

Article-Based Questions

Directions: Read the recent article "[Malaria molecule lures mosquitoes](#)" and then answer these questions:

1. What molecule does *Plasmodium falciparum*, a malaria parasite, produce in blood? When this molecule is present in blood, what effect does it have on malaria-transmitting mosquitoes?
2. According to biologist Ingrid Faye, what observation did researchers make while watching mosquitoes sip blood from artificial feeders? What did their observation make them think?
3. What is produced from red blood cells containing HMBPP? How does this affect malaria-transmitting mosquitoes?
4. Why were the malaria-transmitting mosquitoes *Anopheles gambiae* more attracted to blood that contains HMBPP? Fully explain the relationships stated.
5. What might be the evolutionary advantage of the malaria parasite producing HMBPP in blood?
6. Given the information in this article, come up with a research question you would use to explore decreasing the spread of malaria by mosquitoes.
7. Finished early? Check out this related *Science News* article and answer the question that follows. "In malaria battle, indoor bug spraying has unintended consequence," found at www.sciencenews.org/article/malaria-battle-indoor-bug-spraying-has-unintended-consequence, discusses a possible trend in mosquito evolution, perhaps caused by the use of pesticides. What is the unintended consequence of indoor bug spraying and what implications are noted?

Responses to Article-Based Observation

1. **What molecule does *Plasmodium falciparum*, a malaria parasite, produce in blood? When this molecule is present in blood, what effect does it have on malaria-transmitting mosquitoes?**

Possible student response: Malaria parasite *P. falciparum* produces a molecule called HMBPP or (E)-4-hydroxy-3-methyl-but-2-enyl pyrophosphate that makes parasite-infected blood more attractive to malaria-transmitting mosquitoes.

2. **According to biologist Ingrid Faye, what observation did researchers make while watching mosquitoes sip blood from artificial feeders? What did their observation make them think?**

Possible student response: The researchers noticed that mosquitoes ate a lot more blood from the artificial feeding system when HMBPP was in the blood. But when HMBPP was mixed with serum not containing red blood cells, the allure to infected serum was not as great. This observation led the researchers to believe that HMBPP is not directly attracting the mosquitoes but having its effect through other molecules or chemicals.

3. **What is produced from red blood cells containing HMBPP? How does this affect malaria-transmitting mosquitoes?**
- Possible student response: When HMBPP mixes with red blood cells, more carbon dioxide is released compared with HMBPP-free red blood cells. Also, greater amounts of certain airborne chemicals called aldehydes and monoterpenes are produced. Malaria-transmitting mosquitoes are more attracted to a greater concentration of all of these molecules.

4. **Why were the malaria-transmitting mosquitoes *Anopheles gambiae* more attracted to blood that contains HMBPP? Fully explain the relationships stated.**
- Possible student response: Blood that contains HMBPP produces more carbon dioxide, aldehydes and monoterpenes. Mosquitoes sense exhaled carbon dioxide and use it to find blood sources, so a greater concentration of the chemical would be more attractive to mosquitoes. Similarly, the aldehydes and monoterpenes produced by infected blood attract mosquitoes. Many nectar-containing plants that mosquitoes feed on produce these molecules. A greater number of mosquitoes should be lured toward a higher concentration of these chemicals.

5. **What might be the evolutionary advantage of the malaria parasite producing HMBPP in blood?**

Possible student response: If blood infected with the malaria parasite attracts more malaria-transmitting mosquitoes, there is a greater probability that the parasite will spread to more people.

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Malaria molecule lures mosquitoes

6. **Given the information in this article, come up with a research question you would use to explore decreasing the spread of malaria by mosquitoes.** Possible student response: How does the malaria parasite produce HMBPP? If HMBPP production can be prevented or decreased, then the rate of malaria transmission by mosquitoes would likely decrease.

7. **Finished early? Check out this related *Science News* article and answer the question that follows. “In malaria battle, indoor bug spraying has unintended consequence,” found at www.sciencenews.org/article/malaria-battle-indoor-bug-spraying-has-unintended-consequence, discusses a possible trend in mosquito evolution, perhaps caused by the use of pesticides. What is the unintended consequence of indoor bug spraying and what implications are noted?** Possible student response: Indoor spraying to combat four species of malaria-carrying mosquitoes has been effective in eradicating two species on Bioko Island, but the spraying seems to have driven two other species to biting outdoors instead. Researchers consider the possibility that this shift may be caused by genetic changes. If the trend continues, researchers fear that the indoor spraying will no longer be as effective.