CITIZEN SCIENCE

A GLOBE EDUCATIONAL GUIDE

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Graphics By: Sydney D. Gordon

Acknowledgements

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We also acknowledge Escuela de Boquerón Abajo in Panamá, Escuela Líder Bribrí in Costa Rica, and Liceo Rural de Yorkín in Costa Rica, who cooperated in testing the resources with classroom students. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the funders.

Table of Contents

Introduction

Environmental education can improve education outcomes and empower students (van de Wetering et al 2022). Citizen science, when participants contribute time, effort, knowledge, or experience to scientific investigations, can empower and give individuals a feeling of connection with other participants. Environmental education and citizen science together can improve knowledge about scientific and environmental issues. For example, after a citizen science project, participants had more correct answers on a test about facts relevant to the project (Jordan et al 2011). Students participating in these types of activities can change intentions and behaviors (van de Wetering et al. 2022; Jordan et al 2011), which can translate into environmental action.

A review of published reports on environmental education programs demonstrated an increase in measurable desirable environmental outcomes (98% of reports), with no negative outcomes, and with 2% with no changes detected (Adrion 2020). While there may be some publication bias with authors more likely to report success than failure, these results demonstrate that environmental education can produce positive, measurable environmental outcomes. Further participatory and collaborative processes in environmental education programs (such as citizen science projects) report direct impacts on the improvement of environmental conditions (Adrion et al 2020).

In addition to educational outcomes, environmental education can have positive impacts on the mental health of young people. For example, some young people may have 'ecological anxiety' about climate change and environmental crises, but participation in activism and a sense of purpose can lead to positive management of emotions (Leger-Goodes et al 2022).

Using citizen science projects to meet academic requirements can begin a cycle of change in attitudes and behaviors (Toomey and Dumrose 2013), where students can understand sustainable development and their actions can support sustainable development. This type of science is essential for some projects and problems that

are large. You can use the power of all people to work together to find information and solutions to big problems. Students who participate may feel they can help and do something that is beneficial to the earth and to people.

The activities in this guide are suggestions, any activity can be used. Many of the materials come from NASA's (National Aeronautics and Space Administration) GLOBE (Global Learning and Observations to Benefit the Environment) program and are free to use for educational purposes. A link should be provided if changes are made to the GLOBE program documents. There are links to the documents in the guide and at the end of the document. Please refer to the original documents for more information.

There are other materials that can be used, this guide can serve as an introduction to using the GLOBE program in your classroom.

Bibliography

Adroin NM, AW Bowers, E Gaillard (2020) Environmental education outcomes for conservation: A systematic review. Biological conservation 241: 1-13

Jordan RC, SA Gray, DV Howe, WR Brooks, JG Ehrenfeld (2011) Knowledge gain and behavioral change in citizen-science programs. Conservation Biology 25: 1148-1154

Léger-Goodes T, C Malboeuf-Hurtubise, T Mastine, L Généreux, P-O Paradis, C Camden (2022) Eco-anxiety in children: A scoping review of the mental health impacts of the awareness of climate change. Frontiers in Psychology 21pgs.

Toomey AH, MC Dumrose (2013) Can citizen science lead to positive conservation attitudes and behaviors? Research in Human Ecology 20: 50-62

Level 1-3

Learn About Mosquitoes and Their Habitat

Classroom Activity

Look for Mosquitoes

Learn about the life cycle of mosquitoes and why they important to people. Use the GLOBE app to collect data about potential mosquito habitat.

Information for teachers:

- Mission mosquito: Larvae hunters guide
- Beyond the Bite: GLOBE mission mosquito disease guide
- Resources - Mission Mosquito - GLOBE.gov

1. Read the ZIKA ZINE. The teacher can read the bulletin to the students.
2. Discuss as a class.
    a. Questions: Do you like mosquitoes? Why or why not? What are your experiences with mosquitoes?
        i. Each student writes or mentions 3 things they know or think about mosquitoes. They can discuss in small groups or pairs and then with the whole class.
        ii. Examples: Mosquitoes can bite people. Mosquito bites can transmit diseases, for example dengue, zika, chikungunya to humans.
        iii. Do you know that: There are more than 3,500 species of mosquitoes and ~200 of them bite. Adult mosquitoes eat nectar and are often pollinators. Adult females need blood for their eggs.
3. In what forms can you find mosquitoes?
    a. Eggs, larvae, pupae, adults
    b. Life cycle – Figure 1 Mosquito life cycle – Beyond the bite
    c. Activity 6 Identify the stages of the life cycle of a mosquito – Mission Mosquito Larvae Hunters Guide

Level 1-3

Learn About Mosquitoes and Their Habitat

Classroom Activity

4.Where do mosquitoes live? What are their habitats?

a. Use the cards to play 'Mosquito Habitats and Hideouts' and find mosquito. habitats (standing water).

Discussion

What can you do to prevent the spread of mosquitoes and the diseases they carry?

1. Put on insect repellent.
2. Eliminate standing water when possible.
3. Study and learn more and help scientists learn more about mosquitoes and their habitats.

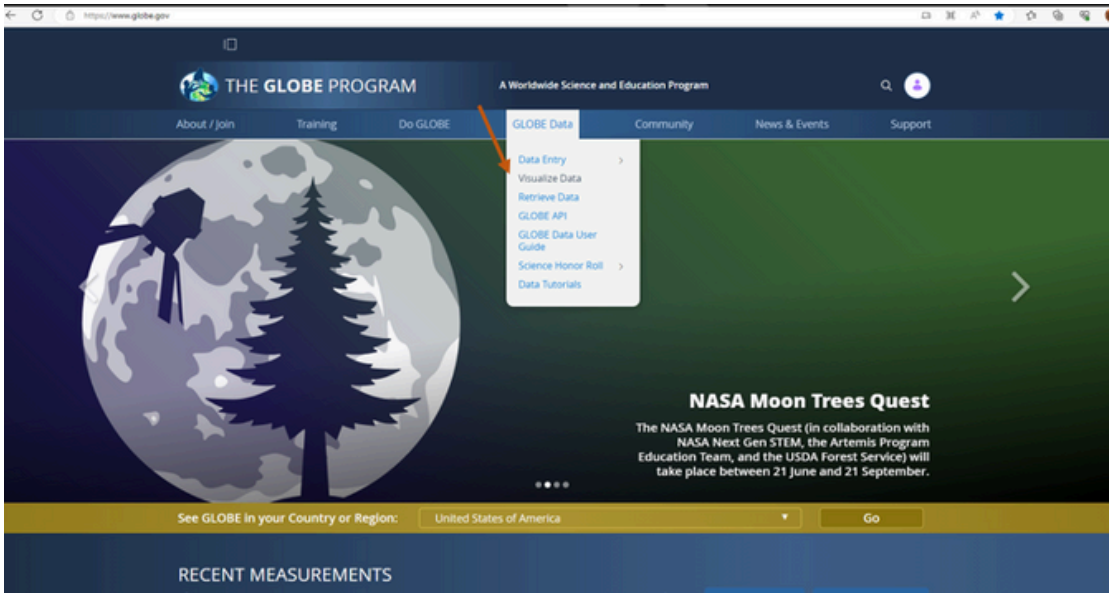
Level 1-3

Learn About Technology and Citizen Science

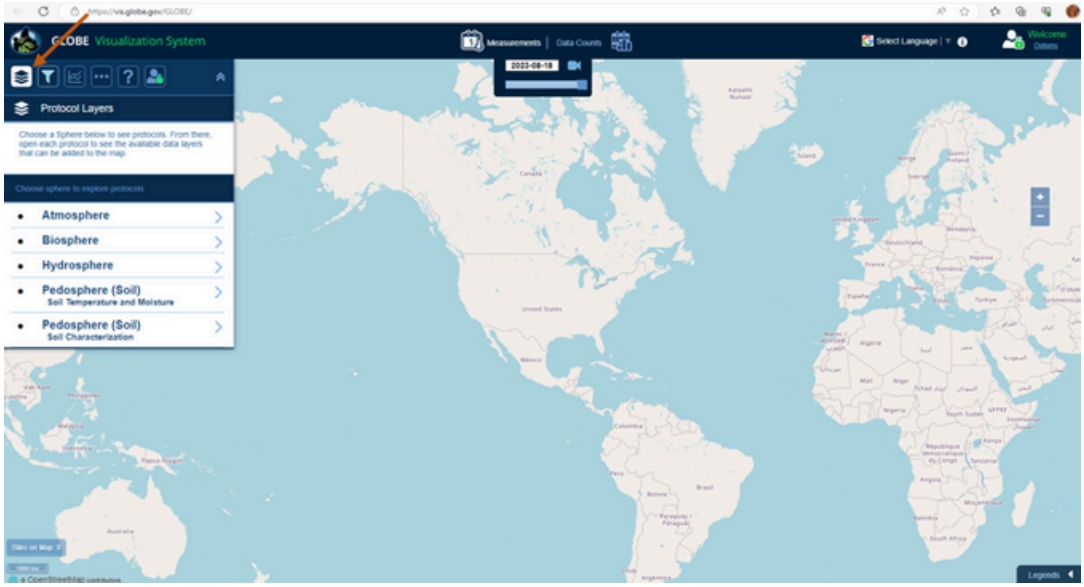
Introduction of GLOBE

Map scavenger hunt!

Use a computer to go to the ***GLOBE website (https://www.globe.gov/)***, open 'GLOBE data', and go to **'Visualize data'**



In the **'Visualization system',** click on **'Enter the visualization system'** and click on the map layers.

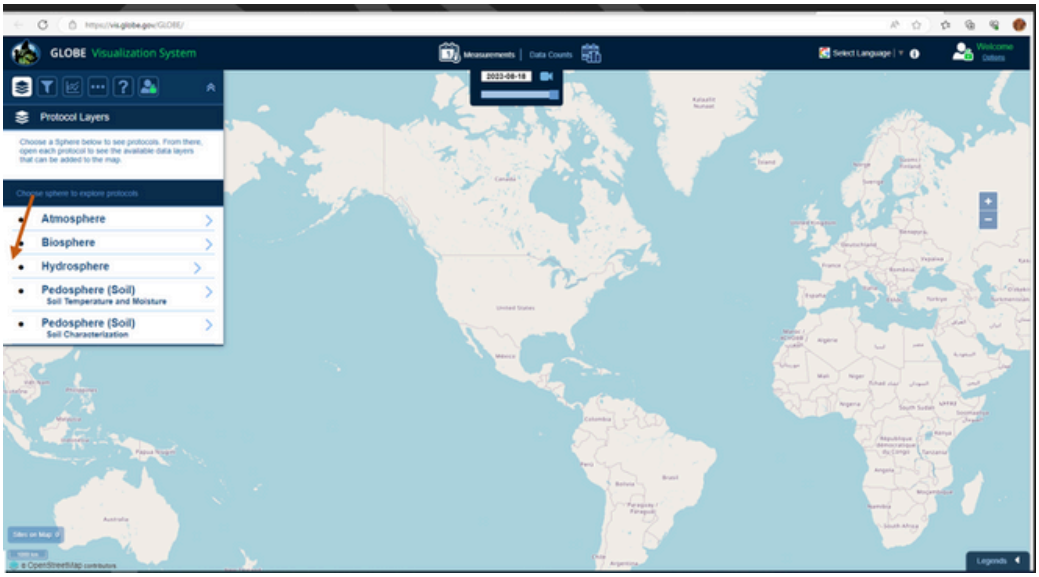


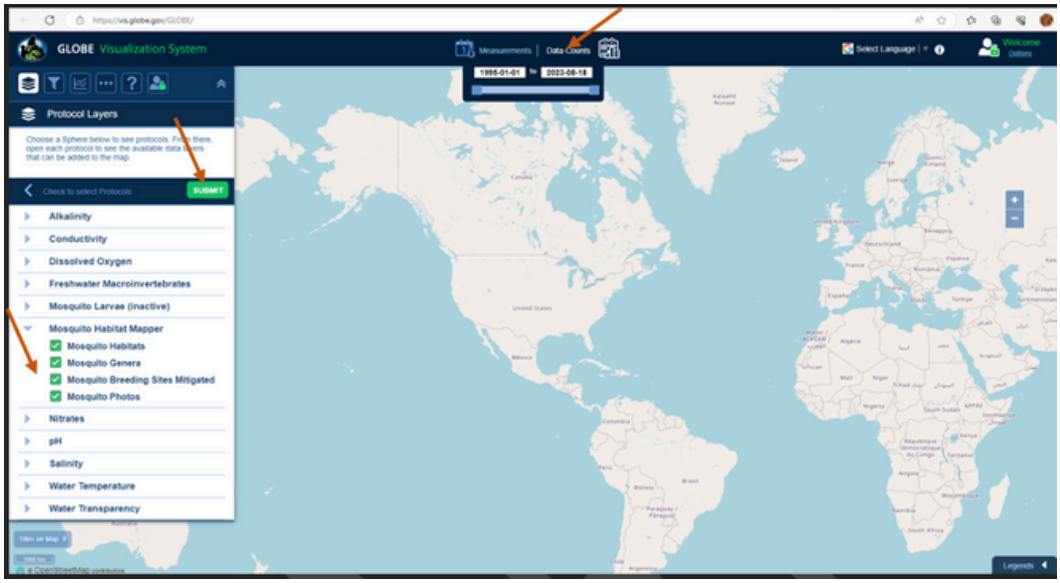
Level 1-3

Learn About Technology and Citizen Science

Introduction of GLOBE

Click on '**Hydrosphere**', and expand the '**Mosquito Habitat Mapper**' layer, click on all the data layers. Choose ‘Data Counts’ at the top of the page and click ‘**SUBMIT**’.



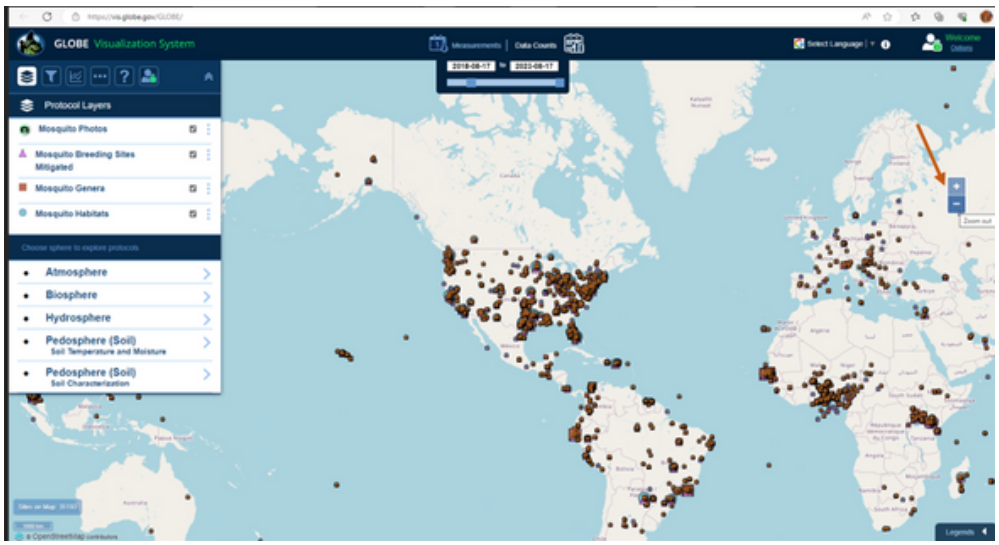


Level 1-3

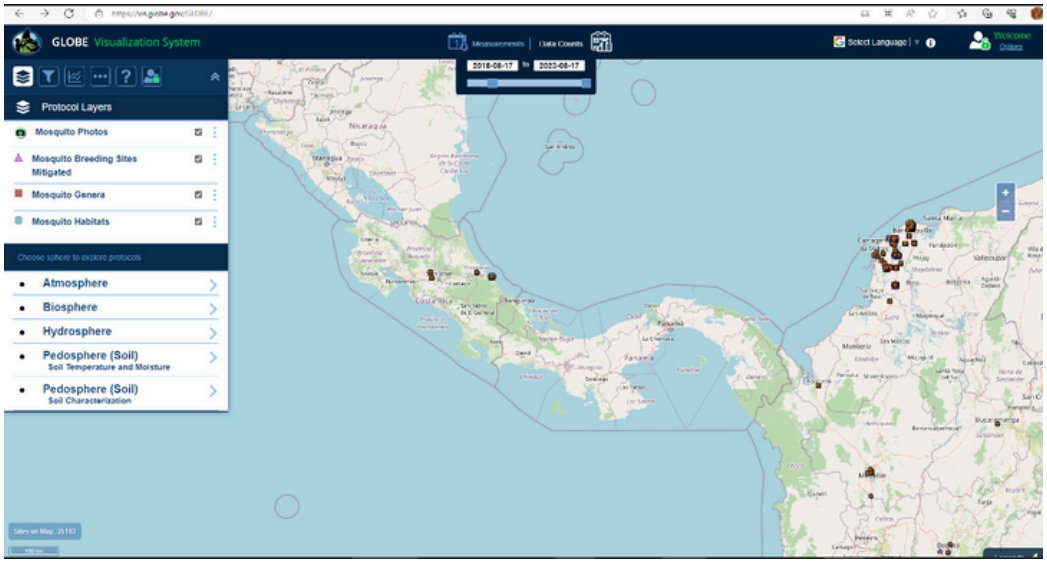
Learn About Technology and Citizen Science

Introduction of GLOBE

Now you should see some points on the map, these are data. Explore the data, you can **use the plus and minus on the right side of the page to zoom,** and you can use the mouse to move the map.



Use zoom and the mouse to find your country.



...Scavenger Hunt! (Click on the dots, you can explore the tabs and pages)

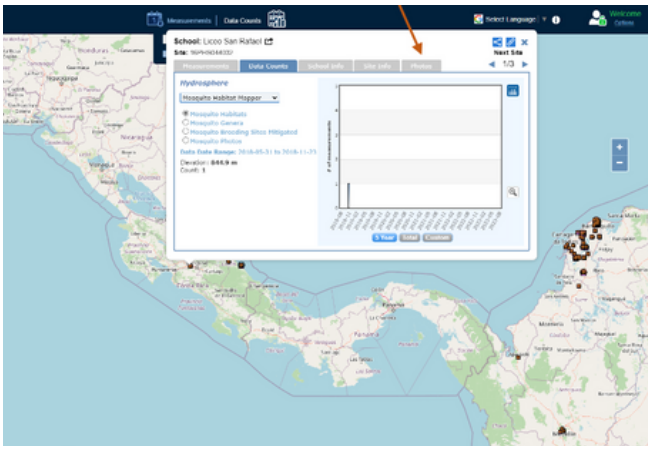
Level 1-3

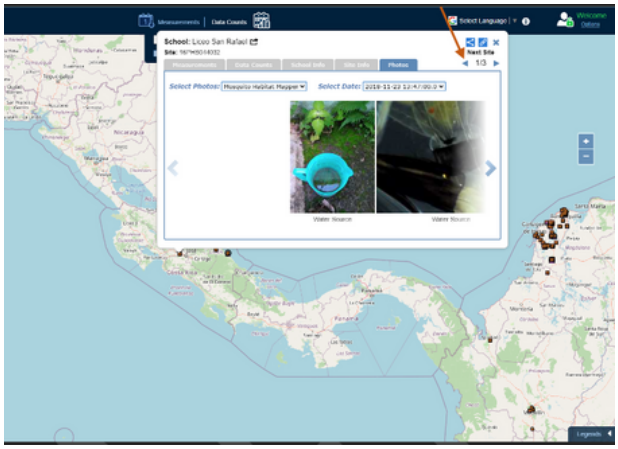
Learn About Technology and Citizen Science

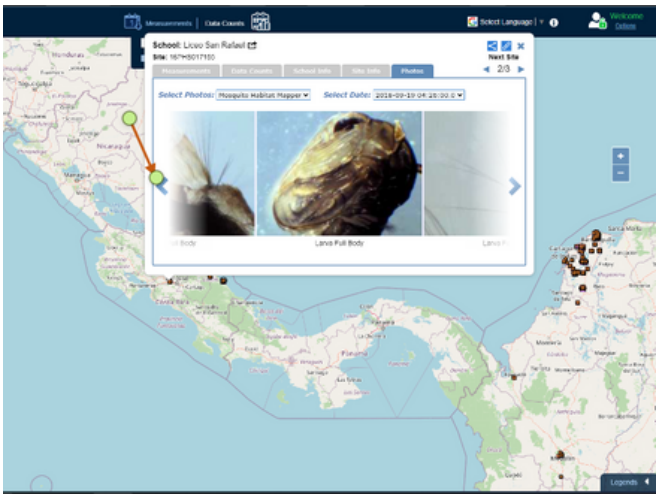
Introduction of GLOBE

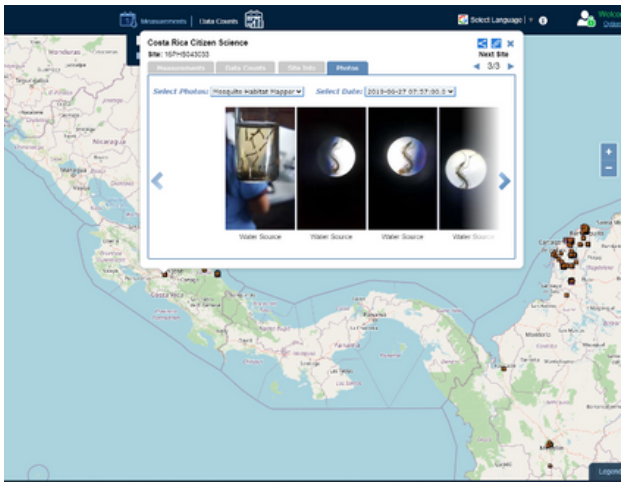
Scavenger Hunt!

Click on the dots to explore the data. In small groups or as a class search the data. Click tabs and page arrows to explore.









Can you find a photo of a mosquito? Try to identify what you can see in the photos (there are photos of larvae, water (habitat)), and enlarged photos of larvae and pupae.

Explore the data. Look in other parts of the world. What do you think you can learn from this data? What can scientists learn from this data? Discuss with your group or class.

All these data were collected by citizen scientists. Do you want to try?

What is citizen science? - Citizen science is the voluntary contribution of time, effort, knowledge, or experience to scientific research

Level 1-3

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outdoor or Fieldtrip Activities

1. Use the guide - Let's build a mosquito larvae trap (slide 38 and 39 in the Larvae Hunters Guide) – to build a trap, you can leave the trap outside for a few days before this activity.

Note to teachers, if you don't have larvae in your trap after a week, you can use a black or dark colored bucket with a piece of wood in the water and the air (as a ramp so the female mosquitoes can stand on the ramp and lay their eggs in the water). Leave it open with grass in the water. Make sure you don't leave it for more than 5 days so you can ensure there are no adult mosquitoes.

1. Go outside (of the school or on a field trip) and look for mosquito habitats (remember the game Mosquito Habitats and Hideouts).
2. Go out in small groups with one adult for each group. When you find habitat, put it on the map with the GLOBE app (an adult can have the app on their phone), you can watch a video on how to use the app. If you don't have a phone with the app, use the Habitat Survey Page.
3. You can continue to the 'Land Cover' page in the GLOBE app, after the 'Mosquito Habitat Mapper'.
4. Congratulations! You have contributed to global citizen science!

Level 4-6

Learn About Mosquitoes and Their Habitat

Classroom Activity

Look for Mosquitoes

Learn about mosquitoes and why they important to people. Use the GLOBE app to collect data about potential mosquito habitat.

Information for teachers:

- Mission mosquito: Larvae hunters guide
- Beyond the Bite: GLOBE mission mosquito disease guide
- Resources - Mission Mosquito - GLOBE.gov

1. Read the ZIKA ZINE.
2. Discuss as a class.
    a. Question: Do you like mosquitoes? Why or why not? What are your experiences with mosquitoes? Each student writes or mentions 3 things they know or think about mosquitoes. They can discuss in small groups or pairs and then with the whole class.
        i. Examples: Mosquitoes can bite people. Mosquitoes can transmit diseases, for example dengue, zika, chikungunya to humans.
        ii. Do you know that: There are more than 3,500 species of mosquitoes and ~200 of these bite. Adult mosquitoes eat nectar and are often pollinators. Adult females need blood for their eggs.
3. Remember - In what forms can you find mosquitoes?
    a. Eggs, larvae, pupae, adults
    b. Life Cycle – Figure 1 Mosquito Life Cycle – Beyond the Bite: GLOBE Mosquito Mission Disease Guide
4. Read Proboscis Mosquito: Mechanics of a Bite
    a. Discuss as a class. How does this adaptation work? What are other adaptations of animals or plants?

Level 4-6

Learn About Mosquitoes and Their Habitat

Classroom Activity

5. Where do mosquitoes live? What are their habitats? Use the cards to play 'Mosquito Habitats and Hideouts' and find mosquito habitats (stagnant water).

Discussion

Where can you find mosquitoes?

- Discuss the concepts of individuals, populations, communities, species, niche, and ecosystem.
- For instance, is there a population in a city, on a river? What is the niche of some mosquito species, are there species that prefer some habitats?
- ***Example***: *Aedes* mosquitoes prefer containers, and *Anopholes* prefer puddles or other more natural habitats.

Further Discussion

Use the Beyond the Bite: GLOBE Mosquito Mission Disease Guide for more information.

What can you do to prevent the spread of mosquitoes and the diseases they carry?

1. Put on insect repellent.
2. Eliminate standing water when possible.
3. Study and learn more and help scientists learn more about mosquitoes and their habitats.

Level 4-6

Learn About Technology and Citizen Science

Introduction of GLOBE

1. You can build mosquito traps in class and see if you can trap some larvae. When you have larvae, you can look at them with magnification and count them.
2. Use the guide - Let's build a mosquito larvae trap (slide 38 and 39 in the Larvae Hunters Guide) – to build a trap, you can leave the trap outside for a few days before this magnification activity.

Note for teachers, if you don't have larvae in your trap after a week, you can use a black or dark colored bucket with a piece of wood between the water and the air (as a ramp so the female mosquitoes can stand on the ramp and lay their eggs in the water). Leave it open with grass in the water. Make sure you don't leave it for more than 5 days so you can ensure there are no adult mosquitoes.

1. Magnification: Magnify that
    a. Practice magnifying things, you can use a hand lens, magnifying glass, or phone magnifier and take photos.
        i. How to use a clip-on microscope (slide 86 in the Larvae Hunters Guide)
    b. If you have mosquito larvae from your traps, you can count them and report the number in the GLOBE app (see upcoming activities).

Map scavenger hunt!

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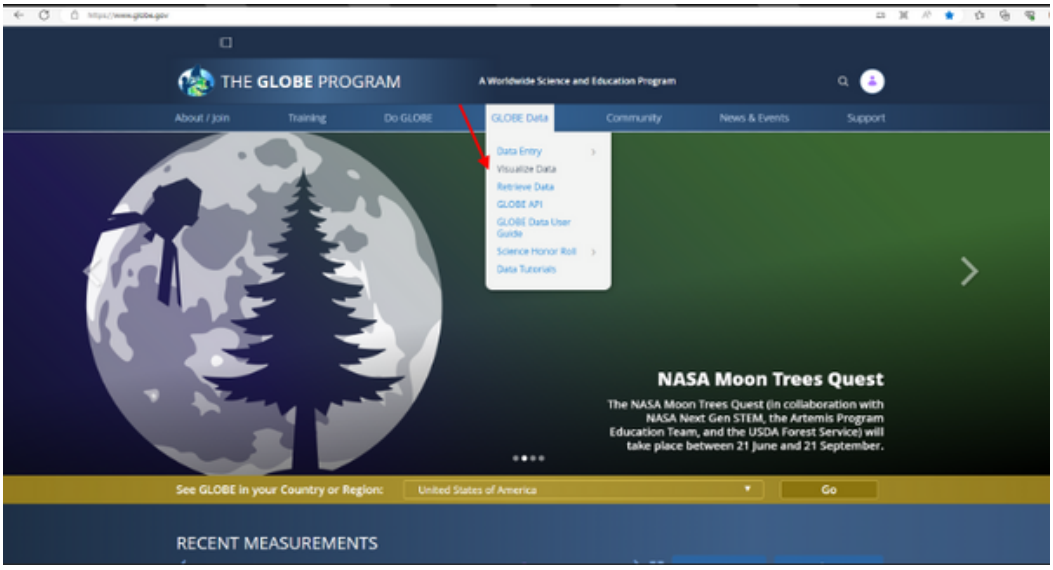

Level 4-6

Learn About Technology and Citizen Science

Introduction of GLOBE

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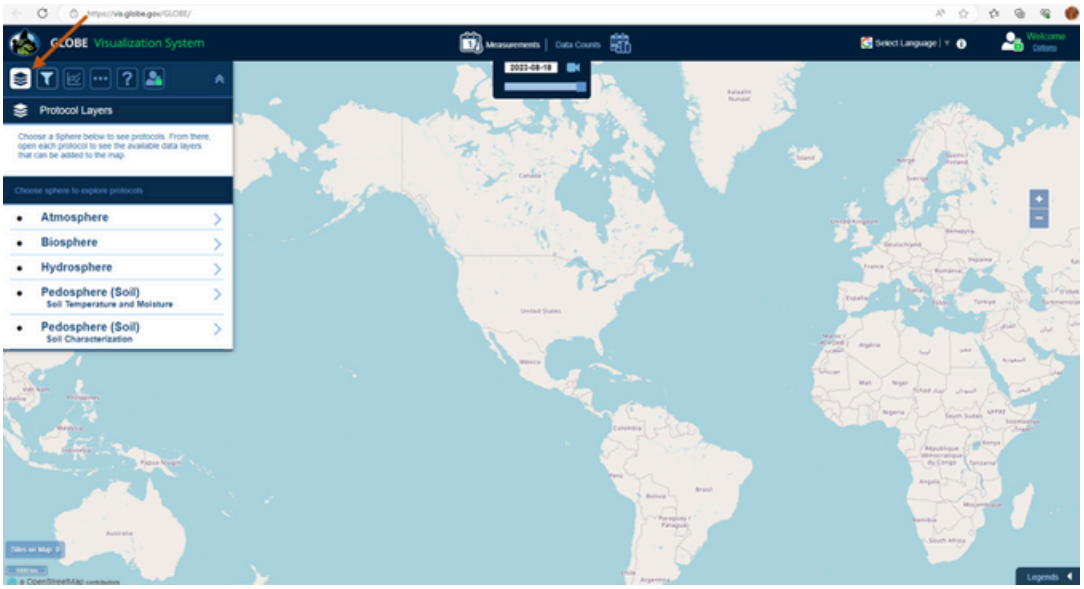

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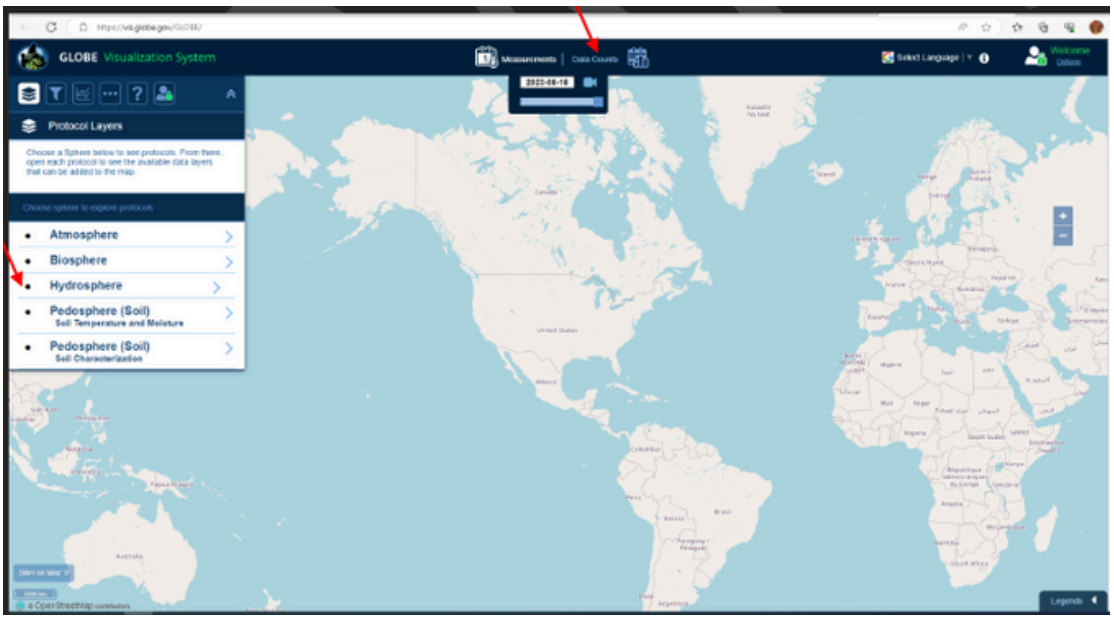
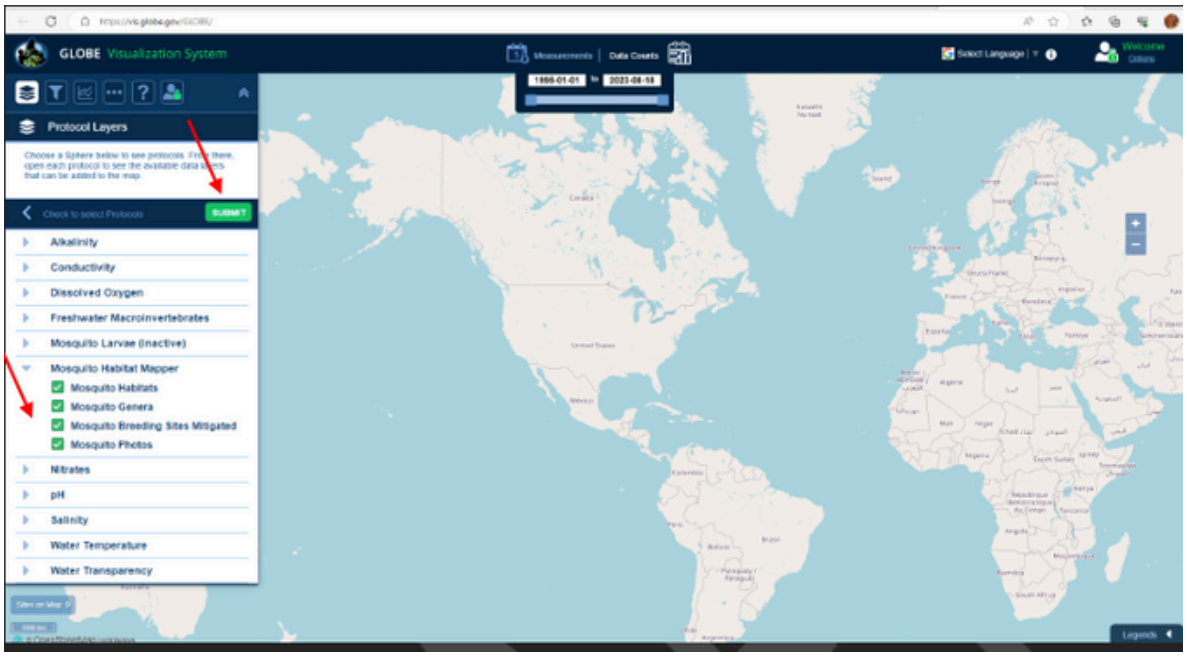


Level 4-6

Learn About Technology and Citizen Science

Introduction of GLOBE



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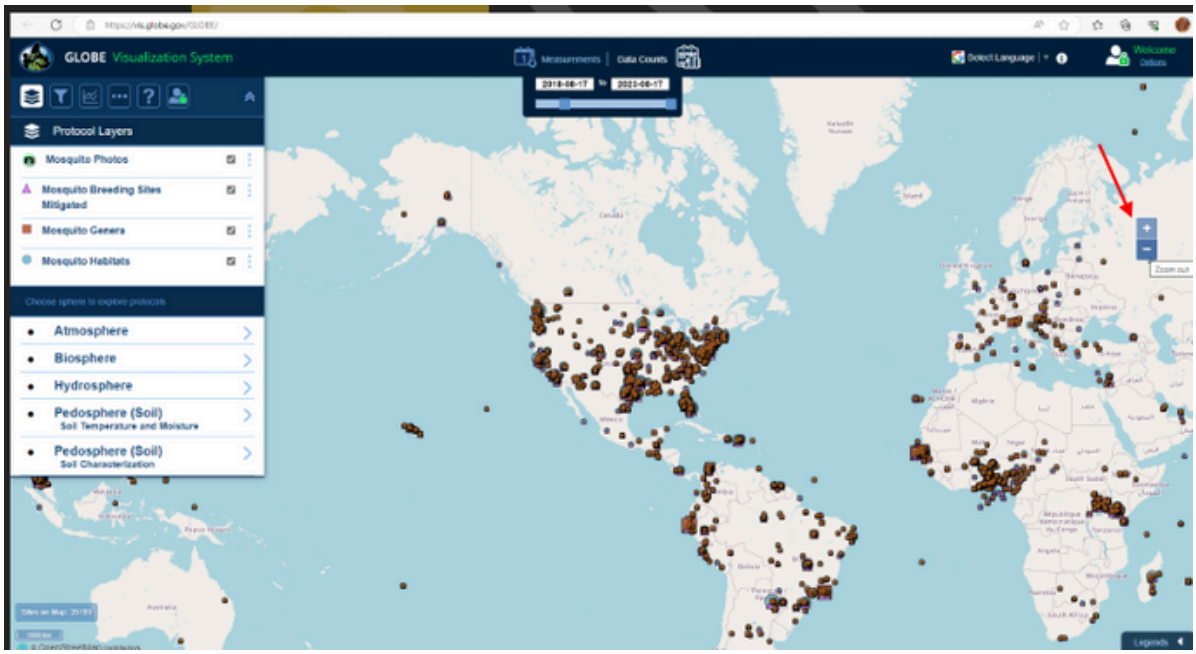
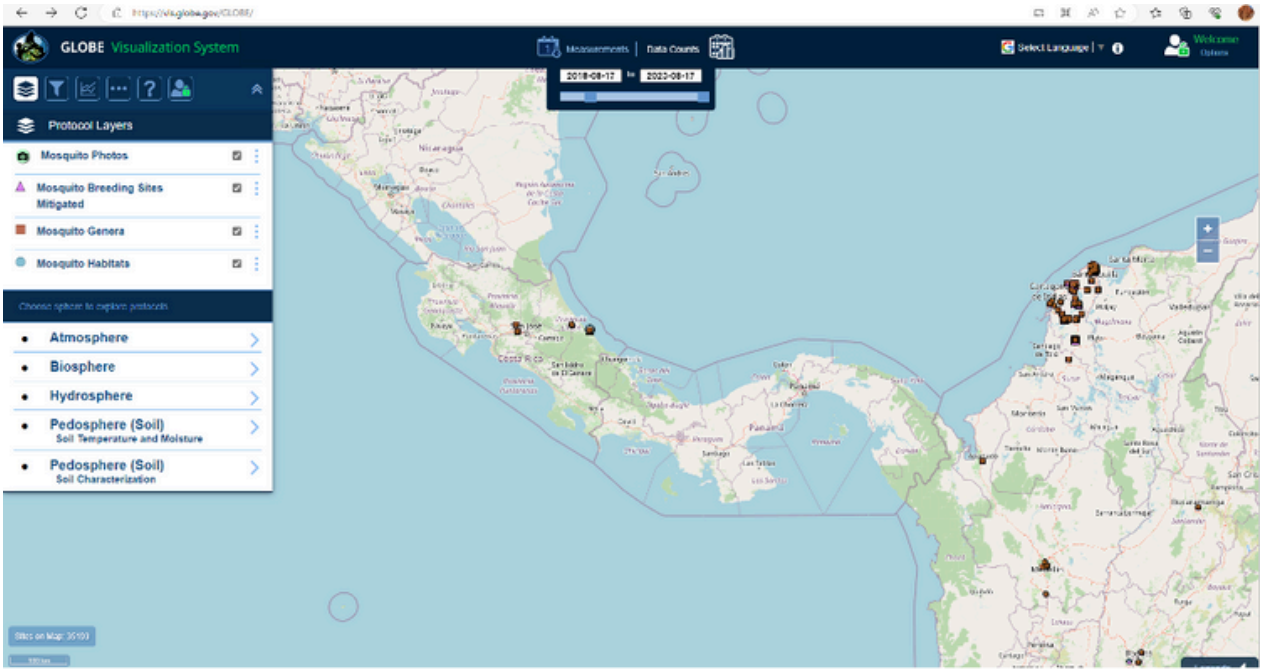


Level 4-6

Learn About Technology and Citizen Science

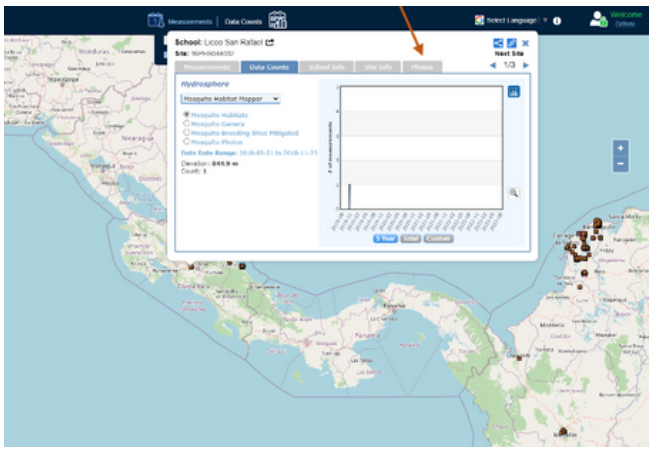
Introduction of GLOBE

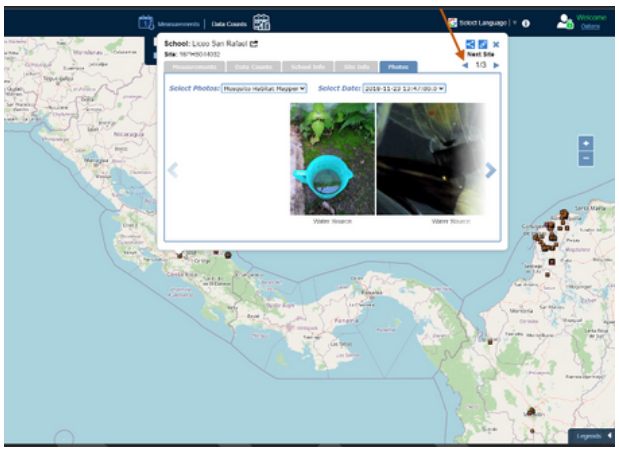
Use zoom and the mouse to find your country.



Scavenger Hunt!

Click on the dots, you can explore the tabs and pages.

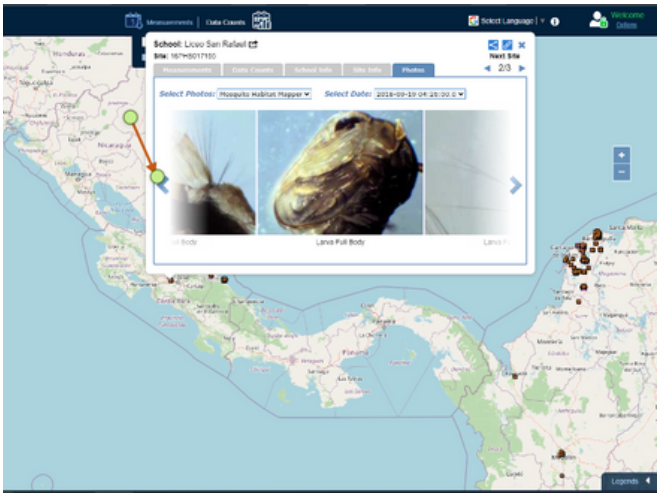


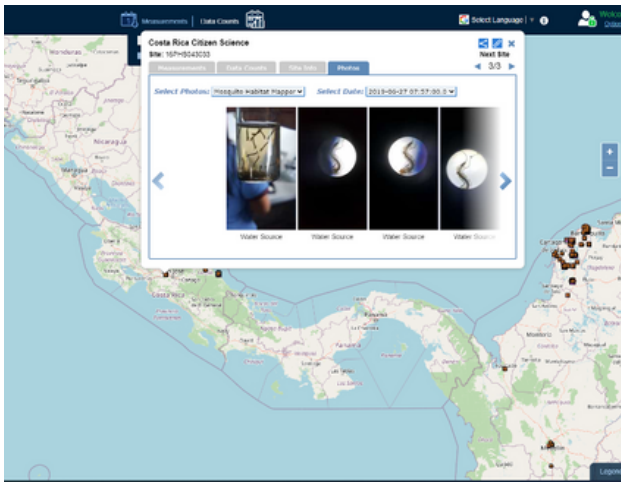


Level 4-6

Learn About Technology and Citizen Science

Introduction of GLOBE





In small groups, or as a whole class, look for data: Can you find a photo of a mosquito? Try to identify what you can see in the photos (there are photos of larvae, water (habitat)), and enlarged photos of larvae and pupae.

Where and when do you find mosquitoes? What does this mean about mosquito habitat? For example, in Alaska when is the data, in the winter or summer? Why? What does this mean with climate change? *Mosquitoes can move to different parts of the world if it is warmer.

Explore the data. Look in other parts of the world. What do you think you can learn from this data? What can scientists learn from this data? Discuss with your group or class.

Can you find photos of the three genera of mosquitoes (*Anopholes, Aedes, Culex*)? Can you use the Mosquito Larvae Hunter: Level 1 to identify them?

All these data were collected by citizen scientists. Do you want to try?

What is citizen science? - Citizen science is the voluntary contribution of time, effort, knowledge, or experience to scientific research

Level 4-6

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outdoor or Fieldtrip Activities

1. Go outside (of the school or on a field trip) and look for mosquito habitats.
2. Go out in small groups with one adult for each group. When you find habitat, put it on the map with the GLOBE app (an adult can have the app on their phone), you can watch a video on how to use the app. If you don't have a phone with the app, use the Habitat Survey Page.
3. You can continue to the 'Land Cover' page in the GLOBE app, after the 'Mosquito Habitat Mapper'.

...Congratulations! You have contributed to global citizen science!

1. If you have built a mosquito trap or if you have some water samples with larvae, continue here.
    a. Can you count and identify some larvae?
2. Use the Mosquito Larvae Hunter: Level 1
    a. Identify the eggs, larva, and pupae. Count the larvae, you can report the numbers in the GLOBE app.

Level 7-9

Learn About Mosquitoes and Their Habitat

Classroom Activity

Look for Mosquitoes

Learn about mosquitoes and why they important to people. Use the GLOBE app to collect data about potential mosquito habitat.

Information for teachers:

- Mission mosquito: Larvae hunters guide
- Beyond the Bite: GLOBE mission mosquito disease guide
- Resources - Mission Mosquito - GLOBE.gov

1. Read the GLOBE Mosquito Mission's Beyond the Bite: Disease Guide.
2. Discuss as a class.
    a. Question: What are your experiences with mosquitoes? What are the potential solutions for disease-carrying mosquitoes? Write or mention 3 things you know or think about mosquitoes. You can discuss in small groups or pairs and then as a whole class.
    b. Examples: Mosquitos can transmit diseases, for example dengue, zika, chikungunya to humans.
    c. Do you know that: There are more than 3,500 species of mosquitoes and ~200 of these bite. Adult mosquitoes eat nectar and are often pollinators. Adult females need blood for their eggs.
3. Small group research - What are people doing about mosquito transmitted illnesses?

Teachers: You can search for information about *Aedes aegypti* and *Wolbachia* – *Wolbachia* is a bacteria that can be introduced into *Ae. aegypti* populations. These bacteria can slow the spread of viruses (yellow fever, dengue, chikungunya) in mosquito populations.

Level 7-9

Learn About Mosquitoes and Their Habitat

Classroom Activity

- You can also look for information on genetic modification of mosquitoes, for example in Panama.
- You can look up information about insecticides. How can the use of insecticides effect other parts of the environment? For example, water, agricultural areas?

Global opportunity for students - International Virtual Science Symposium:
The International Virtual Science Symposium is an opportunity for GLOBE students to showcase their research to the rest of the community. Projects are judged by prestigious scientists from dozens of GLOBE countries. Students are eligible to receive GLOBE stipends and badges.

Discussion

1. Remember - In what forms can you find mosquitoes?
    a. Eggs, larvae, pupae, adults
    b. Life Cycle – Figure 1 Mosquito Life Cycle – Beyond the Bite: GLOBE Mosquito Mission Disease Guide
2. Read Proboscis Mosquito: Mechanics of a Bite
    a. Discuss with the class. How does this adaptation work? What are other adaptations of animals or plants?
3. Remember: Where do mosquitoes live? What are their habitats?
    a. Use the cards to play 'Mosquito Habitats and Hideouts' and find the mosquito habitats (stagnant water).

Level 7-9

Learn About Mosquitoes and Their Habitat

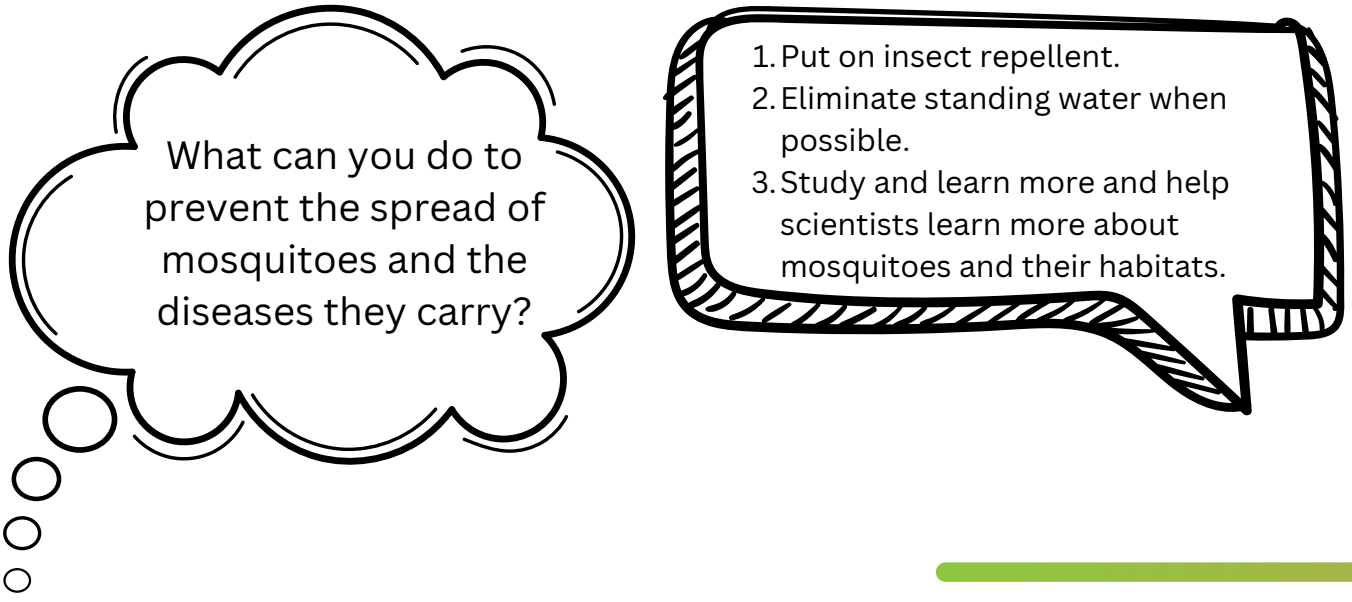
Classroom Activity

Where can you find mosquitoes?

- Discuss the individuals, population, community, species, niche, ecosystem.
  - For example, there is a population in a city, on a river.
- What is the niche of some mosquito species, are there species that prefer some habitats?
  - For example, *Aedes* mosquitoes prefer containers, and *Anopholes* prefer puddles or other more natural habitats

Use GLOBE's Beyond the Bite: Mosquito Mission Disease Guide for more information.

Further Discussion



Level 7-9

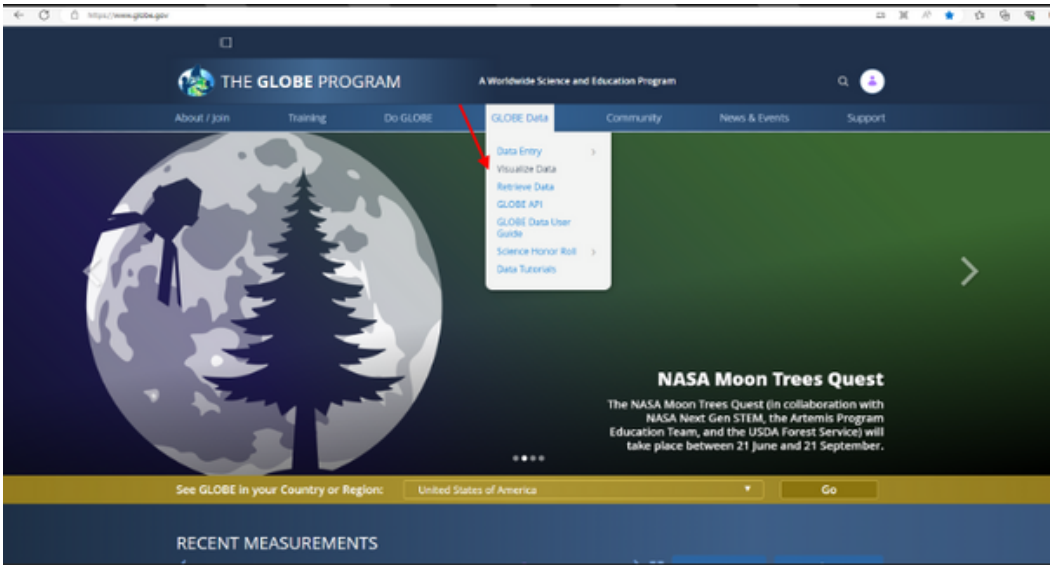
Learn About Technology and Citizen Science

Introduction of GLOBE

1. Remember magnification: Magnify that
    a. Practice magnifying some things, you can use a hand lens, magnifying glass, or phone magnifier and take photos.
2. How to use a clip-on microscope (slide 86 in the Larvae Hunters Guide)
    a. If you have mosquito larvae in your traps, you can count them and report the number in the GLOBE app (see upcoming activities).
3. You can build a mosquito trap in small groups and see if you can catch some larvae.
    a. Use the guide - Let's build a mosquito larvae trap (slide 38 and 39 in the Larvae Hunters Guide) – to build a trap, you can leave the trap outside for a few days.
    b. You can build traps at school and students can also build traps at home as an extension task.
4. Identify eggs, larvae, and pupae. Count the larvae, you can report the numbers in the GLOBE app.
    a. Activities: Mosquito larvae Hunters Level 2

Map scavenger hunt!

Use a computer to go to the ***GLOBE website (https://www.globe.gov/)***, open 'GLOBE data', and go to **'Visualize data'**

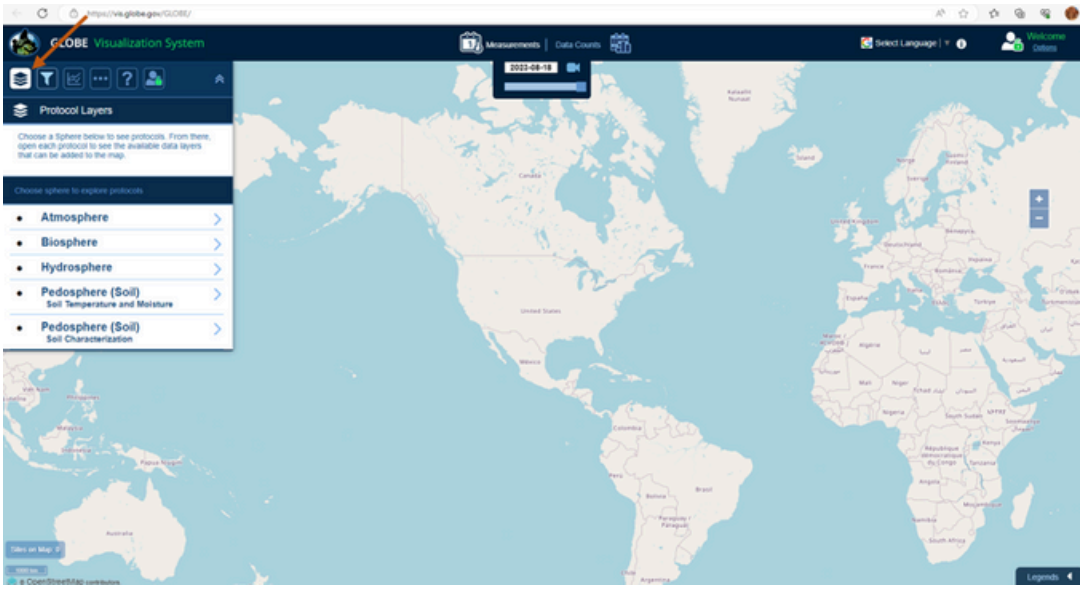


Level 7-9

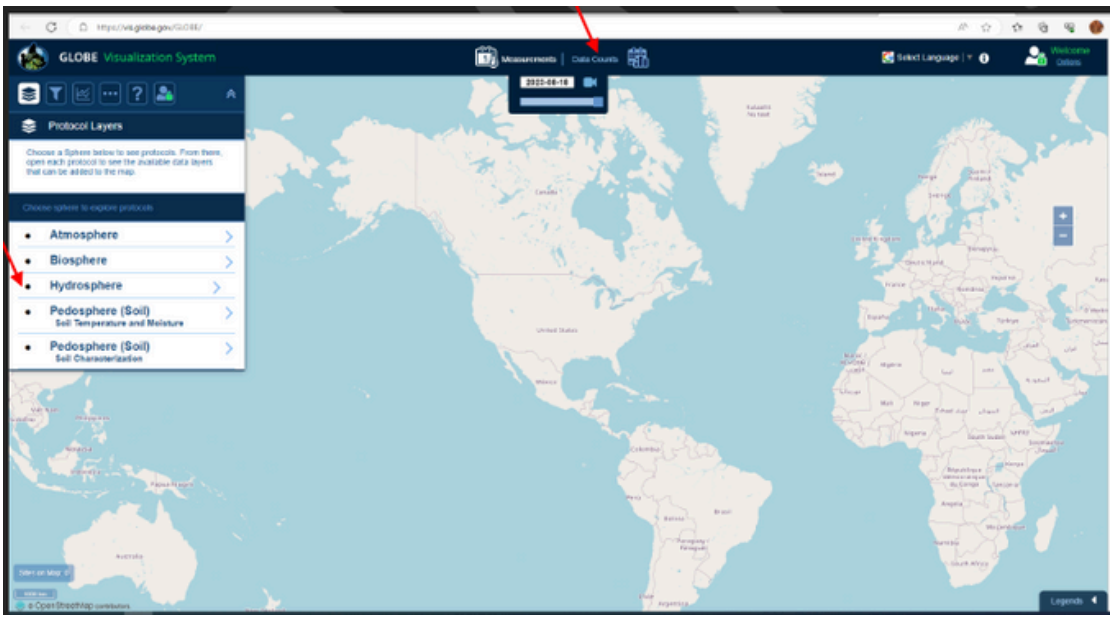
Learn About Technology and Citizen Science

Introduction of GLOBE

In the **‘Visualization system’,** click on **‘Enter the visualization system’** and click on the map layers.



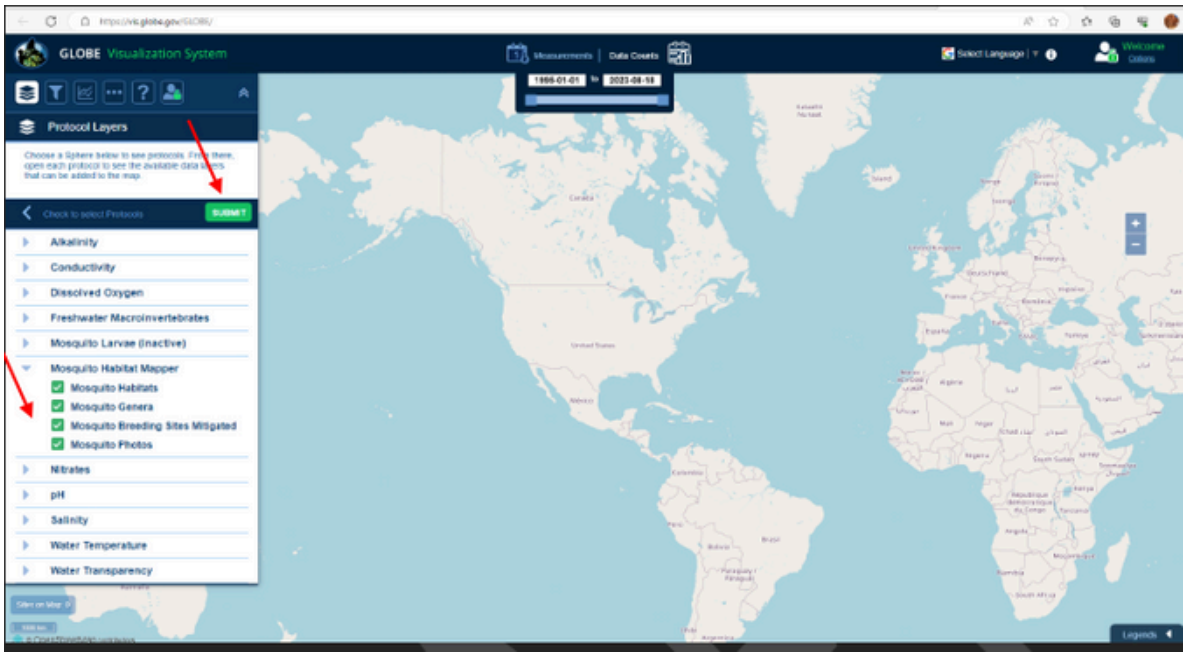
Click on **'Hydrosphere',** and expand the **'Mosquito Habitat Mapper'** layer, click on all the data layers. Choose **‘Data Counts’** at the top of the page and click ‘**SUBMIT’.**



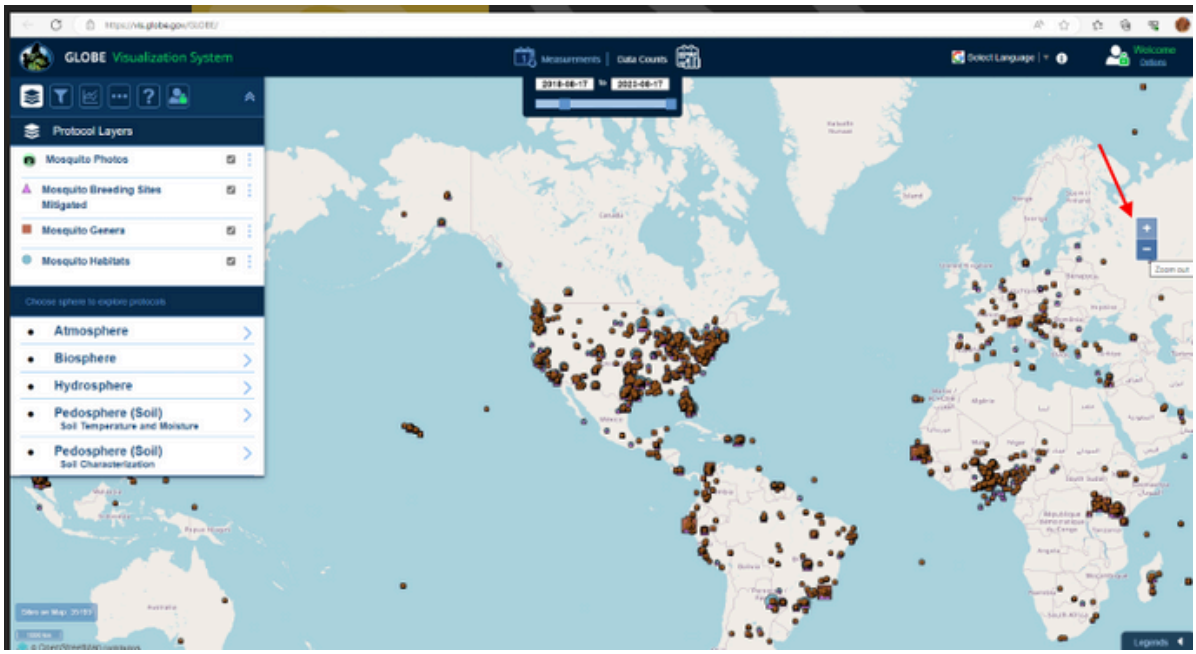
Level 7-9

Learn About Technology and Citizen Science

Introduction of GLOBE



You should see some points on the map, these are data. Explore the data, you can use the plus and minus on the right side of the page to zoom, and you can use the mouse to move the map.

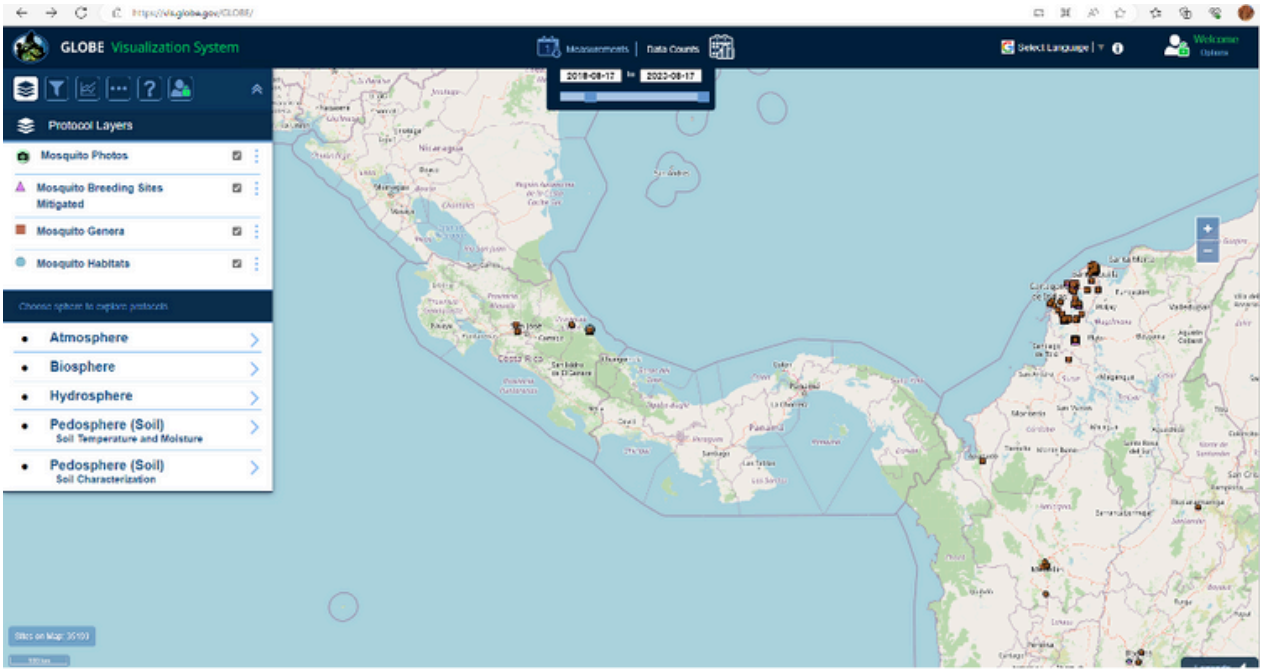


Level 7-9

Learn About Technology and Citizen Science

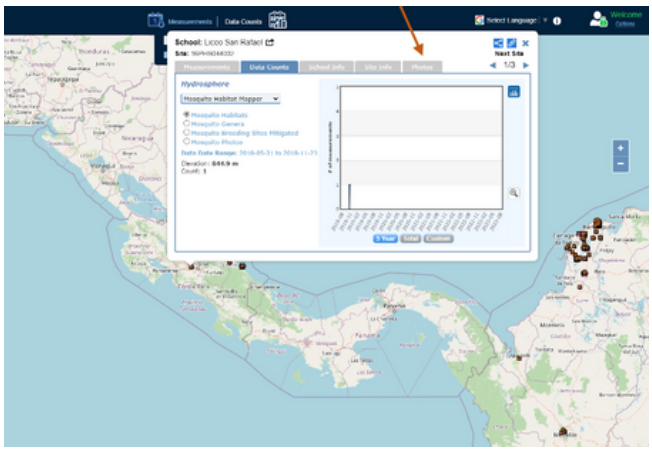
Introduction of GLOBE

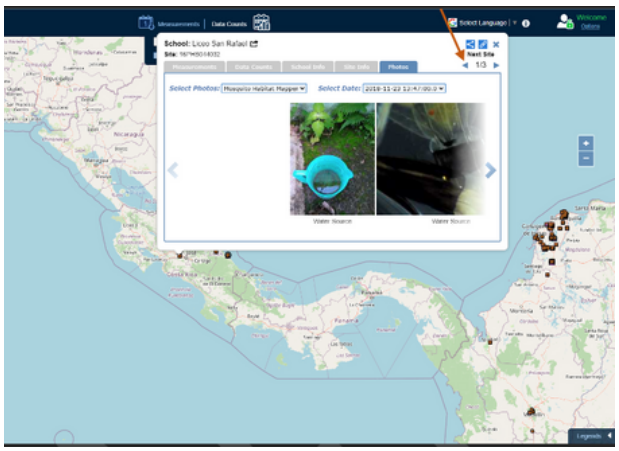
Use zoom and the mouse to find your country.



Scavenger Hunt!

Click on the dots, you can explore the tabs and pages.

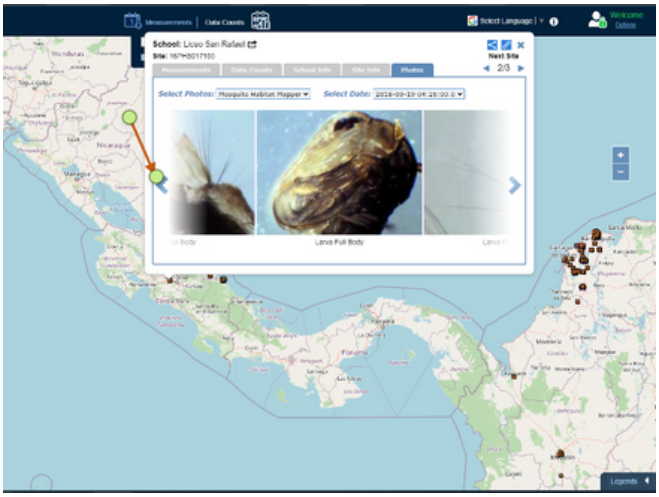


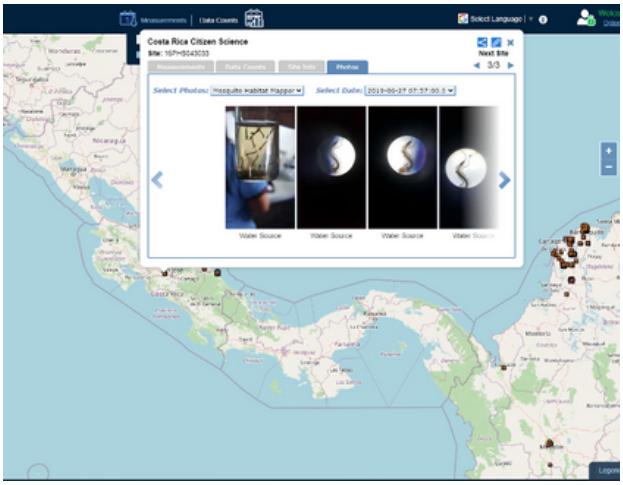


Level 7-9

Learn About Technology and Citizen Science

Introduction of GLOBE





In small groups, or with the class, search for data. Use the Beyond the Bite: GLOBE Mosquito Mission Disease Guide Can you find the three genera of mosquitoes that transmit the diseases (*Anopholes, Aedes, Culex*)? Where and when can they be found?

What does this mean about disease transmission? For example, can you find dengue fever in Africa? Why or why not? Use the table in Beyond the Bite: GLOBE's Mosquito Mission Disease Guide to help explore the data and see how it can support the information people have about these diseases.

Explore the data. Look in other parts of the world. What do you think you can learn from this data? What can scientists learn from this data? Discuss with your group or class.

All these data were collected by citizen scientists. Do you want to try?

What is citizen science? - Citizen science is the voluntary contribution of time, effort, knowledge, or experience to scientific research

Level 7-9

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

1. Go outside (of the school or on a field trip) and look for mosquito habitats.
2. Go out in small groups. When you find habitat, put it on the map with the GLOBE app, you can watch a video on how to use the app. If you don't have a phone with the app, use the Habitat Survey Page.
3. You can continue to the 'Land Cover' page in the GLOBE app, after the 'Mosquito Habitat Mapper'.

...Congratulations! You have contributed to global citizen science!

If you have built a mosquito trap or if you have a water sample with larvae, continue here.

1. Can you count and identify some larvae?
   a. Use the Larvae Hunters Level 2
   b. Identify the eggs, larvae, and pupae.
   c. Count the larvae, you can report the numbers in the GLOBE app.
2. If you find larvae, you can collect data on the larvae.
   a. You can put your data into the GLOBE app or the Habitat Survey Page, and then into the GLOBE app.

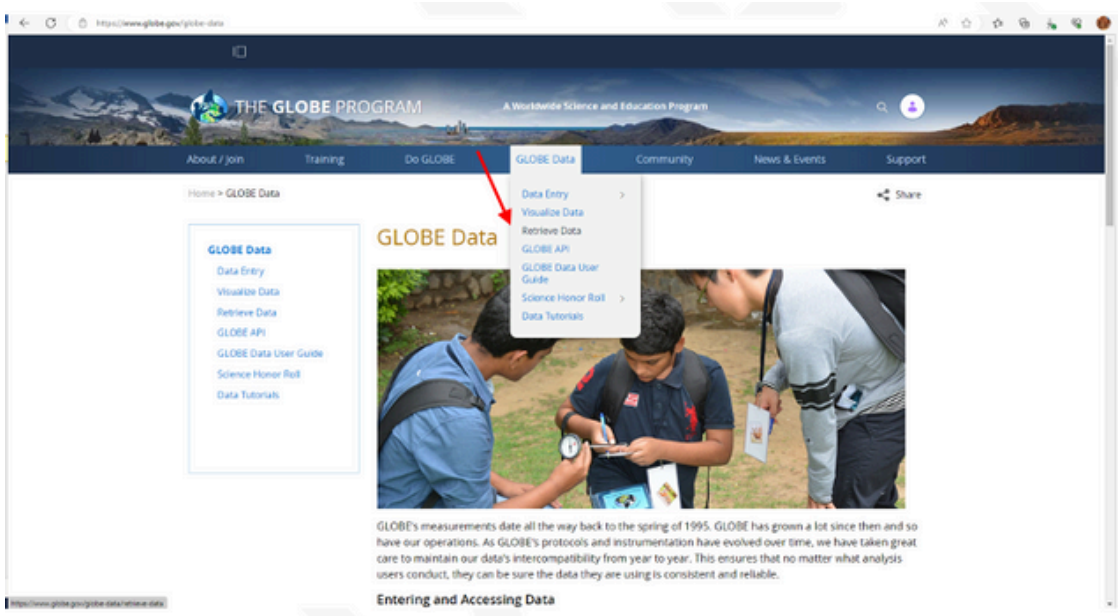
Level 7-9

Contribute to Mosquito Habitat Map as a Citizen Scientist

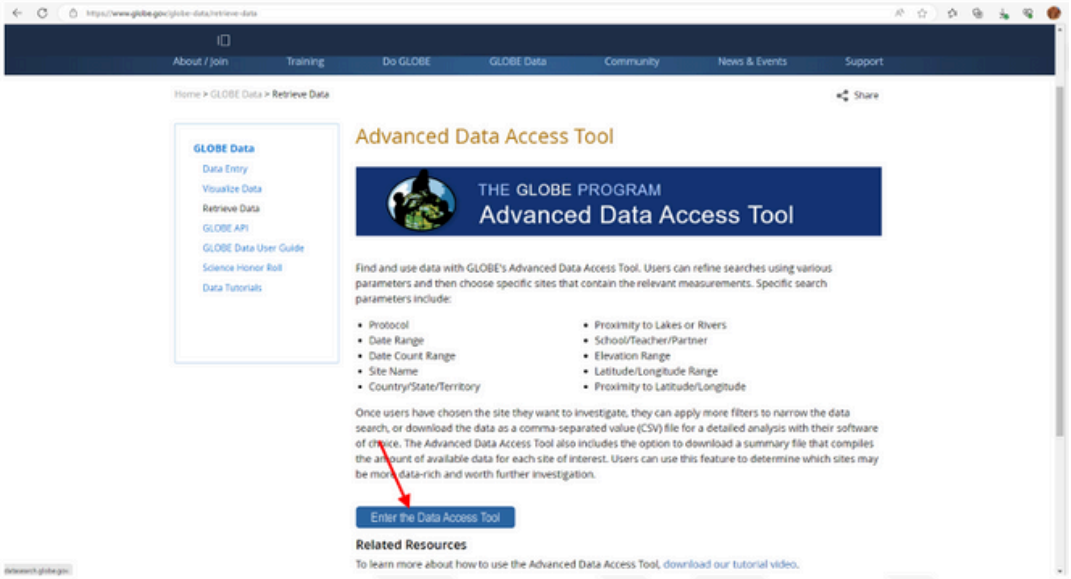
Outside Activities

Find Data

Use a computer to go to the GLOBE website (https://www.globe.gov/), open 'GLOBE data', and go to 'Retrieve data'.



Go to ‘Enter the data access tool’ and click.

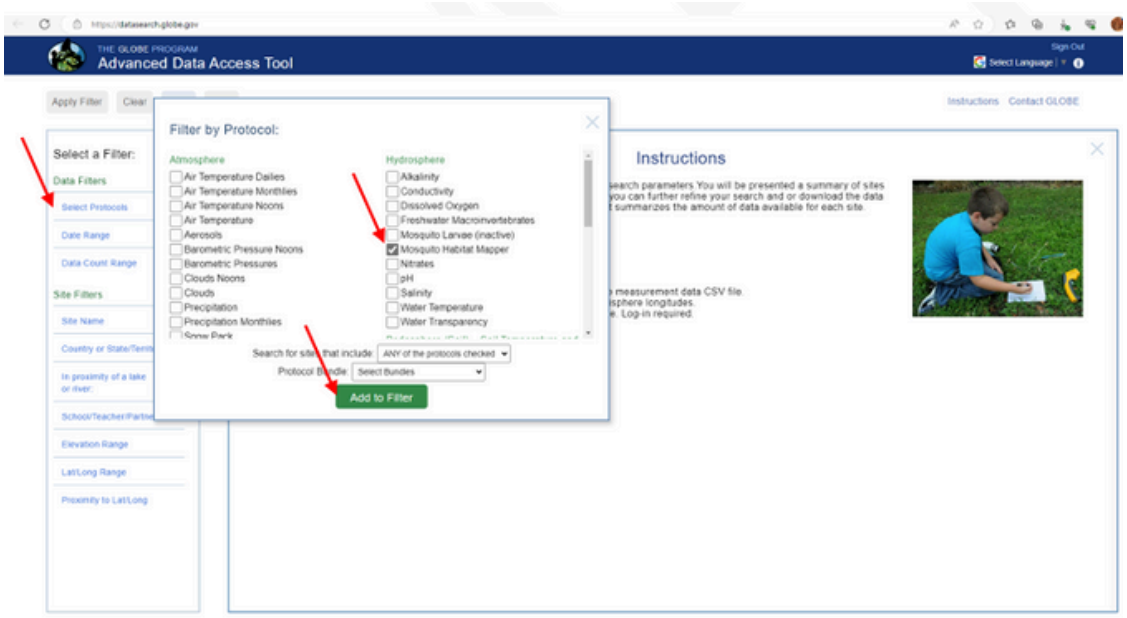


Level 7-9

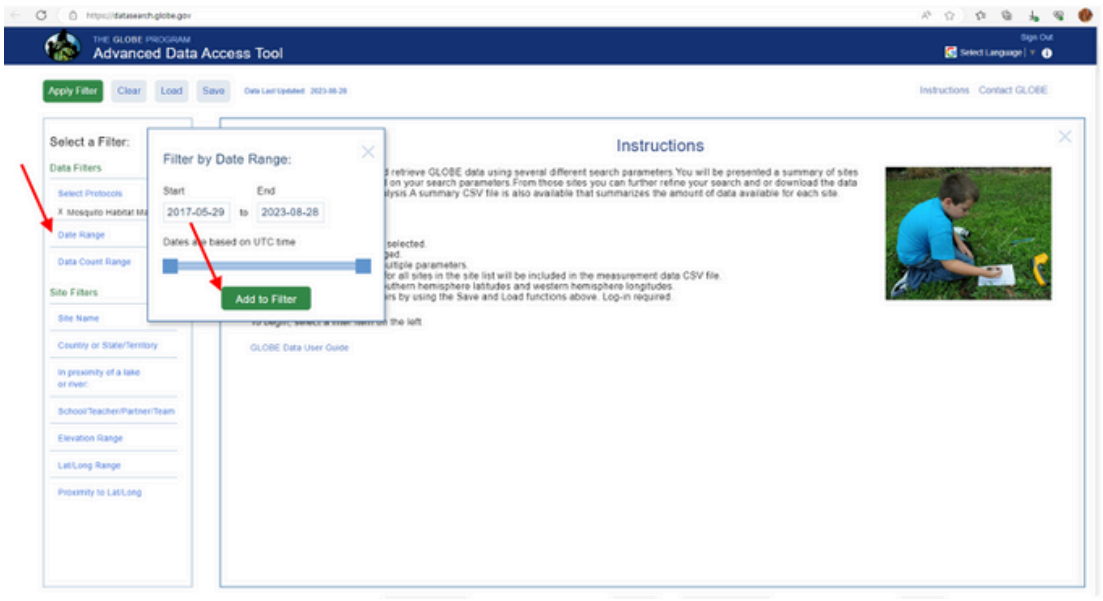
Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Go to 'Select protocol', click and choose 'Mosquito Habitat Mapper', click 'Add to Filter'.



Add a range of data, probably all the data that is available. Click 'Add to Filter'.

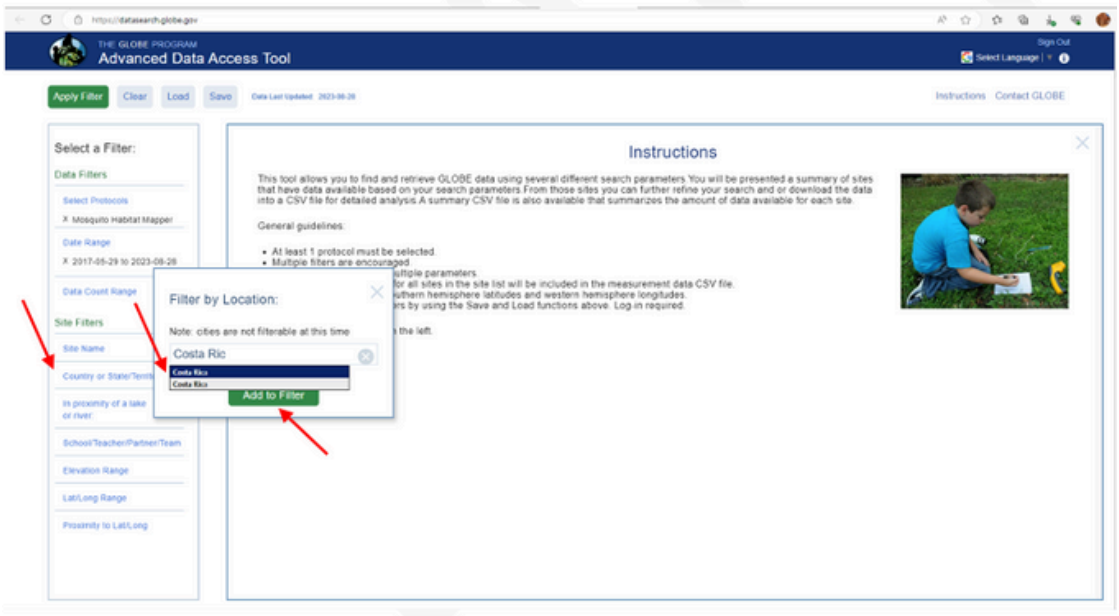


Level 7-9

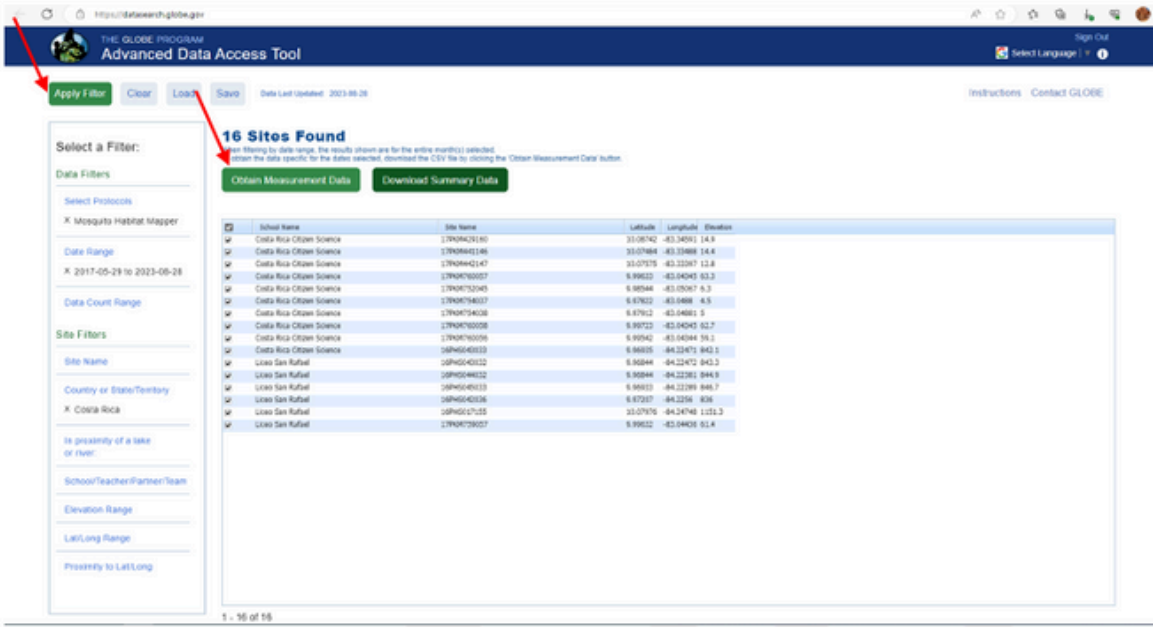
Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Add a country. Enter a country and click 'Add to Filter'.



Click on ‘Apply Filter’ and then on ‘Obtain Measurement Data’.

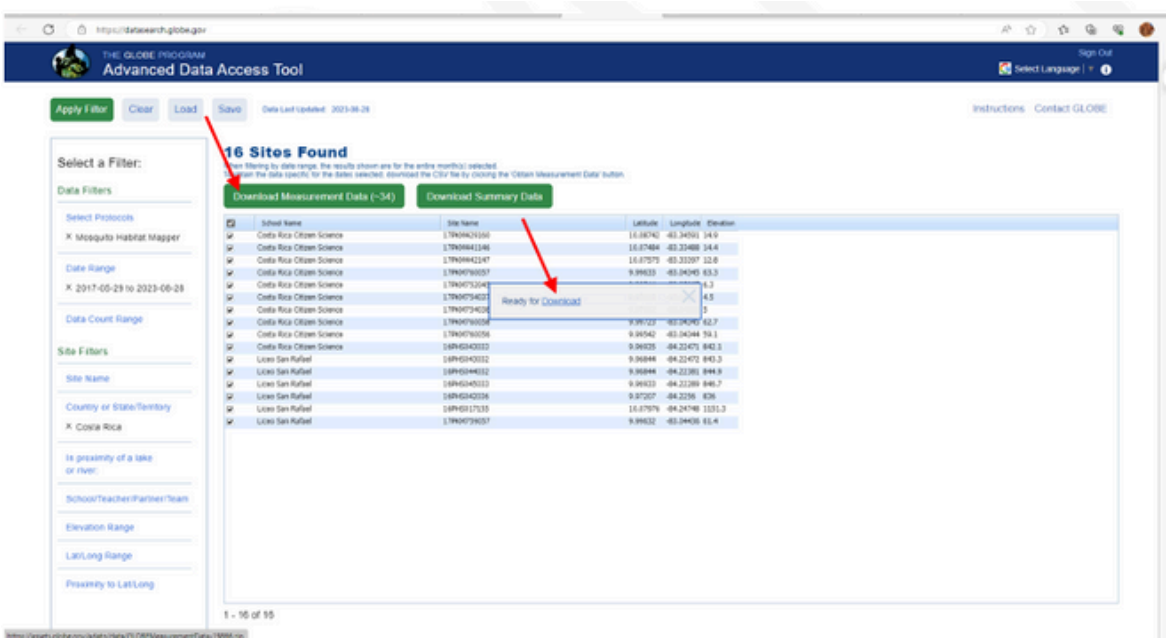


Level 7-9

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

It may take a few minutes, especially if there is a lot of data. When you finish, click 'Download'. You can open or save the data.



Explore data.

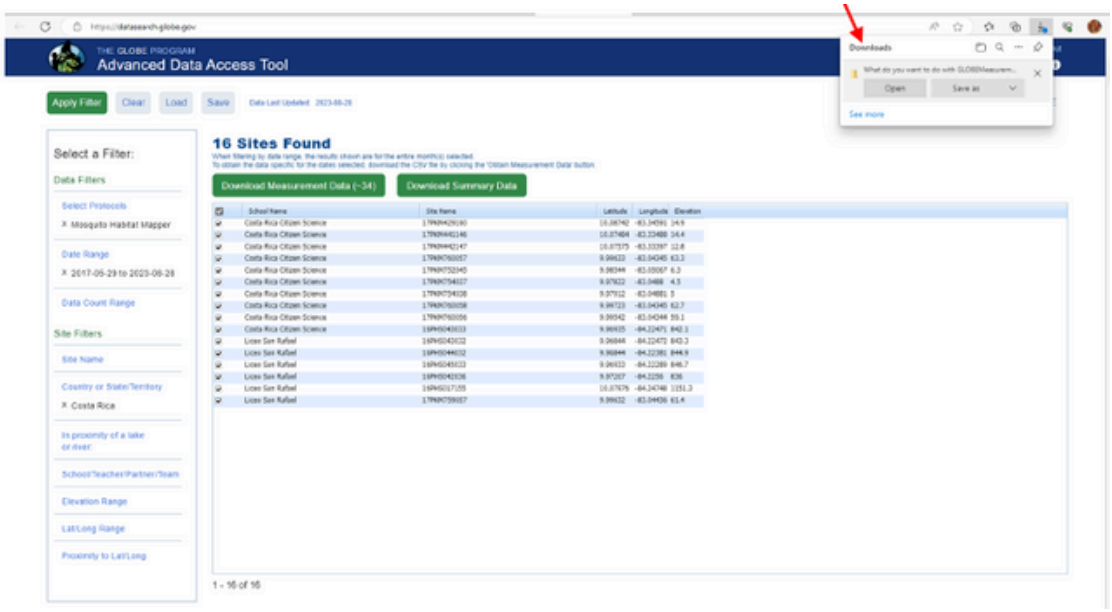
a. In small groups explore the data. What can you learn from the data? For example:
    i. What is the most common life stage to find mosquitoes? (larvae, pupae, adults). Search in P-Q columns.
    ii. What are the most common genera, the most common species found in the selected area? (U-V columns)
    iii. What else can you learn about the data? Work in small groups and then present to the class.
    iv. Which data is the most useful, and which is not useful? Why?
        1. You can also 'clean the data', for example you can delete data you don't want to use or change the titles (in the first two rows).

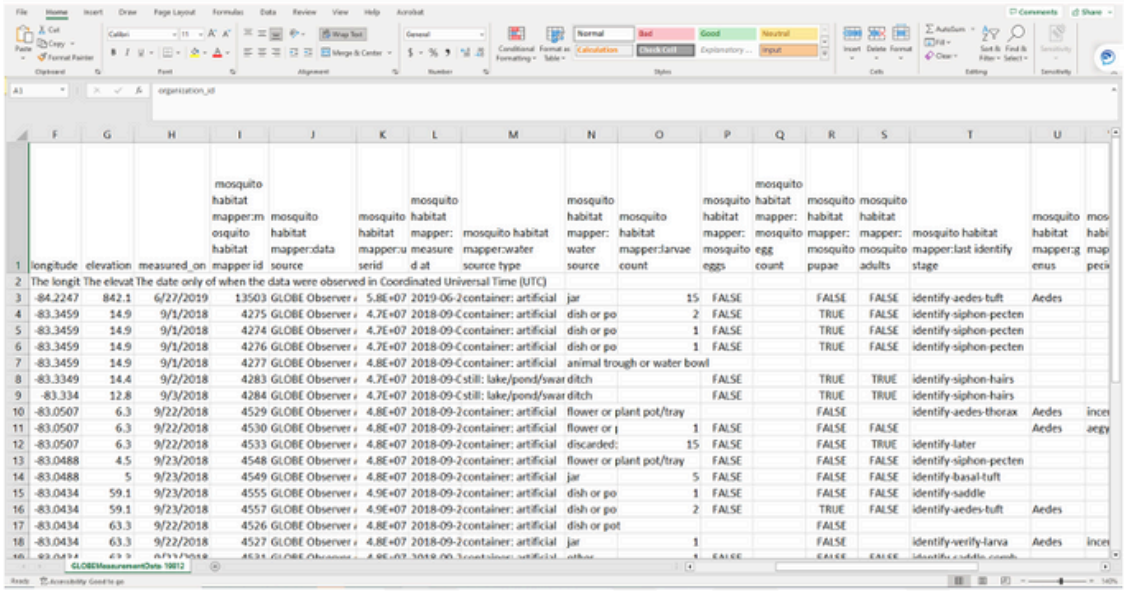
Level 7-9

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Note: The first latitude and longitude data (columns E-F) are not very accurate, the values in columns AC-AB are more accurate, you should use these if you want to use latitude and longitude.





	longitude	elevation	measured_on	mosquito habitat mapper:mosquito habitat mapper id	mosquito habitat mapper:data source	mosquito habitat mapper:data serid	mosquito habitat mapper:measured at	mosquito habitat mapper:water source type	mosquito habitat mapper:water source	mosquito habitat mapper:larvae count	mosquito habitat mapper:mosquito eggs	mosquito habitat mapper:mosquito egg count	mosquito habitat mapper:mosquito pupae	mosquito habitat mapper:mosquito adults	mosquito habitat mapper:last identify stage	mosquito habitat mapper:genus	mosquito habitat mapper:species
2	The longit	The elevat	The date only of when the data were observed in Coordinated Universal Time (UTC)														
3	-84.2247	842.1	6/27/2019	13503	GLOBE Observer	5.8E+07	2019-06-2	container: artificial	jar	15	FALSE		FALSE	FALSE	identify-aedes-tuft	Aedes	
4	-83.3459	14.9	9/1/2018	4275	GLOBE Observer	4.7E+07	2018-09-0	container: artificial	dish or po	2	FALSE		TRUE	FALSE	identify-siphon-pecten		
5	-83.3459	14.9	9/1/2018	4274	GLOBE Observer	4.7E+07	2018-09-0	container: artificial	dish or po	1	FALSE		TRUE	FALSE	identify-siphon-pecten		
6	-83.3459	14.9	9/1/2018	4276	GLOBE Observer	4.7E+07	2018-09-0	container: artificial	dish or po	1	FALSE		TRUE	FALSE	identify-siphon-pecten		
7	-83.3459	14.9	9/1/2018	4277	GLOBE Observer	4.8E+07	2018-09-0	container: artificial	animal trough or water bowl								
8	-83.3349	14.4	9/2/2018	4283	GLOBE Observer	4.7E+07	2018-09-0	still: lake/pond/swar	ditch		FALSE		TRUE	TRUE	identify-siphon-hairs		
9	-83.334	12.8	9/3/2018	4284	GLOBE Observer	4.7E+07	2018-09-0	still: lake/pond/swar	ditch		FALSE		TRUE	TRUE	identify-siphon-hairs		
10	-83.0507	6.3	9/22/2018	4529	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	flower or plant pot/tray				FALSE		identify-aedes-thorax	Aedes	incer
11	-83.0507	6.3	9/22/2018	4530	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	flower or p	1	FALSE		FALSE	FALSE		Aedes	aegy
12	-83.0507	6.3	9/22/2018	4533	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	discarded:	15	FALSE		FALSE	TRUE	identify-later		
13	-83.0488	4.5	9/23/2018	4548	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	flower or plant pot/tray		FALSE		FALSE	FALSE	identify-siphon-pecten		
14	-83.0488	5	9/23/2018	4549	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	jar	5	FALSE		FALSE	FALSE	identify-basal-tuft		
15	-83.0434	59.1	9/23/2018	4555	GLOBE Observer	4.9E+07	2018-09-2	container: artificial	dish or po	1	FALSE		FALSE	FALSE	identify-saddle		
16	-83.0434	59.1	9/23/2018	4557	GLOBE Observer	4.9E+07	2018-09-2	container: artificial	dish or po	2	FALSE		TRUE	FALSE	identify-aedes-tuft	Aedes	
17	-83.0434	63.3	9/22/2018	4526	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	dish or pot				FALSE				
18	-83.0434	63.3	9/22/2018	4527	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	jar	1			FALSE		identify-verify-larva	Aedes	incer

Level 7-9

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Global opportunity for students - International Virtual Science Symposium:
The International Virtual Science Symposium is an opportunity for GLOBE students to showcase their research to the rest of the community. Projects are judged by prestigious scientists from dozens of GLOBE countries. Students are eligible to receive GLOBE stipends and badges.

Level 10-11 (12)

Learn About Mosquitoes and Their Habitat

Classroom Activity

Look for Mosquitoes

Learning about mosquitoes and why they are important to people on a personal, local, and global level. Use the GLOBE app to collect data on potential mosquito habitat.

Information for teachers:

- Mission mosquito: Larvae hunters guide
- Beyond the Bite: GLOBE mission mosquito disease guide
- Resources - Mission Mosquito - GLOBE.gov

1. Read the GLOBE Mosquito Mission's Beyond the Bite: Disease Guide.
2. Discuss as a class.
    a. Question: What are your experiences with mosquitoes? What are the potential solutions for disease-carrying mosquitoes? Write or mention 3 things you know or think about mosquitoes. You can discuss in small groups or pairs and then as a whole class.
    b. Examples: Mosquitos can transmit diseases, for example dengue, zika, chikungunya to humans.
    c. Do you know that: There are more than 3,500 species of mosquitoes and ~200 of these bite. Adult mosquitoes eat nectar and are often pollinators. Adult females need blood for their eggs.
3. Small group research - What are people doing about mosquito transmitted illnesses?

Teachers: You can search for information about *Aedes aegypti* and *Wolbachia* – *Wolbachia* is a bacteria that can be introduced into *Ae. aegypti* populations. These bacteria can slow the spread of viruses (yellow fever, dengue, chikungunya) in mosquito populations.

Level 10-11 (12)

Learn About Mosquitoes and Their Habitat

Classroom Activity

- You can also look for information on genetic modification of mosquitoes, for example in Panama.
- You can look up information about insecticides. How can the use of insecticides effect other parts of the environment? For example, water, agricultural areas?

Discussion

1. Remember: In what forms can you find mosquitoes?
    a. Eggs, larvae, pupae, adults
    b. Life Cycle – Figure 1 Mosquito Life Cycle – Beyond the Bite: GLOBE Mosquito Mission Disease Guide
2. Read Proboscis Mosquito: Mechanics of a Bite
    a. Discuss with the class.
    b. How does this adaptation work? What are other adaptations of animals or plants?
3. Remember: Where do mosquitoes live? What are their habitats?
    a. Use the cards to play 'Mosquito Habitats and Hideouts' and find the mosquito habitats (stagnant water).

Where can you find mosquitoes?

- Discuss the individuals, population, community, species, niche, ecosystem.
    - For example, there is a population in a city, on a river.
- What is the niche of some mosquito species, are there species that prefer some habitats?
    - For example, *Aedes* mosquitoes prefer containers, and *Anopholes* prefer puddles or other more natural habitats

Use GLOBE's Beyond the Bite: Mosquito Mission Disease Guide for more information.

Level 10-11 (12)

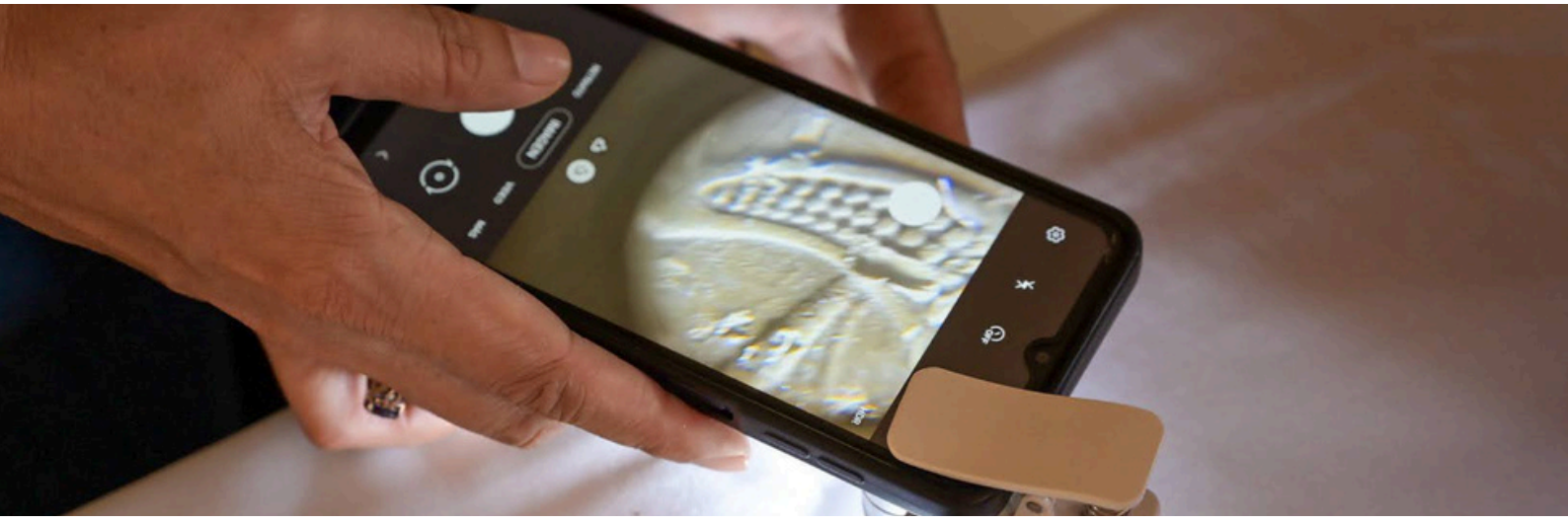
Learn About Mosquitoes and Their Habitat

Classroom Activity

Further Discussion

What can you do to prevent the spread of mosquitoes and the diseases they carry?

1. Put on insect repellent.
2. Eliminate standing water when possible.
3. Study and learn more and help scientists learn more about mosquitoes and their habitats.



Level 10-11 (12)

Learn About Technology and Citizen Science

Introduction of GLOBE

1. Remember magnification: Magnify that
    a. Practice magnifying some things, you can use a hand lens, magnifying glass, or phone magnifier and take photos.
        i. How to use a clip-on microscope (slide 86 in the Larvae Hunters Guide)
    b. If you have mosquito larvae in your traps, you can count them and report the number in the GLOBE app (see upcoming activities).
2. Experiment: Build some mosquito traps in groups or individually and try to catch some larvae.
    a. Use the guide - Let's build a mosquito larvae trap (slide 38 and 39 in the Larvae Hunters Guide) – to build a trap, you can leave the trap outside for a few days.
    b. You can build traps at school and students can also build traps at home as an extension task.
    c. What is your research question, your variables of interest?
        i. For example, you can change the color of the trap (something dark, and something light).
        ii. You can change the materials that are in the water (plants or grass, food, insect repellent).
        iii. Where are you going to put your trap, in the sun, or in the shade.
3. Identify eggs, larvae, and pupae. Count the larvae, you can report the numbers in the GLOBE app.
    a. Activities: Mosquito larvae Hunters Level 2

Note for teachers, if you don't have larvae in your trap after a week, you can use a black or dark colored bucket with a piece of wood between the water and the air (as a ramp so the female mosquitoes can stand on the ramp and lay their eggs in the water). Leave it open with grass in the water. Make sure you don't leave it for more than 5 days so you can ensure there are no adult mosquitoes.

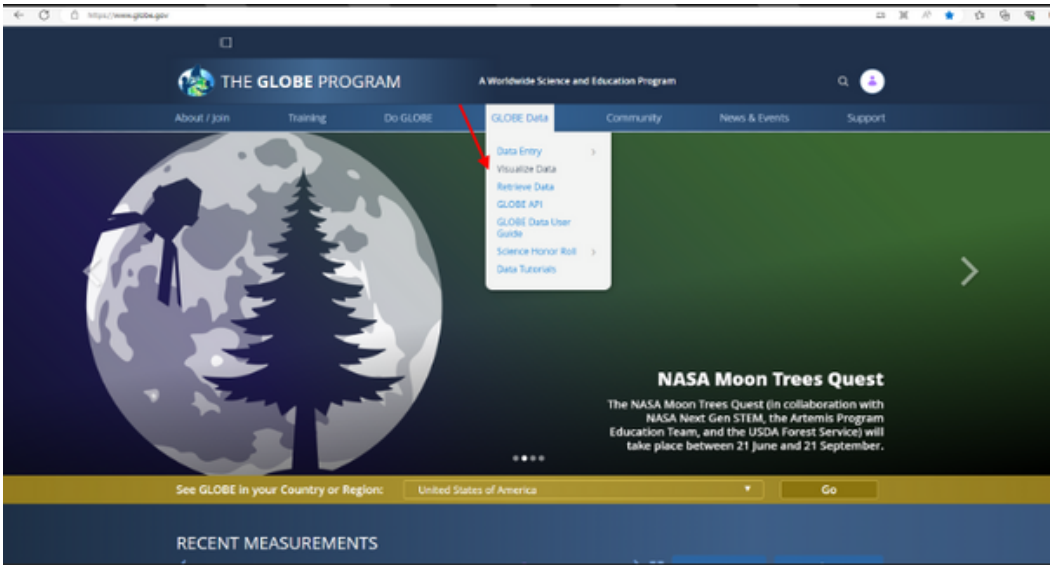
Level 10-11 (12)

Learn About Technology and Citizen Science

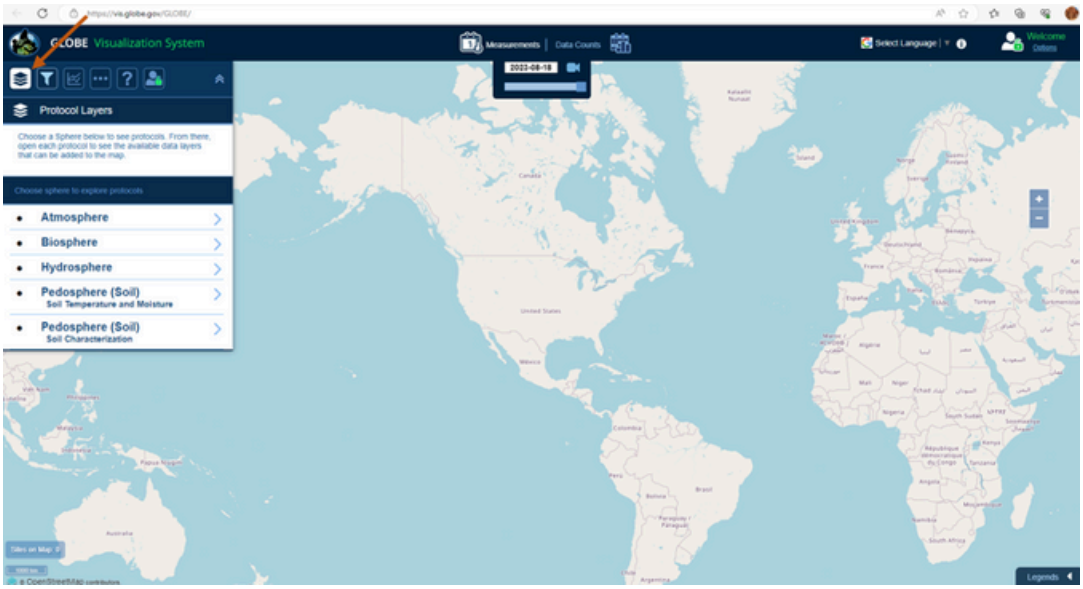
Introduction of GLOBE

Map scavenger hunt!

Use a computer to go to the ***GLOBE website (https://www.globe.gov/)***, open 'GLOBE data', and go to **'Visualize data'**



In the **'Visualization system'**, click on **'Enter the visualization system'** and click on the map layers.

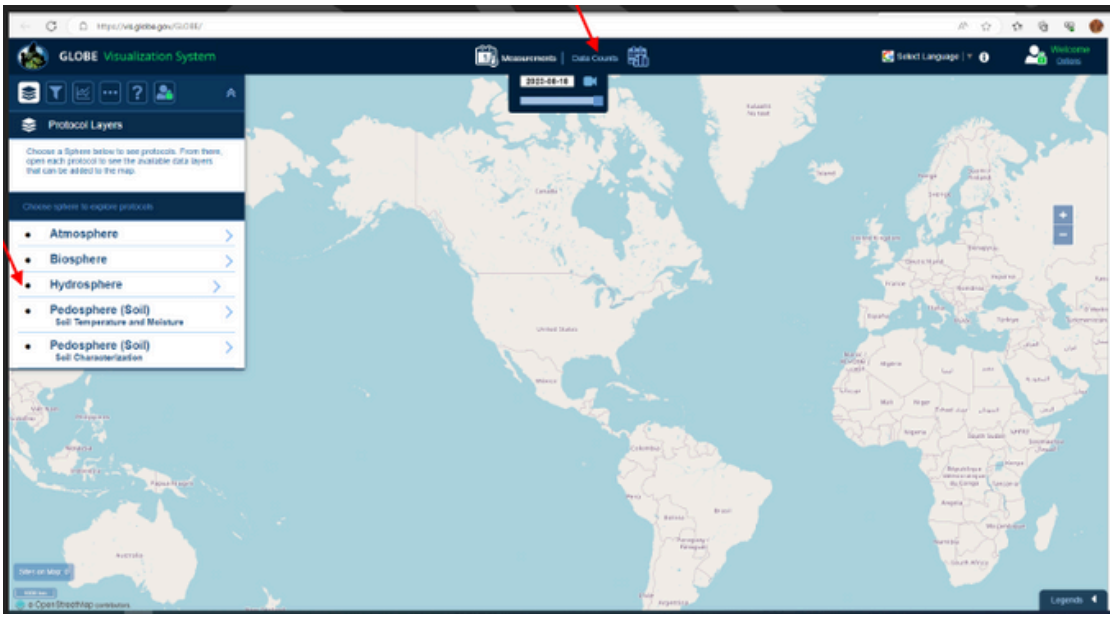


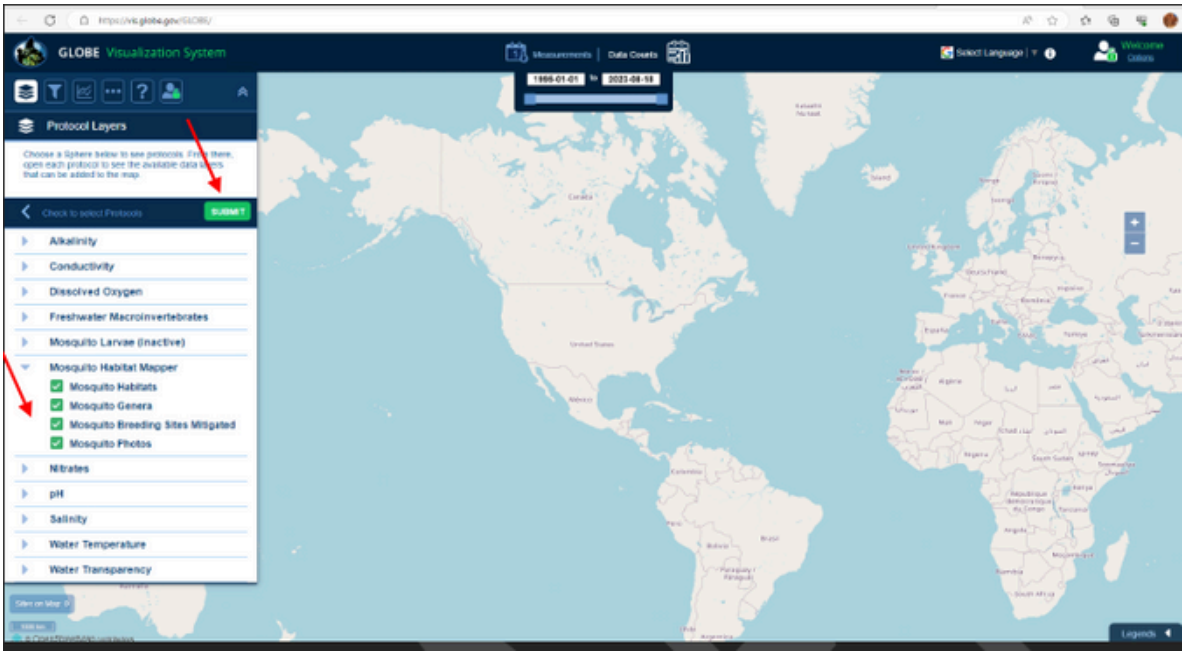
Level 10-11 (12)

Learn About Technology and Citizen Science

Introduction of GLOBE

Click on **'Hydrosphere',** and expand the **'Mosquito Habitat Mapper'** layer, click on all the data layers. Choose **‘Data Counts’** at the top of the page and click ‘**SUBMIT’.**



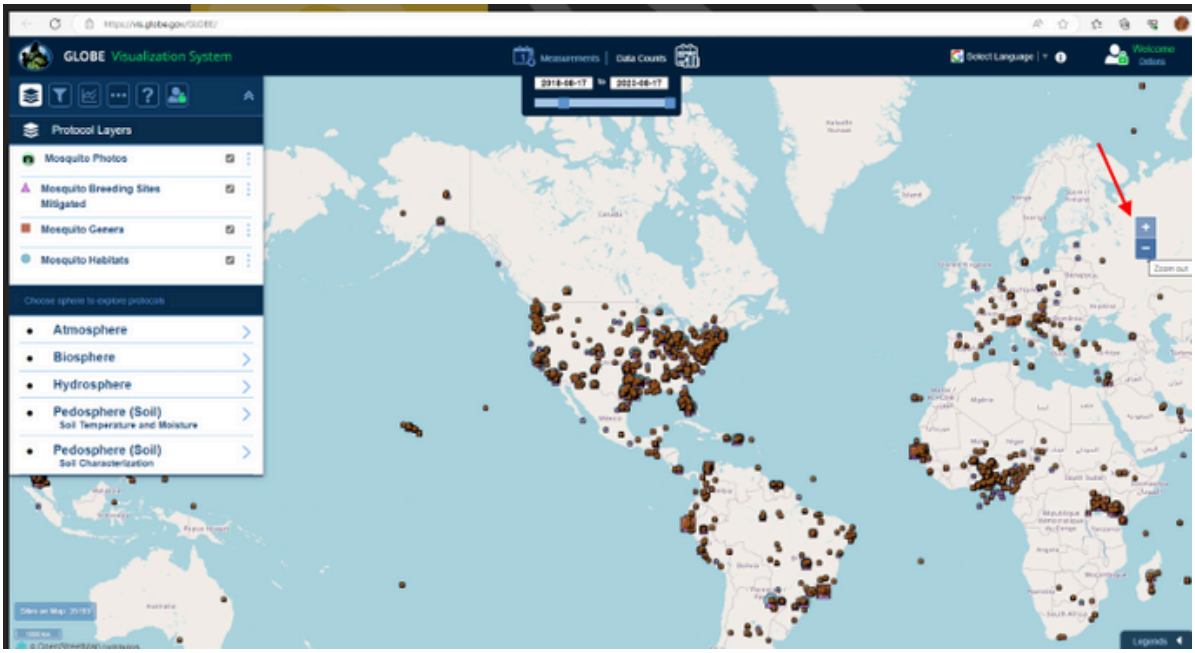


Level 10-11 (12)

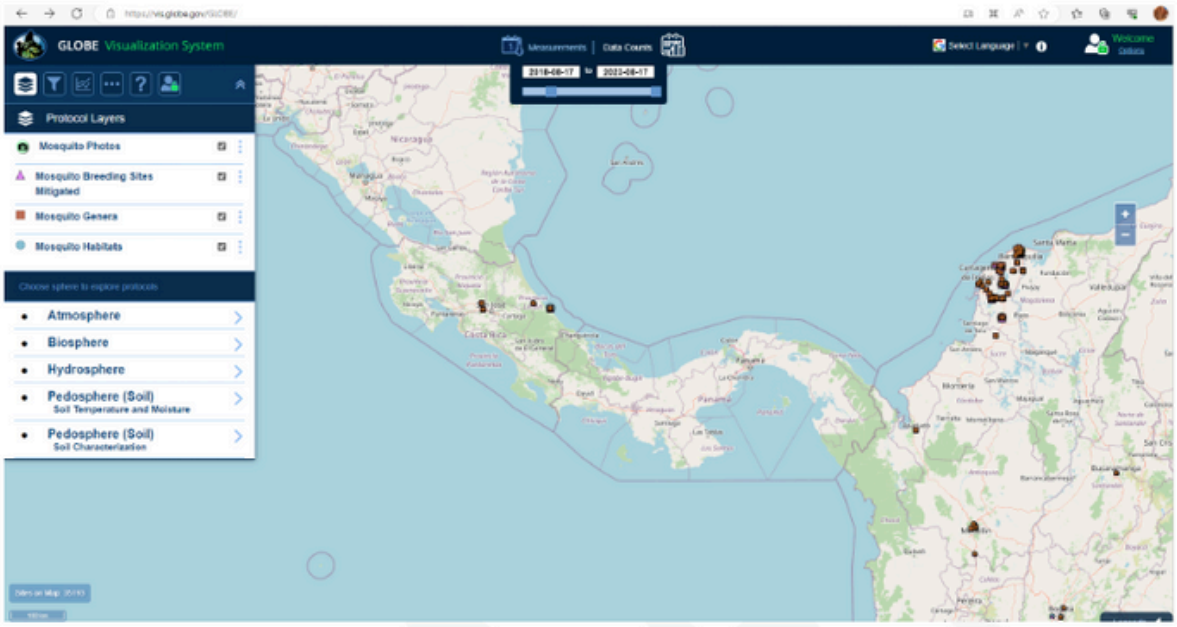
Learn About Technology and Citizen Science

Introduction of GLOBE

Now you should see some points on the map, these are data. Explore the data, you can use the plus and minus on the right side of the page to zoom and you can use the mouse to move the map.



Use zoom and the mouse to find your country.



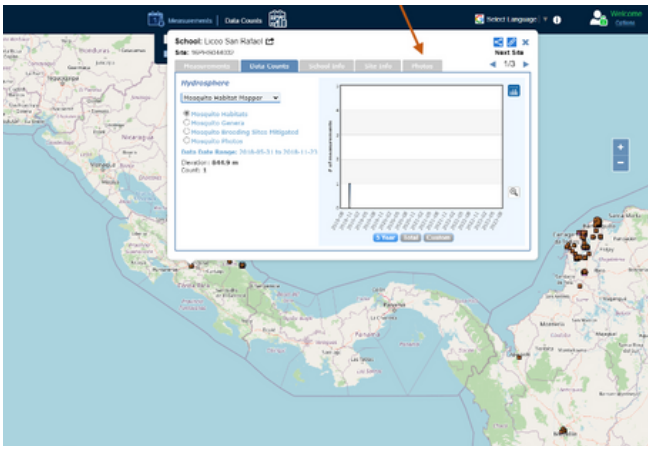
Level 10-11 (12)

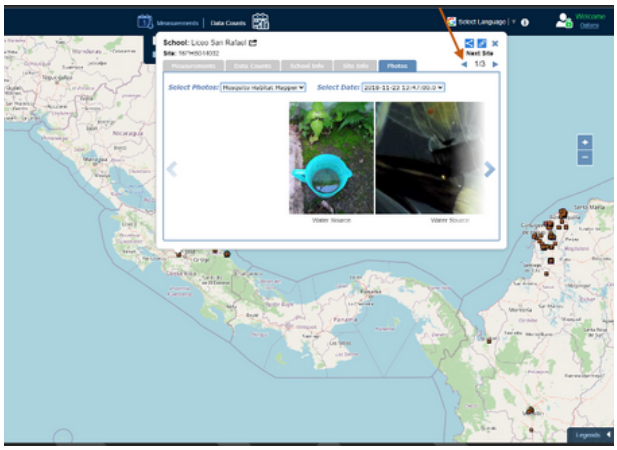
Learn About Technology and Citizen Science

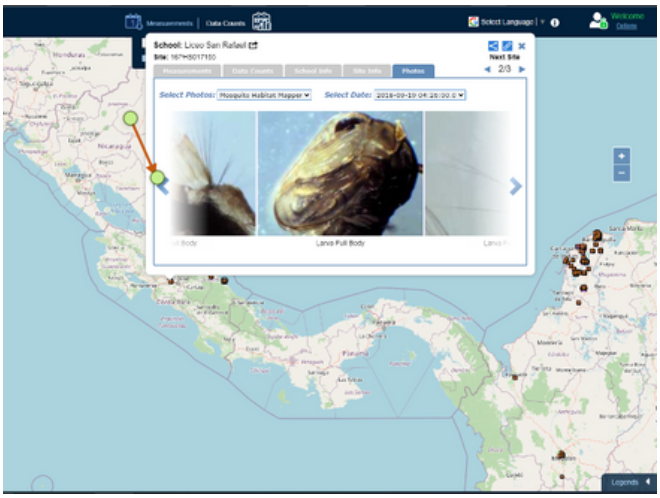
Introduction of GLOBE

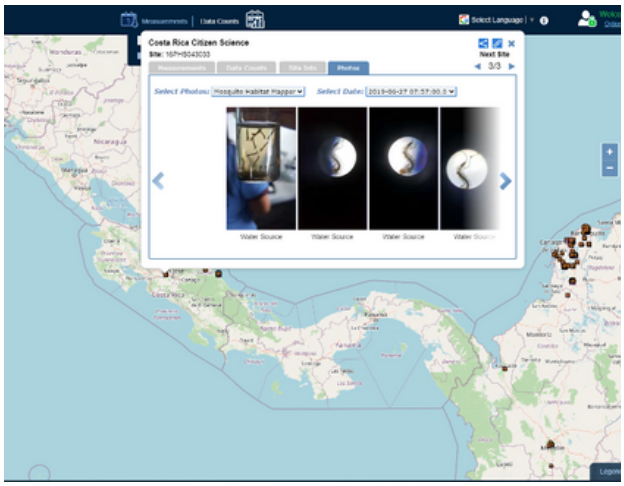
Scavenger Hunt!

Click on the dots, you can explore the tabs and pages.









Level 10-11 (12)

Learn About Technology and Citizen Science

Introduction of GLOBE

In small groups, search for data. Use GLOBE's Beyond the Bite: Mosquito Mission Disease Guide. Can you find the three genera of mosquitoes that transmit diseases (*Anopholes, Aedes, Culex*)? Where and when can they be found?

What does this mean about disease transmission? For example, can you find dengue fever in Africa? Why or why not? Use the table in Beyond the Bite: GLOBE Mission's Mosquito Disease Guide to help explore the data and see how you can support the information people have about these diseases.

Explore the data. Look in other parts of the world. What do you think you can learn from this data? What can scientists learn from this data? Discuss with your group or class.

What else can you learn about data? Work in small groups and then present to the class.

Which data is the most useful, and which is not useful? Why?

All these data were collected by citizen scientists. Do you want to try?

What is citizen science? - Citizen science is the voluntary contribution of time, effort, knowledge, or experience to scientific research

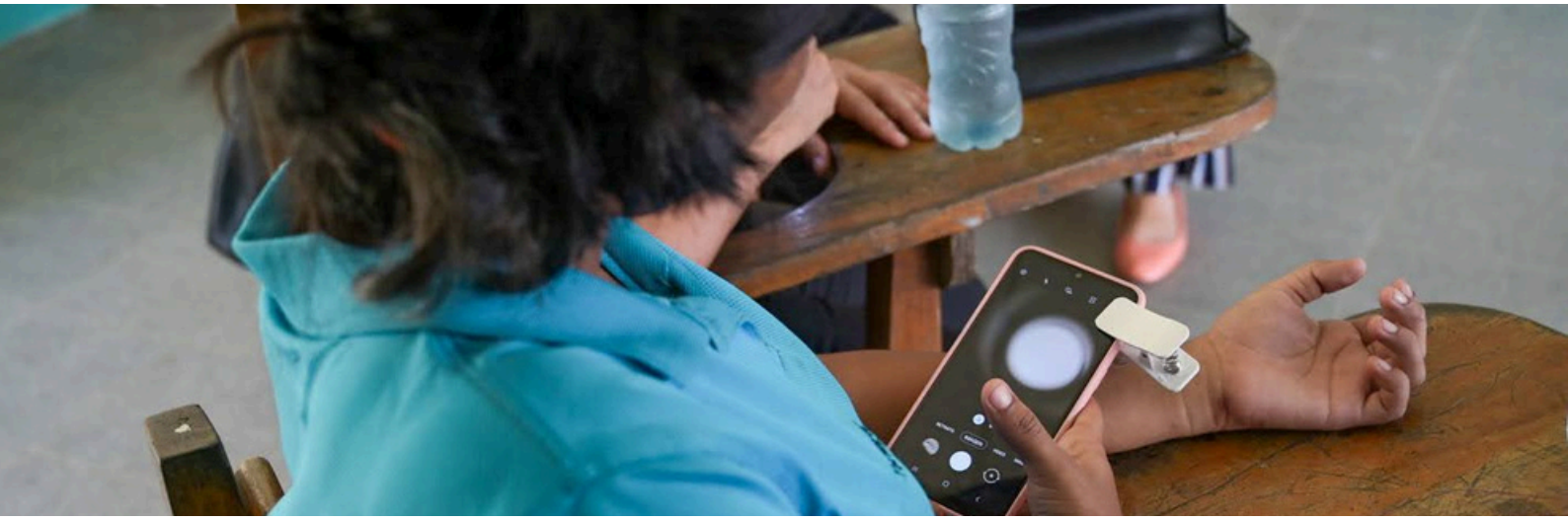
Level 10-11 (12)

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

1. Go outside (of the school or on a field trip) and look for mosquito habitats.
2. Work in small groups. When you find habitat, put it on the map with the GLOBE app, you can watch a video on how to use the app. If you don't have a phone with the app, use the Habitat Survey Page.
3. You can continue to the 'Land Cover' page in the GLOBE app, after the 'Mosquito Habitat Mapper'.

...Congratulations! You have contributed to global citizen science!



Using your mosquito trap or if you have water samples with larva, continue here.

1. Can you count and identify some larvae?
    a. Use the Larvae Hunters Level 2
    b. Identify the eggs, larvae, and pupae.
    c. Count the larvae, you can report the numbers in the GLOBE app.
2. If you find larvae, you can collect data on the larvae.
    a. You can put your data into the GLOBE app or the Habitat Survey Page, and then into the GLOBE app.

Level 10-11 (12)

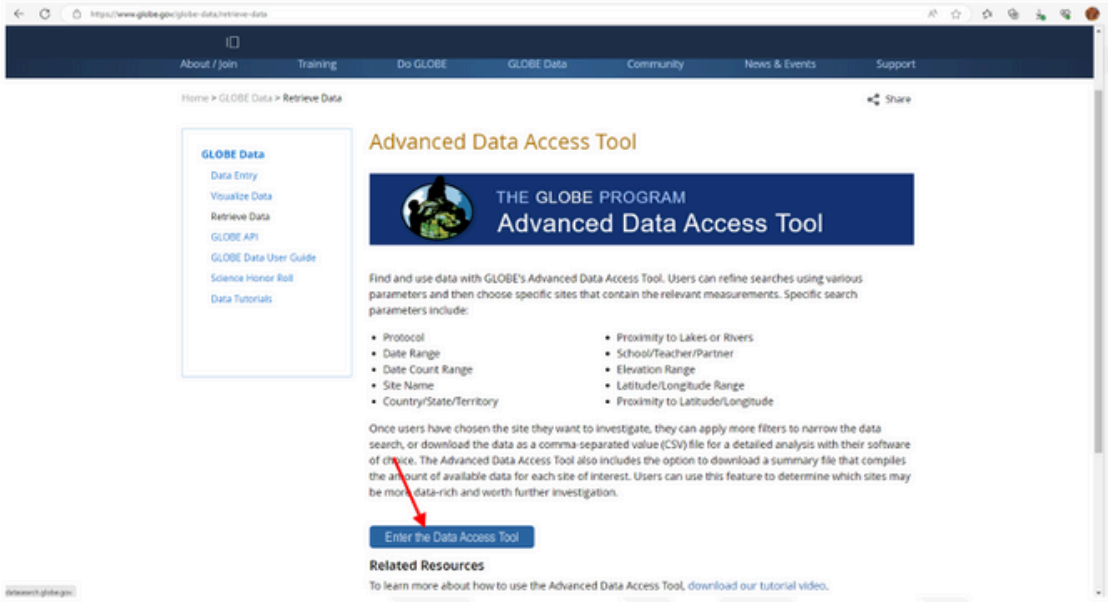
Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Find Data

Use a computer to go to the GLOBE website (https://www.globe.gov/), open 'GLOBE data', and go to 'Retrieve data'.

Go to ‘Enter the data access tool’ and click.

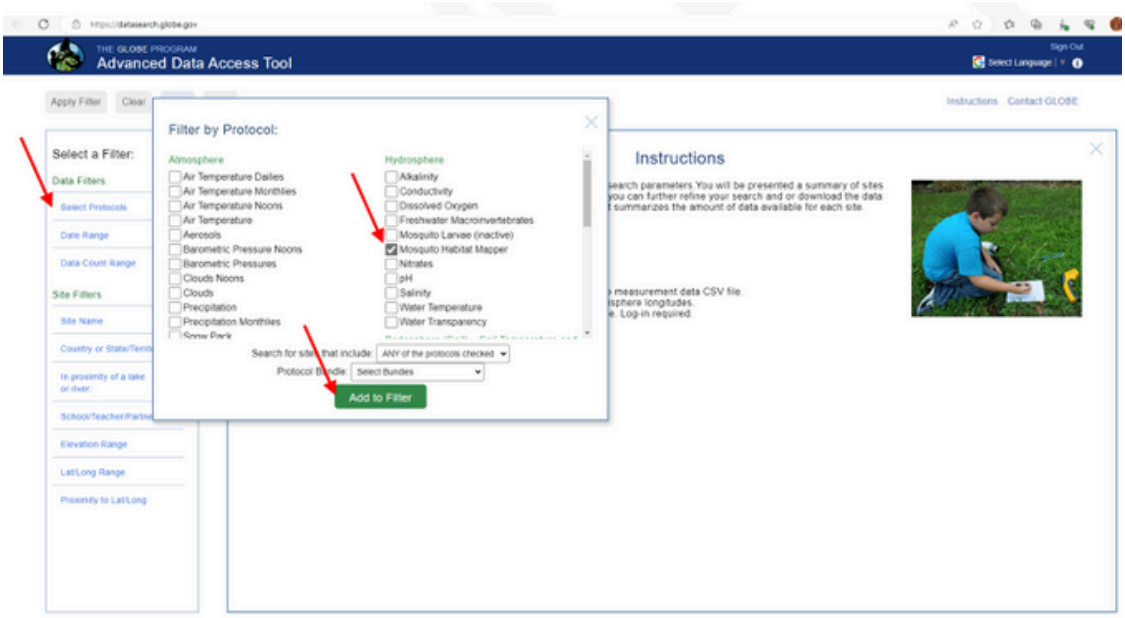


Level 10-11 (12)

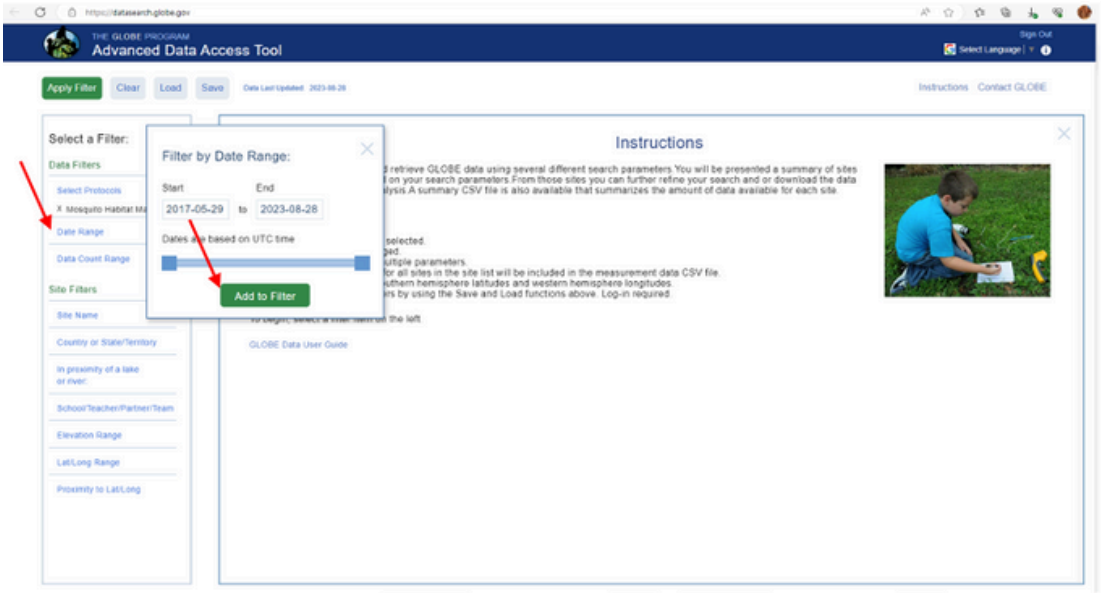
Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Go to 'Select protocol', click and choose 'Mosquito Habitat Mapper', click 'Add to Filter'.



Add a range of data, probably all the data that is available. Click 'Add to Filter'.

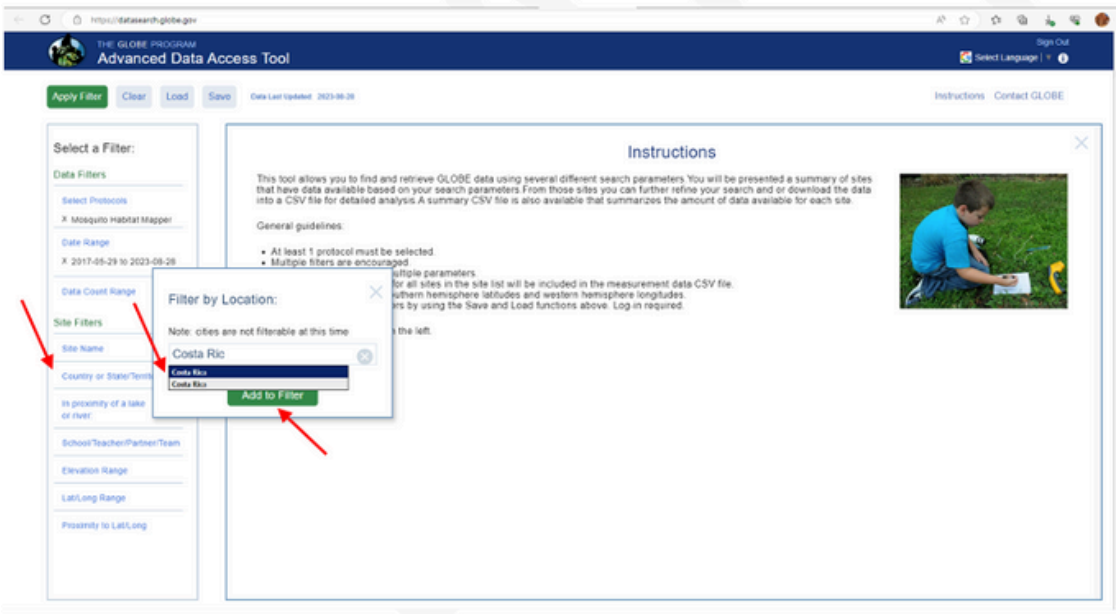


Level 10-11 (12)

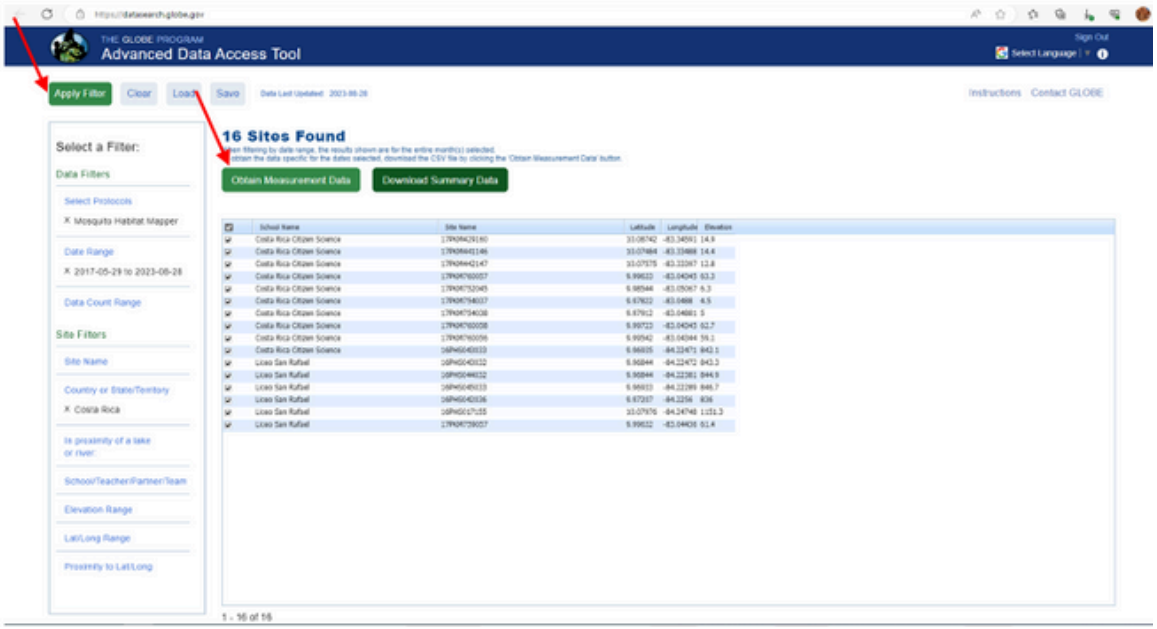
Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Add a country. Enter a country and click 'Add to Filter'.



Click on ‘Apply Filter’ and then on ‘Obtain Measurement Data’.

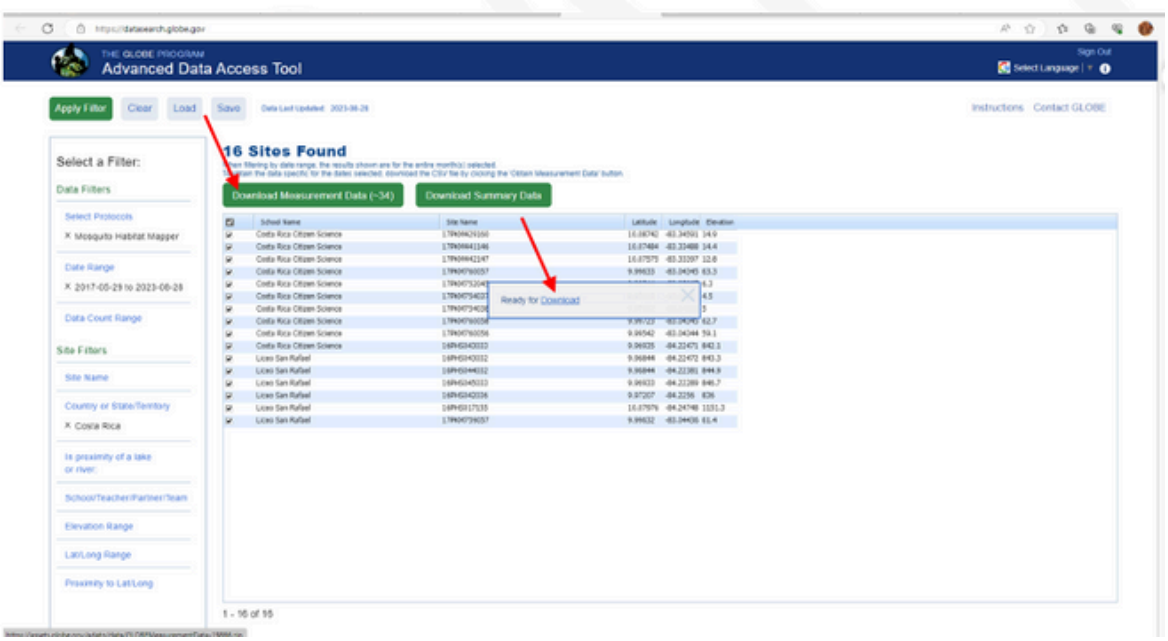


Level 10-11 (12)

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

It may take a few minutes, especially if there is a lot of data. When you finish, click 'Download'.



You can open or save the data.

Explore data.

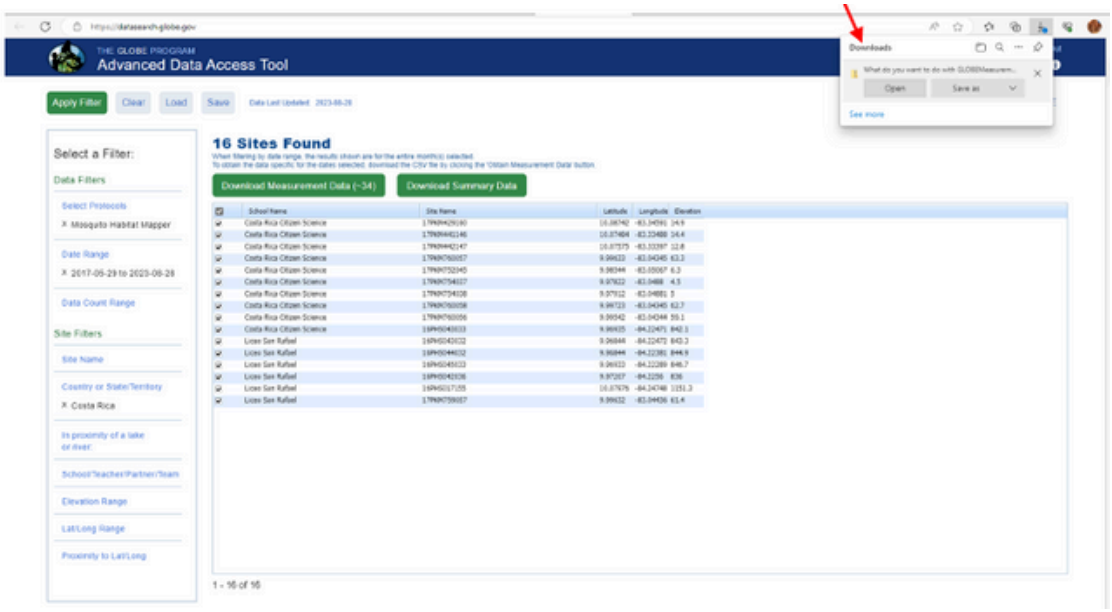
a. In small groups explore the data. What can you learn from the data? For example:
    i. What is the most common life stage to find mosquitoes? (larvae, pupae, adults). Search in P-Q columns.
    ii. What are the most common genera, the most common species found in the selected area? (U-V columns)
    iii. What else can you learn about the data? Work in small groups and then present to the class.
    iv. Which data is the most useful, and which is not useful? Why?
        1. You can also 'clean the data', for example you can delete data you don't want to use or change the titles (in the first two rows).

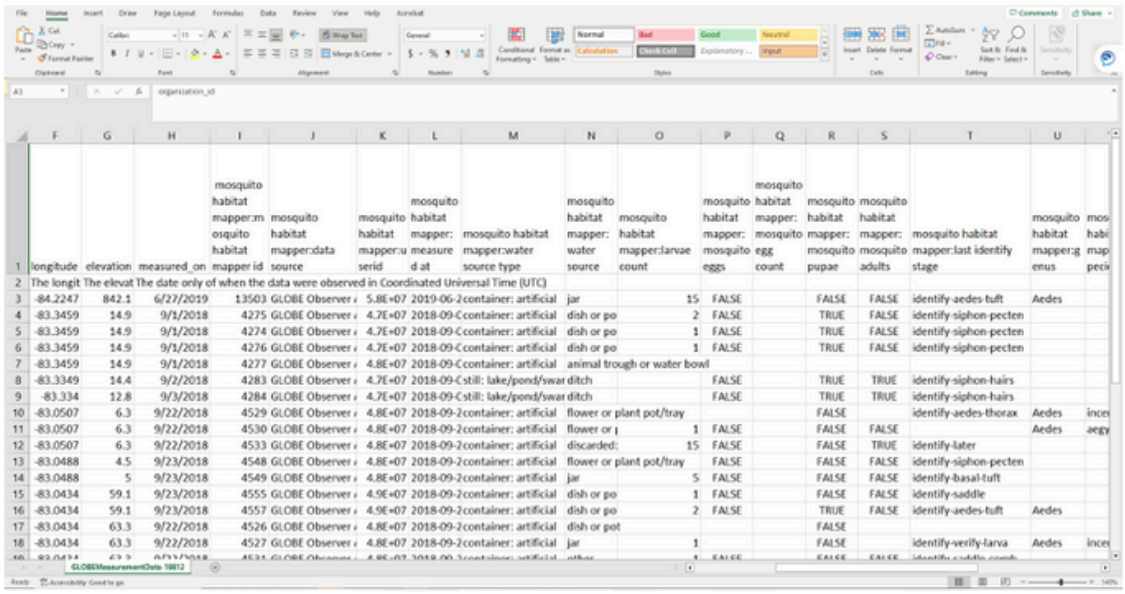
Level 10-11 (12)

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Note: The first latitude and longitude data (columns E-F) are not very accurate, the values in columns AC-AB are more accurate, you should use these if you want to use latitude and longitude.





	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	
1	longitude	elevation	measured_on	mosquito habitat mapper:mosquito habitat mapper id	mosquito habitat mapper:data source	mosquito habitat mapper:user id	mosquito habitat mapper:measured at	mosquito habitat mapper:water source type	mosquito habitat mapper:water source	mosquito habitat mapper:larvae count	mosquito habitat mapper:mosquito eggs	mosquito habitat mapper:mosquito egg count	mosquito habitat mapper:mosquito pupae	mosquito habitat mapper:mosquito adults	mosquito habitat mapper:last identify stage	mosquito habitat mapper:genus	mosquito habitat mapper:species
2	The longit	The elevat	The date only of when the data were observed in Coordinated Universal Time (UTC)														
3	-84.2247	842.1	6/27/2019	13503	GLOBE Observer	5.8E+07	2019-06-2	container: artificial	jar	15	FALSE		FALSE	FALSE	identify-aedes-tuft	Aedes	
4	-83.3459	14.9	9/1/2018	4275	GLOBE Observer	4.7E+07	2018-09-0	container: artificial	dish or po	2	FALSE		TRUE	FALSE	identify-siphon-pecten		
5	-83.3459	14.9	9/1/2018	4274	GLOBE Observer	4.7E+07	2018-09-0	container: artificial	dish or po	1	FALSE		TRUE	FALSE	identify-siphon-pecten		
6	-83.3459	14.9	9/1/2018	4276	GLOBE Observer	4.7E+07	2018-09-0	container: artificial	dish or po	1	FALSE		TRUE	FALSE	identify-siphon-pecten		
7	-83.3459	14.9	9/1/2018	4277	GLOBE Observer	4.8E+07	2018-09-0	container: artificial	animal trough or water bowl								
8	-83.3349	14.4	9/2/2018	4283	GLOBE Observer	4.7E+07	2018-09-0	still: lake/pond/swar	ditch		FALSE		TRUE	TRUE	identify-siphon-hairs		
9	-83.334	12.8	9/3/2018	4284	GLOBE Observer	4.7E+07	2018-09-0	still: lake/pond/swar	ditch		FALSE		TRUE	TRUE	identify-siphon-hairs		
10	-83.0507	6.3	9/22/2018	4529	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	flower or plant pot/tray				FALSE		identify-aedes-thorax	Aedes	inco
11	-83.0507	6.3	9/22/2018	4530	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	flower or p	1	FALSE		FALSE	FALSE		Aedes	aegy
12	-83.0507	6.3	9/22/2018	4533	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	discarded:	15	FALSE		FALSE	TRUE	identify-later		
13	-83.0488	4.5	9/23/2018	4548	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	flower or plant pot/tray		FALSE		FALSE	FALSE	identify-siphon-pecten		
14	-83.0488	5	9/23/2018	4549	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	jar	5	FALSE		FALSE	FALSE	identify-basal-tuft		
15	-83.0434	59.1	9/23/2018	4555	GLOBE Observer	4.9E+07	2018-09-2	container: artificial	dish or po	1	FALSE		FALSE	FALSE	identify-saddle		
16	-83.0434	59.1	9/23/2018	4557	GLOBE Observer	4.9E+07	2018-09-2	container: artificial	dish or po	2	FALSE		TRUE	FALSE	identify-aedes-tuft	Aedes	
17	-83.0434	63.3	9/22/2018	4526	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	dish or pot				FALSE				
18	-83.0434	63.3	9/22/2018	4527	GLOBE Observer	4.8E+07	2018-09-2	container: artificial	jar	1			FALSE		identify-verify-larva	Aedes	inco

Level 10-11 (12)

Contribute to Mosquito Habitat Map as a Citizen Scientist

Outside Activities

Global opportunity for students - International Virtual Science Symposium:
The International Virtual Science Symposium is an opportunity for GLOBE students to showcase their research to the rest of the community. Projects are judged by prestigious scientists from dozens of GLOBE countries. Students are eligible to receive GLOBE stipends and badges.

Links

GLOBE	https://www.globe.gov/
Video	https://www.youtube.com/watch?v=Jh_chDc_HCE
International Virtual Science Symposium	https://www.globe.gov/news-events/meetings_symposia/virtual-conferences
Mosquito Habitats Resource Library - GLOBE Observer	https://observer.globe.gov/do-globe-observer/mosquito-habitats/resource-library#activities
Resources - Mission Mosquito - GLOBE.gov	https://www.globe.gov/web/mission-mosquito/overview/resources
Eyes on the Earth (nasa.gov)	https://eyes.nasa.gov/apps/earth/#/
Earth Map	https://earthmap.org/

Materials in Appendices

The activities in this guide are suggestions, any activity can be freely used for educational purposes. Many of the activities and resources were created by the Institute for Global Environmental Strategies as part of the NASA-funded GLOBE Mission Mosquito (part of the NASA Earth Science Education Collaborative project). Others were created by the UCAR Center for Science Education. There are links throughout the guide to these activities, which are also provided below. Please refer to the original documents for more information.

Resources from IGES:

Note that these activities are also available as a collection titled Mission Mosquito Larvae Hunters Guide. The guide is formatted as Google Slides, which can be copied and saved for offline use. That format allows creative customization. For example, work through the guide individually, in teams, or in small groups on separate computers. Display on an interactive whiteboard for large group collaboration. Selectively print, add, or hide pages not used. The guide is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License. You are free to share and adapt this material as long as you follow the license terms, and link to the original source at: https://strategies.org/products/mosquito-larvae-hunters-guide

- **Mosquito Larvae Hunters**
  - Level 1 Training (PDF), Badge (PDF)
  - Level 2 (Training (PDF), Badge (PDF), Certificate (PDF))
  - Companion guide for parents/caregivers: in Color, or in Black-and-White
- **Mosquito Habitat Survey:** Instructions and a paper data sheet to do a survey of mosquito habitats over several days.
- **Proboscis: Mechanics of a Bite**: An activity to teach how mosquitoes use their proboscis to bite, including a diagram, video, and poem.
- **How to Use a Clip-on Magnifier**: Tips with graphics on photographing mosquito larvae using a clip-on scope with a smart phone.
- **Build a Mosquito Larvae Trap:** Build a do-it-yourself mosquito trap using simple materials. The trap tricks mosquitoes into laying their eggs in a container that the larvae can't escape.
  - Report the larvae using the Mosquito Habitat Mapper tool in the GLOBE Observer app. Video demonstrating how to build the trap
- **Mosquito Habitats and Hideouts :** Play this game to learn the different habitats in the GLOBE Mosquito Habitat Mapper
- **Beyond the Bite:** GLOBE Mission Mosquito Disease Guide. Learn about eight of the most common Mosquito-borne diseases.
- **Resources from UCAR Center for Science Education**
  - Elementary GLOBE activity, Magnify That
  - Zika Zine

Materials in Appendices

The activities in this guide are suggestions, any activity can be used. Many of the materials come from NASA's (National Aeronautics and Space Administration) GLOBE (Global Learning and Observations to Benefit the Environment) program and are free to use for educational purposes. A link should be provided if changes are made to the GLOBE program documents. There are links to the documents in the guide and at the end of the document. Please refer to the original documents for more information.

- Mosquito larvae Hunters Level 2 - https://strategies.org/wp-content/uploads/2021/07/1-MLH-SecondEntry-Final-7-27-2021.pdf
- Habitat Survey Page - https://strategies.org/wp-content/uploads/2020/09/HabitatSurveyPage-COLOR-FINAL-9-28-20-2.pdf
- Mosquito Proboscis: Mechanics of a Bite – https://strategies.org/wp-content/uploads/2021/05/1-HiRes-COLOR-Proboscis-Entry-FINAL-5-11-21.pdf
- Magnify that - https://www.globe.gov/documents/348830/55942515/MagnifyThat_27July2018_FINAL.pdf/a40f605a-f86f-4293-8ff0-17d82f359f7e
- Mosquito Larvae Hunter: Level 1 - https://strategies.org/wp-content/uploads/2021/05/MLH-5-10-2021.pdf
- Mission mosquito: Larvae hunters guide - https://strategies.org/products/mosquito-larvae-hunters-guide
- How to use a clip-on microscope - https://docs.google.com/presentation/d/1Ib8pssP4nyvhsSwHY-g2-FUNHKwKE80Y85zxteu7YUE/view#slide=id.g14711c42f4e_1_27
- Let's build a mosquito larvae trap - https://observer.globe.gov/documents/19589576/721d105e-5cd7-b0fa-5db5-172fd30993ab
- Beyond the Bite: GLOBE mission mosquito disease guide - https://strategies.org/products/beyond-the-bite
- ZIKA ZINE - https://scied.ucar.edu/zikazine
- Mosquito Habitats and Hideouts -https://strategies.org/products/mosquito-habitats-and-hideouts