

What scientists say keeps mosquitoes at bay

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For as long as there have been humans, there have been mosquitoes buzzing around in hopes of a bite to eat.

"We're always in a war, a perpetual war against mosquitoes," said Dr. Conor McMeniman, an assistant professor of molecular microbiology and immunology at the Johns Hopkins Bloomberg School of Public Health and Johns Hopkins Malaria Research Institute in Baltimore.

It's a war that often turns deadly — mosquitoes kill more people than any other animal as they spread diseases such as malaria, dengue fever and West Nile virus.

Even if the mosquitoes near you don't carry these diseases, they're still a nuisance. Here's the lowdown on how mosquitoes hunt us, what attracts them, and what scientists recommend for keeping them at bay.

Most of the time, mosquitoes drink plant nectars and juices, and even help pollinate flowers. But when the time comes for female mosquitoes to produce eggs, the soon-to-be moms require extra protein, which they get by drinking blood.

"When a mosquito bites, it's actually sticking its mouth parts into your skin and probing around in the skin to actually find a blood vessel," McMeniman said. Once it hits sanguine pay dirt, the mosquito sucks up red blood cells and plasma like it's guzzling bubble tea through a straw.

It's to the mosquito's advantage to drink quickly and then buzz off undetected. To accomplish this, "mosquitoes spit into the skin a whole cocktail of different proteins" that act as painkillers and anticoagulants that keep the blood from clotting, he said. The itchiness and discomfort from mosquito bites — a result of our bodies' inflammatory response to this chemical cocktail — only come later, when the perpetrator is no longer at risk of getting swatted.

People have different reactions to mosquito bites — one person can emerge from a barbecue relatively unscathed with a couple of pimple-like spots, whereas a friend is stuck nursing dozens of silver dollar-size welts for the following week.

"How attractive you think you are to mosquitoes might not necessarily correlate with how attractive you actually are to the mosquitoes," McMeniman said. "Some of that is driven by the perception of your reaction to the mosquitoes and whether you're itching."

McMeniman has found that some people really are mosquito magnets, and he's documented it in his recent study in the journal *Current Biology*. Mosquitoes responded differently to the array of chemicals making up each individual's body odor bouquet, and they deem some more appetizing than others. Unfortunately, homing in on what makes some people extra-appetizing to mosquitoes isn't a simple matter.

"There could be a variety of factors that might influence the composition of your scent," McMeniman said, "including your underlying diet and genetics and physiology. All of these things could potentially influence the types of molecules emitted by the human body and also influence the composition of the microbiome that lives naturally on our skin."

It'd be nice simply to replicate the odor profile of the people whom mosquitoes avoid and sell it as a body spray to those with the dubious honor of being "tastier," but at this point, it's not realistic. "We're still trying to understand the chemistry of this process," he said.

While the fine details of which scents draw mosquitoes in are still being explored by researchers, there's a general pattern to the insects' ability to find us.

"First they smell you, then they see you, and then when they're close enough, maybe within a meter of the host, they can actually detect thermal cues dissipating from your skin," McMeniman said. One of the most important scents that draws mosquitoes in from far away is carbon dioxide, the gas that we exhale when we breathe.

"As a universal, most of them are attracted to CO₂ from a long distance," said Dr. Kristen Healy, an associate professor of entomology at Louisiana State University and president of the American Mosquito Control Association. "There's been plenty of studies to show that CO₂ from our breath as we exhale, and especially when you get large groups together" can attract mosquitoes. Body heat and sweat also seem to play a role.

Based on her own experiences, Healy said this hypothesis has held up. "If I'm active and I'm sweating, I definitely will notice a difference in mosquito attraction because they can cue into those other extra odors," she said.

Over the years, a number of scientific studies have pointed to potential keys to mosquito attraction — some have indicated that people drinking beer are likelier to get bitten, while others have suggested that some colors, including red, might be extra-attractive to mosquitoes.

"It would be really useful to scale those studies up to see how general these findings are across different hosts," McMeniman said. Until then, you probably shouldn't throw out all your red shirts and dump all your beer just yet.

Perhaps as a result of the complexity and unsolved mysteries around mosquito attraction, there are countless devices and sprays that promise to drive the insects away. Newfangled gadgets such as ultrasonic mosquito repellent devices are "not necessarily backed by research and science, and they're kind of just out there on the market," Healy said. "I would never trust a product that says it's 100% effective at killing mosquitoes."

Devices that spray insect repellent over a larger area can be effective, but "I think it's worth noting that these are insecticides — obviously, they've passed EPA (US Environmental Protection Agency) registration standards, but you are walking around in a cloud of insecticide," McMeniman said.

Instead, Healy and McMeniman recommend more tried and true methods.

"Covering up as much as possible during the summer is really important, and applying an EPA-registered insect repellent, with ingredients such as DEET and picaridin," McMeniman said. For people who prefer botanical products, he recommends oil of lemon eucalyptus.

To keep mosquitoes out of your home, make sure your windows are screened and run a fan or air conditioner at night. Clear away debris and drain standing water in your yard on a weekly basis to prevent mosquito eggs from hatching.

Ultimately, there's no silver bullet that will protect you from mosquito bites. As tantalizing as the information yielded by various studies may be, there's no simple diet to follow, color to avoid or scent of soap to wash with that will drive mosquitoes away.

Mosquitoes are a part of the natural world, and interacting with them is part of coexisting on our planet. Get a good bug spray and remember to reapply it as needed.

Kate Golembiewski is a freelance science writer based in Chicago who geeks out about zoology, thermodynamics and death. She hosts the comedy talk show "A Scientist Walks Into a Bar."