GLOBE Educator One-Week Pacing Guide: *Mosquito Habitats*

Phenomenon: Mosquito Habitat	**Guiding Question:** What conditions are favorable for mosquitoes?	**Contact:** Reach out to Cassie Soeffing at cassie_soeffing@strategies.org if you have questions.
Grade Level: 6-12		
Further Investigation: Mosquito Habitat Mapper		
Optional: Become a GLOBE Trained Teacher: GLOBE Hydrosphere Protocol Training		
Access GLOBE Pacing Guides: https://www.globe.gov/web/nasa-langley-research-center/home/resources		
Revision Date: 7-2-2025		

Standards - These standards are supported by the activities in this guide but not completely covered.		
Middle	**Performance Expectations:** • **MS-LS1-4** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. • **MS-LS1-5** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. • **MS-LS2-1** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. • **MS-LS2-4** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	**Disciplinary Core Ideas:** • **LS1A** Structure and Function • **LS1.B** Growth and Development of Organisms • **LS2A** Interdependent Relationships in Ecosystems • **LS2B** Cycle of Matter and Energy Transfer in Ecosystems • **LS2C** Ecosystem Dynamics, Functioning, and Resilience

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	Science and Engineering Practices: ● Constructing Explanations and Designing Solutions ● Developing and Using Models ● Engaging in Argument from Evidence ● Analyzing and Interpreting Data	**Crosscutting Concepts:** ● Cause and Effect ● Energy and Matter ● Stability and Change
High School	**Performance Expectations:** ● **HS-LS2-6** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. ● **HS-LS2-7** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	**Disciplinary Core Ideas:** ● **LS2.C:** Ecosystem Dynamics, Functioning, and Resilience
	Science and Engineering Practices: ● Engaging in Argument from Evidence ● constructing Explanations and Designing Solutions	**Crosscutting Concepts:** ● Stability and Change

Background Information and NASA Connection

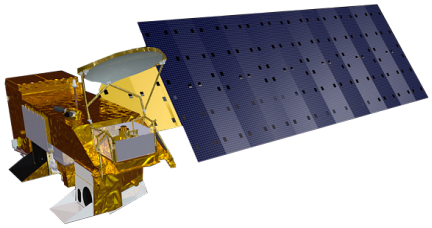
Mosquitoes are common insects that occur in many places around the world particularly in the tropical and subtropical regions. Mosquitoes play an important role in ecosystems. They are food sources for many species of fish, birds, amphibians and reptiles. Mosquitoes are pollinators and so they help to make fruits and vegetables. There are over 40 genera and over 3500 known species. However, three of these genera, *Anopheles, Aedes*, and *Culex*, have species that transmit diseases that impact people including malaria, chikungunya virus, dengue fever, Zika virus, and West Nile virus. Identifying the breeding areas of mosquitos that are disease vectors for humans is an important component of local disease management and eradication.

The life cycle of mosquitoes is closely related to their environment. The egg, larvae and pupae stages of the mosquito life cycle are dependent on water, especially standing water. Different species have different preferences for where to lay their eggs, whether in natural ponds or puddles, or artificial containers left or used by humans. Land cover and vegetation also play a role. Species vary in their preferences for vegetation cover, and some favor urban environments and proximity to human dwellings. Temperature is another important factor. The speed of the mosquito life cycle is

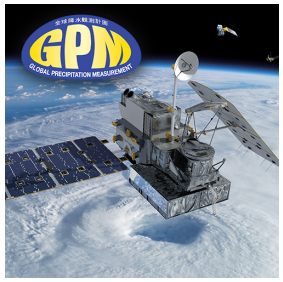
dependent on temperature. Tracking where mosquitoes and larvae have been observed, along with environmental data, can help determine when outbreaks of disease such as malaria or dengue most likely will occur, or when chemical or other controls will be most effective.

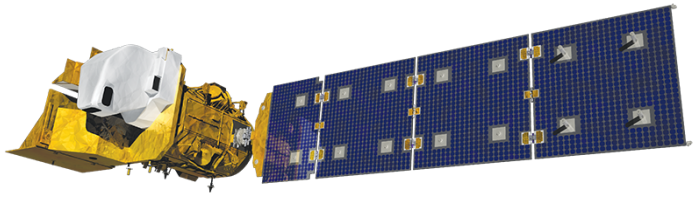
The GLOBE Mosquito Habitat Mapper tool focuses on collecting and identifying mosquito larvae in standing water. Note that handling of eggs and the larvae is safe: the eggs and larvae do not transmit pathogens that result in disease. Only the bites of female mosquitoes transmit pathogens that can cause disease.

Mosquitoes can't be seen from satellites, but the warm, moist conditions that mosquitoes prefer can be observed. NASA studies the seasonal patterns of temperature and precipitation, and how they may be altered by climate change. These changes could affect the movement of insects such as mosquitoes. Climate change can affect the spread of mosquito borne diseases such as Zika, malaria and dengue fever. Other factors, such as land cover, are important factors contributing to the spread of diseases, as they contribute to providing suitable habitat for mosquitoes to breed and grow, and how the disease is spread between people.



Scientists use models with input from satellites which provide information on precipitation, temperature, soil moisture, and land cover. (For example, the Global Precipitation Measurement mission, Landsat, and Terra.) These inform scientists where mosquito breeding sites are likely to be found. Many mosquitoes need rainfall to form their breeding sites – puddles and ephemeral ponds. Rainfall influences soil moisture, which will be important for vegetation, and will also change the humidity conditions near the surface where mosquitoes are breeding and living. Rainfall also eventually makes its way into rivers and lakes, and can mean more breeding sites along the banks for mosquitoes.





Predictions from models need confirmation, whether from ground-based observations of mosquitoes or larvae or reports of disease. In many parts of the world, there are insufficient ground validation measurements, but by using the Mosquito Habitat Mapper tool, GLOBE Observers are able to augment broad scale satellite-based research with highly targeted local ground-based observations at a high level of granularity." (Source: GLOBE Observer Mosquito Science.)

The GLOBE Program is NASA's largest and longest lasting citizen science program about the Earth. There are over 125 member countries with citizen scientists submitting data from all over the world. You can contribute by submitting your own mosquito habitat observations. This pacing guide focuses on the Mosquito Habitat Mapper, additional information regarding identification of larvae can be found on the GLOBE Program's GLOBE Observer Mosquito page or the campaign page.

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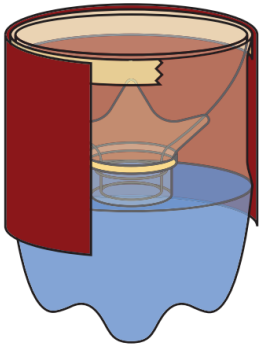
<table>
<tr><th colspan="2">Activities</th><th>Assessment Options</th></tr>
<tr><td colspan="2">Day 1: Build a Mosquito Trap

Consider doing experiments such as:
● Different nutrients in the water
● Different locations
● Different colors on the outside of the trap

Materials: Listed in activity</td><td>  </td><td>● Completed traps

Connection to guiding question:
Which part of the trap is also found in a natural mosquito habitat?
Answer: Standing water and nutrients

Optional Instructional video: Build a Mosquito Larvae Trap</td></tr>
<tr><td colspan="2">Day 2: Mosquito Habitats and Hideouts
Select one of the three ways to use this activity.

Materials:
● Hideouts Bingo Boards (PDF)
● Hideouts Call Slides (PPT)
● Video Demonstration of the activity</td><td>  </td><td>● Name mosquito habitats that are in your area.

Connection to guiding question:
Which mosquito habitats might be in your area? Can you think of other habitats not included in the activity?
Answer: Answers will vary. Habitats that provide a source of standing water are acceptable.</td></tr>
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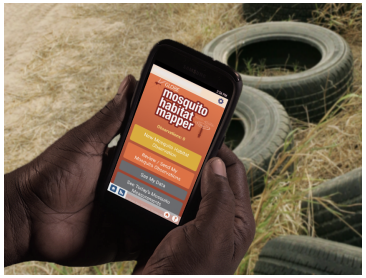
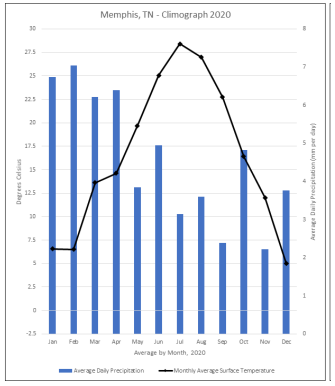
<tr><th colspan="2">Activities</th><th>Assessment Options</th></tr>
<tr><td colspan="2">Day 3: Identify and eliminate mosquito breeding habitats using one of the following options

● GLOBE Program's Mosquito Habitat Mapper in the GLOBE Observer App
● Conducting a Mosquito Habitat Survey

Materials: Listed in activities

Only make observations if you can do so safely and legally.</td><td>  </td><td>● Completed observations

Connection to guiding question: Were you able to eliminate any possible mosquito habitats?
Answer: Answers will vary. Emptying containers of standing water will eliminate mosquito habitats and may protect your community. It is not possible to eliminate all habitats.</td></tr>
<tr><td colspan="2"></td><td>Optional Instructional Videos:
● GLOBE Observer's Basic Mosquito Habitat Mapper: Getting Started</td></tr>
<tr><td colspan="2">Day 4: My NASA Data Mosquito Habitats

Materials: Online Activity</td><td>  </td><td>● Activity answers

Connection to guiding question: Assuming there is enough precipitation or standing water in an area, what temperatures are necessary for Culex pipiens to emerge?
Answer: 12.5 degrees Celsius</td></tr>
</table>

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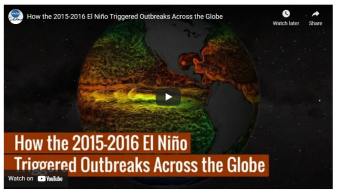
Activities		Assessment Options
Day 5: MND Mini Lesson: [El Niño & Spread of Human Disease] **Materials:** Online activity		• Activity answers ***Connection to guiding question:*** *How can changes in mosquito habitats affect human health?* ***Answer:*** *Additional habitats can lead to more disease spread. If habitats were reduced, there may be less spread of disease. However, droughts in some can cause mosquitoes to move to populated areas with artificial habitats.* ***Connection to NASA:*** *How and why does NASA study mosquitoes?* ***Answer:*** *NASA uses satellites to study moist conditions that mosquitoes prefer by using satellites to study seasonal temperature and precipitation patterns and land cover.* *Longer mosquito seasons and expanding spatial ranges of mosquitoes are two consequences of contemporary climate change.* *Diseases such as Zika, malaria and dengue Fever are among those spread by mosquitoes.*

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Additional Resources		
Online Activities	Audience	Description
ZikaZine	All	Read the Zine, learn how *Aedes* mosquitoes live, and you'll discover how to reduce the number of places where mosquitoes can survive. You'll also find out how citizen scientists are helping NASA by documenting mosquito habitats with **GLOBE Observer.**
How to Draw Wanda in Nine Easy Steps	All	Instructions for how to draw a cartoon mosquito.
Make Your Own Zika Zine Comic	All	Template for creating your own Zika Zine comic.
Additional Resources		
Hands-On Activities	Audience	Description
Monsoons & Health	Grades 6-12	Students learn about the relationship between three infectious diseases and rainfall in the country of Benin.
Mosquito Larvae Hunter for Kids, Level 1	Grades 6-12	Using this, you will develop skills that lead to the identification of mosquito larvae.
Mosquito Larvae Hunter 2	Teacher	Using this, you will use the skills to examine and identify two mystery mosquito larvae specimens.
Videos and Reading	Audience	Description
Predicting Malaria outbreaks w NASA Satellites	All	In the Amazon Rainforest, few animals are as dangerous to humans as mosquitos that transmit malaria.

Additional Resources		
Videos and Reading	Audience	Description
Mosquito Meets MODIS in SD	All	South Dakota is the U.S. hotspot for West Nile disease. Scientists and public health officials there developed a way to use environmental data from NASA satellites to forecast the risk of West Nile. They're giving people working on preventing the disease an important new tool for protecting the population.
Mission Mosquito Science Notebook	All	Use this tool to gather and organize observations, information, and data to solve a problem or answer a question.

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