Champer.

[REDDIT](#)

# **PLOS Science Wednesday: Hi reddit, I'm Jackson and I identified an important barrier to the practical application of gene drives using CRISPR/Cas9 technology, which could be used to fight vector-borne diseases like malaria – Ask Me Anything!**

PLOSSCIENCEWEDNESDAY [R/SCIENCE](#)

Hello Reddit,

My name is Jackson Champer and I am postdoc at Cornell. My research focuses on gene drives, which are genes designed to spread rapidly through populations. A successful gene drive in mosquitoes could help fight vector borne diseases such as malaria and dengue.

Together with my coauthors, I recently published a study titled "[Novel CRISPR/Cas9 gene drive constructs reveal insights into mechanisms of resistance allele formation and drive efficiency in genetically diverse populations](#)" in PLOS Genetics.

We found that resistance alleles, which prevent the spread of the gene drive, can form in both the germline and in the embryo stages in fruit flies. We utilized the nanos promoter for better gene drive performance, and we also found that gene drive could produce greater or smaller numbers of resistance alleles, depending on the genetic background of the insect.

Since our PLOS Genetics article was submitted, we have taken the first steps towards reducing resistance allele formation. A [preprint](#) of our new results is available on bioRxiv

I will be answering your questions at 1pm ET -- Ask me Anything!

I also post occasional research updates and links to gene drive papers on Twitter, follow me [@Jackson\\_Champer](#).

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technology, which could be

Thanks for coming to talk with us! CRISPR has such profound implications. I might compare it to the invention of the hammer--it'll mostly be used to build houses, but someone is also going to use it to smash heads. So my question is, what can developers of such a powerful tool do to influence its constructive use, once it's out in the world and outside their direct control? I teach a class called "Computers, Society, and Professionalism," where we learn about social implications of technology and debate issues like this. I would love to tell my students what you think. Thanks in advance!

[asbruckman](#)

Hello, while CRISPR is easy to use in general, developing a highly effective gene drive capable of being used as a bioterrorism agent will still be challenging, even if scientific studies do this in disease vectors by reducing resistance alleles. Such a group would also need to overcome a few major challenges that the scientific community would not have addressed. Additionally, by pursuing research in gene drives, the scientific community would be creating tools that could be deployed to counteract any inappropriate uses of gene drive, such as a second generation drive that "overwrites" or removes a harmful gene drive, or an organism that is immune to the effects of a gene drive.

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If you could describe your research to the layman in a brief statement, what would you say?

[RyeTiliDie](#)

My research is about gene drive, which theoretically could let us spread a gene throughout a population. If used in mosquitoes, this could be used to help prevent diseases such as malaria and dengue. However, gene drives sometimes form “resistance alleles”, which would prevent their successful spread and persistence in a population. My lab is involved in learning more about how these resistance alleles are formed, and coming up with ways to reduce the rate at which they are formed.

Do you think we should delay releasing gene drives into the wild until we can develop ways to mitigate resistance formation?

[dkeller9](#)

Yes, it would definitely be important to wait until a high efficiency gene drive is developed. If too many resistance alleles are formed, the gene drive won't even properly spread in the first place. Additionally, a bad gene drive might “use up” a potentially valuable target site in the insect's genome (by forming resistance alleles there), which then would not be available when a more effective gene drive is developed.

Is there a big data analytics component to gene editing and where is the foreseeable future of CRISPR going

[Mistaken\\_name](#)

Many CRISPR projects definitely involve a lot of big data/analytics. For example, CRISPR/Cas9 sometimes cuts where it is not supposed to (“off target effects”), but improved versions of Cas9 have greatly reduced off-target effects. One can investigate these by sequencing genomes, which generates a lot of data to analyze. In general, though, a bioinformatics boom has been underway for several years, even before CRISPR.

In general, CRISPR can be used anytime you need to cut DNA at a precise location. A big application of CRISPR would be to fix problems in DNA that cause human disease, though I hope that gene drive will also gain more attention as a way to prevent disease before they even occur!

What are your hopes for CRISPR/Cas9 technology that you would like to see accomplished in your lifetime?

[IF\\_Apple](#)

CRISPR technologies (not just Cas9, but other CRISPR proteins too) have so many potential applications, ranging from gene drive, to direct treatment of human genetic diseases, to basic science. I expect that in the next 50 years, all of these technologies will be very mature (and probably even replaced by better DNA editing tools!). Along the way, they no doubt will have been responsible for taking a major bite out of disease, while increasing our understanding of dozens of different biological systems.

Hello! Fellow drosophila biologist here. I use them for human disease modeling, so not super familiar with this but I find it quite interesting.

1) Do you have any idea whether the resistance allele formation is due to changes in the gene being targeted for CRISPR editing (such as mutations in the target sequence)? Or is it due to failure of the CRISPR itself (mutations within the CRISPR construct, or possibly epigenetic modifications to shut off the CRISPR construct)?

2) With such a variation in strains you have tested this system in, have you thought about using a genetic reference panel to identify the genes that may contribute to resistance allele formation? This could be done fairly efficiently with the Drosophila Genetic Reference Panel (DGRP) to identify the specific genes influence the resistance allele formation.

Thanks!

[rubber\\_ducky](#)

Hello, CRISPR almost always cuts in the germline, and when it doesn't a resistance allele won't be formed, so it's okay. The problem occurs when CRISPR cuts successfully, but HDR does not occur (which would copy the gene drive allele into the target site). Instead, NHEJ occurs, which changes the target sequence (forming a resistance allele), preventing it from being cleaved again by CRISPR. Thus, the resistance allele will never be converted to a gene drive allele and remain in the population.

For you second question, we are actually well underway in studying one of our gene drives in the DGRP lines. It's a very labor intensive project, since there are so many lines, but I have lots of help from my great students for this. We've continued to see significant variation between lines, just like we did for the Global Diversity lines in our PLoS Genetics study.

Who owns the rights to your discovery? How fair do you think the arrangement is?

[thombudsman](#)

I'm not completely sure about this. Different groups originally developed CRISPR technology, and a different research groups first proposed using CRISPR for gene drive and actually made a CRISPR gene drive. Additionally, the idea of gene drive and of the homing type gene drive studied here were each originally developed before CRISPR by different groups.

Overall, though, by far the best applications of gene drive involve providing assistance to third world countries battling vector borne diseases, which isn't likely to be very profitable (in terms of money made by those deploying the gene drive). For this, intellectual property rights probably won't be very important, which is probably a good thing.

On the other hand, other future CRISPR technologies could involve suppression of major crop pests or fighting relatively rare vector borne diseases in developed countries. Intellectual property rights may get very confusing for these cases...

Can and when will we be able to use Crispr and other similar tools to fight aging and age based diseases like Alzheimer or dementia?

[sasuke2490](#)

Yes, to elaborate on this answer, for CRISPR to be useful for fighting human genetic diseases, we usually need to actually know what genes we need to modify to fix the disease. For most diseases, it's not quite that simple. Other challenges such as delivery of the CRISPR system to the appropriate cells

also need to be managed. It might be possible in the future, but more research is needed.

I know your research focused on germline and post fertilization models, but could this resistance allele mechanism be a naturally occurring response for somatic cell CRISPR alterations as well? What about single celled organisms such as bacteria and yeast? They don't have a germline per se, so their somatic and germline DNA is the same, and they do have different alleles of genes, so can they also develop resistance alleles preventing the spread of a CRISPR inserted gene? (Since bacteria undergo mitosis to reproduce their entire gene gets passed on, that would that make any CRISPR inserted gene a drive gene as well?) Could this be the reason CRISPR uptake isn't 100% for all cells exposed to it?

[DreamWithinAMatrix](#)

If a resistance allele is inherited or formed in an early embryo, it will definitely be found in the somatic cells of an organism too, which sometimes can be very important. It is also possible that for an organism that is heterozygous for the gene drive and wild type allele initially that resistance alleles can originally form in somatic cells. This is the "leaky expression" of Cas9 that we refer to. In our follow-up bioRxiv study, we confirmed that the vasa promoter for Cas9 lead to formation of these somatic resistance alleles, but the nanos promoter did not form such alleles.

For bacteria, a gene drive like this is not possible, since they are haploid (one chromosome) not diploid (two chromosomes). Gene drive need a gene drive chromosome and a wild type chromosome to function. It is definitely possible in yeast, and in fact, the Church lab made a yeast gene drive. They did not find any resistance alleles in this drive, which indicates that the problem of resistance alleles can vary a lot by species.

For bacteria, you could still use CRISPR tools to edit its DNA. It just wouldn't be a gene drive. The efficiency of "HDR vs NHEJ" could still be important in how well your editing works, though, as well as some other factors.

Do you feel that the ability to modify DNA will be used in human models in our lifetime? If it is eventually used, what do you feel the initial human applications will be, and how will it impact us if released to the general populace?

Thank you so much for your extremely important (and interesting!) work. I'm not a professional in any sense, but I am endlessly fascinated with work in genetics (I got into it because I'm over the CAG repeat threshold for Huntington's, and beginning to show symptoms), and endlessly thankful that there are brilliant people like you doing these crucial studies.

[StellaMcFly](#)

Yes, I think that CRISPR can definitely be used to prevent genetic diseases in our lifetime, probably even within the next decade or two! This will likely be the first human application that involves directly modifying our DNA. CRISPR may also be used as part of immunotherapy against cancer even before then.

Where do you see this technology in 5 years?

What do you think about diy-science enthusiasts using these technologies in their homes?

[PM\\_M-E\\_NUDES\\_GIRL](#)

Optimistically, in five years, we will know how to reduce resistance alleles to a very low level, and

perhaps be doing field tests in mosquitoes for these gene drives. Of course, resistance alleles are tricky, and we may still be working to get them to a low enough level (though I'm sure that we will have gotten them much lower than they are now!).

It would be quite difficult for DIY enthusiasts to make gene drives without a fully equipped science laboratory, since it involves lots of genetic engineering and insect handling. It might be possible, though. I would encourage any individuals to follow strict safety protocols to prevent the accidental release of any gene drive insects, and to consult with some gene drive scientists when planning experiments.

Can viruses and bacteria adapt or develop an immunity to CRISPR?

[eddardtargareyn](#)

CRISPR is actually a system that bacteria use to naturally defend themselves against phage (viruses that infect bacteria). These phage are always trying to adapt to avoid the CRISPR system.

Thank you for your time in answering these questions. My question is that will CRISPR/Cas9 be able to target HIV proviruses in CD4 T-cells? To follow up, how will the prevention of off-targeting be addressed with CRISPR. Thank you.

[anabolicbro](#)

CRISPR is actually already being tested against HIV, though "resistance alleles" have also been a problem for that. As for off-target effects, improved Cas9 version have already come out to get rid of these effects. The new versions don't have as high cleavage efficiency as regular Cas9, but I'm pretty sure that they will quite soon.

How cheap do you think CRISPR technology applications could get in 10 years?

[ImmodestPolitician](#)

Depends very much on the applications! For making gene drives in insects, it's not really the CRISPR elements themselves that contribute much to the costs. It's the molecular engineering, insect rearing, and salaries for personnel.

Given that CRISPR only operates over a short range of matching DNA sequences that it edits, what is the actual likelihood that CRISPR will ever achieve any of the pundit claims **without causing cancer or other severe metabolic damage or side effect** if ever used clinically given that it also replaces hundreds of same-phrases appearing through out any given genome.

Recent work by Tsang, Bito, et al. show that using CRISPR on one target creates hundreds of unintended mutations in the rest of the organism's genome. We don't even know exactly what genes are affected. It's unlikely to be benign.

<https://phys.org/news/2017-05-crispr-gene-hundreds-unintended-mutations.html>

CRISPR really seems **only a bit** more specific than shotgun recombination.

CRISPR is like doing a substitution of a short (yet inevitably common) phrase like "of loving" in Tolstoy (this appears hundreds of times alone in Anna Karenina): it NOT just the gene you intended that gets

edited - ever - with CRISPR. This seems like a sobering reality for CRISPR.

[mantrap2](#)

Off-target mutations have actually been known about for quite a while now. It might affect some experiments, but it won't be a big deal at all. There are actually already lots of versions of CRISPR with massively reduced off-target effects, and these versions are getting better very quickly!

If malaria can be prevented with this technology, how far into the future are we talking before it gets utilized?

[shigewara](#)

Scientists will still need to create an efficiency gene drive that minimizes resistance alleles and functions well in mosquitoes. Optimistically, this could potentially be done within a few years. Depending on how things go, I hope to see successful gene drives deployed on a large scale in the 2020's.

Don't you think this technology could be used to develop some very scary genetic weapons? Are you or the scientific community in general taking any steps to prevent that? Is it feasible if funding comes from the government?

[stonerbobo](#)

Gene drive could potentially be used to develop weapons (though it would be more difficult to develop a weapon than a beneficial gene drive), but the best way to deal with this would be another gene drive that erases the weapon. Such gene drives are conceptually very possible. By researching gene drives in general, such counterterrorism gene drives would also become easier to create, allowing us to gain the benefits of gene drive while being prepared for any trouble.

DARPA actually did recently fund most gene drive labs, so the defense community definitely has gene drive on its mind. Unfortunately, we had only just started our program then, so we weren't part of this grant. We do have designs for gene drive that overwrite other gene drives, or even non-driving constructs that can erase parts of our gene drives, so hopefully we will be able to investigate these soon.

CRISPR/Cas9 has been lauded as one of the most promising tools to eliminate a plethora of genetic diseases. What do you think is the most effective way to ensure that resistance to gene drive does not develop? Would limiting the gene's expression to mosquitos of a certain background for now be an intelligent way to move forward with malaria reduction quickly?

[melibelly42](#)

One of the most promising ways of reducing resistance alleles is to use multiple gRNAs targeting nearby sites. If a resistance allele forms at one of the target sites, the other sites could still allow the gene drive to function, converting the partial resistance allele to a gene drive allele. We tested this in our recent study posted as a preprint on bioRxiv and found that two gRNAs does indeed reduce resistance alleles, but this strategy will probably need to be combined with something else to make the gene drive good enough for use in the wild. There are many other potential strategies that you could read about in the discussion sections of our papers.

By targeting DNA sequences found only in some populations, one could potentially confine a gene

drive to a relatively small geographic area. This, of course, wouldn't actually help the gene drive spread, but it could potentially be useful as a way of testing the gene drive in the wild if some people are too worried about it spreading everywhere.

Could you ELI5 what you've identified?

[stryz18](#)

ELI5

Gene drives could let us spread a gene throughout an entire population. This could let us prevent malaria and other disease. However, real gene drives have a big problem. They make resistance alleles that prevent them from working properly. We investigated these resistance alleles and found that they come from two sources. Hopefully, by learning more about resistance alleles, we will find a way to stop them, so we can have gene drives that work well.

Hi Jackson, thank you for doing this AMA. Your paper suggests multiple possible methods to avoid the formation of resistant alleles (aside from utilising the nanos promoter as opposed to vasa). Which do you think would be the best approach to prevent resistant allele formation, and what would you do if you were to design your own gene drive from scratch?

[logicnologic](#)

Well, I'm definitely designing new gene drives that test all of these approaches. I'm testing them separately, so that we can see their individual effects. If I had to guess, I would say that combining the following methods may produce a very efficient gene drive. 1. Four gRNAs using the tRNA method. 2. A germline-only promoter for the gRNAs. 3. A less active Cas9 that also reduces off target effects (maybe spCas9HF1?). 4. Targeting and reforming of a haploinsufficient gene. I've also got other methods in the works!

Hi Jackson! I'm a college student currently majoring in biology, but currently, the subject I am most interested in is genetics. So I wanted to ask how to get into the field you currently are in, and what the job prospects are like. What you do, especially, is very exciting to me as I would like to help fight all kinds of diseases such as malaria and help make the world healthier. I appreciate your advice and hope everything is going well.

[IAmYourUnspokenMind](#)

Hello, if you want to work on gene drive and CRISPR, genetics is definitely the place to be. You'll need to get a Ph.D. to get the best jobs, but you will be working with this stuff already during your Ph.D. research. Job prospects are overall pretty good in biotechnology, though actually getting a professorship is very difficult. Feel free to E-mail me if you have follow-up questions (jc 3248 at cornell.edu)(remove the spaces and change the 'at' to an @).

How long will it take for us to know the full ramifications for any changes we would make to a human genome?

[McMish](#)

Depends on the change. If it is something (relatively) simple like fixing a genetic disease, the effects

could become apparent quite quickly.

Can you compare the magnitude of the breakthrough to something in IT so I can relate how big of a deal CRISPR is?

[DrecksVerwaltung](#)

1.44 inch floppy disc to CD-Rom. We could edit genomes before, but we can do it much easier/cheaper now, and almost wherever we want. That's why it's been adopted so quickly after only a few years.

Being a high school senior that has done major projects on CRISPR, what would you recommend students to focus on in their education path to be able to do research like yours? CRISPR and gene editing in general are very limited for students that are not in college, how would topics like these branch out for younger students since CRISPR would play a huge role in the future?

[forgotmyusernamest](#)

You should be able to conceptually understand CRISPR after some genetics and molecular biology. Exactly which education path after that depends on what you are interested in. You could potentially get involved in research at a lab at your future university that uses CRISPR. Since CRISPR pervades so many aspects of biology now, you could focus on computational biology, genetics, molecular biology, or even others like immunology. Feel free to E-mail me if you have follow-up questions (jc3248@cornell.edu)(remove the spaces and change the 'at' to an @).

Could gene drives be used to decrease a pathogen's antibiotic resistance in an ongoing infection?

[HevC4](#)

Technically, you could cut out something that gives antibiotic resistance. This wouldn't be a gene drive, though, and if you got CRISPR into a bacteria cell, it would probably be easier to just get something in there that kills the bacteria. Thus, CRISPR would not be of use in an ongoing infection without a more advanced method,

The closest you could get to this with gene drive would be to remove pesticide resistance from a crop pest population.

What's your opinion on the Berkeley v MIT/Harvard law suit regarding CRISPR?

Could the outcome have any effects on your own work and research?

[youremomoriginal](#)

I haven't followed it closely, actually. The applications of gene drive that I'm most interested in (reducing vector borne diseases in third world countries) probably wouldn't be much affected by intellectual property regulations. The research itself probably won't be affected either.

Do you think this will be used to 'enhance' someone's physical traits (like MSTN gene that enhances muscle growth) or otherwise?

[DarkDevildog](#)

Gene drive isn't really closely related to eugenics, even though it uses CRISPR. The closest thing to this now are projects that are trying to change human DNA to cure genetic diseases, and CRISPR can definitely be the basis for this. This seems like a very reasonable application to me.

As for human improvement, the scientific technology is not nearly mature enough to do more than consider it. Hopefully, this means that by the time it becomes possible, it can be done in a sensible manner to eventually benefit everyone. By the time it does become possible, CRISPR will probably have been superseded by something even better, or at least the CRISPR tools currently in use.

Will CRISPR be affordable and accessible to the average person?

[14th Eagle](#)

Depends on the application, but right now, there aren't any CRISPR treatments that could benefit someone. When it does come out, it will likely be expensive, but perhaps less expensive than the cost of treating a lifelong genetic disease.

What are other major ways, if any, of driving deleterious alleles through a population, and do they have as much potential as CRISPR approaches?

[jrbouldin](#)

Well, you could potentially link a deleterious allele to any gene drive system, such as underdominance or Medea. These won't work too well for that, though. For suppressing populations, an X-shredder located on the Y chromosome would work pretty well, in theory.

Do you have any thoughts on the Bxb1 system?

[potatorunner](#)

I'm not very familiar with this system, but I hear it works quite efficiently in mammalian cells. (I've thought mostly about insects)

Thank you for doing this! Ever since I've learned of what CRISPR/ Cas9 does I have been quite interested in the various applications of it in the future. What do you think of the "biohacker" ex NASA scientist who is providing CRISPR kits to the general public? Also what do you think would be its implications in the food industry?

[dandydolly](#)

In general, CRISPR should have positive implications for the food industry. It should be easier to genetically modify food and get exactly what we were trying to get, reducing the effect of unintended consequences. As for readily available CRISPR kits, it's not that big a deal. Everything in the kits is freely available in the scientific community. The kit just puts it all together.

What's the current status of the ethical debate surrounding the release of gene drive systems into the environment? I'm not an ecologist, but leaving aside resistance concerns, it seems unreasonable to

think that altering a single input (i.e. mosquito population) in an ecosystem wouldn't have reverberations that are felt by other organisms elsewhere in the food web.

What is the impact to birds and fish that feed off of mosquitoes and their larvae?

[geefzilla](#)

I'm more in favor of population modification systems, which leave the target species intact, just a bit modified (and not in a way that would likely affect the ecosystem).

That said, population suppression for mosquitoes could potentially work too. Fortunately, it probably won't have very bad implications for the ecosystem. On a few species of mosquitoes go after humans, so even after eradicating them, there would still be many mosquitoes of other species population the ecosystem. It's not the best solution, but it would be worth it to get rid of major diseases. Keep in mind that malaria is also ruining ecosystems. For example, birds in Hawaii with no natural resistance are dying off in large numbers due to introduced malaria.

What vector did you use for introduction, and what does the future look like in terms of delivery platforms for CRISPR cassettes? AAV is going to be too small for a lot of applications, I would imagine.

[iquiz1852](#)

For creating a gene drive, we don't need a special introduction system. We just use the CRISPR itself and HDR. AAV is more for human applications, and I'm not familiar enough with the specifics of these to comment...

Hi, Beekeeper here.

I apologize for asking a question that is very much to the side of what you're actually working on, but....

I have heard (but don't totally understand) that CRISPR can be used to control mosquito populations. Is it reasonable to believe that the same approach could be used to control verroa mites which plague the honey bees? Do you know if anyone is doing research on that?

[DivergentMind](#)

I'm fairly sure that no one is doing research on gene drives for this at the moment (at least that I've heard of), but it definitely sounds interesting. If those verroa mites have a short generation time and can spread over a landscape relatively quickly, they may be an excellent candidate for a population suppression gene drive.

is cancer and or viruses like aids considered a gene drive? Why or why not?

[Robotic-communist](#)

No, gene drive is something that spreads when passed vertically through different generations. Infectious diseases are usually transmitted horizontally (with some unfortunate exceptions), so they are not considered gene drives. That said, some infections can be vertically transmitted, so they may share some similarities with gene drive if they have a mechanism to bias their inheritance (such as Wolbachia,).

When will CRISPR be available to the public? I always hear how there is some brand new thing that can be revolutionary but then it just fades away and you don't hear about it ever again because it has to be tested in a lab.

[SauceeCode](#)

Well, some CRISPR treatments are undergoing clinical trials, so their might be some treatments soon. They definitely need testing first, as do all human disease treatments.

As for gene drive, we still need to get them up and running, but hopefully, we can start field trials within a few years.

I have a quick question.

What kind of barriers exist in being able to have CRISPR technologies be able to identify the end sequences of DNA, right before the telomere sequence, and replacing that sequence with an additional fully lengthened telomere?

[DasPickles](#)

I'm not as familiar with this, since it's not related to gene drive. CRISPR is all about cutting, but having to attach something to the end is a little more challenging. Perhaps you would combine it with another enzyme.

Thanks for participating in an AMA. I have a couple questions.

First, what is the most effective gene editing to prevent mosquitos from transmitting vector diseases? Population control by breeding sterile males, internal chemistry that prevents pathogens from maturing, physiological changes like breeding them without wings, disruption of pheromones, or have you found another process that is more effective.

Second, I know someone that works in a vector control office. They have a biologist on staff and an outfitted lab. I know that there are DIY CRISPR kits that are under \$200. Is there a means of using CRISPR on a small local level to help prevent vector diseases?

[EatTheBiscuitSam](#)

It's unclear what the most effective method for gene drive is. Intensive research is still underway regarding this. I'd lean toward population replacement, but this only works if there is a good payload gene available to fight the disease. Population suppression has the advantage of not needing a payload, but you still need a good target gene.

Local CRISPR kits won't be enough, since an effective gene drive will be fairly complicated to engineer. Instead, I see a central insect product plant, and then these insects could be distributed in areas that suffer the most from the diseases.

What's your favorite ratio?

[BabyFossaMerchant](#)

Not sure. Maybe 1:1?

[u/PLOSScienceWednesday](#) I have a test on Malaria on Friday that I completely under prepared for. What can you tell me about how malaria has be treated and prevented up to now?

[u/PLOSScienceWednesday](#) It's looking increasingly likely that I'm going to fail my test on friday. What new stuff am I going to have to know for my repeat this time next year as a result of your findings?

[Feynization](#)

Well, malaria can be treated directly with drugs, which have been available for several decades.

The best way to deal with malaria though, is something large scale. Pesticides have worked well in developed areas where malaria has a more limited impact. There is just too much malaria for this to work properly in the third world, though. Gene drive may be the solution to this, but it's development is still a few years off.

Hi,I have a mild form of a rare genetic disorder called Myoclonal dystonia. Its not a big obsticale in regular day buisness and i go to school and sport's just like all the other kids. It is one letter in my genes that is a T instead of a C. I have read some articles about the CRISPER/CAS9 but could this be used in the future to correct this "mistake" in my genetic code?

[Spacegamer2312](#)

CRISPR could definitely be part of a solution to help you. However, the big problem is getting CRISPR and the repair machinery into all of your cells efficiently. Such things are under development, though, so hopefully there will be a good solution available eventually.

Pineapple on pizza or no?

[drchopsalot](#)

Eh, I'm boring enough that I prefer no toppings...

Sooooo how much to clone me? #kiddingnotkidding

[BHarris2017](#)

Hmmm, cloning people hasn't been done before. It's theoretically possible since similar animals have been cloned before, but I believe that it's banned in most countries....

What does your title mean in layman's terms?

[isgame](#)

Basically, we made a CRISPR gene drive and found that resistance alleles are formed in both the germline and the embryo. These resistance alleles were formed at different rates depending on the genetic background of the insect.

What about chikungunya? Any news for hope?

[millyvawilly](#)

I'm not aware of any payload that could go after chikungunya (though I don't know much about it, something might be out there), but a suppression gene drive could definitely cut down on *Aedes aegypti* and *Aedes albopictus*, which are the main mosquitoes that transmit this disease.

Why do still have issues fighting malaria if there are vaccines already made?

[KI30s](#)

Malaria vaccines are promising, but vaccines are still much more expensive than a gene drive (critical for third world countries, even when air is available from sources like the Gates Foundation), and the malaria vaccines, according to my latest understanding, are not highly efficient either.