



Lesson 6: Mapping Mosquito Habitats

Overview Students participate in a community science project to identify mosquito breeding habitats in their local areas and share the data they collect through the GLOBE Observer program, an international network of youth and professional scientists working together to learn more about our global environment. The data the students collect through the GLOBE Observer app's Mosquito Habitat Mapper will help local scientists with Clackamas County Vector Control District, as well as those across the country and around the world, to identify mosquito habitats and how they might be changing due to factors such as global climate change.

Adaptations / extensions are listed at the end of the lesson, including an introductory video about the project, a reading assignment about a recent study from the Centers for Disease Control and Prevention (CDC) about the dramatic rise in rates of vector-borne illness in recent years, and more ways to share the results of your research.

Subjects: Science, Reading, Writing, Speaking & Listening, Social Studies

Grades: Adaptable for 3–12

Time: 30–40 min. of class time, plus 30 min. or more to conduct the investigation outdoors

Vocabulary

- Collaboration
- Disease
- Infection
- Investigation
- Larvae
- Pathogen
- Pupae
- Research (study) protocol

Lesson Goals

- Increase students' understanding of how mosquitoes breed and ways to control their spread through first-hand research
- Provide students with the opportunity to conduct a scientific investigation in their local community with relevance for helping to reduce the spread of vector-borne illness



Mosquito Habitat Mapper is a powerful community science program that can be done with NASA's free Globe Observer app

Objectives

- Students will brainstorm with a partner about how global climate change may be affecting the spread of vectors such as mosquitoes and the diseases they can transmit, recording their ideas in words and/or pictures.
- Students will work as community-based scientists to gather data about mosquito habitats in their local areas and share it with a global network researchers through the GLOBE Observer app.
- Students will reflect in writing and through class discussion on what worked well with the sampling protocol and technology, and what could be improved to help in the global investigation.

Standards		Middle School (Grades 6-8)
Next Generation Science Standards (NGSS)	Crosscutting Concepts	<ul style="list-style-type: none"> • Patterns • Cause and Effect • Stability and Change
	Science & Engineering Practices	<ul style="list-style-type: none"> • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Obtaining, Evaluating, and Communicating Information • Engaging in Argument from Evidence
	Disciplinary Core Ideas	LS1: From Molecules to Organisms: Structures + Processes LS2: Ecosystems: Interactions, Energy, and Dynamics LS4: Biological Evolution: Unity and Diversity
Common Core State Standards ELA	Speaking & Listening	1, 2, 4, 6
	Language Standards	1, 2, 3, 6
	Writing Standards Science & Technical Subjects	4, 7, 10

Materials + Preparation

1. Prepare to demonstrate the GLOBE Observer app: observer.globe.gov. It is available for free download at observer.globe.gov/about/get-the-app.
2. Read through the Mosquito Habitat Mapper tutorial and other resources available at observer.globe.gov/do-globe-observer/mosquito-habitats.
3. Data projector and ability to connect your smart phone or tablet to it so you can demonstrate for students how to use the Mosquito Habitat Mapper in the *Globe Observer* app.
4. Gather materials for GLOBE Kits which student groups can share, and contact Clackamas County Vector Control at (503) 655-8394 or fightthebites.com/service-request if you would like help obtaining them; contents listed at observer.globe.gov/toolkit/mosquito-habitat-mapper-toolkit:
 - Magnifying macro lens that attaches to a mobile device (smart phone or tablet compatible with the GLOBE Observer App)
 - Latex gloves and goggles (to safely collect the water sample)

- Water bottle, ketchup bottle, turkey baster, or bucket (to collect larvae sample)
 - Plastic bag (to transport larvae sample)
 - Permanent marker (to write date and location of where sample was taken on the collection bag)
 - Ethanol OR hand sanitizer (optional, to euthanize larvae)
 - Pipette (to transfer sample from sampling container to plate)
 - White plastic plate (to view and count the larvae in your sample)
 - Paper towels (to keep the observation area clean and dry)
 - Probe (bamboo skewers or toothpicks to help with larvae identification)
 - Vial (to store larvae samples - for individuals conducting training workshops)
5. Prepare to take you class outside to do field work, including getting signed permission forms and arranging transportation, if necessary.
 6. Review the additional resources listed at globe.gov/web/globe-mosquito-project/overview/for-teachers and those in the More Resources / References section at the end of the lesson.

Suggested Procedure

1. Engage students with a quick brainstorming session in pairs about how global climate change may be affecting the spread of vectors such as mosquitoes and the diseases they can transmit. Ask students to record their ideas in words and/or pictures on paper or with an electronic device.
2. Circulate through the room, answering any questions. After 1-2 minutes, tell students they have one more minute to brainstorm and that they should be prepared to share one or more of their best ideas with the class.
3. After another minute of observing the conversations and answering questions, ask the pairs to share their best ideas and discuss them briefly. Include a review of how mosquitoes breed and relevant vocabulary from earlier lessons in the discussion, such as vector, larve, pupae, pathogens, disease, host, and transmission.
4. Tell students they will be investigating nearby areas to see where mosquitoes might be breeding and collect reliable data. They will be sharing it with Clackamas County Vector Control District scientists, as well as others across the country and around the world, to help identify mosquito habitats, how they might be changing due to factors such as global climate change, and take action to stop their spread.

Demonstrate for students how to use the GLOBE Observer app and its Mosquito Habitat Mapper available for free download from observer.globe.gov/about/get-the-app. Explain that they will be using it as part of a global collaboration with other community-based scientists and professional scientists.



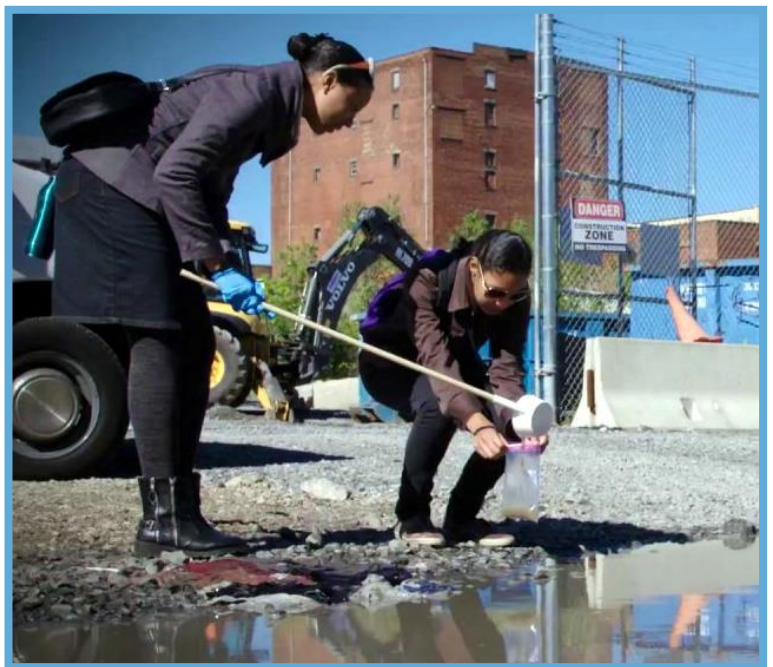
6. As explained in the Mosquito Habitat Mapper Tutorial PowerPoint available at observer.globe.gov/training/mosquitoes, show students how they can record reliable data and reduce the threat of mosquitoes through 4 steps:
 - Record time and location
 - Observe and count
 - Identify: Photograph the larvae with a macro lens
 - Eliminate breeding grounds
7. Show students the equipment they will need for habitat mapping, sampling, and identification, listed above in the Materials / Preparation section.
8. Talk about how GLOBE recommends sampling each water source 5 times. Because larvae are not evenly distributed on the surface, they may need several dips to obtain a sample with larvae in it. Then tell students to wait a couple minutes between each dip and ask them why they think that is recommended. Discuss how when the surface of the water is disturbed, the larvae will swim below for safety. However, they will soon return to the surface because they have to breathe.
9. Review ways to stay safe from mosquito bites, such as:
 - Wear long sleeves, pants, socks, shoes, and hats
 - Use insect repellent
10. Talk about how gloves and/or goggles should be used when collecting data if the water where samples are being taken could be polluted.
11. Demonstrate the exact protocol students will be using to collect data. Different sampling methods are shown in the Mosquito Habitat Mapper Tutorial starting on slide 16.
12. Talk about best practices for handling samples:
 - It may be easiest to identify specimens inside
 - Leave air in bags (ask students why)—so that they can breathe
 - Do not keep bags in direct sunlight for too long (overheating will kill larvae)
 - Identify the larvae soon after collection. If left overnight, any pupae in the sample may become adult flying mosquitoes.
 - If you find adult mosquitoes in your sample bag, shake the bag to drown the adult mosquitoes and dispose of the sample by pouring all contents on the ground.
13. Tell students that they should avoid sampling on private property. Samples should be taken in public areas such as school grounds, parks, or their own yards. They should not take samples on private property unless they have gotten permission to do so.



14. If the apps have not already been installed on student electronic devices, share the link with students where they can download them:
observer.globe.gov/about/get-the-app.
15. When students return to the classroom, they can finish identifying the larvae they collected and then submitting the data through the app. Discuss the subtle differences that evolved in different mosquito species, and how they can be used to identify the species and the potential diseases that can be spread by them. Useful identification tools they can use for reference include the Mosquito Larvae Identification Chart listed on the GLOBE program's training page: globe.gov/documents/11865/0dcf909a-b4b3-4793-969a-5f88c48fbf26.
By submitting images of their specimens taken with a macro lens through the GLOBE Observer app, students can also receive help with identification through the global network of experts. Biologists from Clackamas County Vector Control are also available to answer questions:
16. Ask students to reflect on the project in writing. What worked well with the sampling protocol and technology, and what could be improved to help in the global investigation? What was interesting about the project, and how could the student work be helpful for Clackamas County scientists and communities, as well as those around the world? Be sure to tell students that the research is valuable, even if they did not find any mosquito larvae.
17. Discuss the activity as a class to give students the opportunity to share their ideas and reflect as a class about the science and meaningfulness of the project. Include an analysis of how their work could be increasingly important as the threat of vector-borne illnesses increases due to climate change. And discuss why the research is valuable even if no mosquito larvae were found.

Adaptations / Extensions

- **Show and discuss the video on the “Crowd & the Cloud” website about a school using the GLOBE Observer: Mosquito Habitat Mapper program:** crowdandcloud.org/globe-observer-mosquito-habitat-mapper
- **Have students review the results of this study by the Centers for Disease Control (CDC) that found the rate of vector-borne disease increased 300% in recent years: “Illnesses on the rise from mosquito, tick, and flea bites”:** cdc.gov/vitalsigns/vector-borne/index.html. Discuss the likely causes of the increases and predict what might happen in the future, based on how we respond to the dangers of disease vectors and global climate change.



Scene from the “Crowd & the Cloud” video

- **Ask students to create their own maps** of the field site(s) with ArcGIS Online. Pass out copies of the “Create a Custom Map with ArcGIS Online” handout at the end of the lesson for groups of 2 – 3 students to share. Depending on your class, students can step themselves through the process with your support, or you could guide them step-by-step through direct instruction.
- **Students can design different experiments to learn more about vectors in your area**, such as one with dry ice and a smart phone’s microphone, designed with this fascinating research from Iqbal Pittawalla in mind: How Mosquitoes Are Drawn to Human Skin and Breath: ucrtoday.ucr.edu/19377
- **Pass out the “Design an Investigation” graphic organizer** from Shape of Life to help students conduct original research projects: shapeoflife.org/lesson-plan/sol/science-action.
- **Students can work in pairs or small groups to create short videos** about their project to share with the rest of the school and/or the wider community.
- **Make presentations to your community about the project(s)** and send invitations to local newspapers and other media outlets. See the next lesson about community presentations for strategies about effective ways to host community events and a rubric to help students prepare effective presentations.

More Resources / References

- Detailed training information about GLOBE Observer’s Mosquito Habitat Mapper: globe.gov/get-trained/protocol-ettraining/etraining-modules/16867649/12273
- Another excellent training is available at astc.org/wp-content/uploads/2017/05/GlobalExperiment-UsingTheMosquitoHabitatMapperApp.pdf
- More resources from Clackamas County Vector Control District: fightthebites.com/education.
- More information about the Next Generation Science Standards, including a link to the [Framework for K-12 Science Education](http://nextgenscience.org/framework-k%E2%80%9312-science-education) to which this lesson was aligned: nextgenscience.org/framework-k%E2%80%9312-science-education
- More information about the Common Core State Standards and links to the complete documents: corestandards.org



Create a Custom Map with ArcGIS Online



Create free maps of mosquito habitats or anything else!

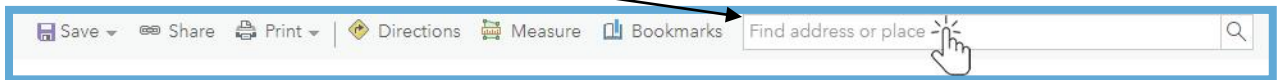
1. Login to Esri's ArcGIS Online: arcgis.com

Get it free for schools: esri.com/en-us/industries/k-12-education/schools-software


2. Click **Map** at the top of the ArcGIS Online site.

3. Focus on an area:


- **Search** for an address or place:






- **Pan** across the map by clicking and dragging it.
- **Zoom In** with the “+” button and **Zoom Out** with the “-” button (shown below)

4. Choose a  **Basemap**.

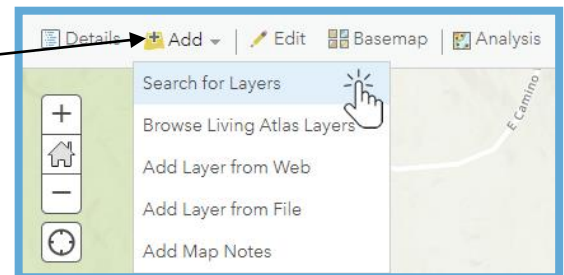
5. Add features to your map:

- Click  **Add > Search for Layers**:

“National Wetlands Inventory - NWI” is one ArcGIS Online option

- Click  **Add > Browse Living Atlas Layers**
- Click  **Add > Add Layer From File** to upload data
- Click  **Add > Add Map Notes** to add labels, icons, and descriptions:

Choose a template (such as “Recreation”) for options that might be helpful.



6. Click **Details > Content** to turn layers off and on with checkboxes

7. Click **Save** to save your map.

8. Click **Share** to get a link to it.

9. Click **Print** to prepare a map for the field.

