Buzz Off

By Kirsten Weir

Can Bioengineering Mosquitoes Stop The Spread Of Tropical Diseases?

It’s a bright, sunny day in the Caribbean. You roll out your beach towel and settle down in the sand when—drat!—a mosquito interrupts the serenity. You reach over and swat it.

If you happened to be on the island of Grand Cayman not long ago, you needn’t have bothered. In a test on the island, scientists released millions of lab-created mosquitoes. The insects were engineered to self-destruct. No need for swatters.

Although a tropical vacation without biting bugs sounds like a true paradise, there’s a bigger goal at stake. Mosquitoes transmit dengue fever, a devastating and sometimes fatal disease. No vaccine or cure for it exists. Could tailor-made mosquitoes be the answer?

No Fly Zone

Dengue fever strikes about 100 million people each year in tropical and subtropical regions. It’s also called breakbone fever for the joint and muscle aches and the intense headaches it causes. In some cases, the fever worsens into dengue hemorrhagic fever, which leads to internal bleeding, organ damage, and possible death.
Dengue fever is caused by a virus, which the mosquito *Aedes aegypti* spreads through its bite. Until now, the best way to control the disease has been to prevent contact between mosquitoes and humans, says Anthony James, a molecular biologist at the University of California, Irvine. One way to do that is to put up window screens. Another is to douse people and places with *insecticides* (chemicals that kill insects). Unfortunately, insecticides can harm other organisms, including beneficial insects. And mosquitoes can develop a resistance to them over time.

James believes there’s a better option: *genetically engineering* the *A. aegypti* mosquito. Genetic engineering is the process of manipulating an organism’s *deoxyribonucleic acid* (DNA). James tweaked *A. aegypti* by adding some extra *genes* to its DNA. Genes are short DNA segments that are responsible for individual traits in an organism. The genes that James added prevent flight muscles from forming in female mosquitoes. “Only the adult females feed on blood and therefore are responsible for transmitting diseases,” he says. Unable to fly, the engineered females can’t mate, bite, or spread dengue fever.
In order to get flightless females, James actually engineered male skeeters instead. The *transgenic* (genetically engineered) males mate with females and pass on their extra genes to their offspring. Any female mosquitoes born to those fathers are unable to fly and, therefore, unable to mate. As the genes spread, the population dwindles. “The idea is to get a zero population,” James says.

So far, James has tested his mosquitoes in the lab and in large outdoor mesh cages in Mexico. He’s now working on securing approval to test the engineered mosquitoes in the wild. Meanwhile, Oxitec, a British company James has collaborated with, has marched ahead and released engineered mosquitoes into nature.

**Into The Wild**

The Oxitec mosquitoes are engineered in a slightly different way from those James designed. The males are unable to produce healthy offspring. In 2009, the company released a batch of those males into a small area of Grand Cayman. Wild females mated with the engineered males, and their offspring died before they reached adulthood. Within three months, the mosquito population in the area fell by 80 percent.
A young man being treated for dengue fever in a hospital in Lahore, Pakistan

Despite the success of that first experiment, it may be awhile before transgenic mosquitoes are released on a bigger scale. The next step, James says, is to prove that the dip in a mosquito population actually reduces the number of dengue fever cases.

An even bigger problem may be dealing with critics who are wary of releasing transgenic organisms into the environment. Oxitec reportedly chose Grand Cayman for the experiment because of weak regulations there. Most other countries, including Mexico, where James works, have stricter policies about releasing transgenic organisms.

Genetic engineering has been going on for years. In fact, much of today’s packaged food contains genetically engineered corn or soy. Still, many people are suspicious of genetic engineering. The environmental organization Greenpeace, for instance, likens transgenic organisms to “a giant genetic experiment” that could have unforeseen consequences for the environment and for human health.

James is sensitive to the criticisms. But, he says, “we don’t think there are risks.” For one thing, the engineered mosquitoes won’t persist in the environment indefinitely. After all, they’re designed to die. And in most of the world, A. aegypti is a nonnative species, he adds. Getting rid of the buzzing pests would actually return those habitats to a more natural state.

If the experiment is a success, dengue fever may be just the start. “Mosquitoes can transmit a number of diseases,” James says. The most devastating is malaria, which kills close to 1 million people every year. Unlike dengue fever, which is spread by just one mosquito species, more than 30 species can transmit the malaria parasite. That makes it a trickier target for genetic engineering, but James contends the goal is within reach.
“We develop vaccines and medications, but for some diseases we have no tools,” he says. “It’s important that we look at all the science available to find something that will actually work.”
1. Which of the following is not a symptom of dengue fever?

A joint and muscle aches  
B fever  
C internal bleeding  
D blindness

2. James and other molecular biologists are genetically engineering mosquitoes in order to solve what problem?

A flight muscle damage in female mosquitoes, which prevents them from flying  
B the irritating noise of buzzing mosquitoes and the itchiness of mosquito bites  
C the spread of dengue fever, an infectious disease spread by mosquitoes  
D the spread of insecticides, which are harmful to the environment

3. Which of the following conclusions about science is best supported by the passage?

A Science is a useful tool for understanding the world around us but can do nothing to solve problems.  
B If used responsibly, science can be used to help solve problems humans and the environment face.  
C Science can have unforeseen consequences for the environment and for human health.  
D It is interesting to study science so that we can better understand the problems humans and the environment face.

4. Read the following sentences and answer the question below: “For one thing, the engineered mosquitoes won’t persist in the environment indefinitely. After all, they’re designed to die.”

In this context, what does the word indefinitely mean?

A aggressively  
B forever  
C slowly  
D accidently

5. The primary purpose of this passage is to

A advertise a vacation to the Grand Canyon  
B warn people about dengue fever  
C persuade the reader to oppose genetic engineering  
D explain a problem and identify possible solutions
6. What are two consequences of spraying *insecticides* to get rid of mosquitoes?

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

7. How are the Oxitec mosquitoes different from the mosquitoes that Anthony James engineered?

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

8. The question below is an incomplete sentence. Choose the word that best completes the sentence.

James understands the criticism of transgenic organisms, _________ he believes his genetically engineered mosquitoes will not be harmful to the environment.

A before  
B so  
C but  
D because

9. Answer the following questions based on the sentence below.

Some people oppose genetic engineering because it could have unintended negative consequences now and in the future.

Who? _________________________________________________________________

(do) What? oppose genetic engineering

Why? ________________________________________________________________
10. Read the vocabulary word and definition below, and complete questions 10a, 10b, and 11.

**Vocabulary Word**: serenity (se · ren · i · ty): a feeling of calm and peace, like how you might feel sitting next to a mountain stream or listening to classical music.

10a. Read the sentences below and underline the word **serenity**.

1. Some people believe that practicing yoga is a good way of experiencing serenity.

2. Martina is only thirteen years old, but as soon as she picks up a violin, she can turn a chaotic room into an oasis of serenity.

3. Just as Max sat down alongside the creek to enjoy a picnic and a moment of quiet reflection, a swarm of bees came buzzing past him, interrupting the serenity and leaving him with two bee stings!

4. Floating on clouds high above the noise and bustle of city life would be perfect serenity.

5. I was sitting quietly on the beach, enjoying the cool ocean breeze when my brother rudely dumped a bucket of sand on my head, ruining the serenity of the moment.

10b. Which image below better illustrates serenity?

11. Would a loud rock or rap concert be a good place to go if you are looking for serenity?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
Teacher Guide & Answers

**Passage Reading Level**: Lexile 1010

**Featured Text Structure**: Problem/Solution – the writer poses a problem and suggests possible solutions

**Passage Summary**: In “Buzz Off,” the author explains dengue fever, a disease transmitted by mosquitoes, and describes a possible scientific solution that involves genetically engineering mosquitoes without flight muscles.

1. Which of the following is not a symptom of dengue fever?
   A. joint and muscle aches
   B. fever
   C. internal bleeding
   D. blindness

2. James and other molecular biologists are genetically engineering mosquitoes in order to solve what problem?
   A. flight muscle damage in female mosquitoes, which prevents them from flying
   B. the irritating noise of buzzing mosquitoes and the itchiness of mosquito bites
   C. the spread of dengue fever, an infectious disease spread by mosquitoes
   D. the spread of insecticides, which are harmful to the environment

3. Which of the following conclusions about science is best supported by the passage?
   A. Science is a useful tool for understanding the world around us but can do nothing to solve problems.
   B. **If used responsibly, science can be used to help solve problems humans and the environment face.**
   C. Science can have unforeseen consequences for the environment and for human health.
   D. It is interesting to study science so that we can better understand the problems humans and the environment face.

4. Read the following sentences and answer the question below: “For one thing, the engineered mosquitoes won’t persist in the environment indefinitely. After all, they’re designed to die.”

   In this context, what does the word **indefinitely** mean?
   A. aggressively
   B. forever
   C. slowly
   D. accidently

5. The primary purpose of this passage is to
   A. advertise a vacation to the Grand Canyon
   B. warn people about dengue fever
   C. persuade the reader to oppose genetic engineering
   D. **explain a problem and identify possible solutions**
6. What are two consequences of spraying *insecticides* to get rid of mosquitoes?

**Suggested answer:** Insecticides can harm other organisms, including beneficial insects, and mosquitoes can develop a resistance to them over time. [paragraph 5]

7. How are the Oxitec mosquitoes different from the mosquitoes that Anthony James engineered?

**Suggested answer:** Oxitec’s mosquitoes are different from the mosquitoes James engineered in two primary ways. James engineered female mosquitoes by adding extra genes to their DNA that prevented them from forming flight muscles. Since the engineered females are unable to fly, they can’t mate, bite, or spread dengue fever. On the other hand, Oxitec engineered male mosquitoes that are unable to produce healthy baby mosquitoes, ensuring reduction in the mosquito population. [paragraphs 6 and 9]

8. The question below is an incomplete sentence. Choose the word that best completes the sentence.

James understands the criticism of transgenic organisms, ____ he believes his genetically engineered mosquitoes will not be harmful to the environment.

A before  
B so  
C but  
D because

9. Answer the following questions based on the sentence below.

Some people oppose genetic engineering because it could have unintended negative consequences now and in the future.

Who? *some people*  
(Do) What? oppose genetic engineering  
Why? *because it could have unintended negative consequences now and in the future*

10. ReadWorks recommends that you teach this vocabulary word to the whole class out loud using the four steps listed below.

**Vocabulary Word:** serenity

**Step 1:** Introduce the word

a. Teacher writes the word on the board and divides it into syllables: (se · ren · i · ty)

b. Teacher says: “This word is serenity. What is the word?” [All students reply together out loud: “serenity.”]

**Step 2:** Provide a child-friendly definition

a. Teacher says: “Serenity is a feeling of calm and peace, like how you might feel sitting next to a mountain stream or listening to classical music.”

b. Teacher says: “In this passage it’s a bright, sunny day in the Caribbean. You roll out your beach towel and settle down in the sand when—*drat!*—a mosquito interrupts the serenity, or peacefulness. You reach over and swat it.”

© 2012 ReadWorks®, Inc. All rights reserved.
c. Teacher says: “What is the word?” [All students reply together out loud: “serenity.”]

**Step 3: Practice the word**

Teacher provides examples and additional opportunities to repeat the word. Read the first sentence out loud to your students. Begin reading it again and when you come to the vocabulary word, prompt students to say the vocabulary word out loud. Then, finish reading the sentence out loud to your students.

10a. 1. Some people believe that practicing yoga is a good way of experiencing **serenity**.

2. Martina is only thirteen years old, but as soon as she picks up a violin, she can turn a chaotic room into an oasis of **serenity**.

3. Just as Max sat down alongside the creek to enjoy a picnic and a moment of quiet reflection, a swarm of bees came buzzing past him, interrupting the **serenity** and leaving him with two bee stings!

4. Floating on clouds high above the noise and bustle of city life would be perfect **serenity**.

5. I was sitting quietly on the beach, enjoying the cool ocean breeze when my brother rudely dumped a bucket of sand on my head, ruining the **serenity** of the moment.

**Step 4: Check for student understanding**

This step can be completed as a whole class activity or as an independent practice.

10b. Which image below better illustrates serenity?

11. Would a loud rock or rap concert be a good place to go if you are looking for serenity?

**Suggested answer:** A loud rock or rap concert would not be a good place to go if you are looking for serenity because the music and the crowd at such concerts are usually loud. This environment does not allow for much peace.

*Suggested Additional Vocabulary:* fatal, persist, indefinitely