TECHNOLOGY SCIENCE JOURNAL FOR TEENS

Can graphene in your clothing stop mosquito bites?

TEACHER'S KEY

Check your understanding

1 Why should we be concerned about mosquito bites?

Answer

While some mosquitoes might just cause some itching, others act as vectors for many serious and potentially deadly diseases, such as yellow fever, malaria, and Zika.

2 Can we not just spray chemicals against mosquitoes?

Answer

Even though some chemicals are effective protection against mosquitoes, they can have harmful side effects for people or the environment. Therefore, we were excited to conduct research on a non-toxic, non-chemical way to prevent mosquito bites.

3 How did we find out that graphene kept mosquitoes from biting people?

Answer

We asked human volunteers to expose their bare arm, their arm covered by cheesecloth, or covered by cheesecloth layered with graphene to 100 mosquitoes for five minutes at a time. We then compared the number of mosquito bites on their skin for the three different exposures, and saw that mosquitoes did not bite through the graphene layer. We also simulated the bite experiments with needles, and had computers calculate whether the bite force that mosquitoes can exert on the graphene was enough to bite through it (it wasn't).

4 Why did we think that graphene did not act as a mere physical barrier for the mosquito biting apparatus?

Answer

When we compared how many times mosquitoes landed on the volunteers' arms for the 3 different scenarios, and how much time they spent on their arm, it became obvious very quickly that something else was going on. The mosquitoes did not seem to care much at all about skin covered with graphene! Knowing that graphene is a nanomaterial, and has very small pores, we suspected that it also blocked chemical signals that mosquitoes use to detect human skin.

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5 How did we confirm our hypothesis that graphene acted as a chemical barrier, too?

Answer

We applied sweat on top of the graphene, so that it became accessible to the mosquitoes. Sweat contains many chemical signals that attracts mosquitoes. All of a sudden, the mosquitoes landed on the graphene covered arms again and spent much more time there, and tried to bite more frequently.

6 What was the problem when water or sweat was applied to the graphene?

Answer

Unfortunately, it broke down the graphene oxide layer to an extent where mosquitoes could bite through. Luckily, we found a slightly altered material (called "reduced graphene oxide"), that blocked the mosquito's bites even when wet, but it lost breathability, making potential clothes covered in it less comfortable to wear.