

Mapping Your Identity

Welcome to the team and Task 1-1. As you heard, you will be making many decisions as a team during your research about mosquitoes. Many of the decisions you will make in your research may be influenced by your identity. Since your team will be making many decisions together, it is good to learn more about the different identities of your team. In future tasks, you will use this identity map to see if parts of your identity are causing you to think in one way or the other. So keep your identity map in a safe place.

Objective

In this task, each team member will make an identity map about themself.

- Go to the Task 1-1 folder to get the identity map instructions, Think, Pair, Share instructions, and discussion questions. This task has only one version for everyone.
- Discuss using Think, Pair, Share instructions to develop categories for the question, "Who am I?" or, "What different things about me make up me?"
- 3. Add your list of extra identity map categories to the Task 1-1 folder.



The Task 1-1 folder can be found on Learning Lab. When you see this blue arrow you should go there. Try it now!

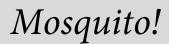
learninglab.si.edu/ profile/ ScienceForGlobalGoals

- 4. Look at the identity map example in the instructions to see how they look.
- 5. Use this list of categories; plus the ones you added, to create an identity map for yourself.
- Team members should keep their identity maps safe for future tasks.
- 6. Pick one thing from your identity map you can share with the team. Circle it!

Hooray! You completed Task 1-1. Check it off the task list. Go to Task 1-2!

Mosquito!





Task 1-1. Mapping Your Identity

Identity Map Instructions

Identity maps are a graphic tool that can help people better understand the many things that shape who they are as individuals. These are also things that can influence a person's thoughts or the decisions they make in different situations. Each team member will create an identity map to deepen their understanding of themselves and their team members.

- 1. **Think, Pair, Share** how you would answer the question, "Who am I?" or, "What different things about me make up me?"
- 2. After the Think, Pair, Share conversation, brainstorm a list of categories you might use to describe someone's identity or who they are.
- 3. Add the extra categories to your list that will be used when creating your identity maps.
- 4. Look at a sample identity map.
- 5. Write your name in the middle of a piece of paper.
- 6. Have each team member create an identity map for themselves using the list of categories.
- 7. As a team, answer the discussion questions.

Think, Pair, Share Instructions

Think: On your own, have the team quietly think to themselves about the question or topic that has been presented. Take a few minutes to let each team member make notes or a list of ideas on their own.

Pair: Each team member should be paired with another team member or a small group. As a pair or small group, share your list of ideas with one another.

Share: Students share their thinking with their partner. Team leaders expand the sharing into a whole-class share or discussion.

Identity Map Categories

Age School/class Race Gender Nationality Family background/origin

Role in family (sister, brother, cousin...)







Ethnicity

Interests

Hobbies

Religion

Things you like to do

Personality traits (shy, loud, talkative, quiet, funny, sad...)

Physical traits (tall, short, brown hair, black hair, blue eyes, brown eyes...)

Discussion Questions

Which item on your identity map is most essential to your sense of self? Circle it!

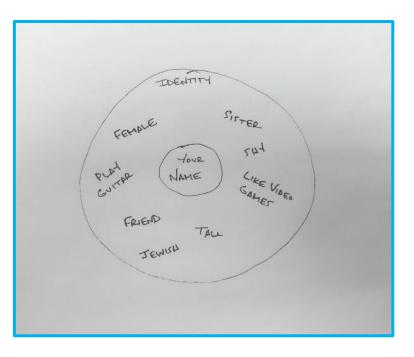
Are certain aspects of your identity more influential than other aspects? Why?

How might your identity map change over time?

How much control do you have over the things on your identity map?

How might things on your identity map affect decisions you make in your life?

Example





Go back to Research Guide now

-2 Thinking About Decisions

Welcome to the team and Task 1-2. As you heard, you will be making many decisions as a team during your research about mosquitoes. Before you begin your research, the team must think about how each team member makes decisions. You will also need to use your identity map from Task 1-1 to see if any parts of your identity are affecting the decisions you make.

Objective

- In this task, the team will learn how to work and talk together about decisionmaking and how it may be influenced by the identity map you made in Task 1-1. This will be especially important when we all do not agree.
- 1. Go over these team norms together:
 - Recognize the benefit of listening to different ideas from people on your team.
 - Be open to new ideas and perspectives that challenge your own.
- 2. Go to the Task 1-2 folder and get the Thinking About Decisions activity and discussion questions.
- 3. Choose the Mosquito A or Mosquito B activity from the task folder. You can also do both versions of the task if you want. Or half of the team can do Mosquito A and half can do Mosquito B. You decide!
- 4. Do the activity according to the instructions in the folder and discuss the questions.

Remember, when engaging in meaningful discussion as a team, we must respect our team. For example, use these sentence starters:

- I agree with _____because ...
- I disagree with _____because ...
- I'd like to go back to what _____said about ...
- I'd like to add ______

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Hooray! You completed Task 1-2. Check it off the task list. Go to Task 1-3!

15

Task 1- 2

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Task 1-2 Thinking About Decisions — Mosquito A

Materials: Paper and pens or pencils, Task 1-1 identity maps

Description: Ask each team member to write on a piece of paper all of the decisions that they can remember making so far today. (Examples: what to wear, what to eat, how to spend free time, etc.) Include all types of decisions on your list.

Allow about three minutes for team members to write. Now, ask each team member to go back through their list and rate their decisions on a scale from 1 to 10, with 1 meaning an automatic decision you made without much thought, and 10 meaning a decision that required careful studying and much thought before you made the decision.

Task 1-2 Thinking About Decisions Discussion Questions

- 1. As a group, share different types of decisions you rated as 1 that are automatic and do not require much thought. Which decisions did you rate at 10 that require much thought before making the decision?
- 2. Did any of your decisions affect another person? If so, how?
- 3. Look at the identity map you created in Task 1-1. Were your decisions influenced by any things on your identity map, such as your values? Attitudes? Biases?
- 4. Which aspects of your identity map do you think are most influential when making decisions?
- 5. What is the worst decision you ever made? (Team members can write or discuss these.)
- 6. Do you consider it the worst because of the decision, or was it a reasonable decision with a bad outcome?
- 7. Does a good decision guarantee a good outcome?
- 8. Do you have control over the decision, the outcome, neither, or both?
- 9. What does this exercise tell you about how you make most of your decisions?

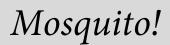
Modified from: "More About Decisions" from <u>Helping Teens Reach Their Dreams</u> by Schilling & Palomares, 1993.



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Task 1-2 Thinking About Decisions — Mosquito B

Materials: Writing Materials (Such as poster board, paper, chalkboard with the Patient Waiting List (from below) written on it, Task 1-1 identity maps

Form groups of five to seven people.

In your group, you will be making a decision about an imaginary situation.

The situation is:

You are doctors at a large hospital. Your committee must make a very important decision. Seven patients are sick with a disease they got from a mosquito bite. They all need medicine to help them survive. There is only enough medicine to help one of the patients at this time. All of the patients would be saved by the medicine. The patients who do not receive the medicine will not automatically die. Some (not all) will, hopefully, survive until more medicine arrives at the hospital. Which patient would you choose to receive the medicine? Why? Your committee must agree on the choice.

Patient Waiting List

(Select one of the following patients to receive the medicine.)

- 31-year-old male; Black, brain surgeon; no children
- 12-year-old female; Asian; accomplished violinist; blind
- 40-year-old male; Hispanic, teacher, two children
- 15-year-old female; White, unmarried, six months pregnant
- 35-year-old male; Hispanic; Roman Catholic priest
- 17-year-old female; White; waitress; high school dropout; supports and cares for a brother who is severely disabled
- 38-year-old female; Black; AIDS researcher; no children

Allow at least 10 minutes for each group to make their decision about who should receive the medicine (20 minutes is recommended).

Then meet up as the whole team.



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Have each group share its decision and decision-making process.

- 1. What was your decision?
- 2. How did you arrive at your decision?
- 3. What are the potential effects or consequences of your decision?

Task 1-2 Thinking About Decisions Discussion Questions

- How did your group come to a decision? Did you use a specific technique (consensus, voting, etc.)?
- How were disagreements and conflicts handled? What strategies could you use in future situations to better handle these?
- Look at your identity map you created in Task 1-1. Which aspects of your identity map most influenced your decision? How was your decision influenced by the things on your identity map, such as your values? Attitudes? Biases?
- Was there anyone who felt their voice was not heard? How could we ensure their voice is heard equally in the future?
- Did anyone change their mind after hearing another group's explanation?

Modified from:

"More About Decisions" from Helping Teens Reach Their Dreams by Schilling & Palomares, 1993





1-6 Defining the Research Problem

You now have a better understanding of your personal and team's identity and knowledge about mosquitoes. That information will be useful as you begin to define the mosquito problem in your local community. So keep those identity maps safe for later use.

Objective

- In this task, the team will meet some researchers who study the mosquito problem to learn more about different parts of the problem. These researchers will give the team some ideas about the things you should consider when doing research in your local community.
- 1. Go to the Task 1-6 folder to get the instructions and readings.
- 2. Watch the videos if you can. Do not worry if you are not able to.
- 3. As a team, read the Problem Introduction together.
 - During the reading, circle or underline all the words you do not understand.
 - Do not worry, there are many big words in science.
- 4. As a team, make a list of all the words people circled or underlined so we can start to help each other better understand them all.
- 5. Make a plan for how we could learn more about what these words mean.
 - Where could we search or whom could we ask to learn more about these words?
- 6. Go back and identify a Very Important Part (VIP) from the reading.
- 7. Share these VIP's as a team.
- 8. Follow the instructions for the Meet the Team Jigsaw Part One.
- 9. Have each group present their researcher to the team, including:
 - Name, job title, organization
 - Most interesting thing from their identity map



Part One. Problem



- One VIP from each of the three questions
- Make a list of the VIPs from all groups

Follow the instructions for the Meet the Team - Jigsaw Part Two.

- 10. Have each group present their researcher to the team, including:
 - VIP for each perspective (ethical, economic, social, environmental)
 - VIP for why it is important to consider perspectives when making decisions about this problem
 - Make a list of the VIPs from all groups

To help your local community, we will need your team to create a research site and develop a variety of suggestions for solutions to this question:

How can we ensure health for all from mosquito-borne diseases?

Just remember, research is not always easy. There is not one right answer.

There are many possible solutions. So, you might get confused.

You might get frustrated. Things might not always work out the way you thought.

This is normal. All you can do is try again, start over, ask a different question, talk to a different person, or create a new pathway.

Just remember, there are many questions to consider. There are many decisions to make. There are many possible solutions.

Hooray! You completed Task 1-6. Check it off the task list. Go to Task 1-7!







Task 1-6 Defining the Research Problem

Introduction Videos

If the team is able to watch a video, start with one of the videos in the Learning Lab Task 1-6 folder. Do not worry if you are not able to watch videos. You can go straight to the reading.

Problem Introduction

Mosquitoes are all around us. Mainly during the warmer season, their constant buzzing follows you when you step outside. They leave itchy red bumps on your skin. They buzz in your ear when you sleep. They are unavoidable and annoying.

In addition to being annoying, some female mosquitos feast on your blood—most of the time without you noticing. In some places, a sleeping human can be bitten many times in a night without noticing. Female mosquitos need the blood to make eggs. These eggs grow into more mosquitoes. More mosquitoes mean more buzzing and more blood sucking. These mosquitoes are good at surviving around humans.

However, itchy bumps and annoying buzzing are not the only problems. Mosquitoes are very good at carrying and transmitting some diseases. Sometimes, when mosquitoes suck on your blood, they also inject a pathogen that transmits disease to your body. The diseases they carry are called mosquito-borne diseases. You may have heard of these diseases. They include malaria, dengue fever, Zika, West Nile virus, yellow fever, chikungunya, and encephalitis.

There are many people interested in studying and learning more about mosquitoes and the diseases they spread to humans. Let us meet some of these people to learn more about the mosquito problem.

Meet the Researchers: Jigsaw Part One Instructions

- 1. Divide the group into six groups.
- Assign each group one of the team member profiles from the Meet the Team reading. The profiles are Rusty Low, Meera Venkatesan, David Pecor, Kelly Bennett, Bridget Giles, and Lee Cohnstaedt.
- 3. Each group is responsible for reading about one researcher.
- 4. When reading, complete the following in each group.
 - a. Each group member should read the first page about their researcher to themselves.
 - b. Have one group member read the entire reading out loud to the rest of the group.
 - c. Each group member should go back and identify a Very Important Part (VIP) from each section of the first page.

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- i. Identify one thing on the researcher's identity map you find most interesting.
- ii. Why is the mosquito problem such an important issue for people to understand?
- iii. Briefly describe the researcher's work on mosquito-borne diseases.
- iv. How much is still not known about mosquitoes and mosquito-borne diseases?
- d. Circle or place a sticky note on what each group member thinks is the most important part of the reading.
- e. In your group, have each person share their VIPs with the group and their reasons for selecting them and the item on the researcher's identity map.
- f. As a group, summarize the VIPs from your group and your thoughts on the identity map.
- g. Make sure each group member is ready to share their VIPs with the rest of the team.

Meet the Researchers: Jigsaw Part Two Instructions

- 1. Each group is responsible for reading the second page about their researcher.
- 2. When reading, complete the following in each group.
 - a. Each team member should read the second page about their researcher to themselves.
 - b. In each group, have one group member read the entire reading out loud to the rest of the group.
 - c. Each group member should go back and identify a Very Important Part (VIP) from each section of the second page.
 - i. Identify one VIP from each perspective (Ethical, Economic, Social, Environmental)
 - ii. Why is it important to consider various perspectives when making decisions on the problem question: How can we ensure health for all from mosquito-borne diseases?
 - d. Circle or place a sticky note on what each group member thinks is the most important part of the reading.
 - e. In your group, have each person share their VIPs with the group and their reasons for selecting them.
 - f. As a group, summarize the VIPs from your group and your thoughts on the four perspectives.
 - g. Make sure each group member is ready to share their VIPs with the rest of the team.

Go back to Research Guide now







Meet the Team



Organization: Institute for Global Environmental Strategies

What is on Rusty's identity map?

LIKES TO SLEEP OUTSIDE. SPEAKS FIVE LANGUAGES. LIVED IN SIX COUNTRIES. LIKES BIG DOGS. PLAYS MANDOLIN. FASCINATED WITH OLD THINGS. LIVES IN THE MOUNTAINS. ENJOYS LOOKING IN A MICROSCOPE. WENT TO SCHOOL IN CANADA, GERMANY, AND U.S. ENJOYS KAYAKING AND CROSS-COUNTRY SKIING. NAMED AFTER GRANDPARENTS. **Compare it** with yours!

Mosquito! Task 1-6 Defining the Problem

RUSTY LOW

SENIOR EARTH SCIENTIST

Why is the mosquito problem such an important issue around the world?

Mosquitoes are the most dangerous animal on the planet for humans! Mosquito-borne diseases affect half a billion people every year. Mosquito borne diseases kill up to a million people every year. Climate change is now affecting where some mosquitoes can live. These changes mean some mosquitoes and diseases move into new places. Many of these places have not had mosquito or disease problems recently. We have learned that all places must be prepared for this problem in the future.

Provide a brief description of your work on mosquito-borne diseases.

I have been working on developing the GLOBE Observer Mosquito Habitat Mapper. It is an app for smartphones and mobile devices. The app allows kids and adults to locate sites in their community that mosquitoes might like. People can share this information with one another. Then they can find out if the mosquitoes are the type that transmit diseases. The data is shared with the science community to help make decisions around the world. It is a fun way to use science to make a difference locally!

How much is still not known about mosquitoes and diseases in your field of work?

We still do not know many things about mosquitoes. That means there are many opportunities for citizen scientists like you. We need your help to conduct local research. This research will help us all better understand mosquitoes. It will also help us know where they live. Most of our understanding of mosquitoes comes from laboratory research. This is why we need the help of teams like yours. We need teams around the world to come together. We must share information about what is happening outside of the laboratory. We must share what is happening in our local communities. This will help us all learn more about this problem.

Why is it important to look at the mosquito problem from different perspectives?

Ethical

We must think about the ethical parts of the mosquito problem. "Ethical" means the fairness of something. Is it okay that some people are at greater risk from mosquitoes than others? Is it okay that because of factors out of their control, they are at more risk? These are all questions we must ask.

Есономіс

We must think about the economic parts of the problem. "Economic" is concerned with money, income, and use of wealth. Citizen scientists like you can provide economic support in your community. Many communities do not have the money to have good mosquito surveillance. The data from citizen scientists like you can help authorities make tough decisions - for example, decisions about where to spray expensive insecticides to keep mosquitoes away.

Social

It is important to consider the social part of the problem. "Social" is concerned with the interaction of people in a community. People must work together to create and maintain protection from mosquitoborne diseases in the community. Do some people have a greater risk of disease? Why or why not? These are questions we must ask.

ENVIRONMENTAL

It is important to understand the environmental parts of the problem. "Environmental" is concerned with the natural world. It is also concerned with human impacts on the natural world. What things can help mosquitoes reproduce? How can we identify these things? How can we use this information to reduce disease risk in the community? These are questions we must ask.

Why is it important to consider a problem from various perspectives (social, ethical, environmental, economic) when making decisions and developing solutions to problems?

I was trained as an Earth system scientist. System science looks at the connections between different parts of a larger system. For example, climate change is a large system. It cannot be understood without looking at how the changing climate affects the different parts. Some of the parts are the ocean, living things, the land, and ice. You must look at the connections of these parts to have a better picture of the whole system.

We also live not only in our physical environment, but in our social one. When considering a problem, we need to think about the social and environmental parts of the problem. It is very hard to predict the outcomes of changes in either part. This is why models are so useful to scientists and social scientists. When you are trying to solve problems, you need to think about each part and how the parts all work together.





Organization: President's Malaria Initiative, United States Agency for International Development (USAID)

What is on Meera's identity map?

SISTER. FAMILY FROM INDIA. FRIEND. VEGETARIAN. CHOCOLATE LOVER. STUDENT. SCIENTIST. LOVE TO READ. FROM CALIFORNIA. LOVE TO COOK. WIFE. CURIOUS. AUNT. TRAVELER. EMPATHIC.

Compare it with yours!



Meet the Team

MEERA VENKATESAN

MALARIA TECHNICAL ADVISOR

SCIENCE

for Global Goals

Why is the mosquito problem such an important issue for people to understand around the world?

The mosquito is the most dangerous creature on the planet. It causes thousands of deaths. It also makes people, often children, very sick. Even if it is not a problem where you live, it can still have a huge effect on people. One thing we have learned recently is that mosquito-borne diseases can occur anywhere. They also move quickly across the world - even into places we did not think mosquitoes could survive. Sometimes, diseases like Zika or chikungunya emerge in places they were not seen before. So, we all must prepare for the future.

Provide a brief description of your work on mosquito-borne diseases.

I work on improving the control of malaria. Malaria is the most deadly mosquito-borne disease. Malaria kills around 500,000 people per year. Most of these deaths are kids living in Africa. Luckily, we have many tools to fight malaria that work. The task now is getting them to people in need. We also need them to be used by people at risk. These tools include:

- Tests to know when you have malaria
- Treatments that help sick people
- Bed nets to sleep under

• Spraying insecticides on the walls of homes to keep mosquitoes away I work at USAID for the President's Malaria Initiative. My work helps countries in Africa and Asia. My work helps these countries with their own local malaria control programs.

How much is still not known about mosquitoes and mosquito-borne diseases in your field of work?

Many mosquito control projects are growing in Africa and Asia. However, there is still a problem of the "left over" spread of disease. Mosquitoes that still live in a place can cause problems. Mosquitoes that are resting and biting outdoors where people are not protected can cause problems. The malaria research community is working hard to figure out how to target these mosquitoes. They are also working hard to learn how to protect people from being exposed to infected bites. Exposure can happen when working, sleeping, or spending time outside. This is where we need the help of teams like yours. When teams come together, we can learn more about this problem. This will help us create solutions that work better for different communities. Why is it important to look at the mosquito problem from different perspectives?

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ETHICAL

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We must think about the ethical parts of the mosquito problem. "Ethical" means the fairness of something. First, we must not ignore the people who are at great risk from mosquito-borne diseases. These people may be the hardest to reach or get involved. We have a duty to be fair. We must make sure they are not forgotten. We must be fair to all people. We must provide all people the safety and medical help the rest of the population enjoys.

Social

It is important to consider the social part of the problem. "Social" is concerned with the interaction of people in a community. People must work together to create and maintain protection from mosquito-borne diseases within the community. The community includes leaders, parents, and children. The community needs to understand the importance of fighting these diseases. The community is needed to successfully implement solutions at the local level. If the people in a community are not involved, you will not get very far with any solutions or changes.

ECONOMIC

We must think about the economic parts of the problem. "Economic" is concerned with money, income, and use of wealth. Getting sick from mosquito borne diseases costs people large amounts of money. This is felt at the household, community, and industry level. It is important to show people how much can be gained economically by reducing the problem of mosquito-borne diseases. We must also convince people that there are more than just health benefits. A country may grow faster and improve the economic status of its people by reducing malaria. People can save money when they are no longer spending money getting care from doctors. They can save money by not missing days of work and school due to malaria illness.

Environmental

It is important to understand the environmental parts of the problem. "Environmental" is concerned with the natural world. It is also concerned with human impacts on the natural world. For example, any insecticide that is used to fight mosquitoes first must go through rigorous tests. The tests should determine potential environmental effects on all parts of the natural world. These tests should ensure the insecticides are safe to use. Plans must make sure that exposure of the environment to chemicals is reduced.

Why is it important to consider a problem from various perspectives (social, ethical, environmental, economic) when making decisions and developing solutions to problems?

You must make sure you can get participation from all parts of a community or country. Mosquito-borne diseases should not be seen just as a health issue. They are also an economic issue. You can engage with the finance and private sectors to get involved and increase your impact. In addition, you must work on environmental issues with the agricultural sectors of your community. This will ensure that everyone has the same goals. It will also help make progress on health, food, nutrition, and environmental protections.





Organization: The Walter Reed Biosystematics Unit (WRBU)

What is on David's identity map?

LOVE DOGS. LOVE PUNK ROCK MUSIC. BIG BROTHER. FATHER. WRITER. BALD. LOVE TO HIKE. FRIENDLY. COFFEE FANATIC. FAVORITE PLACE: GLACIER NATIONAL PARK, MONTANA.

Compare it with yours!

Mosquito! Task 1-6 Defining the Problem

Meet the Team

DAVID PECOR

SCIENCE

for Global Goals

RESEARCH TECHNICIAN

Why is the mosquito problem such an important issue for people to understand around the world?

There are almost no places you will not experience some impact from mosquitoes, besides Antarctica. In many places they are just annoying biters. In other places, they carry diseases. There is no escaping them. Although mosquitoes are found nearly everywhere, individual species distributions can change dramatically over time. Humans spread mosquitoes around the world via travel and trade. Climate change may also cause mosquitoes to move into new areas. Many places are currently free of mosquito-borne diseases. This does not mean they are completely safe in the future. If an infected person is exposed to the local mosquitoes, the diseases can be spread to people who are not aware of these diseases.

Provide a brief description of your work on mosquito-borne diseases.

I primarily work on the VectorMap project. This is an online source for mosquito collection data. It also includes information about the places mosquitoes like to live. It is designed to permanently store data associated with mosquito observations. This is similar to a museum that is tasked with permanently protecting samples. The goal is to determine the risk of mosquito-borne diseases in different places. It also helps us monitor how the problem may be changing over time. It is important to capture as much detailed observation data as possible.

How much is still not known about mosquitoes and mosquito-borne diseases in your field of work?

There are many things to discover in this field. There are more than 3,600 known types of mosquitoes. Many of these and more have not yet been described. The impact of many of these mosquitoes on humans is also unknown. Another thing we do not know is the number and nature of the diseases that have not been described. Diseases in nature could spill over into humans via mosquitoes. One of the biggest challenges in this work is providing access to the tools to combat mosquito-borne diseases, mainly for the people who need it most. Mosquito-borne diseases unfairly affect people living in the developing world. This is because many of these diseases are common to tropical and sub-tropical climates (Africa, South America, Southeast Asia). For this reason, access to tools, education, and training must be provided to people with the greatest risk.

Why is it important to look at the mosquito problem from different perspectives?

ETHICAL

We must think about the ethical parts of the mosquito problem. "Ethical" means the fairness of something. I believe countries with technology and education related to mosquitoes have an ethical duty. These people must share that knowledge with the developing world. This is because the disease problem is much greater for people living in developing countries. We must help them solve the biggest issues surrounding mosquito control.

ECONOMIC

We must think about the economic parts of the problem. "Economic" is concerned with money, income, and use of wealth. No other animal has affected human economics more than the mosquito. Mosquitoes have been responsible for countless lives lost over our history. Even now, mosquito control strategies are expensive (for example, pesticide development, spraying insecticides, digital mosquito monitoring tools, etc.).

Social

It is important to consider the social part of the problem. "Social" is concerned with the interaction of people in a community. Community participation is a big part of mosquito reduction. The community must understand that mosquitoes can use human products left outside. Therefore, making it socially unacceptable to leave out trash is one step in addressing the problem.

Environmental

It is important to understand the environmental parts of the problem. "Environmental" is concerned with the natural world. It is also concerned with human impacts on the natural world. Mosquitoes play many important roles in the places they live. Mosquitoes help many plants survive. They are also food for other animals, such as birds, bats, and fish. In many communities, mosquitoes are all considered bad. However, there is growing evidence that they have more value in nature than we typically give them credit for.

Why is it important to consider a problem from various perspectives (social, ethical, environmental, economic) when making decisions and developing solutions to problems?

Solutions that only address single or limited perspectives are unlikely to be successful. I believe an integrated approach to problem-solving is essential, especially when dealing with hard problems like mosquitoes and mosquito-borne disease. This problem is universal and affects everyone. We must consider multiple perspectives to ensure solutions help everyone involved.





Meet the Team



Organization: Smithsonian Tropical Research Institute (STRI)

What is on Kelly's identity map?

FEMALE. SISTER. WHITE BRITISH. SPEAK SPANISH. BROWN EYES. YOGA. LOVE READING AND ART. LOVE TO HIKE AND TRAVEL. QUIET. LIVE IN A SMALL TOWN IN THE JUNGLE. LOVE MUSIC. LOVE TO SWIM. BROWN CURLY HAIR. SHORT.

Compare it with yours!

Mosquito! Task 1-6 Defining the Problem

KELLY BENNETT

BIOLOGIST

Why is the mosquito problem such an important issue for people to understand around the world?

The problem of mosquito-borne disease has been greatly affected by increased human movement and trade around the world. This human movement has allowing these mosquitoes to travel and establish new places to live. In addition, people are having increased contact with forests. As humans urbanize their surroundings, diseases can switch from using animals to using humans as a host. This worldwide network of invasion and increasing urbanization is a big part of the problem. It means we must work together as one to reduce the introduction of mosquitoes into new places. Mosquitoes tend to be highly adaptive. New diseases are also emerging and spreading rapidly. A recent example is Zika virus. This disease has been around for a long time. Yet only recently has it become a world-wide problem. This is likely due to the mosquitoes adapting to their surroundings. These mosquitoes are adapting to take better advantage of humans.

Provide a brief description of your work on mosquito-borne diseases.

I am currently working on two projects focusing on the Aedes mosquito in Panama. These mosquitoes can transmit dengue, chikungunya and Zika virus. The first goal of my work is to identify whether mosquito populations in Panama are adapting to their local environments. We also are trying to learn how these populations are connected. This is important to understand when thinking about mosquito control efforts in Panama. In the second project, I am investigating the natural strains of *Wolbachia* bacteria. Infection with this bacteria can affect disease transmission in mosquitoes. However, whether the bacteria effectively reduces transmission depends on the interaction of *Wolbachia* strains. Therefore, it is important to understand which strains are naturally present. This is helpful to determine whether such control methods would work in Panama.

How much is still not known about mosquitoes and mosquito-borne diseases in your field of work?

Relatively little is known about even basic life and behaviors. We must learn more about things that contribute to disease risk and how mosquitoes transmit diseases. We need to acquire information about many mosquito life history traits. These traits include mating behavior, egg-laying behavior, preferred habitats, seasonal differences in amount of mosquitoes, distribution, host preferences, development, and competition between and within species. All of these factors contribute to disease risk. The greatest challenge is to bring all the expertise together to understand how to control mosquito-borne diseases.

Why is it important to look at the mosquito problem from different perspectives?

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ETHICAL

We must think about the ethical parts of the mosquito problem. "Ethical" means the fairness of something. There are many new and alternative mosquito control methods currently being researched. Many of these new methods raise ethical concerns. For example, releasing genetically modified mosquitoes into the wild. Should we do this? We must think about the ethical side of all decisions we make.

ECONOMIC

We must think about the economic parts of the problem. "Economic" is concerned with money, income, and use of wealth. Many countries suffer from a large economic burden due to mosquito-borne disease. This burden puts pressure on medical facilities and health workers. It also requires large amounts of money to support these facilities and sick people. Many of these places must also spend money on mosquito monitoring and control.

SOCIAL

It is important to consider the social part of the problem. "Social" is concerned with the interaction of people in a community. For example, people in many areas of the world do not have a piped water supply to their home. This means people without access to a reliable water source must store drinking water, providing habitats in which mosquitoes breed. Furthermore, poor housing and garbage disposal means lower income areas have greater exposure to biting mosquitoes. Many of these areas also do not have as much access to medical facilities. This can increase the number of fatalities from mosquito-borne diseases.

ENVIRONMENTAL

It is important to understand the environmental parts of the problem. "Environmental" is concerned with the natural world. It is also concerned with human impacts on the natural world. Spraying insecticides is an environmental part of the problem. These methods can possibly contaminate water sources and kill other non-mosquito species. These environmental parts of the problem must be considered when making decisions.

Why is it important to consider a problem from various perspectives (social, ethical, environmental, economic) when making decisions and developing solutions to problems?

Without taking into account all perspectives, an approach is likely to fail. For example, imagine there is an effective way to control mosquitoes that requires the active participation of the local community. Without the community support, the method is unlikely to succeed. Similarly, if this hypothetical approach successfully reduces the mosquitoes but is too expensive to maintain, the approach will not be successful into the future.





Organization: Virginia Modeling Analysis & Simulation Center at Old Dominion University (VMASC)

What is on Bridget's identity map?

FEMALE. MOTHER. AFRICAN AMERICAN. WIFE. LOVE TO READ. LOVE MOVIES. LOVE TO DANCE. **BELIEVES IN EQUALITY FOR** EVERYONE. LIKES GOSPEL AND R&B. BELIEVES IN GOD. BORN IN VIRGINIA. LOVE SPENDING TIME WITH MY SONS. Compare it with yours!

Mosquito! Task 1-6 Defining the Problem

Meet the Team

BRIDGET GILES

SCIENCE

for Global Goals

RESEARCH ASSISTANT PROFESSOR

Why is the mosquito problem such an important issue for people to understand around the world?

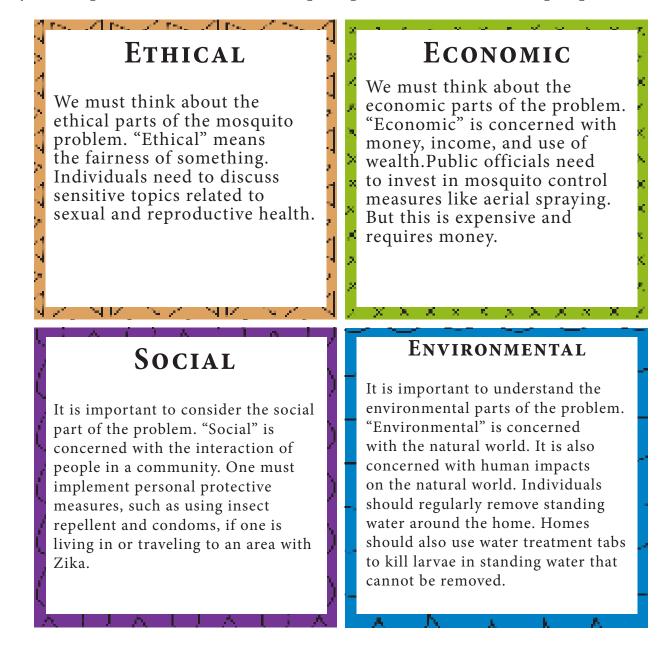
Mosquitoes are the most dangerous animals in the world. They cause millions of deaths each year. Recent changes in the climate and longer warm-weather seasons are creating more problems. These warmer temperatures create more mosquitofriendly habitats around the world. This will potentially lead to more mosquito-borne diseases including Zika, malaria, dengue fever, yellow fever and West Nile virus.

Provide a brief description of your work on mosquito borne diseases.

I lead a team of researchers. Together we developed a video game to educate families about their ability to stop the mosquito-borne disease Zika. The video game is call ZAP. ZAP stands for Zika Awareness and Prevention. The 3D simulations provide interactive education exercises about individual-level protection practices. This includes how to remove mosquito breeding sites around your home, correct use of larvicide, placement of screens on windows and doors, and how to dress to defend yourself against mosquito bites. The video game also addresses symptoms of Zika virus infection. It gives special precaution recommendations for pregnant women. Videos are included in the game. In addition, Zika trivia and matching games are provided to test knowledge.

How much is still not known about mosquitoes and mosquitoborne diseases in your field of work?

One challenge people are currently working on is a safe and effective Zika vaccine. Although pregnant women are usually excluded from vaccine research, pregnant women are at the center of the Zika epidemic. So, bioethics groups have to consider the pros and cons of including pregnant women in Zika vaccine research. Why is it important to look at the mosquito problem from different perspectives?



Why is it important to consider a problem from various perspectives (social, ethical, environmental, economic) when making decisions and developing solutions to problems?

That is the only way to consider the whole picture of the problem. Considering the problem from various perspectives is the only way to come up with an effective solution.





Organization: United States Department of Agriculture (USDA)

What is on Lees's identity map?

LOVE ANIMALS. THESPIAN. SPANISH SPEAKER. RUNNER. WRESTLER. NERD. COMMUNITY SERVICE. BACKPACKER. GERMAN SPEAKER. TRAVELER. LIKE STRATEGY GAMES. HARD WORKER. LOYAL. INVENTOR. LIKE CHESS. TEAM PLAYER. SCIENTIST. LIKE TO HELP PEOPLE. **Compare it** with yours!

Mosquito! Task 1-6 Defining the Problem

LEE COHNSTAEDT

RESEARCH ENTOMOLOGIST

SCIENCE

for Global Goals

Why is the mosquito problem such an important issue for people to understand around the world?

Mosquitoes are a nuisance at best and at worst the most dangerous animals in the world. Billions of people are at risk of mosquito-borne diseases every day. Globally, mosquitoes can change the landscape by influencing where animals and people live. Mosquitoes influence global production in most of the developing world. Furthermore, mosquito-borne diseases can always be introduced to a country where they were not before. This was the case with West Nile, Zika, and chikungunya viruses. Even if mosquitoes are not as abundant or a problem in the developed world, this does not mean they are not for the rest of the world or in the future.

Provide a brief description of your work on mosquito-borne diseases.

Two, four, six, eight: The USDA works to protect two-legged and four-legged animals from six- and eight-legged ones (insects and ticks). Specifically, I try to prevent outbreaks of diseases that will affect humans or animals in the United States. I do this by looking at various ways to monitor, control, or treat disease related insects such as mosquitoes or their associated diseases. The main focus of my work is zoonotic diseases, or animal diseases that may result in human illness.

How much is still not known about mosquitoes and mosquito borne diseases in your field of work?

The more we know, the more we realize we don't know. Research always advances understanding and creates more questions. Currently there is a large amount of research on sterile mosquitoes. Other research is on genetic changes that can make mosquitoes not blood feed. However, mosquito research can also be used to address big ecological questions such as global climate change. In 2001, mosquitoes were one of the first organisms to show genetic shifts in as short as five years. Similarly, genetic flexibility allows exotic mosquitoes to adapt rapidly to new environments. There is no limit to what we need to learn or what we can learn about mosquitoes.

Meet the Team

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Why is it important to look at the mosquito problem from different perspectives?

ETHICAL

We must think about the ethical parts of the mosquito problem. "Ethical" means the fairness of something. There are many ethical questions to consider about mosquitoes. Such as, should humans intentionally kill off a species of mosquito? Or how do we protect the more than 2 billion people making less than \$2 a day who are at risk of mosquito-borne diseases?

SOCIAL

It is important to consider the social part

of the problem. "Social" is concerned with

the interaction of people in a community.

Mosquitoes are not restricted by boarders

or property lines. They will move and live

where the blood is. Therefore, we must all

work together to eliminate mosquitoes from

the others, to take up the work because the

the entire community will suffer.

our communities. If one of us fails, it is up to

mosquitoes will live where they can and then

Économic

We must think about the economic parts of the problem. "Economic" is concerned with money, income, and use of wealth. However, the brunt of mosquito-borne illness is suffered by the poorest individuals worldwide. Providing low-cost, easy-touse materials and methods for mosquito control is an effective way to quickly help alleviate some of the disease burden. However, this is not a sustainable plan. Only by changing the economic status of people and providing them with permanent, stable housing with screeens, running water, and other basic amenities can mosquito-transmitted diseases be reliably controlled.

Environmental

It is important to understand the environmental parts of the problem. "Environmental" is concerned with the natural world. It is also concerned with human impacts on the natural world. Mosquitoes are clearly an environmental problem. If the larval habitats are removed, the mosquitoes will be eliminated. However, removing the environmental problem means addressing the need for the water containers. Providing clean, reliable drinking water eliminates the need to store water in containers, where mosquitoes like to breed. Environmental change alone will not solve the problem, though. That change can only happen with simultaneous social and economic change.

Why is it important to consider a problem from various perspectives (social, ethical, environmental, economic) when making decisions and developing solutions to problems?

We are humans and many things influence our lives every day. These include work, life, community, the environment, family, and friends. If we make decisions based only on one of these perspectives, the solution will only address one of these areas. Our world is complicated and consists of many parts and perspectives. Without addressing all of the parts, the solution is not likely to work with the other parts. Simple questions tend to have simple answers. However, a simple single perspective answer will likely only address the symptoms of an issue and not the problem. It can then leave other people with different perspectives answerless. For example, we may ask people to empty water containers around their houses, which is a simple task. But it takes time and effort over the other many individual needs that must be done daily. Most people do not have or do not make the time to monitor their property even weekly for mosquito larval habitat. This is likely for many social, environmental, or economic reasons. For a solution to be universally acceptable, it must address most, if not all the problems and perspectives, not just the symptoms.







Video Links for Task 1-6

The Loathsome, Lethal Mosquito

Mosquito Problem Overview

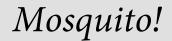
Description: Good overview of mosquitoes and the mosquito borne disease problem.

https://youtu.be/lkmjCmvfeFl

Mosquito Hunter - Frontline Video Description: Good video to present overview of mosquito problem and community involvement. https://youtu.be/0n6VtSam9To







Zika Awareness and Prevention (ZAP) Game

The Zika Awareness and Prevention (ZAP) Game was developed to strengthen students and communities in their ability to stop Zika virus disease. Zika virus is a mosquito-borne virus, spread primarily by the bite of an infected *Aedes* species mosquito. Through simulation, this game educates students about Zika virus, common mosquito breeding sites, Zika virus disease symptoms, and pregnancy risks associated with Zika. Practices that help to prevent mosquito bites are also covered such as using an EPA registered insect repellent with DEET, the importance of wearing long sleeved shirts and long pants when outdoors, and treating clothing with permethrin. Multiple choice and matching games are provided to gauge how much you learned about Zika.

Use the following link to access the game, and have fun! http://zika.vmasc.odu.edu/zap/

Computer WebGL Compatibility: Chrome 64 bit Version 57 and newer, Microsoft Edge version 16 or newer, Safari version 11 or newer, and Firefox version 52 or newer. Firefox users check your privacy settings.

For more information about the ZAP Game or for any other concerns please email us at Zapzika@odu.edu or contact:

Bridget Giles PhD Virginia Modeling Analysis and Simulation Center Old Dominion University 1030 University Blvd. Suffolk, VA 23435 Email: bgiles@odu.edu Phone: 757-638-4436









Team News Article Links for Task 1-6

Zika ZAP Game Bridget Giles News Article https://www.odu.edu/news/2017/6/zika_game#.WzE7aadKiUk

Rusty Low Institute for Global Env. Strategies News Article <u>https://medium.com/usaid-2030/arming-citizen-scientists-with-an-app-to-</u> identify-zika-carriers-f8af4ff7391d

Lee Cohnstaedt USDA News Article <u>http://www.fox5dc.com/news/local-news/md-students-taking-part-in-research-project-to-help-track-mosquitos-that-may-carry-zika</u>

Kelly Bennett STRI News Article https://newsdesk.si.edu/releases/smithsonian-scientists-track-aedes-mosquitoinvasions

David Pecor WRBU News Article https://insider.si.edu/2016/06/smithsonians-mosquito-collection-weapon-battlezika/



7 Understanding Community Action Plan

As you learned in Task 1-6, the team will be focused on creating solutions to the problem question: How can we ensure health for all from mosquito-borne diseases?

There are many possible solutions to this question. This is why we must conduct research to learn more about the problem in our community. Then we can suggest decisions and actions we think people should take. At the end of your research, the team will need to create and communicate a community action plan. All of the team research will help you create the community action plan.



In this task, the team will learn more about the community action plan you will make in the future.

- 1. Go to the Task 1-7 folder to read the details of the community action plan.
- 2. There is only one version of the community action plan.
- Read through the details of the action plan as a team. Ask questions about any parts that are not clear. Remember not to worry. Research is not easy. Sometimes things might not work out the way you planned. Learning how to work through the problem is part of the challenge and fun.
- 4. Read the Meet the Team Reading, with stories about when things did not work out during research projects and action plans. Think about how your team can work together when things do not work out as planned to reach your research and action plan goals.





Part Seven of the Community Research Guide is all about creating your community action plan. Remember that all of your research is leading to the creation of this plan.



Hooray! You completed Task 1-7. Check it off the task list. Go to Task 1-8!

21

Part One. Problem

Task 1- 7

🗦 Smithsonian



Mosquito!

Task 1-7 Understanding Community Action Plan

This document details the Community Action Plan that the team will create at the end of your research. The team will not be creating this plan now. However, understanding what you will be working toward completing at the end of your research is helpful even before you begin your research. Read through this plan, so the team understands everything they will need to complete by the end of your work. Then, as you are doing your research, think about how the information you are gathering could be useful for this final action plan and to address the problem question: How can we ensure health for all from mosquito-borne diseases?

The Community Action Plan will have three parts.

- 1. Research area background, evidence collected, integrated management plan developed (this part involves organizing what you will have already completed during your research)
- 2. Action goals (this part involves figuring out what you will do after you finish your research)
- 3. **Communication strategy** (this part involves telling people about your research, action goals, and plan)

Research Area Background

Provide a brief overview of your location and research site. This will help other people who are looking at your plan now and in the future. This section involves organizing what you did during your research. Include the following.

- 1. **Research location physical description:** Provide a brief description of your physical location. Include your position within your community, country, and the world.
- Team and local culture description: Provide a brief description of your team and any local culture your team identified during your research. Include your team's identity map from Task 1-5 as part of this description.
- 3. **Map of research site:** Provide a map of your research site and any important information you collected concerning the site that would be useful to understand your plan. If possible, include pictures of your research site.
- 4. **Evidence and claims:** Organize and share all of the evidence you collected during your research and any claims you developed.
- 5. Local integrated management plan: An integrated management plan outlines all of the different management strategies you think your community should consider to address the problem question: How can we ensure health for all from mosquitoes? Tasks 6-1 and 6-3 will help you outline an integrated management plan for your community.





Mosquito!

Action Goals

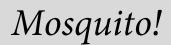
It is one thing to have an integrated management plan and another to set local goals to help people act on that plan. For example, part of your plan could be to empty the standing water from all containers in an area. Another part of the plan could be to educate various people in your community about the problem. Setting local action goals will help you determine what actions need to be taken now and in the future, who is responsible for taking them, and how the actions will be monitored to determine their effectiveness over time.

- Develop a list of action goals that could be carried out by various people in your community to work toward different parts of your integrated management plan. Consider the following when creating your action goals: What type of action is needed and what is the action meant to address? Provide a description of the action. Some examples include:
 - Education action goals: Create and hand out brochures to educate the community about mosquitoes. This action will increase local knowledge and spark actions of community members concerning mosquitoes and mosquito management.
 - Advocacy action goals: Create posters to advocate for a group of people at risk from mosquitoes. Write letters to local officials and community leaders concerning mosquitoes and their effect on different groups of people in your community.
 - Physical action goals: Monitor your research site weekly for standing water where mosquitoes could breed. This action will reduce the number of possible breeding sites mosquitoes can use in the community. Document and remove any standing water found in the site every week throughout year.
 - Be creative and develop your own goals for your community!
- **2.** Who is responsible for the action: self, team member, team, specific community member(s), all community members
- **3.** Action schedule or timeline: When and how often does the action need to take place?
- **4.** Action monitoring: How will the action goals be documented or monitored over time to determine their effectiveness? How will your team determine whether the action is working effectively? Create a strategy to monitor these goals over time.
- 5. Put the actions in order: If you have a list of action goals, which ones would you recommend be done first, second, and third? Create an order for all of your actions so the team knows where to start.





SCIENCE for Global Goals



Communication Strategy

If no one outside of your research team knows about your plan, can it make an impact? Next, you will need to develop a plan to creatively communicate parts of your action plan to your community. Make sure you include the social, ethical, economic, and environmental parts of the problem. How will you educate others about your evidence, claims, decisions, and action goals?

Be creative! This plan can include:

- Making posters or art projects to communicate parts of your plan
- Writing a song or a one-act play to communicate parts of your plan
- Writing and recording a public service announcement (audio or video) to communicate parts of your plan
- Creating a social media campaign to communicate parts of your plan
- Be creative; come up with your own ideas!

After you have developed your communication strategy, you will need to share and present this information with your community. This can include parents, educators, administrators, local community members, and other team members.

Each group should include the following when communicating with community members.

- Present social, ethical, environmental and economic considerations for the community.
- Support all claims with evidence (data and statistics, expert opinion, personal and secondhand experience) within the plan.
- Support all suggested actions using claims and evidence.
- Clearly explain, demonstrate, and illustrate parts of your integrated management plan.
- Clearly explain, demonstrate, and show all aspects of your action goals.
- Clearly outline how the plan will be monitored for effectiveness over time. Discuss how the plan can be adjusted if it is not working or needs to be improved.









Meet the Team

Mosquito!: Task 1-7 Understanding Final Action Plan

Tell us about a time when a research project did not work out as planned?



David Pecor - Research Technician - Walter Reed Biosystematics Unit (WRBU)

Recently our team developed a big plan for a project to reduce malaria in three countries. We developed the project plan for over a year. We also spent many months working with new partners for three teams. After nearly a year of work, our project was rejected by the group providing the money. Although it is common for at least some projects to be rejected, we did not expect it. It was somewhat disappointing. However, that rejection taught me to except failure as part of any learning process. Instead of giving up, we went back to the drawing board with the failed project. We listed all of the issues we thought were behind the failure. Since that time, this project has seen new life as parts in several other

new projects. We submitted these new projects and have been awarded funds to make them happen. This lesson taught me that rejection is not failure. It is only failure if you do not take the time to learn from it and work to improve. Think about how your team can work together when things do not work out as planned to reach your goals. It is important to be creative!



Meera Venkatesan - Malaria Technical Advisor - President's Malaria Initiative -United States Agency for International Development (USAID)

When I went to school, I wanted to work on a research project about mosquitoes and malaria. I also wanted to get experience working in different parts of the world. I picked my project with that expectation. Unfortunately, by the time I chose my research project, there were not opportunities to work on malaria mosquitoes in Africa, as I had planned. I was very disappointed. Luckily, I found a lab that was working on West Nile virus mosquitoes in the United States. This was a time when the disease was spreading across the country. I got to learn a lot

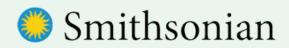
of the same science working on West Nile virus. I also spent some time in Zambia using these new skills. Eventually I was able to transfer my knowledge and experience to malaria in Asia and Africa. I learned some important lessons along the way: 1) Getting a good background in any field is more important than the specific topic you work on; and 2) The exact opportunity you want may not always present itself. But with a little hard work, you can use it to get closer to your goals. Think about how your team can work together when things do not work out as planned to reach your goals.



Rusty Low - Senior Earth Scientist - Institute for Global Environmental Strategies

When I was a student, I had a research project looking at remains in the ground of an ancient cave. I was doing research about ancient flower grains on the floor of the cave. I had 60 samples to process. My goal was to develop a story about the past environment of the cave. What was there 10,000 years ago? Was it a forest? Was it a meadow? It was very time consuming work. I worked all summer. At the end of the summer, 58 of the 60 samples did not have anything in them. I was very disappointed. I thought I was going to have to quit the project. But my advisor Charlie said, "Great! Now you have an interesting research problem! Why did only those two samples have preserved plant fossils

and the other 58 didn't?" He was right! Ever since, I think about this when I have a problem where things do not work out. I think about what my advisor Charlie said. It was a great life lesson when doing research projects. Think about how your team can work together when things do not work out as planned. Sometimes you just need to think about it from a different perspective!





Mosquito!: Task 1-7 Understanding Final Action Plan

Tell us about a time when a research project did not work out as planned?



Kelly Bennett - Biologist - Smithsonian Tropical Research Institute (STRI)

Experiments fail in the area of science frequently. However, perseverance and a positive attitude is the key to success. You can learn just as much from a failure as a success. In science, failures can lead you to a new path you may not have seen before. This is why you must stay positive when your research fails and try again.



Lee Cohnstaedt - Research Entomologist - United States Department of Agriculture (USDA)

We learn from our success, but we learn more from our failures. I make mistakes daily. That is why it is called research. If it worked the first time, it would just be called search. My lab motto is, "If you are going to be stupid, you have to be tough." Which means if we don't plan something out or if we mess something up, or if things

do not go as planned (which always happens), we learn, adapt, and continue with the modifications, and try again. This is true for all aspects of life, and we cannot let mistakes stop us from accomplishing our goals. Lastly, we learn much more from our mistakes than from our successes. So make mistakes, take calculated risks, learn, keep going, and never suffer the same failure twice.



Bridget Giles - Research Assistant Professor - Virginia Modeling Analysis & Simulation Center at Old Dominion University

Recently I applied to several grants to make improvements to the ZAP game. These improvements would make the tool more accessible to many people via Web, tablet, and app. Although I have not been successful, I have decided to keep trying to get funded to make improvements to ZAP. However, I am very

fortunate to have met team members at the Smithsonian Science Education Center, who sees the value of this work, and through this partnership ZAP can reach learners throughout the world.







Team News Article Links for Task 1-7

David Pecor WRBU News Article https://insider.si.edu/2016/06/smithsonians-mosquito-collection-weaponbattle-zika/

Kelly Bennett STRI News Article https://newsdesk.si.edu/releases/smithsonian-scientists-track-aedesmosquito-invasions

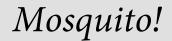
Lee Cohnstaedt USDA News Article 1 http://www.fox5dc.com/news/local-news/md-students-taking-part-inresearch-project-to-help-track-mosquitos-that-may-carry-zika

Rusty Low News Article -USAID https://medium.com/usaid-2030/arming-citizen-scientists-with-an-app-toidentify-zika-carriers-f8af4ff7391d

Zika ZAP Game News Article https://www.odu.edu/news/2017/6/zika_game#.WzE7aadKiUk







Zika Awareness and Prevention (ZAP) Game

The Zika Awareness and Prevention (ZAP) Game was developed to strengthen students and communities in their ability to stop Zika virus disease. Zika virus is a mosquito-borne virus, spread primarily by the bite of an infected *Aedes* species mosquito. Through simulation, this game educates students about Zika virus, common mosquito breeding sites, Zika virus disease symptoms, and pregnancy risks associated with Zika. Practices that help to prevent mosquito bites are also covered such as using an EPA registered insect repellent with DEET, the importance of wearing long sleeved shirts and long pants when outdoors, and treating clothing with permethrin. Multiple choice and matching games are provided to gauge how much you learned about Zika.

Use the following link to access the game, and have fun! http://zika.vmasc.odu.edu/zap/

Computer WebGL Compatibility: Chrome 64 bit Version 57 and newer, Microsoft Edge version 16 or newer, Safari version 11 or newer, and Firefox version 52 or newer. Firefox users check your privacy settings.

For more information about the ZAP Game or for any other concerns please email us at Zapzika@odu.edu or contact:

Bridget Giles PhD Virginia Modeling Analysis and Simulation Center Old Dominion University 1030 University Blvd. Suffolk, VA 23435 Email: bgiles@odu.edu Phone: 757-638-4436



-8 Exploring Research Perspectives

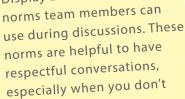
As you learned in Task 1-6 and 1-7, the team will be presented with various perspectives of the problem throughout your research: social, ethical, environmental, and economic.



In this task, the team will explore these perspectives to understand them better.

This task only requires space for a continuous line (real or imagined) from one side of the room to the other.

- 1. Post one sign stating STRONGLY AGREE and one sign stating STRONGLY DISAGREE on opposite walls or corners of the room. The space between these two signs is the continuum. Put a sign in the middle of these two signs that states NOT SURE.
- 2. The team will hear a variety of statements.
- 3. After each statement, each team member should place themselves along the continuum based on how much they agree or disagree.
- Go to the Task 1-8 folder to get the statements, further instructions, discussion questions and Meet the Team Reading. Choose the Mosquito A or Mosquito B version of this task.
- 5. Go over the team norms together in the task folder.
- 6. Follow the instructions to play the warm-up round.
- 7. As a team, discuss the Warm-Up Discussion Questions.
- 8. Follow the instructions to play four Perspectives rounds and questions.
- 9. As a team, discuss the Task 1-8 Discussion Questions.
- 10. Read the Meet the Team Reading on what to do when the team does not agree?. Learn about and discuss the ways their teams work through disagreements. Think about how your team can best work together to respect everyone's ideas.



Research Tip

Display a set of talking

agree.

7.11.222



Hooray! You completed Task 1-8. Check it off the task list. Go to Task 1-9!

Mosquito!







Task 1-8 Exploring Research Perspectives—Mosquito A

Team Norms

- Recognize the benefits of listening to a range of different perspectives and viewpoints.
- Be open to new ideas and perspectives that challenge your own.
- Be willing to cooperate with others to change things for the better.
- Use active listening skills.
 - Face the person talking.
 - Look them in the eye.
 - Be attentive.
 - Keep an open mind.
 - Don't interrupt.
 - Ask questions if you are confused.

Warm-Up Round Instructions

1. Here is the warm-up round statement.

Bananas are the best-tasting fruit.

2. There are not necessarily any right or wrong answers, and everyone's view will fall somewhere along the continuum, from strongly agree to strongly disagree.

3. Take a minute and let each team member think about their position on that statement. Explain the next step, so team members can choose where to stand along the continuum.

• Explain that relative location is also important; that is, standing closer to the strongly agree or disagree side of the room means you feel very strongly about this statement.

4. Once each team member is located along the continuum, direct the team members to begin explaining to those standing near them why they placed themselves as they did. Students should explain their reasoning for their location.

5. Based on these discussions with the people near them, they should be "recalibrating" with each other. This is the process of listening to other team members near them and determining whether they really are more or less extreme in their thoughts and feelings on the topic. Encourage team members to move as necessary to accurately represent the continuum of opinion on the team.

Warm-Up Round Discussion Questions

- Can individual team members explain to the team the reasons for their position on the continuum?
- How many team members changed their positions after talking to other team members around them on the continuum?
- How many team members changed their positions after hearing people talk during the whole team discussion?
- What led you to change your mind?



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Mosquito!

• Conclude the discussion by asking team members on both sides of the issue to identify what they believe to be the strongest arguments and reasons they heard from the *opposing* side.

Four Perspectives Rounds Instructions and Questions

- 1. The line continuum setup for the next four rounds stays the same. The main difference is the team is now divided into groups of three to four team members.
- 2. Each group will negotiate their position along the continuum, based on the following statement.

Ethical perspective: It is okay to kill all of the mosquitoes on the planet.

- 3. Each group must determine where they are located on the continuum as a group.
- 4. Each group will send one representative to identify the place on the continuum line that best represents the group's view.
- 5. Now the representatives from each group will explain to the whole team the reasons for their group's position on the continuum. Members of the group speaking can support the representative at any time.
 - 6. After each group has had a chance to share, each group should have a brief discussion about whether they would like to move their location on the continuum, based on the team discussion.
 - How many groups changed their positions after hearing people talk during the whole team discussion?
 - What led you to change your mind or not change your mind?
 - Conclude the discussion by asking team members on both sides of the issue to identify what they believe to be the strongest arguments and reasons they heard from the *opposing* side.
 - 7. Repeat steps two through six for *one* statement from each of the following three perspectives categories.

Social Perspective

- 1. People who live in places with mosquito-borne diseases should not be able to travel to other places to visit family.
- 2. People who get mosquito-borne diseases engage in some type of risky behavior.

Environmental Perspective

- 1. All mosquitoes are dangerous to humans.
- 2. Spraying potentially harmful chemicals to control mosquitoes around children and pregnant women is okay.

Economic Perspective

- 1. Mosquito bed nets protect you from mosquito bites when you are sleeping. It is okay that people who cannot afford to buy a bed net get sick more often from mosquito-borne diseases.
- 2. Every person should be required by the government to pay some tax money to help people who cannot afford to protect themselves from mosquito-borne diseases.





SCIENCE for Global Goals Mosquito!

Task 1-8 Discussion Questions

As an entire team, discuss the following questions.

Remind the team that you will now engage in a discussion. When engaging in any type of meaningful discussion as a team, you must respect your team. Use the meaningful conversation starters in your discussion to respect your other team members.

Meaningful conversation starters used in the language of argumentation:

- I agree with _____ because ...
- I disagree with _____because ...
- I'd like to go back to what ______ said about ...
- I'd like to add _____
- I noticed that ...
- Another example is ...
- So, what you are saying is ...
- Do you think that ...?
- Couldn't it also be that ...?
- Why do you think that?
- Can you explain what you mean?
- Can you tell me more?
- Can you give me an example of that?
- 1. How did your group arrive at your decisions?
- 2. What decision-making methods did your group use (consensus, voting, etc.)?
- 3. How were your decisions influenced by the values? Attitudes? Prejudices? Aspects of identity of people in your group?
- 4. How were disagreements and conflicts handled?
- 5. What are some benefits to listening to a range of different perspectives and viewpoints on the team?
- 6. Is it helpful to be open to new ideas and perspectives that challenge your own? Why or why not?
- 7. Is there anything you learned in this task that would be useful when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?



Go back to Research Guide now









Task 1-8 Exploring Research Perspectives—Mosquito B

Team Norms

- Recognize the benefits of listening to a range of different perspectives and viewpoints.
- Be open to new ideas and perspectives that challenge your own.
- Be willing to cooperate with others to change things for the better.
- Use active listening skills.
 - Face the person talking.
 - Look them in the eye.
 - Be attentive.
 - Keep an open mind.
 - Don't interrupt.
 - Ask questions if you are confused.

Warm-Up Round Instructions

1. Here is the warm-up round statement.

Bananas are the best-tasting fruit.

2. There are not necessarily any right or wrong answers, and everyone's view will fall somewhere along the continuum, from strongly agree to strongly disagree.

3. Take a minute and let each team member think about their position on that statement. Explain the next step so team members can choose where to stand along the continuum.

• Explain that relative location is also important; that is, standing closer to the strongly agree or disagree side of the room means you feel very strongly about this statement.

4. Once each team member is located along the continuum, direct the team members to begin explaining to those standing near them why they placed themselves as they did. Students should explain their reasoning for their location.

5. Based on these discussions with the people near them, they should be "recalibrating" with each other. This is the process of listening to other team members near them and determining whether they really are more or less extreme in their thoughts and feelings on the topic. Encourage team members to move as necessary to accurately represent the continuum of opinion on the team.

Warm-Up Round Discussion Questions

- Can individual team members explain to the team the reasons for their position on the continuum.
- How many team members changed their positions after talking to other team members around them on the continuum?
- How many team members changed their positions after hearing people talk during the whole team discussion?
- What led you to change your mind?



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• Conclude the discussion by asking team members on both sides of the issue to identify what they believe to be the strongest arguments and reasons they heard from the *opposing* side.

Four Perspectives Rounds Instructions and Questions

- 1. The line continuum setup of the next four rounds stays basically the same—but with some differences that are described in the step three.
- 2. Present the following statement to the entire team.

Ethical perspective: It is okay to kill all of the mosquitoes on the planet.

- 3. Have each person individually place themselves along the continuum.
- 4. Next, create groups of three to four team members with the team members that are nearest you on the continuum.
- 5. Have each group work together to develop an explanation of the reasons for their group's position on the continuum. Share these explanations with the entire team.
- 6. After each group has had a chance to share, each group should have a brief discussion about whether they would like to move their location on the continuum, based on the team discussion.
 - How many groups changed their positions after hearing people talk during the whole team discussion?
 - What led you to change your mind or not change your mind?
 - Conclude the discussion by asking team members on both sides of the issue to identify what they believe to be the strongest arguments and reasons they heard from the *opposing* side.
 - 7. Repeat steps two through six for *one* statement from each of the following three perspectives categories.

Social perspective

- 1. People who live in places with mosquito-borne diseases should not be able to travel to other places to visit family.
- 2. People who get mosquito-borne diseases engage in some type of risky behavior.

Environmental Perspective

- 1. All mosquitoes are dangerous to humans.
- 2. Spraying potentially harmful chemicals to control mosquitoes around children and pregnant women is okay.

Economic Perspective

- 1. Mosquito bed nets protect you from mosquitoes when you are sleeping. It is okay that people who cannot afford to buy a bed net get sick more often from mosquito-borne diseases.
- 2. Every person should be required by the government to pay some tax money to help people who cannot afford to protect themselves from mosquito-borne diseases.



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Task 1-8 Discussion Questions

As an entire team, discuss the following questions.

Remind the team that you will now engage in a discussion. When engaging in any type of meaningful discussion as a team, you must respect your team. Use the meaningful conversation starters in your discussion to respect your other team members.

Meaningful conversation starters used in the language of argumentation:

- a. I agree with _____ because ...
- b. I disagree with _____because ...
- c. I'd like to go back to what ______ said about ...
- d. I'd like to add _____
- e. I noticed that ...
- f. Another example is ...
- g. So, what you are saying is ...
- h. Do you think that ...?
- i. Couldn't it also be that ...?
- j. Why do you think that?
- k. Can you explain what you mean?
- I. Can you tell me more?
- m. Can you give me an example of that?
- 1. How did your group arrive at your decisions?
- 2. What decision-making methods did your group use (consensus, voting, etc.)?
- 3. How were your decisions influenced by the values? Attitudes? Prejudices? Aspects of identity of people in your group?
- 4. How were disagreements and conflicts handled?
- 5. What are some benefits to listening to a range of different perspectives and viewpoints on the team?
- 6. Is it helpful to be open to new ideas and perspectives that challenge your own? Why or why not?

Is there anything you learned in this task that would be useful when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?









Mosquito!: Task 1-8 Exploring Research Perspectives

What do you do when the team does not agree?



David Pecor - Walter Reed Biosystematics Unit (WRBU)

Sometimes people on our team do not agree. When the team does not agree, we make sure to treat each other with respect. It is important to not bring your personal feelings or opinions into the argument. Just as in science, the best evidence will determine which path to take. Sometimes there is not enough evidence to decide the argument. This means the solution is to gather more information. The team will gather information until enough exists to support one side or the other. Sometimes the solution is to

discuss issues or generate new ideas. Brainstorming sessions are needed for our team. We start by focusing the group around a single issue. Then we freely explore all possible (and even some impossible) solutions together via discussion. We begin to build ideas that will eventually become real solutions. Think about how your team can work together to respect everyone's ideas.



Meera Venkatesan - President's Malaria Initiative - United States Agency for International Development (USAID)

Sometimes people on our team do not agree. When this happens I try to understand where the other side is coming from. I try to put myself in their shoes. Even if we do not agree, I can at least see the discussion from their perspective. This helps me approach the discussion with humility and openness. It also helps the team come

to a decision we all can support. Think about how your team can work together to respect everyone's ideas.



Russane Low - Institute for Global Environmental Strategies

Sometimes people on our team do not agree. However, it is important to see the value of listening to each member of the team. Listening deeply is not easy. It is actually very hard work. I try and see an issue from each person's point of view. Sometimes I do not completely know where they are coming from. In these cases I try and imagine what their story might be. It is a useful way to help me talk with people I do not agree with. Being a good leader means being a good listener. Think about how your team can work

together to respect everyone's ideas.





Mosquito!: Task 1-8 Exploring Research Perspectives

What do you do when the team does not agree?



Kelly Bennett - Biologist - Smithsonian Tropical Research Institute (STRI)

Sometimes people on our team do not agree. This is an important part of science. Conferences, meetings, and networking events are invaluable to present our work to the scientific community. Public outreach events are also important to raise awareness of our findings to the nonscientific community. These events provide opportunities to engage the thoughts and concerns of all people involved.



Lee Cohnstaedt - Research Entomologist - United States Department of Agriculture (USDA)

Sometimes people on our team do not agree. Respect and empathy for others, perspectives are essential to effectively defending and presenting one's arguments. This is especially helpful when people do not agree. Bruce Lee, the famed martial artist, had a philosophy for his martial art (Jeet Kune Do), which

was understanding other martial arts and incorporating their key pieces to make your own style. Another way to say this is: Understand what others are trying to do so you can defend yourself, and learn from them so you can use their moves, if it fits your style. When this philosophy is applied to life, it becomes: Learn about others, their motivations, drive, and perspective. Then, when you debate or communicate with them, be able to use the best tools - theirs, yours, or others, - to maximum effectiveness. Be true to oneself, but keep learning about others, so as to continue growth and

development while maintaining an understanding of others and oneself.



Bridget Giles - Research Assistant Professor - Virginia Modeling Analysis & Simulation Center at Old Dominion University

Sometimes people on our team do not agree. Here at the Virginia Modeling Analysis and Simulation Center we build models, simulations, and visualizations to understand problems and make decisions. We investigate complex problems, design experiments, analyze data, and interpret results to help people

begin to agree when at first they might not.



Surveying Community

In Task 2-2, you learned more about what the team thinks about mosquitoes. Now it is time to survey other people in your community to see what they know. This will help the team understand what people think about these various parts of the mosquito problem. This survey will also provide evidence that will be useful to understand what things people might not understand about mosquitoes.

Objective

In this task, the team will be focusing on the following questions from the question map in Task 1-10: What do people in our local community think and know about mosquitoes and mosquito-borne diseases? How can we effectively share and communicate mosquito-borne disease evidence with the community?

Go to the Task 2-3 folder and get the Survey and Meet the Team reading. Use the same version (A or B) of the survey the team used for the team survey in Task 1-3.

- 1. Read the Meet the Team reading on Mosquito Misconceptions. These are things people around the world commonly do not understand about mosquitoes.
- Watch the Mosquito Hunter video in the Task 2-3 folder on the Smithsonian Learning Lab.
- 2. Determine who the team will survey in the community. The survey will help you understand any misconceptions in your community.

a. If you're surveying your family, friends, or people at school, decide who you will survey and why.







Research Tip

Use the field safety tips in the safety documents on Learning Lab before going out into the community to survey or interview people. Be polite, never go alone, and always be aware of your surroundings.



b. You can survey more than one person if you want.

c. If you're surveying someone in your community, decide who this person is and set up a way to conduct or provide them with the survey.

d. Whenever you're surveying people in your community, get permission from your team leader before contacting these people. Read through the safety documents concerning surveying or interviewing people in the Task 2-3 folder.

3. Determine how team members would like to conduct the survey.

a. Oral interview: You ask the questions and document the responses.

b. Provide each person a paper version of the survey and have them complete the survey on their own.

c. If you have access to digital survey tools, figure out how you could use them. Tools such as SurveyMonkey and Google Forms/ Docs can be used, if available.

d. If you have another strategy that works best for your team, do that!

4. Before you start surveying people, complete the following based on your team claims from Task 2-2.

Write a hypothesis about which form of communication you think will be most available to your community.

Example: Television is the most useful way to communicate to the community.

 Conduct the survey and bring the results back to the next team meeting. In Task 2-4, the team will compile and analyze the results of parts one and two of these surveys.

Hooray! You completed Task 2-3. Check it off the task list. Go to Task 2-4!

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SCIENCE for Global Goals Mosquito!

Task 2-3 Surveying Community—Mosquito A

If technology is available, watch the videos in the Learning Lab Task folder to understand why it is important to learn about what your local community knows about mosquitoes, and how you can educate your community to help ensure health for all.

The survey starts on the next page.







Task 2-3: Community Mosquito—Survey A

Name:

Part 1: Background Information

Age:					
0-10	11-20	21-40	41-64	65+	

Gender				
Male	Female	Non-binary/third gender	Prefer to self-describe:	Prefer not to say

What town do you live in?						

Is your home in the city, village, or rural?					
City	Village	Rural	Other		

Availability of communication media in the house (check all that apply)					
Television	Newspaper	Radio	Computer		
Tablet	Internet	Telephone	Mobile phone		
SMS	Social media	Mobile phone with Internet	Other		

Part 2: Community

How well do you understand mosquitoes?						
1. Not at all2. Hardly3. Somewhat4. Well5. Very well						

How concerned are you about mosquitoes in your community?						
2. Hardly	3. Somewhat	4. Concerned	5. Very concerned			
	•					





Part 3: Life

Are both male and female mosquitoes able to transmit diseases to humans?						
Only male mosquitoes are able to transmit diseases to humans	Only female mosquitoes are able to transmit diseases to humans	Both male and female mosquitoes can transmit diseases to humans	Not sure			

What time of the day do mosquitoes bite? (check all that apply)					
Day time	Night time	Morning	Not sure		

Part 4: Transmission

Can mosquito-borne diseases be transmitted simply by being near people who are sick?					
Yes, mosquito-borne diseases can be transmitted by being near people who are sick	No, mosquito-borne diseases are not transmitted simply by being near people who are sick	Not sure			

Can some mosquito-borne diseases be transmitted to other animals (birds, horses, dogs)?					
Yes, some mosquito-borne diseases can be transmitted to other animals	No, mosquito-borne diseases cannot be transmitted to animals	Not sure			

Part 5: Habitats

Where do mosquitoes breed? (check all that apply)					
Still, stagnant water	Moving water	Drain	Water storage container	Garbage	
Trash container	Old tire	Old car	Old boat	Holes in tree	
Animal shell	Other	Not sure			





Do you have any containers holding water, or low areas with standing water around your home?					
Yes	No Not sure				

Part 6: Management

Where do you receive information on mosquitoes in the community? (check all that apply)						
Personal experience/observation	Family/friends	School/university	Television	Radio		
Print/newspaper	Social media	Internet	Mobile phone	Doctors/health workers		
Government	Other	Not sure				

Do you currently take any action to prevent yourself from getting a mosquito-borne disease?							
Yes	No	Not sure					
If yes, please describe your action.							





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Mosquito!

Task 2-3 Surveying Community—Mosquito B

If technology is available, watch the videos in the Learning Lab Task folder to understand why it is important to learn about what your local community knows about mosquitoes and how you can educate your community to help ensure health for all.

The survey starts on the next page.







Task 2-3: Community Mosquito Survey—Mosquito B

Name:

Part 1: Background Information

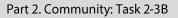
Age:						
0-10	11-20	21-40	41-64	65+		

Gender				
Male	Female	Non-binary/third gender	Prefer to self-describe:	Prefer not to say

What town do you live in?		

Is your home in the city, village, or rural?					
City	Village	Rural	Other		

Availability of communication media in the house (check all that apply)					
Television	Computer				
Tablet	Internet	Telephone	Mobile phone		
SMS Social media Mobile phone with Other Internet					











Part 2: Community

Is this the first time someone has surveyed you about mosquitoes?					
Yes No Not sure					

How well do you understand mosquitoes?						
1. Not at all	2. Hardly	3. Somewhat	4. Well	5. Very well		

How concerned are you about mosquitoes in your community?						
1. Not at all 2. Hardly 3. Somewhat 4. Concerned 5. Very concerned						

During the worst times of the year, how severe are the mosquitoes around your home?						
1. Not severe2. Minimal3. Average4. Fairly severe5. Extremely						
severe						

During the worst times of the year, how many times do you get bitten by mosquitoes in a day?						
0 bites	1-5 bites	5-10 bites	10-20 bites	20-40 bites	40+ bites	

What impact do mosquitoes have on your quality of life?				
Health Risk	Nuisance	No Impact	Other	







Part 3: Life

Are there different types of mosquitoes, or are they all the same?			
There are different types of mosquitoes	They are all the same	Not sure	

Are both male and female mosquitoes able to transmit diseases to humans?				
Only male mosquitoes are able to transmit diseases to humans	Only female mosquitoes are able to transmit diseases to humans	Both male and female mosquitoes can transmit diseases to humans	Not sure	

What time of the day do mosquitoes bite? (check all that apply)				
Day time	Night time	Morning	Not sure	

Where do mosquitoes get their food from? (check all that apply)			
Flowers Sap from plants Garbage			
Blood from animals	Other	Not sure	

Do mosquitoes lay eggs or give birth to developed mosquitoes?						
Lay eggs Developed mosquitoes Not sure						





Part 4: Transmission

Can mosquito-borne diseases be transmitted simply by being near people who are sick?			
Yes, mosquito-borne diseases can be transmitted by being near people who are sick	No, mosquito-borne diseases are not transmitted simply by being near people who are sick	Not sure	

Can some mosquito-borne diseases be transmitted to other animals (birds, horses, dogs)?			
Yes, some mosquito-borne diseases can be transmitted to other animals	No, mosquito-borne diseases cannot be transmitted to animals	Not sure	

Part 5: Habitats

Where do mosquitoes breed? Check all that apply				
Still stagnant water	Moving water	Drain	Water storage container	Garbage
Trash container	Old tire	Old car	Old boat	Holes in tree
Animal shell	Other	Not sure		

Do you have any containers holding water, or low areas with standing water around your home?				
Yes	No Not sure			





Part 6: Management

Where do you receive information on mosquitoes in the community? (check all that apply)				
Personal experience/observation	Family/friends	School/university	Television	Radio
Print/newspaper	Social media	Internet	Mobile phone	Doctors/health workers
Government	Other	Not sure		

Which source do you most trust for accurate information about mosquito-borne diseases?					
Personal experience/observation	Family/friends	School/university	Television	Radio	
Print/newspaper	Social media	Internet	Mobile phone	Doctors/health workers	
Government	Other	Not sure			

Are you aware of the mosquito control services in the community?						
Yes	No	Not sure				
If yes, please describe which servi	ces.					

Do you currently take any action to prevent yourself from getting a mosquito-borne disease?					
Yes	No	Not sure			
If yes, please describe your action	If yes, please describe your action.				

How concerned are you about mosquito-borne diseases in your community in the future?						
1. Not concerned 2. Hardly 3. Somewhat 4. Concerned 5. Very concerned						
concerned concerned						

Go back to Research Guide now









Task 2-3 Surveying Community

What things do people commonly not understand about mosquitoes?



David Pecor - Research Technician - Walter Reed Biosystematics Unit (WRBU)

I have encountered one misconception constantly. This misconception is about how many different types of mosquitoes there are in the world. Some people think of the "mosquito" as a single type of insect. They think all mosquitos are the same throughout the world. In fact, there are thousands of different species of mosquitoes. Less than 10 percent of them play a role in the spread of disease. People must understand that there are different types of mosquitoes. Each type has different behaviors. The behaviors will directly affect how effective control measures will be. Most types of mosquitoes are

not harmful to humans. They actually play essential roles in the environment as pollinators and food for other organisms. Even within the small number of mosquitoes that spread disease, behaviors vary widely (what and when they like to eat, where they rest and reproduce). It is important that all people in a community understand these behaviors so they can design effective control strategies. What do people in your community think about mosquitoes? Ask them.



Meera Venkatesan - Malaria Technical Advisor - President's Malaria Initiative - United States Agency for International Development (USAID)

Many people in countries with mosquito-borne diseases know about the mosquitoes that carry the disease. They also know how to protect themselves. However, there are still misconceptions about when to use a net. Sometimes people will only use the net during the rainy season. People do not know that malaria can be transmitted all year round. The goal is to get net use to be regular, day in and day out. This is so people receive maximum protection from mosquitoes. It is important that all people in a community understand these things about the mosquito problem. What do people in your community

think about mosquitoes? Ask them.



Rusty Low - Senior Earth Scientist - Institute for Global Environmental Strategies

Many people have misunderstandings about mosquitoes. For example, most people do not realize adult mosquitoes feed on plants and nectar. Only the female mosquitoes of some species bites people. Some mosquitoes do not bite at all! For example, Toxorhynchites are day-flying mosquitoes that do not need a blood meal to produce eggs, so they do not bite. As larvae these mosquitoes eat the larvae of its own kind and also other possibly dangerous mosquitoes. They eat so much that when they mature, they are ready to lay eggs without

a blood meal! So these are good mosquitoes! (Ever hear of a good mosquito?) These are important mosquitoes in our ecosystems. They naturally reduce the number of other problem mosquitoes, like those that can spread diseases if allowed to mature into adults. Many people also do not know that mosquito larvae do not transmit disease. Diseases are transmitted through bites from a female preparing to lay eggs. It is important that all people in a community understand these things about the mosquito problem. What do people in your community think about mosquitoes? Ask them.



What things do people commonly not understand about mosquitoes?



Kelly Bennett - Biologist - Smithsonian Tropical Research Institute (STRI)

One misconception I encounter is that mosquito infestation can be successfully counteracted just with insecticides. This understanding causes many countries to rely only on this method to control mosquito-borne disease at great expense. However, due to the increase in insecticide resistance in mosquito populations worldwide, the application of chemical control is largely ineffective and can also have adverse environmental impacts.



Lee Cohnstaedt - Research Entomologist - United States Department of Agriculture (USDA)

If we do not understand a problem, we cannot hope to solve it. Therefore, people cannot protect themselves or their pets if they fear mosquitoes or worse, the tools used to reduce mosquito populations. For example, many people fear using DEET and other repellents because they are chemicals. However, being bitten by an infected

mosquito and contracting malaria or dengue is much worse than the minimal risk of protecting oneself. Individuals should always try to be educated about what works, how it works, and how to use it. Then they can balance the risks between personal protection and exposure to chemicals.



Bridget Giles - Research Assistant Professor - Virginia Modeling Analysis & Simulation Center at Old Dominion University

Many people have misunderstandings concerning mosquitoborne diseases that affect their behaviors. Some people believe, "Oh, it will never happen to me" when it comes to getting bitten by a mosquito with a harmful virus like Zika. Therefore they do not take protective measures, like putting on insect repellent or wearing long pants and long-sleeve shirts. One challenge people

are currently working on is a safe and effective Zika vaccine. Although pregnant women are usually excluded from vaccine research, pregnant women are at the center of the Zika epidemic, so bioethics groups have to really weigh the pros and cons of including pregnant women in Zika vaccine research. It will then be very important for this information to be understood by the public to move forward appropriately.







Team News Article Links for Task 2-3

Mosquito Hunter - Frontline Video Description: Good video to present overview of mosquito problem and community involvement. https://youtu.be/0n6VtSam9To



2-4 Analyzing Community Surveys

In Task 2-2, the team learned how to analyze the team survey results for parts one and two. In task 2-3, you then surveyed people in your local community. In this task, you will do the same kind of analysis you did during Task 2-3. Now you will focus on the community survey results only for parts one and two, Background and Community, of the survey. The team will use this analysis to think about the social perspecitve of the problem. The team will analyze the other parts of the survey in future tasks. So keep the survey results in a safe place.

Objective

In this task, the team will be focusing on the following questions from the question map in Task 1-10: What do people in our local community think and know about mosquitoes and mosquito-borne diseases? How can we effectively share and communicate mosquito-borne disease evidence with the community?

- 1. Go to the Task 2-4 folder and get the survey analysis instructions and questions.
 - Choose Mosquito A or Mosquito B task from the task folder.
- 2. As a team, determine how to compile the community survey results for parts one and two for all team members. You will want to analyze the compiled data from the entire team. Develop your own method for compiling the data for parts one and two, or use one of the methods in the instructions.
- 3. Create some graphs about this compiled community survey data. Use the instructions and examples in the task folder.
- 4. Use your graphs and data to answer these questions:
- What interesting patterns do you see in the data from part one or two questions of the survey.

33





As you may have noticed, the survey is broken into the same parts as this research guide. Analyze only the results from that part of the survey while working on that Part of the guide to make the analysis more manageable. Task

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- 2-4
- Which questions did most people in the community agree on?
- Which questions did people in the community have different responses for?
- Discuss how this survey evidence could be useful when thinking about the question: What do people in our local community think about mosquitoes and mosquito-borne diseases?
- Discuss how this survey evidence could be useful when thinking about the question: How can we effectively share and communicate mosquito-borne disease evidence with the community?
- Discuss how this survey evidence could be useful when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?
- 5. In Task 2-3, you wrote a hypothesis about which form of communication would be most available to the community.
- Example: Television is the most useful way to communicate to the community.
- 6. Using your team and community survey results, analyze the data from the question about availability of communication media to determine whether or not your hypothesis was supported by the evidence.
- 7. As a team, discuss different hypotheses and the evidence that supported it or not.
- 8. Select two or three survey questions, write a claim, and provide the supporting evidence for the claim based on the surveys you collected.
- 9. Examples:
- People in our community are not concerned at all about mosquitoes and mosquito-borne diseases.
- Social media is a useful way to communicate to our community.
- 10. Explain how the data evidence from the community survey supports your claims.
- 11. As a team, share some claims you created and the evidence that supports them.

Hooray! You completed Task 2-4. Check it off the task list. Go to Task 2-5!

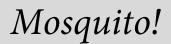
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Task

Mosquito!







Task 2-4 Analyzing Community Surveys—Mosquito A

Compiling Survey Data Options

First we must compile the answers from the community surveys to all of the questions from Parts One and Two: Background Information and Community. The team will look at the other parts in later tasks.

Here are some options for compiling the answers to the survey questions. But, as always, if you have different method you prefer, do that!

Option 1

Hand out a survey to each person.

Go through each question and team members can raise their hands to vote for the answer they prefer. Some team members can count up the votes and others can write down the totals for the team.

Option 2

Have questions on a board, paper, or computer where tallies can be compiled. Tally the responses and share the results.

Option 3

Digital survey: If you did the survey digitally, you should be able to see the results for each question.

Option 4

Create your own way of compiling survey data.

Graphing Survey Data

How could you graph parts of these survey results?

Which questions could you graph?

View the Task 2-4 graph examples.

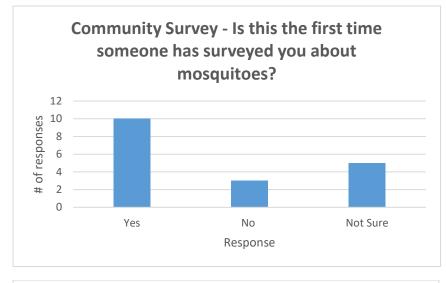
If you have the resources, pick some questions to graph that you think would be useful.

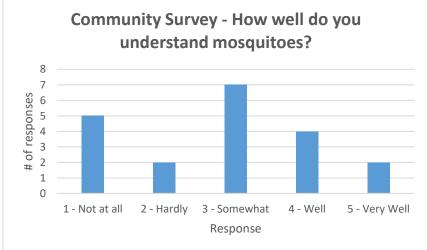
How would these graphs be useful when supporting claims with evidence?

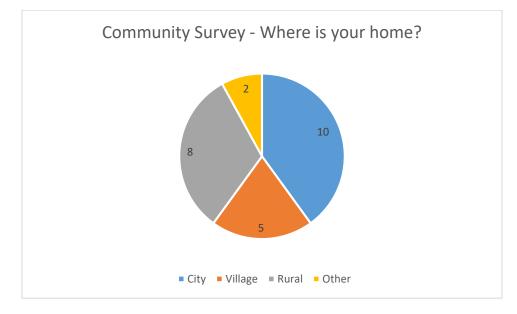




Community Survey Graph Examples











Community Survey–Mosquito A

Use this survey to compile data.

Part 1: Background Information

Age				
0-10	11-20	21-40	41-64	65+

Gender					
Male	Female	Non-binary/third gender	Prefer to self-describe:	Prefer not to say	

What town do you live in?		

Is your home in the city, village, or rural?					
City	Village	Rural	Other		

Availability of communication media in the house (check all that apply)					
Television	Newspaper	Radio	Computer		
Tablet	Internet	Telephone	Mobile phone		
SMS	Social media	Mobile phone with Internet	Other		

Part 2: Community

How well do you understand mosquitoes?						
1. Not at all	2. Hardly	3. Somewhat	4. Well	5. Very well		

How concerned are you about mosquitoes in your community?					
1. Not at all	2. Hardly	3. Somewhat	4. Concerned	5. Very concerned	

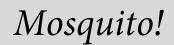


Go back to Research Guide now









Task 2-4 Analyzing Community Surveys—Mosquito B

Compiling Survey Data Options

First we must compile the answers from the community surveys to all of the questions from Parts One and Two: Background Information and Community. The team will look at the other parts in later tasks.

Here are some options for compiling the answers to the survey questions. But, as always, if you have different method you prefer, do that!

Option 1

Hand out a survey to each person.

Go through each question and team members can raise their hands to vote for the answer they prefer. Some team members can count up the votes and others can write down the totals for the team.

Option 2

Have questions on a board, paper, or computer where tallies can be compiled. Tally the responses and share the results.

Option 3

Digital survey: If you did the survey digitally, you should be able to see the results for each question.

Option 4

Create your own way of compiling survey data.

Graphing Survey Data

How could you graph parts of these survey results?

Which questions could you graph?

View the Task 2-4 graph examples

If you have the resources, pick some questions to graph that you think would be useful.

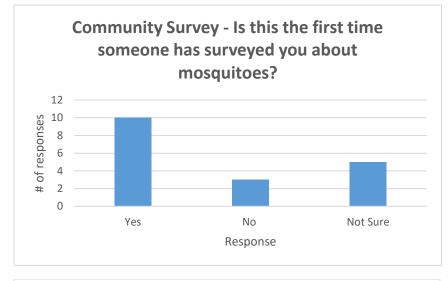
How would these graphs be useful when supporting claims with evidence?

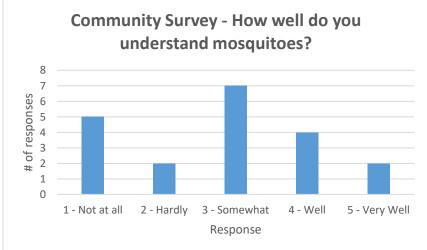


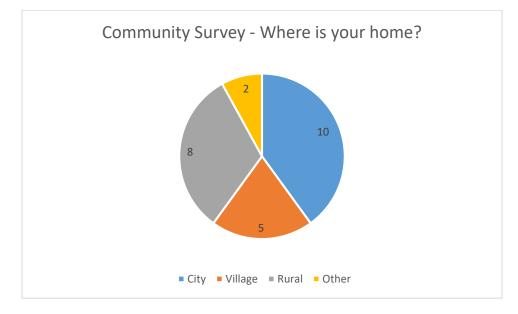


Mosquito!

Community Survey Graph Examples











Community Survey-Mosquito B

Use this survey to compile data.

Part 1: Background Information

Age:					
0-10	11-20	21-40	41-64	65+	

Gender						
Male	Female	Non-binary/third gender	Prefer to self-describe:	Prefer not to say		

What town do you live in?		

Is your home in the city, village, or rural?					
City	Village	Rural	Other		

Availability of communication media in the house (check all that apply)					
Television	Newspaper	Radio	Computer		
Tablet	Internet	Telephone	Mobile phone		
SMS	Social media	Other			









Part 2: Community

Is this the first time someone has surveyed you about mosquitoes?				
Yes	No	Not sure		

How well do you understand mosquitoes?					
1. Not at all	2. Hardly	3. Somewhat	4. Well	5. Very well	

How concerned are you about mosquitoes in your community?					
1. Not at all	2. Hardly	3. Somewhat	4. Concerned	5. Very concerned	

During the worst times of the year, how severe are the mosquitoes around your home?						
1. Not severe	2. Minimal	3. Average	4. Fairly severe	5. Extremely		
				severe		

During the worst times of the year, how many times do you get bitten by mosquitoes in a day?						
0 bites	1-5 bites	5-10 bites	10-20 bites	20-40 bites	40+ bites	

What impact do mosquitoes have on your quality of life?					
Health risk	Nuisance	No impact	Other		



Go back to Research Guide now



3-3 Investigating Mosquito Distribution

In Task 3-2, the team learned that not all mosquitoes spread diseases to humans. We also learned more about the medically significant mosquitoes that can spread disease to humans. These are the mosquitoes we will focus our research on. A big question we must investigate is where these mosquitoes live. We also need to learn about the environmental conditions that affect where mosquitoes like to live.

Task 3-3

Part Three. Life



In this task, the team will look at various maps to help us with these questions. Then the team will determine how to monitor the local environment over time. This data can be used to support decisions about when mosquitoes may be a problem in the community.

In this task, the team will be focusing on the following questions from the question map in Task 1-10. Where do mosquitoes live? What factors influence where they live?

Go to the Task 3-3 folder and get the Mosquito Distribution Maps. This task has only one version.



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Research Tip

Maps can be printed or viewed digitally. Do what works best for your team. And if you have other maps you want to include in this analysis, do it!

- Follow the directions in the task folder to complete the Mosquito Distribution Map analysis on the following:
 - Political distribution
 - Aedes and political distribution
 - Temperature, Aedes, and political distribution
 - Precipitation, temperature, *Aedes* and political distribution
 - Anopheles, precipitation, temperature and political distribution
 - Culex, precipitation, temperature and political distribution



- 2. As a team, discuss:
 - How can maps be helpful when studying mosquitoes and mosquitoborne diseases?
 - How do the environmental conditions (temperature and precipitation) change throughout the year in your location?
 - Does it rain more or less in your community at different times of year?
 - Does it snow in your community?
 - Does the temperature change at different times of the year in your community?
 - How does understanding the environmental conditions (temperature and precipitation) of your location help when thinking about the problem question: How can we ensure health for all from mosquitoborne diseases?
 - How could you monitor the changes in temperature and precipitation in your community throughout the year?
- 3. To understand the mosquito problem better in your local community, it is useful to collect some data evidence in your research site about the environmental conditions of temperature and precipitation. This data can then be used to determine if there are different times of the year when the conditions are better for mosquitoes.
- 4. Go to the Task 3-3 folder and get the Monitoring Local Weather instructions. Use the information and data sheet to determine how you will monitor the local weather over time in your community. Determine how this information could be useful to your local community when thinking about mosquitoes.

Hooray! You completed Task 3-3. Check it off the task list. Go to Task 3-4!

45







3-3 Investigating Mosquito Distribution:

Monitoring Local Weather Instructions and Log Table

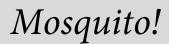
When studying mosquitoes, it is useful to understand changes in local weather throughout the year. The team will need to compare this local weather data to your observations of mosquitoes in the research site. This information will help support your claims about when mosquitoes may be more of a problem for the community. It will also help support claims about the possible future effects on mosquitoes of changes in the climate in your community. Depending on what resources you have available, you can monitor your local weather in many different ways. Pick the method that works best for you.

- 1. Use current and historical weather data collected by regional weather stations. This data can be collected online or from television or radio broadcasts.
- 2. Use tools to manually collect temperature and precipitation data in your research site.
 - **a.** Build your own weather station. Use the NOAA instructions to build your own weather collection tools to track data over time in your research site.
 - **b.** Purchase and set up a weather station in your research site.
- 3. The team will focus mainly on temperature and precipitation data at this time. However, please collect any other weather data you think could be useful for your research or would like to explore. These could include:
 - a. Wind speed
 - **b.** Wind direction
 - **c.** Atmospheric pressure
- 4. Use or make a data table to collect daily or weekly measurements in your research site throughout the year.
- 5. Mark on your research site map from Task 2-1 where you are taking your daily or weekly measurements.
- 6. When collecting weather data, make a daily general mosquito observation in your research site. Do you see adult mosquitoes in or around your site? If so, can you do a general count?
- 7. If you are collecting mosquito eggs as outlined in Task 3-1, note on your data sheet what days you did or did not collect eggs.
- 8. Compare your temperature, precipitation, and egg and adult collection data.
- 9. How could this data be useful to address the problem question: How can we ensure health for all from mosquitoes?





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Weather Observation Data Table

Date	Time	Outside	Precipitation	Notes (observations of
		temperature (°C)	(mm)	mosquitoes in research site,
				atmospheric pressure, wind)

Go back to Research Guide now





Task 3-3 Investigating Mosquito Distribution

Mosquito Distribution Maps

Questions from Map: Where do mosquitoes live? What factors influence where they live?







Mosquito! © 2018 Smithsonian Institution

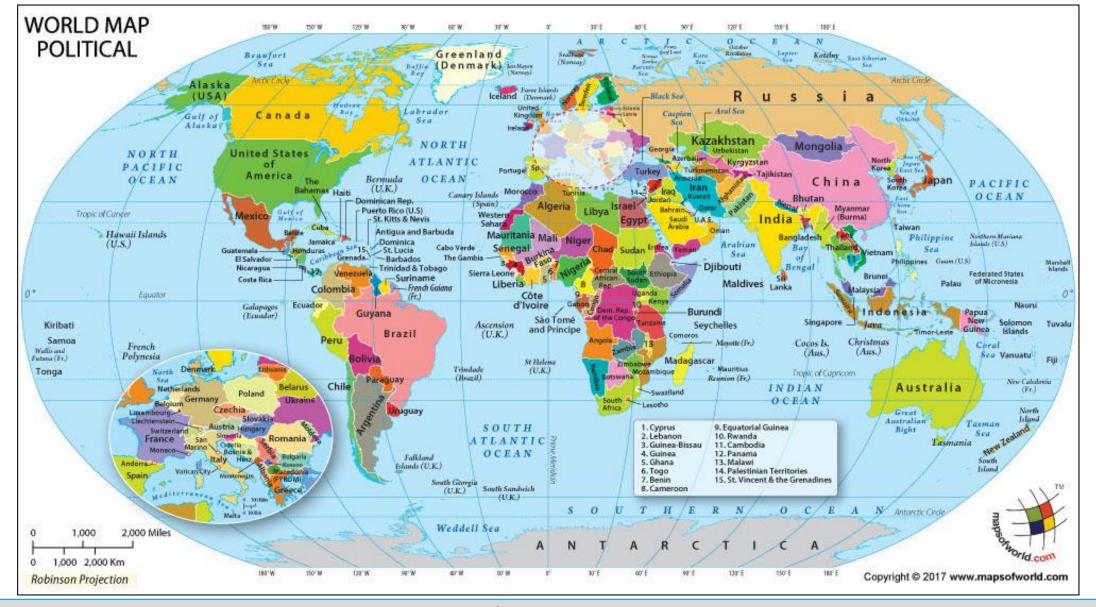
Step 1 – Political Distribution

- Look at the Political map of the World on the next slide.
- As a team, find the country where you live. Where inside this country do you live?
- What are the names of some other countries near or around you?





Mosquito! Part 3. Life: Task 3-3







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Step 2 – Aedes and Political Distribution

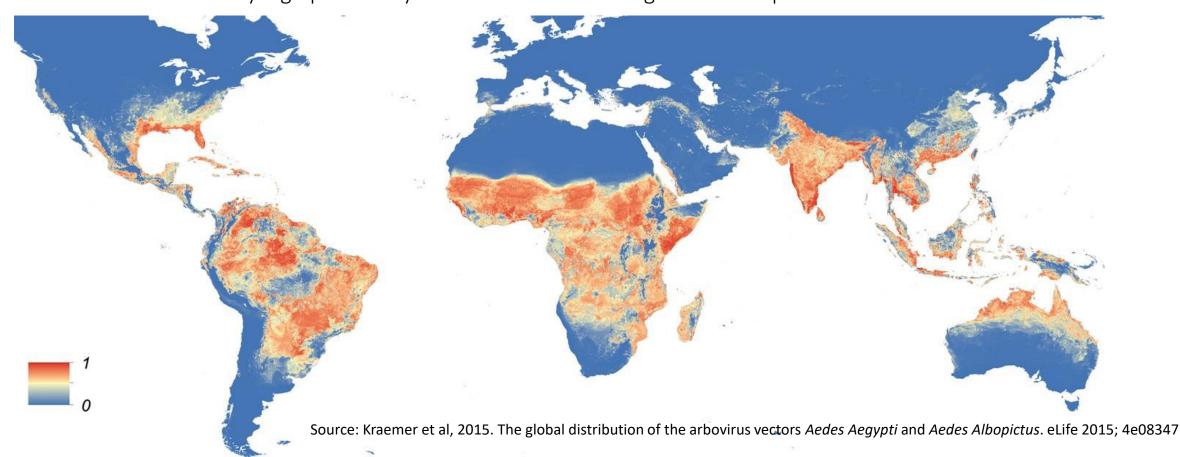
- Look at the Global Distribution Map of the Aedes Mosquito on the next slide
 - Work with your team to read the instructions and understand the color scale
- Find where you live on this Aedes distribution map
- Using the color key, what is the probability or chance that Aedes live where you live?
- Describe the distribution of *Aedes* in countries near or around where you live.
- Describe the distribution or patterns of *Aedes* in other parts of the world.
- Using the World Political Map and Global *Aedes* Map together, make a list of the names of some different countries where *Aedes* has a very high probability or chance of living.
- Identify some clear lines of divide between areas of high and low mosquito distribution.
- What do you think could be causing these patterns?
- What could this relationship possibly tell you about the environment *Aedes* prefer to live in?





Global Distribution Map of Aedes Mosquito

The color tells us how likely it is to be present at that location.Blue indicates low probability or chance of there being *Aedes* mosquitoes Yellow indicates higher probability or chance of there being *Aedes* mosquitoes Red indicates very high probability or chance of there being *Aedes* mosquitoes





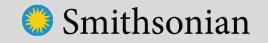




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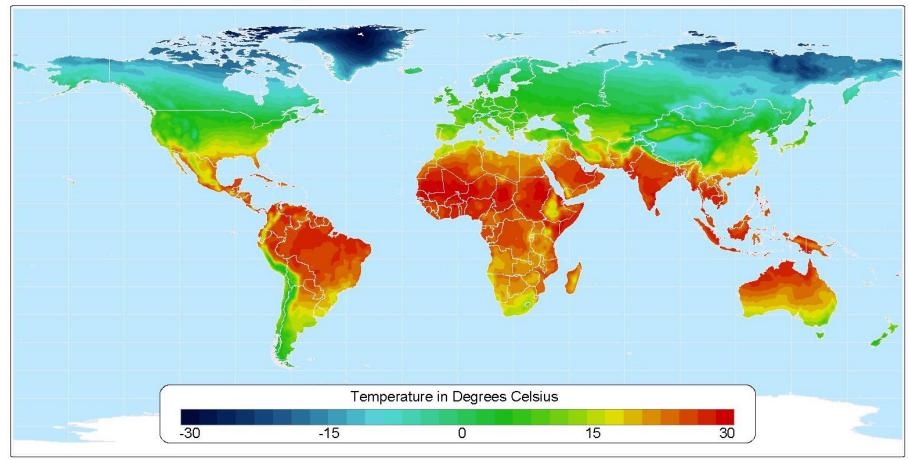
Step 3 – Temperature, *Aedes* and Political Distribution

- Look at the Average annual Temperature map
 - This map tells you how hot or cold on average a place is throughout the year.
 - Red indicates it is hotter
 - Blue indicates it is colder
- Find where you live on the Temperature map
- What is the approximate average annual temperature where you live?
- Describe any patterns you notice on the temperature map.
- List some countries where the average temperature is very low. List some countries where the average temperature is very high.
- Compare and contrast the patterns on the *Aedes* map to the Average Annual Temperature map.
- Do you see any similarities between where *Aedes* live and the temperature?
- List some countries and places where you see very similar patterns between the temperature and *Aedes* mosquitoes.
- What does this relationship possibly tell you about the environment Aedes prefer to live in?





Average Annual Temperature



Data taken from: CRU 0.5 Degree Dataset (New, et al.)

Atlas of the Biosphere

Center for Sustainability and the Global Environment University of Wisconsin - Madison





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Step 4 – Precipitation, Temperature, *Aedes* and Political Distribution

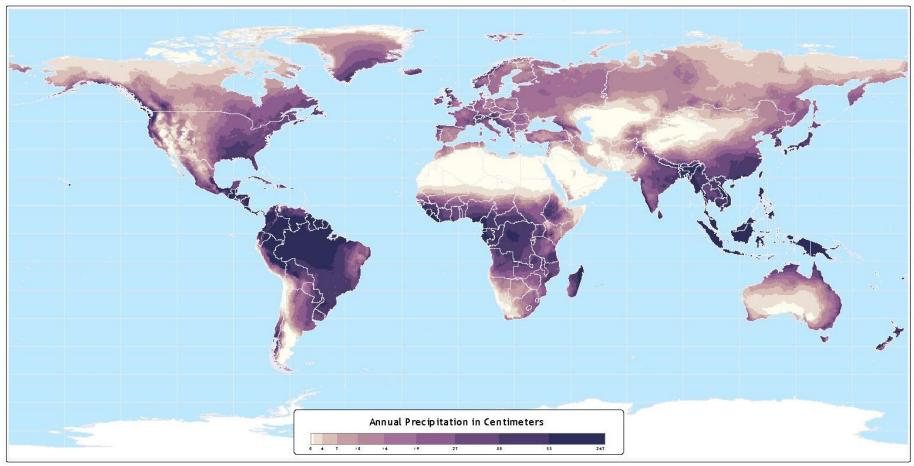
- Look at the Annual Total Precipitation map
 - This map tells you how much it rains in a place throughout the year.
 - The darker areas mean it rains more there
 - The lighter areas mean it rains very little there
- Find where you live on the Precipitation map
- What is the approximate annual precipitation where you live?
- Describe any patterns you notice on the precipitation map.
- List some countries where the precipitation is very low. List some countries where the average precipitation is very high.
- Compare and contrast the patterns on the *Aedes* map to the Precipitation map.
- Do you see any similarities between where *Aedes* live and the amount it rains there?
- List some countries and places where you see very similar patterns between these two maps.
- List some countries and places where you see very similar patterns between the *Aedes* map, the Annual Total Precipitation map, and the Average Annual Temperature map.
- What does these relationships possibly tell you about the environment *Aedes* prefer to live in?





Mosquito! Part 3. Life: Task 3-3

Annual Total Precipitation



Data taken from: CRU 0.5 Degree Dataset (New et al)

Atlas of the Biosphere

Center for Sustainability and the Global Environment University of Wisconsin - Madison







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Step 5 - Anopheles, Precipitation, Temperature and Political Distribution

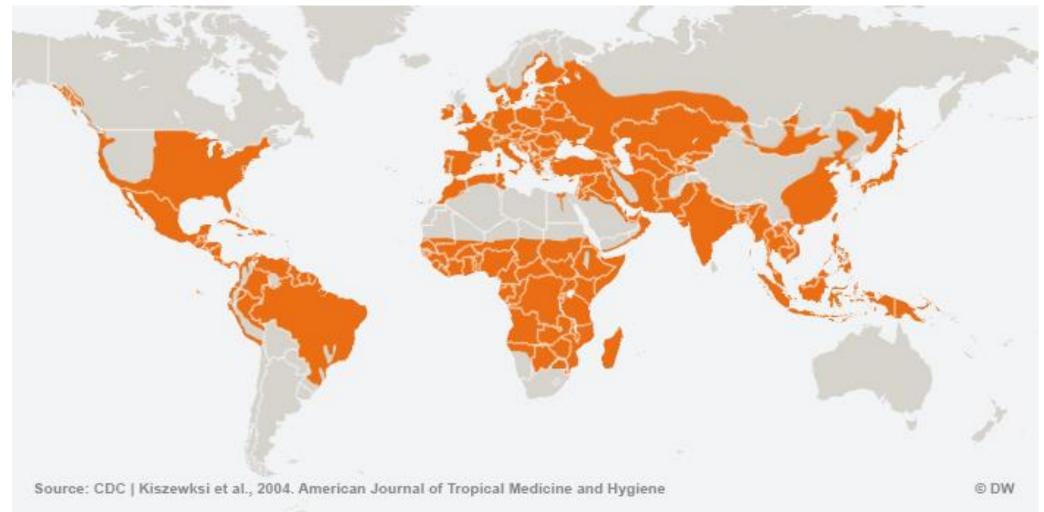
- Look at the map showing the distribution of the mosquito Anopheles globally.
 - Work with your team to read the instructions and understand the color scale
- Find where you live on the *Anopheles* map. Do *Anopheles* mosquitoes live where you live?
- Describe any patterns you notice on the Anopheles map.
- What are some countries that might have high probability of *Anopheles*, use the political map to see the names?
- Compare and contrast the patterns on the *Anopheles* map to the *Aedes* mosquito map.
- List some countries where both Aedes and Anopheles mosquitoes are probably living.
- List some countries where Aedes mosquitoes are probably living, but Anopheles are not.
- List some countries where Anopheles mosquitoes are probably living, but Aedes are not.
- Compare the *Anopheles* map with the Annual Total Precipitation map and the Average Annual Temperature map.
- What do these relationships possibly tell you about the environment *Anopheles* prefer to live in?





Distribution of Anopheles mosquitos

The orange area indicates where they are likely to be found. The grey indicates areas where they are not likely found.





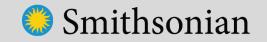


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Step 6 - *Culex*, Precipitation, Temperature and Political Distribution

- Look at the map showing the distribution of the mosquito *Culex* globally.
 - Work with your team to read the instructions and understand the color scale
- Find where you live on the *Culex* map. Do *Culex* mosquitoes potentially live where you live?
- Describe any patterns you notice on the *Culex* map.
- What are some countries that might have high probability of *Culex*, use the political map to see the names?
- Compare and contrast the patterns on the *Culex* map to the *Anopheles* and *Aedes* mosquito maps.
- List some countries where Culex, Aedes and Anopheles mosquitoes are all potentially living.
- List some countries where *Culex* are living, but *Aedes* or *Anopheles* are not.
- Compare the *Culex* map with the Annual Total Precipitation map and the Average Annual Temperature map.
- What do these relationships possibly tell you about the environment *Culex* prefer to live in?

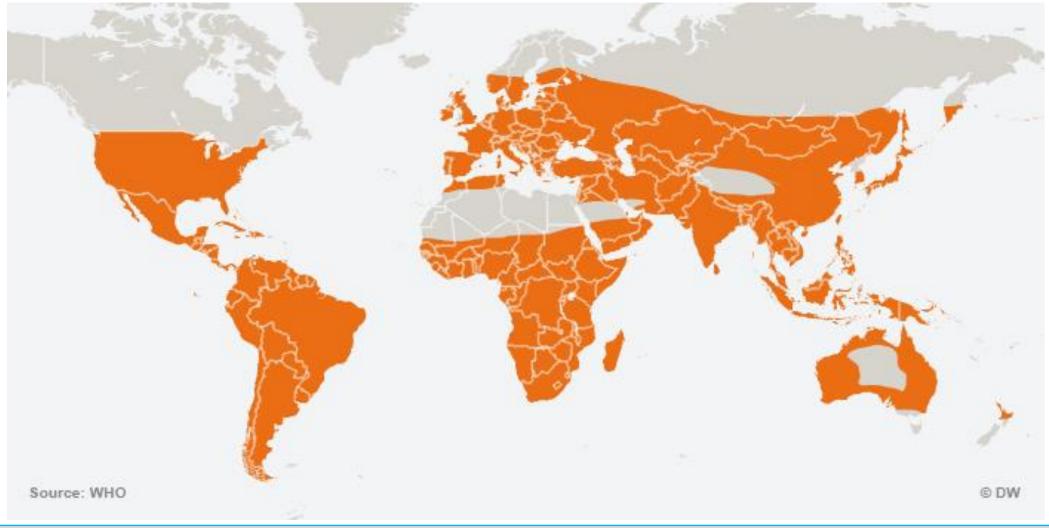




Mosquito! Part 3. Life: Task 3-3

Distribution of *Culex* mosquitos

The orange area indicates where they are likely to be found. The grey indicates areas where they are not likely found.







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Build Your Own Weather Station



"I believe there is a train under here somewhere!"

Standing tall on North Dakota snow. A March blizzard nearly buried utility poles. Caption jokingly read "I believe there is a train under here somewhere!" Courtesy Dr. Herbert Kroehl, NGDC Every year, thousands of lives and millions of dollars are saved by severe weather warnings from the National Weather Service. From its earliest beginnings (on February 9th, 1870), the primary mission of the National Weather Service has been to protect life and property by providing information about dangerous weather conditions. Originally, the National Weather Service was called "The Division of Telegrams and Reports for the Benefit of Commerce" and was part of the U.S. Army. Later, its name was shortened to the Weather Bureau and it became part of the Department of Agriculture, then the Department of Commerce.

The first "weathermen" were "observing-sergeants" of the Army's Signal Service Corps. Weather forecasting in those early years was based almost entirely on the assumption that the weather observed in one location on a particular day would move to downwind locations on following days. Today, satellites, computers, and a variety of scientific instruments are added to this basic assumption to make accurate weather predictions and provide warnings about dangerous weather.

Here's how you can make your own weather observation station!

What You Will Do Build six instruments that you can use to make scientific measurements of your local weather

Build an Anemometer to Measure Wind Speed

What You Will Need

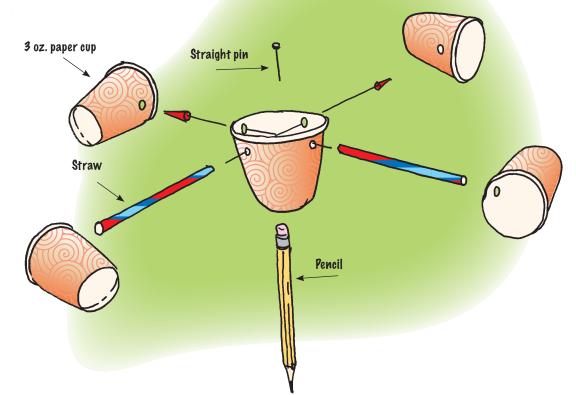
- □ Five paper cups Three ounce size
- **T**wo straight plastic soda straws
- □ Straight pin
- **D** Paper punch
- □ Stapler
- □ Sharp pencil with eraser
- **D** Felt tip marker
- □ Watch or timer

Warning

Be careful with the straight pin!

How to Do It:

- 1. Using a paper punch, punch a hole in four paper cups about 1/2-inch below the rim of the cups.
- 2. Punch four equally spaced holes in a fifth paper cup about 1/4-inch below the rim, and a fifth hole in the center of the bottom of the cup (you will probably need to use the pencil to make the hole in the bottom).
- 3. Push a soda straw through the hole in one of the first four cups. Flatten the end of the straw and staple it to the side of the cup

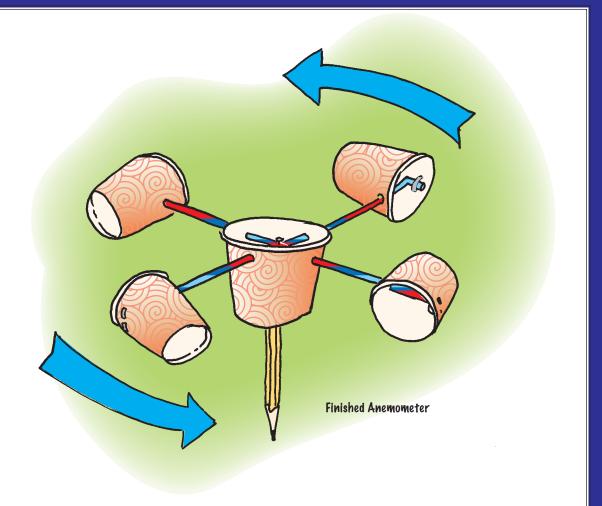


opposite the hole. Repeat this step with the other straw and another of the first four cups.

 \mathcal{H} . Slide one of the cup and straw assemblies through two opposite holes in the side of the fifth cup. Push another one-hole cup

onto the straw, and turn this cup so that the open ends of the two cups on the straw face in opposite directions. Flatten the end of the straw, and staple it to the side of the second cup. Measure the distance between the centers of the two cups. This is the diameter of your anemometer.

- 5. Repeat Step 4 with the remaining cup and straw assembly and the remaining one-hole cup. Before stapling the end of the straw to the last cup, turn the cups so that the open end of each cup faces the closed end of the next cup.
- G. Adjust the cup and straw assemblies so that they are centered inside the fifth cup. Push the straight pin through the two straws where they intersect.
- 7. Push the eraser end of the pencil through the hole in the bottom of the fifth cup, and push the straight pin into the eraser as far as it will go. Now your anemometer is ready to use.
- 8. To use the anemometer, hold the pencil vertically in a wind, and count the number of revolutions per minute (use the felt tip marker to make a mark on one cup so that you can easily see when the cup has travelled through one complete revolution). To convert revolutions per minute (rpm) into approximate wind speed:



a. Multiply rpm by the diameter (in inches) of your anemometer (measured in Step 4)

b. Multiply the result by 0.003. This is the approximate wind speed in miles per hour.

This calculation does not give exact wind speed, because drag, friction, and other forces also affect the speed at which your anemometer rotates.

Build a Weather Vane to Find Wind Direction

What You Will Need

- Broomstick or long wooden dowel, about one inch diameter
- Aluminum baking dish, about six inches x nine inches
- Wood stick, about 3/4 inch square and 12 inches long
- □ Nail, about one inch long
- Metal washer with a hole slightly larger than the nail
- Duct tape
- □ Small saw or serrated knife
- Scissors strong enough to cut the aluminum baking dish
- □ Ruler or tape measure
- Silicone or other glue that will stick to aluminum
- □ Leather gloves
- Optional) Hand drill, and small drill bit slightly larger than the nail

Warning

Be careful of the sharp edges on the pieces of cut aluminum! Use gloves to protect your hands until the edges are taped.

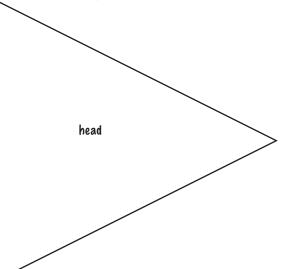
How to Do It

- Use the saw or serrated knife to cut a notch about 1/2-inch deep into each end of the wood stick. The notches shuld be parallel (see drawing on page 65).
- 2. Rotate the stick so that the two slots are vertical. Use the ruler or tape measure to find the exact center of the wood stick.

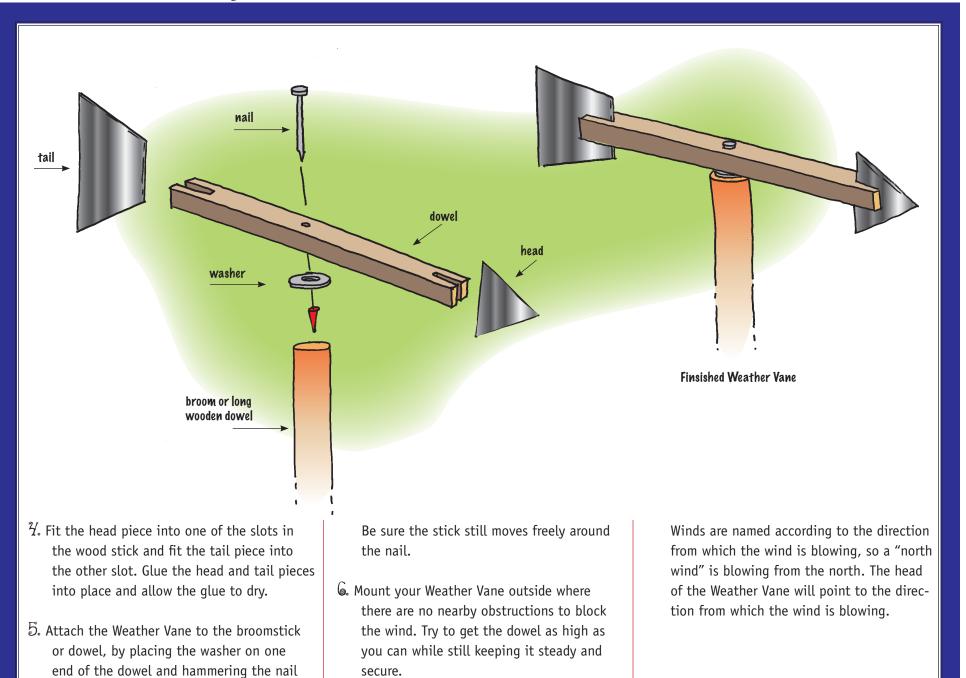
tail

Mark this spot on the upper surface of the stick, and drive a nail through the marked spot. Be careful: if the nail is too big, the stick will probably split. To avoid this, drill a hole slightly larger than the nail through the marked spot. You may need an adult to help with the drilling.

3. Cut the head and tail pieces of the Weather Vane from the aluminum baking dish using the pattern as a guide. Be Careful—The Edges Are Sharp! Use duct tape to cover the sharp edges.



through the wooden stick into the dowel.



65

Build a Barometer for Measuring Atmospheric Pressure

What You Will Need

- □ 12-inch ruler
- Drinking glass or other container with sides tall enough to support the ruler
- Clear plastic drinking straw or piece of clear plastic tubing, about 12-inches long
- □ Modeling clay or chewing gum
- Clear tape
- □ (Optional) Food coloring

How to Do It

- Tape the plastic straw or plastic tubing to the ruler so that one end is lined up with the "1/2-inch" mark on the ruler.
- 2. Stand the ruler-tubing assembly upright in the glass (or other container), and tape the assembly to the top of the container.
- 3. Fill the container about 3/4-full of water. If you want colored water, first mix food coloring with the water in another container.
- ⁴ Use the modeling clay or chewing gum (you'll have to chew it until it is soft enough) to plug the end of the straw or plastic tubing near the top of the ruler.

5. Carefully pour out some of the water so the container is about half full. Be sure the lower end of the straw or tubing stays beneath the water surface while you do this! When you are finished, the water in the gum or clay straw or tube should be higher than the water in the container. Your barometer is now fintape ished. Since barometers are sensitive to minor changes in weather conditions, keep your clear straw or barometer indoors for plastic tubing greatest accuracy.

tape

ruler

glass container

 Keep a daily record of the height of the water in the tube, using the scale on the ruler. The water level in the tube will rise and fall as atmospheric pressure changes. When atmospheric pressure increases, air presses on the surface of the water in the container causing the height of

66

the water in the tube to rise. When atmospheric pressure decreases, there is less pressure on the surface of the water in the container so the height of the water in the tube falls. Decreasing atmospheric pressure usually indicates that a low pressure area is approaching, and this often brings clouds and rain. Increasing atmospheric pressure often indicates fair weather.



Build a Screened Thermometer to Measure Air Temperature

What You Will Need

- A wooden or plastic box, large enough to hold the thermometer and your hygrometer; see Step 1 under "How to Do It"
- □ Thermometer, about 0°F to 120°F
- **D** White paint and paint brush
- Nails, screws, glue, or tape to attach the thermometer to the box

How to Do It

- 1. The wood or plastic box is supposed to protect your weather instruments from wind, rain, and direct sun, but still allow air to circulate so the instruments can get accurate readings. A box with a hinged lid that can be turned on its side is perfect. Turn the box on its side, and cut several slots near what is now the bottom of the box. Paint the outside of the box with white paint, and find a safe, shady outdoor location. The north side of buildings has the most shade. Try to find a location that is three to four feet above the ground.
- 2. Attach the thermometer to the back of the box with tape, glue, screws, or nails. The bulb of the thermometer should be about two inches above the bottom of the box.

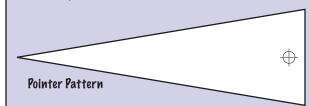
Build a Hygrometer to Measure Humidity

What You Will Need

- Piece of wood or styrofoam about nine inches long and four inches wide
- Flat piece of plastic, thin enough to cut with scissors; about three inches long and one inch wide (an old credit card or laminated luggage tag works well)
- Two small nails
- Three strands of human hair, about eight inches long
- 🗖 Dime
- 🗖 Glue
- Tape
- Hammer
- **D** Scissors

How to Do It

1. Cut the plastic into a pointer as shown on the pattern below.



67

- 2. Poke one of the nails through the pointer near the base of the triangle. Wiggle the nail around until the pointer moves freely and loosely around the nail.
- 3. Tape the dime onto the pointer near the tip of the triangle.
- \mathcal{U} . Glue the hair strands onto plastic between the nail hole and the dime.
- 5. Use a nail to fasten the pointer to the wood or styrofoam base about 3/4 of the way down the side. Be sure the pointer can still turn freely on the nail.
- 6. Attach the other nail to the base about one inch from the top of the base, in line with the spot where the hair is glued to the pointer.
- 7. Pull the free ends of the hair tight so that the pointer is horizontal. Wrap the hair

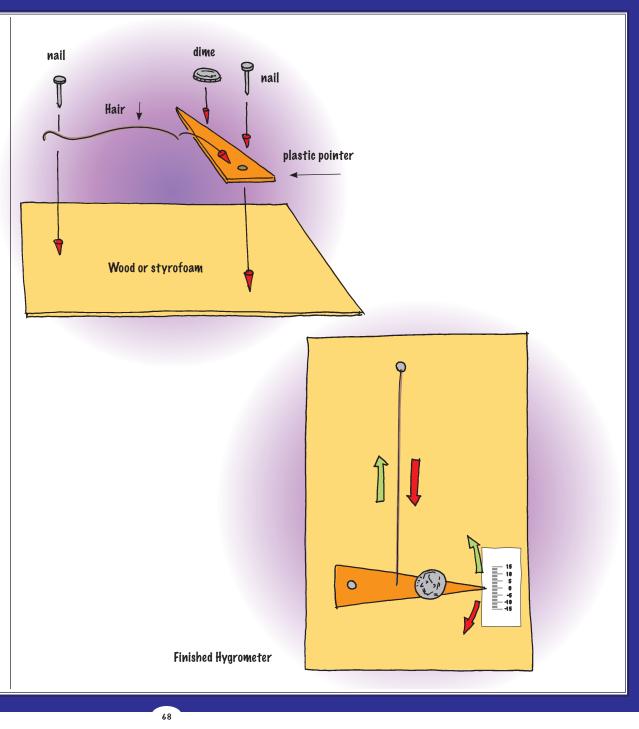
around the upper nail and glue to hold the hair in place.

- & Make a photocopy of the scale and cut it out. Glue the scale to the base so that the pointer is pointed to the "0" mark. Your hygrometer is finished!
- 7. Human hair will expand and lengthen when the air is moist, causing the pointer to move down. When the air is dry, the hair will contract and shorten, causing the pointer to move up. Use the scale to record the pointer's position. Keep your hygrometer in a sheltered location. The box used for the screened thermometer is ideal.

15

10 5

-10 -15



Build a Rain Gauge to Measure Rainfall

What You Need

- Straight-sided glass or plastic container, with a diameter of about two inches or less (such as an olive jar)
- Coat hanger or wire bent to make a holding rack (see picture)
- Measuring spoons: One teaspoon and 1/4 teaspoon
- □ Hammer and nails to secure the rack
- $\ensuremath{\square}$ Felt tip marker

How to Do It

1. Rain gauges measure the amount of rainfall in cubic inches. So your first task is to make a scale for your container that shows how many cubic inches of water are in the container. One cubic inch of water is about 3 1/4 teaspoons, so you can draw the scale on your container by measuring 3 1/4 teaspoons of water to your container, then drawing a short line at the level of the water. If you look closely, the top of the water will seem to be slightly curved and thickened. Draw your line so that it matches the bottom of the curved surface (which is called a meniscus). This line corresponds to a rainfall of one inch.

- 2. Add another 3 1/4 teaspoons of water to the container and draw another line. The second line corresponds to a rainfall of two inches.
- 3. Repeat Step 2 until you have at least five marks on the container. This will be enough for most rain events; but you may want to add another line or two, just in case!
- 4. Find a location for your rain gauge where there is nothing overhead (such as trees or a building roof) that could direct water into or away from your gauge. The edge of a fence away from buildings is often a good spot. Another possibility is to attach your

69

rain gauge to a broomstick driven into the ground in an open area. Be sure to record rainfall soon after a rain event to avoid false readings caused by evaporation. Empty your gauge after each reading, and you are ready for the next event!

This activity is adapted from "Build Your Own Weather Station" by the Educational Technology Programs Team at the Franklin Institute, Philadelphia, PA (<u>http://www.fi.edu/</u> weather/todo/todo.html).

Finished Rain Guage

glass container

coat hanger or wire



Understanding Mosquito Life Cycle

In Part Three the team has learned about different types of mosquitoes. Your team may have already collected mosquito eggs during Task 3-1. These eggs are one stage of the mosquito life cycle. Soon they will become adult mosquitoes. It is important to understand all stages of the mosquito life cycle.

Objective

In this task, the team will work to understand the life cycle of the mosquito. If live egg, larvae, or pupae samples are available to the team from Task 3-1, experimentation methods are suggested here. If live samples are not available do not worry. Continue to monitor your collection cups in your research site. You can always come back to this experiment after you collect samples.

In this task, the team will be focusing on the following questions from the question map in Task 1-10. How do mosquitoes develop and reproduce? What factors influence how mosquitoes develop and reproduce?

The team will use this analysis to think about factors that may effect the life cycle and problem question. The team will also think about how understanding the life cycle could be useful when making solutions for the community.

- Go to the Task 3-4 folder and get the Understanding Mosquito Life Cycle instructions. Choose the Mosquito A or Mosquito B task from the task folder. The Mosquito B task includes the instructions for working with live samples. You can also do both tasks if you want.
- 2. As a team, discuss how understanding the life cycle of the mosquito could be helpful when thinking about our problem question: How can we ensure health for all from mosquito-borne diseases?



Research Tip

When collecting or working with live samples, follow basic safety precautions. Review the safety documents in the task folder as needed.

Hooray! You completed Task 3-4. Check it off the task list. Go to Task 3-5!



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Mosquito!

Task 3-4 Understanding Mosquito Life Cycle—Mosquito A

Cut out the pictures.

Put the pictures in the life cycle chart in the order you think they belong.

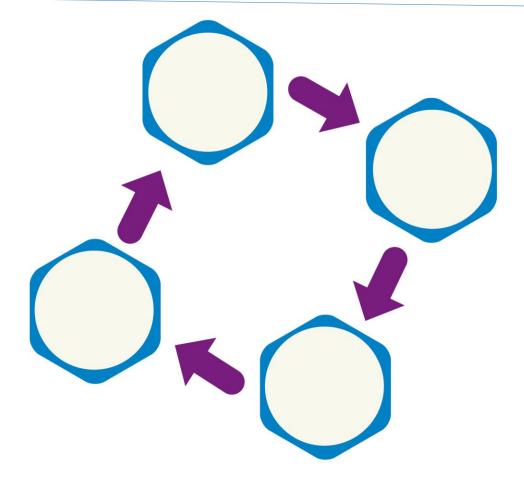
Label each stage.

Images: J. Stoffer, WRBU











😌 Smithsonian

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Mosquito!

Use one or both of the following pieces of evidence to assess your life cycle chart.

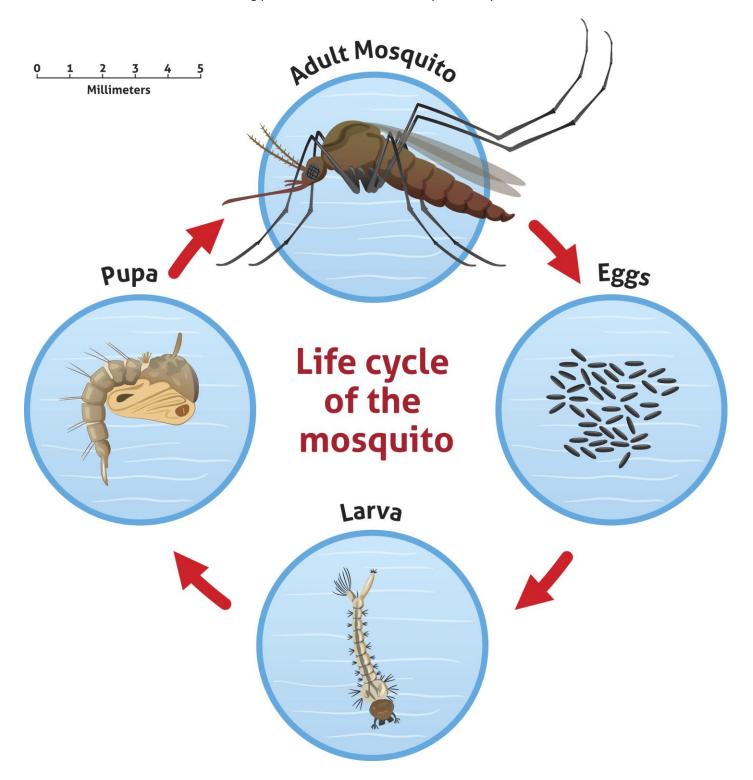


Image: LCOSMO/iStock/Thinkstock



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Mosquito!

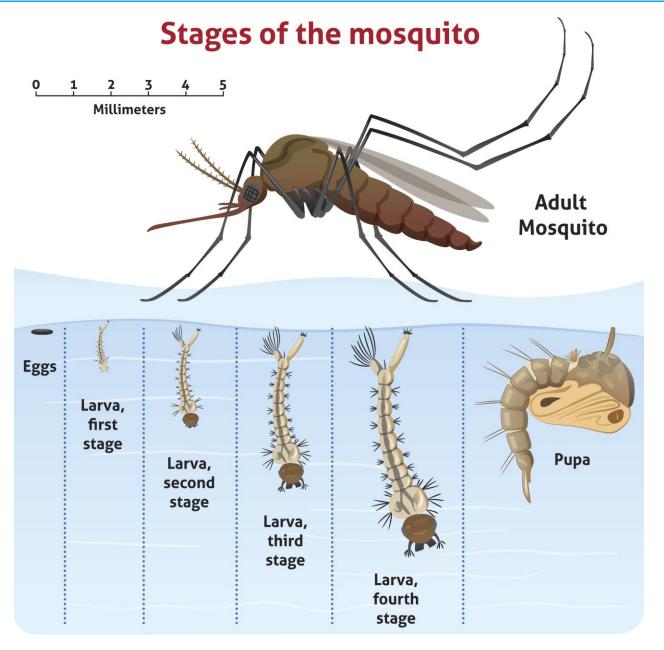


Image: LCOSMO/iStock/Thinkstock

Additional resources for this task (images and videos) can be folder. View these resources in the Task 3-4 folder on Learnir

Based on this picture and any of the videos you watched, revis needed.

Mosquito life cycle PowerPoint: Use the PowerPoint in the task folder to go over life cycle vocabulary and parts of the cycle, as needed.

Go back to Research Guide now





Smithsonian

Task 3-4 Understanding Mosquito Life Cycle—Mosquito B

1. Additional resources for this task (images and videos) can be found in the Learning Lab task 3-4 folder. View these resources in the Task 3-4 folder on Learning Lab.

2. Mosquito life cycle PowerPoint: Use the PowerPoint in the task folder to go over life cycle vocabulary and parts of the cycle.

3. Mosquito life cycle emergence chambers activity: Follow the instructions in the HHMI mosquito life cycle emergence chambers activity to observe the life cycle with live mosquitoes.

Build the emergence chamber described in these instructions, and use any eggs or larvae you collected during Task 3-1. Do not use any collected adult mosquitoes for this activity.

Place the eggs or larvae you collected in Task 3-1 from your research site into the emergence chambers described in this task.

Record your results and observations according to the instructions in the activity.

Analyze your results according to the instructions.

Safety: Make sure to follow the disposal instructions after all adults have emerged! If you're concerned about safety or mosquitos getting released indoors, complete the entire experiment outside.

4. Extension: Using the materials, setup, and live egg samples from the life cycle activity, experiment with factors (temperature, light exposure, water composition) that might affect the mosquito life cycle. Use the instructions in the task folder to help set up your experiment and collect the results. Share the results of the team experiments and determine how these results could help with the problem question.





Go back to Research Guide now



GLOBE Observer

mosquito habitat mapper





GLOBE is a science and education program that connects a network of students, teachers and scientists from around the world to better understand, sustain and improve Earth's environment at local, regional and global scales.

To date, more than 130 million measurements have been contributed to the GLOBE database, creating meaningful, standardized, global research-quality data sets that can be used in support of student and professional scientific research.



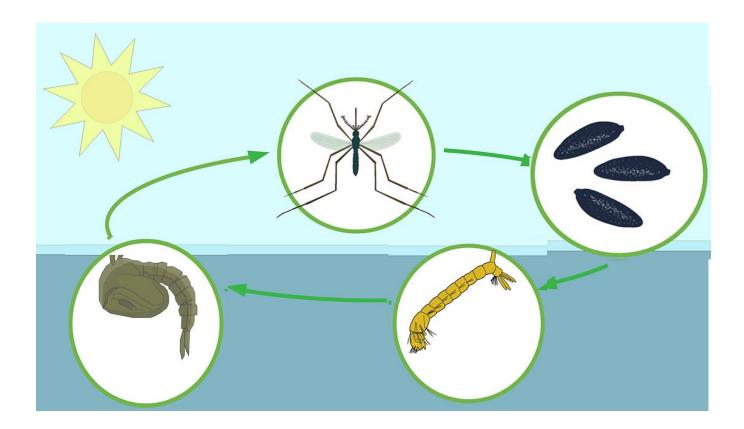
It's easy to get started! You are here!



What do you know about the life cycle of mosquitoes?



Mosquito Life Cycle Four stages: Egg, Larva, Pupa, Adult



Important Vocabulary

Egg: laid in or near water; hatches to become larva.

GLOBE Observe

Larva: (larvae) immature form that lives in water; breathes at surface; eats microorganisms; molts four times to grow.
Instar: phase between two periods of molting. (We observe the 4th instar- which is also called a "wiggler.")
Pupa: (pupae) last immature stage before emerging as an adult. Non-feeding stage.
Also known as tumblers.
Adult: flying insect

*Length of each stage depends on species and ambient temperatures.







The adult female mosquito lays eggs in or near water. The eggs are deposited singly, or attached together to form rafts.

Some mosquitoes, like those that transmit yellow fever mosquito and dengue, prefer to lay their eggs in small containers near humans- like flower pots and water containers.

Most eggs hatch into larvae within 24-48 hours after becoming moist but some can also persist for weeks or months through dry periods. Others can withstand subzero winters!



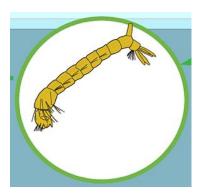


Egg

Many mosquitoes lay eggs on the surface of fresh or stagnant water. If they prefer open air, breeding sites they usually choose where the water is sheltered from wind by vegetation. Other mosquitoes prefer a protected habitat, such as a natural container (tree or rock holes) or an artificial container, such as a dish or cup. Eggs can be found in pastures, tree holes, and stream bottoms and hatch when flooded with water.

- *Culex* lay eggs in a "raft" that floats on the surface of the water.
- Anopheles lay single eggs on the water surface
- *Aedes* lay eggs in damp soil or on the sides of containers; the eggs begin to develop when the water level rises and floods the eggs.





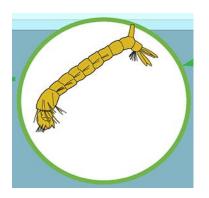
Larva

The larva hatches from the egg and lives in the water. Some mosquito eggs, however, need to be dried completely before they will hatch.

Most species, such as found in *Culex* and *Aedes* genera, have a siphon or air tube and spend most of their time on the surface breathing. *Anopheles* does not have a siphon. Instead, it lays parallel to the surface and breathes through openings on its 8th abdominal segment (spiracles).

Some species have specialized siphons and attach to emergent plants found in water, using the plant tissue to access air to breathe.



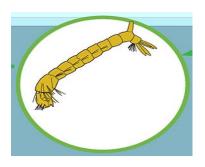


Larva

Larvae eat constantly- feeding on algae, plankton, fungi, bacteria and other aquatic organisms. One genera of mosquito is specifically adapted to eat other mosquito larvae!

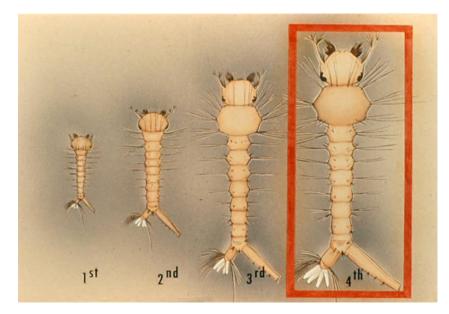
The larvae hang on the surface of the water with their mouths open. They have brushes (hairs around their mouth) that filter water- so only particles small enough to be eaten enter the mouth.



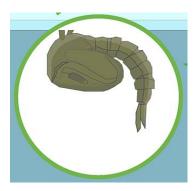


Larva

- During growth, the larva molts (sheds its skin) four times. (The fourth molt results in the change from larva to pupa)
- The stages between molts are called instars.
- At the 4th instar, the larva can a length of almost 10 mm. Toward the end of this instar feeding ceases.





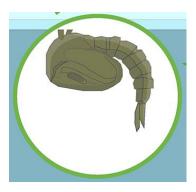


Larva

• When the 4th instar larva molts, it becomes a pupa.

• When identifying mosquito larvae, look for the largest larvae in your sample, the 4th instar. The diagnostic features you are looking for are most pronounced in this stage.

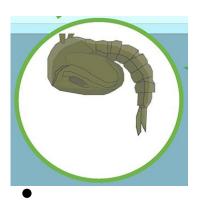




Pupa

- Mosquito pupae, commonly called "tumblers," live in water from 1 to 4 days, • depending upon species and temperature.
- The pupa is lighter than water and therefore floats at the surface. It takes ٠ oxygen through two breathing tubes called "trumpets."
- The pupa does not eat, but it is not an inactive stage. When disturbed, it ۲ dives for safety in a jerking, tumbling motion and then floats back to the surface.



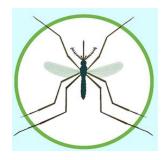


Pupa

The metamorphosis of the mosquito into an adult is completed within the pupal case.

 The pupal case is like a "factory" where the mosquito larva becomes an adult. The adult mosquito splits the pupal case and emerges to the surface of the water where it rests until its body dries and hardens.





Adult

- Adults emerge, and fly away looking for their first meal and to mate.
- Adults eat nectar, like many other insects.





Adult Female

- Only female mosquitoes bite, seeking blood from humans and other animals. Blood provides pre-natal supplements needed for egg development.
- After her blood meal, the female lays eggs on or near the water. The eggs can survive dry conditions for a few months.
- Not all species of mosquitoes require females to eat a blood meal to make eggs, but those are the mosquitoes you are most familiar with!

Acknowledgements

GLOBE Observer

The **GLOBE Observer Mosquito Habitat Mapper** is a NASA-sponsored project that is the result of the combined efforts of an extended team that includes the Institute for Global Environmental Strategies (IGES); NASA Goddard Space Flight Center, Langley Research Center, and Jet Propulsion Laboratory; Space Science Applications, Inc. (SSAI); the GLOBE Implementation Office (GIO), GLOBE DIS and Brooklyn College.

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This presentation was prepared by the Institute for Global Environmental Strategies (IGES) and does not necessarily reflect the views of the NASA or USAID. For more information, contact the Principal Investigator, Dr. Russanne Low, at IGES:

Educators: did you modify this file for your class? Put your name here!

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Activity Link for Task 3-4

Mosquito! Task 3-4 Understanding Mosquito Life Cycle - HHMI Activities https://www.hhmi.org/biointeractive/mosquito-life-cycle-activity









Videos for Task 3-4

Life Cycle of a Mosquito - Video

Description:

Watch this video to see the entire life cycle of a mosquito. Think about how this could be useful when thinking about the problem question. https://www.youtube.com/watch?v=AYpFTrVnteg

Animated Life Cycle of a Mosquito Explained

Description: Use this video to learn more about each stage of the mosquito life cycle. https://youtu.be/93wPfE78SYY





Investigating Mosquito-borne Disease Distribution

Welcome to Part Four: Transmission and Task 4-1. In Part Three you learned more about the mosquito as an animal. Now the team will begin learning more about how diseases are spread from mosquitoes to humans and other animals.

Objective	

In this task, the team will be focusing on the following questions from the question map.

- What is the distribution of mosquito-borne diseases around the world?
- What factors influence the spread of mosquito-borne diseases?

The team will now examine a variety of maps to think about the relationship between mosquitoes, diseases spread by mosquitoes, temperature, and precipitation. The team will also read some frequently asked questions (FAQs) about the different mosquito-borne diseases, to learn more.

- Go to the Task 4-1 folder and get the Mosquito-Borne Disease FAQ Sheets, maps, and analysis questions. There is only one version of this task, but two options for organizing are provided.
- 2. As a team, use the maps and FAQ sheets to complete the analysis questions.
- 3. As a team, share all important information that could be useful to the research.
- 4. As a team, discuss the following questions:

• How can maps be helpful when studying mosquitoes and mosquito-borne diseases?

• How does understanding the environmental conditions (temperature, precipitation, elevation) of your location help when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?

54



• How does understanding the distribution of different mosquitoes and diseases help when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?

• How do the environmental conditions (temperature and precipitation) change throughout the year in your location? Does it rain more or less in your community at different times of year? Does it snow in your community? Does the temperature change at different times of the year in your community?

• Have you been monitoring the environmental conditions of your location since Task 3-3? If so, what have you learned so far? If not, how could you monitor the changes in temperature and precipitation in your community throughout the year? Look at the instructions in Task 3-3 to get started.



Research Tip

What other mosquito-borne diseases are affecting people in your location or in other parts of the world? Do some research to find out and compare it to the analysis you did here. Citizen Science Tip

Collecting and sharing data about your research site can be helpful to scientists when making and updating maps like these about diseases around the world. Think about how you could share your data with others.

Hooray! You completed Task 4-1. Check it off the task list. Go to Task 4-2!

55

Task 4-1

Investigating Mosquito Borne Disease Distribution

Analysis Questions







Task Options

- A Jigsaw this task. Four diseases will be covered in this task: Malaria, Dengue Fever, Zika, and West Nile.
 - Break the team into four groups.
 - Have each group read the FAQ sheet and analyze the maps for one disease.
 - Have each group share out important information they identified in the FAQ sheet.
 - Have each group share out to the team their map analysis of their disease according to the questions in this document.
 - Post the information so all groups can see the analysis.

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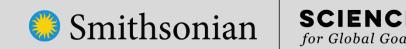
- B Have each team member or small group look at all four diseases and FAQ sheets. Compare and contrast all four diseases.
 - Have individuals or groups share out important information they identified in the FAQ sheet.
 - Have each group share out to the team their map analysis of their disease according to the questions in this document.





Political Distribution

- Look at the Political map of the World. (Map 1)
- As a team, find the country where you live. Where inside this country do you live?
- What are the names of some other countries near or around you?





Malaria Disease Distribution

- Read the Malaria Frequently Asked Questions Sheet to learn more about this disease.
 - Identify 3-5 Very Important Parts from the FAQ sheet.

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- Look at the Malaria Disease Distribution Map (2).
- Find your country on this map.
- Determine the color of your location. This color tells you if your location is at risk or not .
- Use the key to determine the risk status of your country. Red means high risk of getting malaria. Blue means lower risk. Light grey means no risk. Dark grey means risk is unstable, so not likely.
- Make a list of 10 countries that have higher risk of malaria (reds, yellows) according to this research in the year 2010. Use the political map to find names.
- Make a list of 10 countries that have lower risk of malaria (blues) according to this research in the year 2010. Use the political map to find names.
- Make a list of 10 countries that have no current risk of malaria transmission (grey) according to this research in the year 2010.





Malaria – Anopheles Mosquito

- Malaria is spread by the Anopheles mosquito.
- Look back at pictures and information about the *Anopheles* mosquito from task 3-2.
- Look at the Distribution map of the Anopheles mosquito (3)
- Compare the Anopheles map to the Malaria Risk Map (2+3)

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- Determine some countries where *Anopheles* mosquitoes live, but Malaria is currently not a risk. What could be causing this?
- Compare and contrast the Malaria map with the temperature and precipitation maps. (2+ 4 + 5)
- Describe the relationships between temperature, precipitation, Anopheles mosquitoes, and malaria (2+3+4+5).
- Compare and contrast the Malaria map with the Income map. (2+ 6)
- Describe the relationships between temperature, precipitation, Anopheles mosquitoes, malaria, and income (2+3+4+5+6).





Dengue Fever Disease Distribution

- Read the Dengue Fever Frequently Asked Questions Sheet to learn more about this disease.
- Identify 3-5 Very Important Parts from the FAQ sheet.

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- Look at the Dengue Fever Suitability Map (7).
- Find your country on this map.
- Determine the color of your location. This color tells you if your location is good for Dengue Fever or not.
- Use the key to determine the how suitable your country is for Dengue fever. Red means more suitable and more likely to have Dengue. Blue means lower suitability and less likely to have Dengue. Grey means unsuitable, so Dengue should not be found in these places.
- Make a list of 10 countries that have higher suitability of dengue (reds, yellows) according to this research in the year 2012. Use the political map to find names.
- Make a list of 10 countries that have lower suitability of dengue (blues) according to this research in the year 2012. Use the political map to find names.
- Make a list of 10 countries that have no current suitability of dengue transmission (grey) according to this research in the year 2012.





Dengue Fever – Aedes Mosquito

• Dengue Fever is spread by the Aedes mosquito.

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- Look back at pictures and information about the *Aedes* mosquito from task 3-2.
- Look at the Distribution map of the Aedes mosquito (map 8).
- Compare the Aedes map to the Dengue Fever Suitability Map.
- Compare and contrast the Dengue map with the temperature and precipitation maps (4+5+7).
- Describe the relationships between temperature, precipitation, *aedes* mosquitoes, and dengue (4+5+7+8).
- Compare and contrast the Dengue map with the Income map. (6+7)
- Describe the relationships between temperature, precipitation, *Aedes* mosquitoes, dengue, and income (4+5+6+7+8).





Zika Disease Distribution

- Read the Zika Frequently Asked Questions Sheet to learn more about this disease.
- Identify 3-5 Very Important Parts from the FAQ sheet.
- Look at the Zika Risk Map (9).
- Find your country on this map.
- Determine the color of your location. This color tells you if your location has a risk of Zika or not .
- Use the key to determine how suitable your country is for Zika.
 - Orange means your location is at risk due to only environmental factors, such as temperature and precipitation.
 - Purple means your location is at risk because of Socioeconomic status and accessibility. Socioeconomic status is based on income, education, and occupation. Accessibility has to do with how easily people can move into and out of these places.
 - Blue means that all factors (environmental, socioeconomic status, and accessibility) are in place at these locations.
 - Grey indicates that Zika cases are currently unlikely at these locations.
- Make a list of 10 countries that have risk for Zika for environmental reasons (orange) according to this research in the year 2016. Use the political map to find names.
- Make a list of 10 countries that have risk for Zika for Socioeconomic and Accessibility reasons (purple) according to this research in the year 2016. Use the political map to find names.
- Make a list of 10 countries that have risk for Zika for all factors (blue) according to this research in the year 2016.. Use the political map to find names.
- Make a list of 10 countries that have no current risk of Zika (grey).

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Zika-Aedes Mosquito

- Zika is spread by the Aedes mosquito.
- Look back at pictures and information about the *Aedes* mosquito from task 3-2.
- Look at the Distribution map of the Aedes mosquito (8).
- Compare the *Aedes* map to the Zika Risk Map (8+9).

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- Compare and contrast the Zika map with the temperature and precipitation maps (4+5+9).
- Describe the relationships between temperature, precipitation, *aedes* mosquitoes, and Zika (4+5+8+9).
- Compare and contrast the Zika map with the Income map. (6+9)
- Describe the relationships between temperature, precipitation, *Aedes* mosquitoes, Zika, and income (4+5+6+8+9).





West Nile Virus Disease Distribution

- Read the West Nile Virus Frequently Asked Questions (FAQ) Sheet to learn more about this disease.
- Identify 3-5 Very Important Parts from the FAQ sheet.
- Look at the West Nile Virus Distribution Map (10).
- Find your country on this map.
- Determine if your country is Red, Blue, or Grey. This color tells you if West Nile is present in your country or not .
- Use the key to determine the status of your country.
- Make a list of 10 countries that have human cases of west nile virus (red) according to this research in the year 2015. Use the political map to find names.
- Make a list of 10 countries that have nonhuman cases of west nile virus (blue) according to this research in the year 2015. Use the political map to find names.
- Make a list of 10 countries that have no data or positive cases of west nile virus (grey) according to this research in the year 2015.





West Nile Virus – *Culex* Mosquito

- West Nile virus is spread by the *Culex* mosquito.
- Look back at pictures and information about the *Culex* mosquito from task 3-2
- Look at the Distribution map of the *Culex* mosquito (11)
- Compare the *Culex* map to the West Nile Map (10 +11)
 - On the West Nile map (1) there are some dashed lined circles. What do you think those areas indicate?
 - Determine some countries where *Culex* mosquitoes live, but West Nile is currently not found. What could be causing this?
 - Determine some countries where West Nile is currently found, but *Culex* mosquitoes do not live there. What could be causing this?
- Compare and contrast the West Nile map with the temperature and precipitation maps (4+5+10).
- Describe the relationships between temperature, precipitation, *Culex* mosquitoes, and West Nile (4+5+10+11).
- Compare and contrast the West Nile map with the Income map. (6+10)
- Describe the relationships between temperature, precipitation, *Culex* mosquitoes, West Nile, and income (4+5+6+10+11).



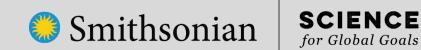




Task 4-1

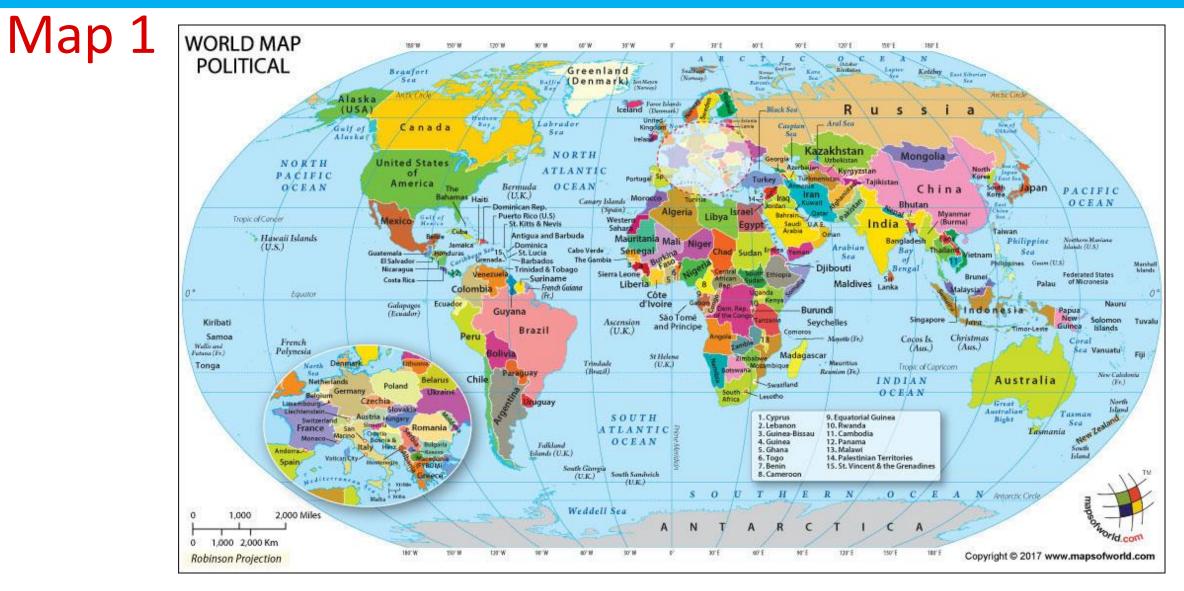
Investigating Mosquito Borne Disease Distribution

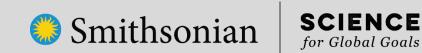
Maps





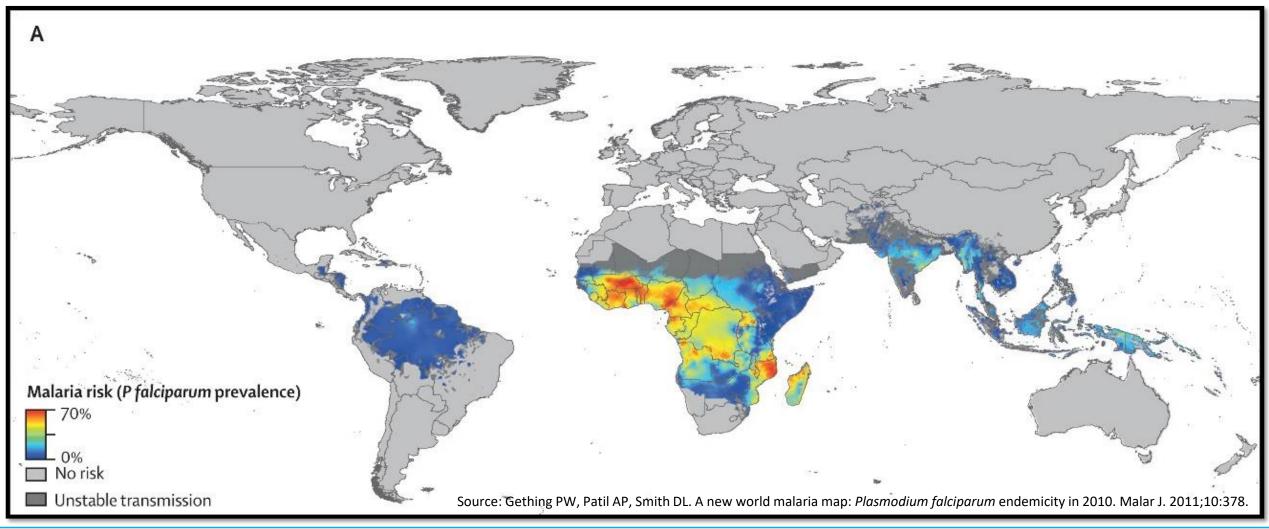
Mosquito! Part 4. Transmission: Task 4-1

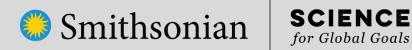






Map 2 Malaria Risk Map - Spread by Anopholes Mosquito



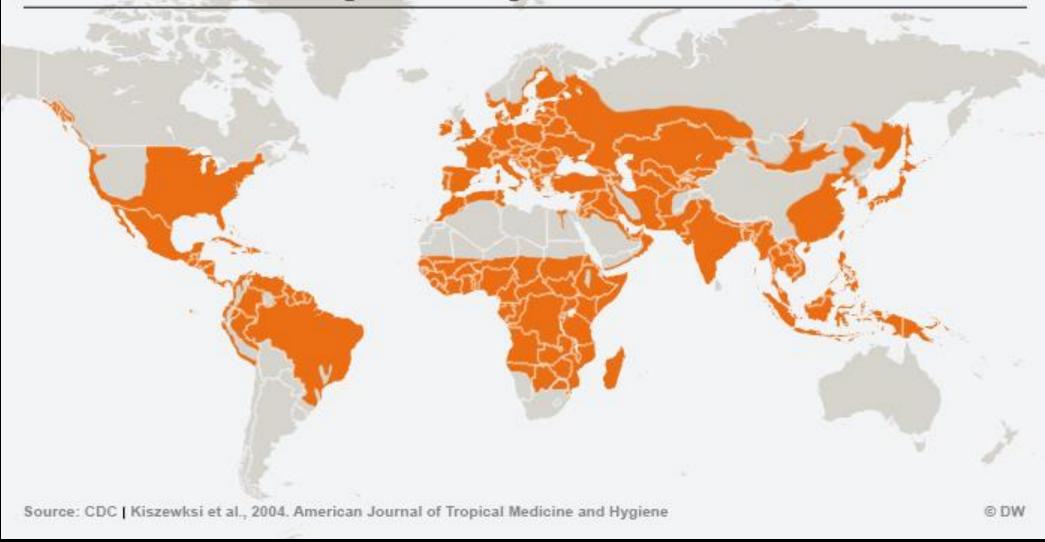




Mosquito! Part 4. Transmission: Task 4-1

Map 3

Distribution of the Anopheles mosquito - carrier of malaria

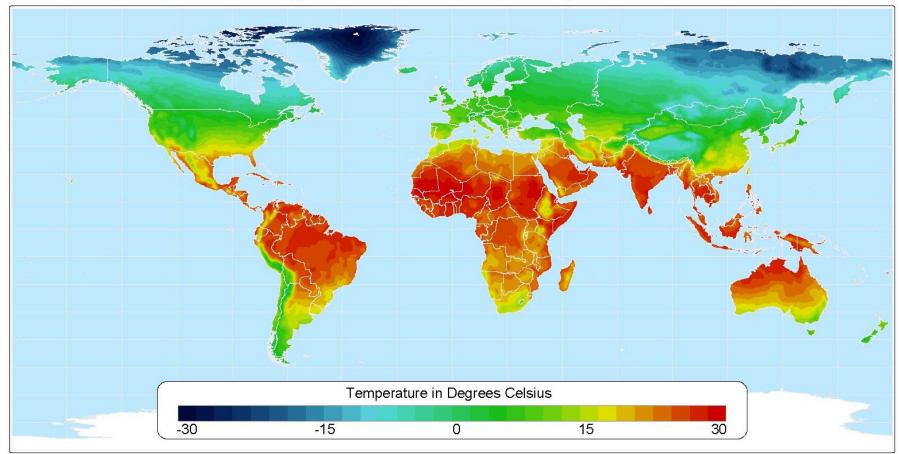






Map 4

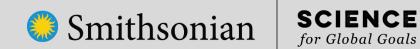
Average Annual Temperature



Data taken from: CRU 0.5 Degree Dataset (New, et al.)

Atlas of the Biosphere

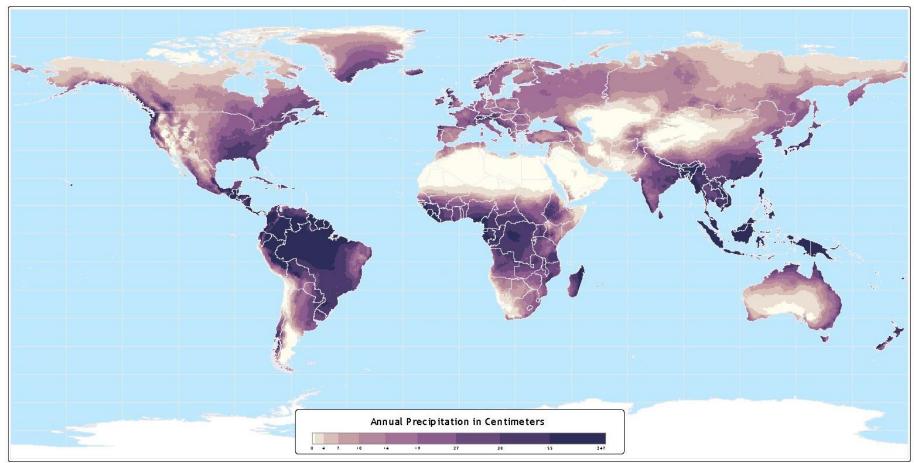
Center for Sustainability and the Global Environment University of Wisconsin - Madison





Map 5

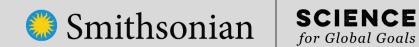
Annual Total Precipitation



Data taken from: CRU 0.5 Degree Dataset (New et al)

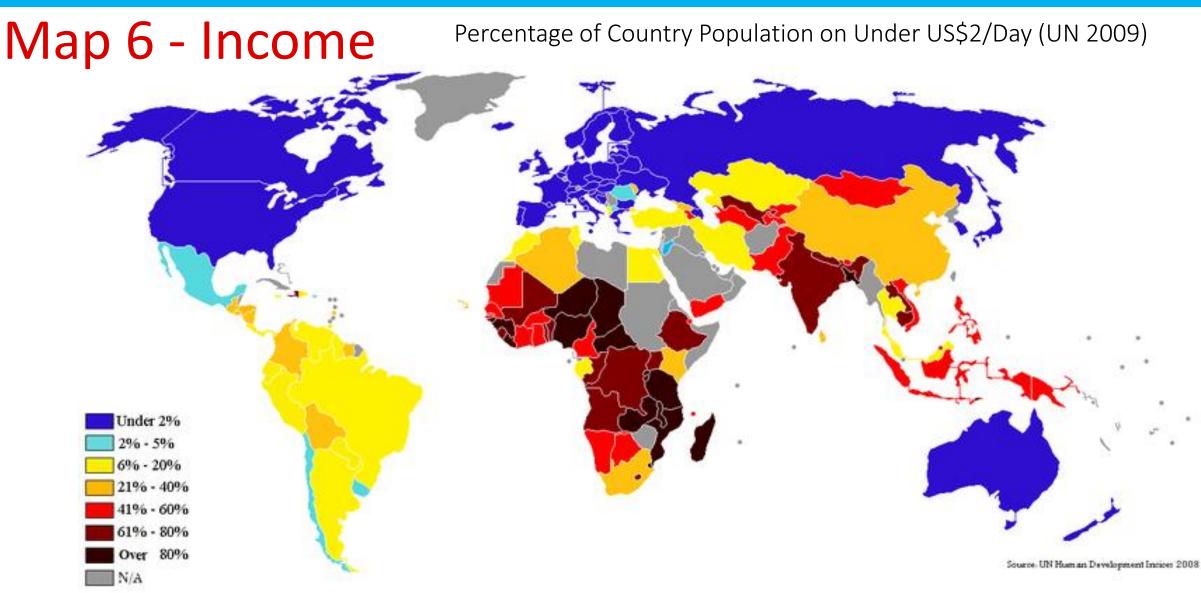
Atlas of the Biosphere

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Mosquito! Part 4. Transmission: Task 4-1

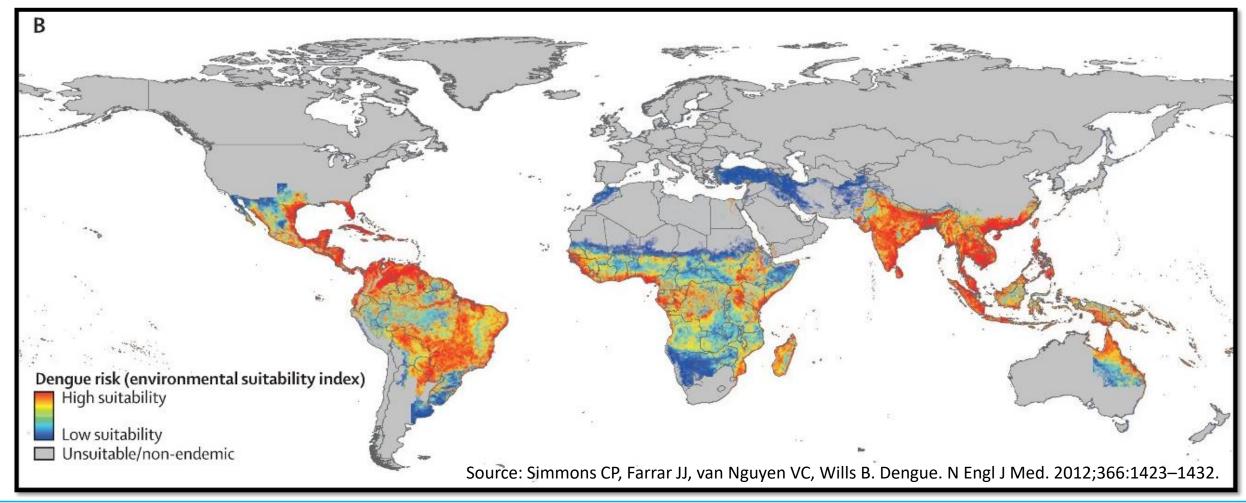


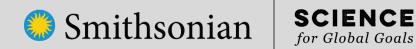




Map 7

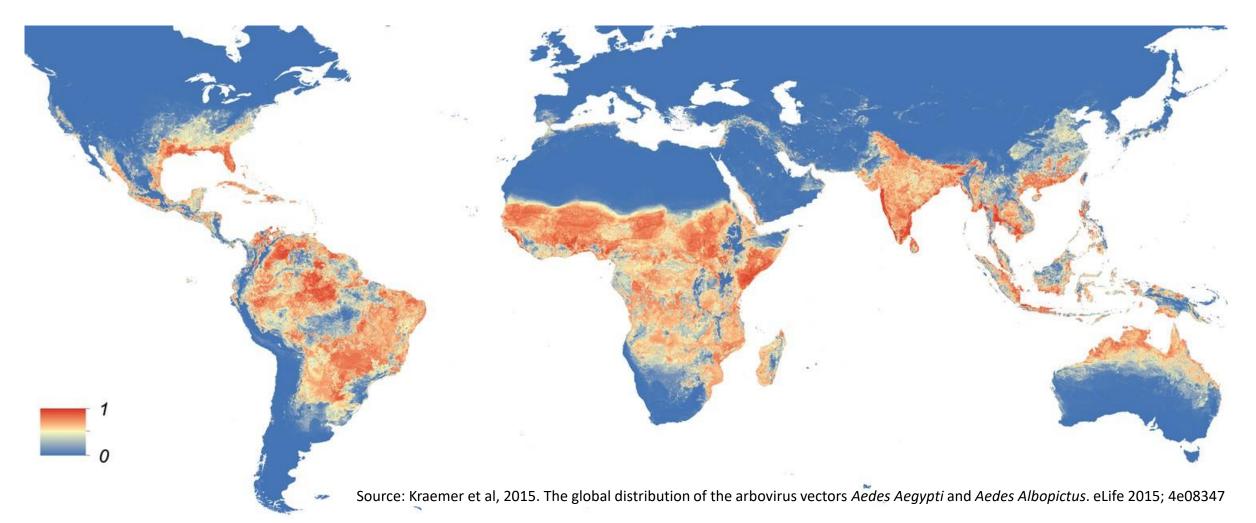
Dengue Fever Environmental Suitability Map – Spread by Aedes Mosquito







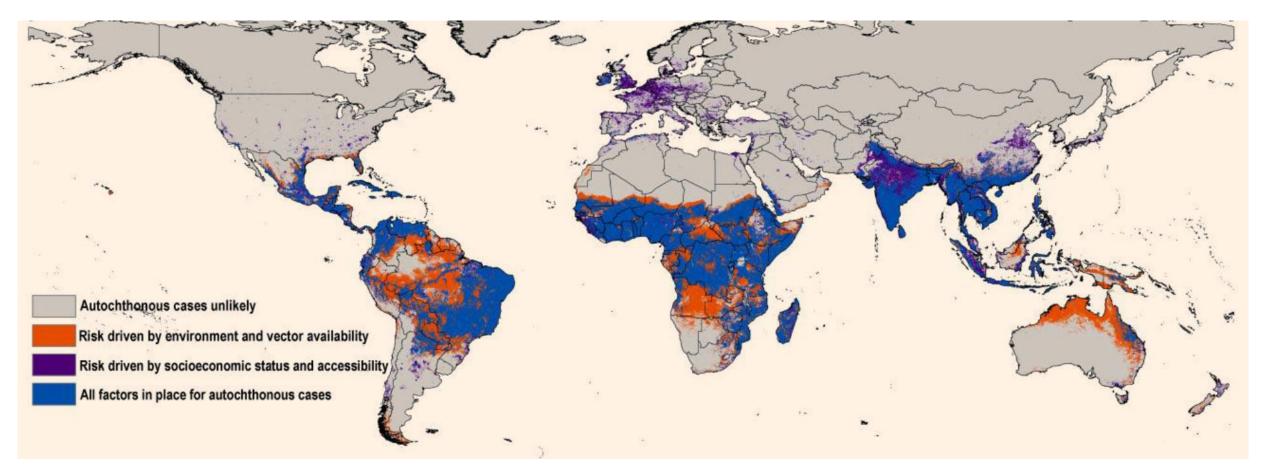
Map 8 Distribution of Aedes Mosquitoes



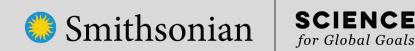




Map 9 Zika Risk Map – Spread by Aedes Mosquito



Source: Samy, Thomas, Wahed, Cohoon, Peterson. 2016. Mapping the global geographic potential of Zika virus spread. Mem Inst Oswaldo Cruz



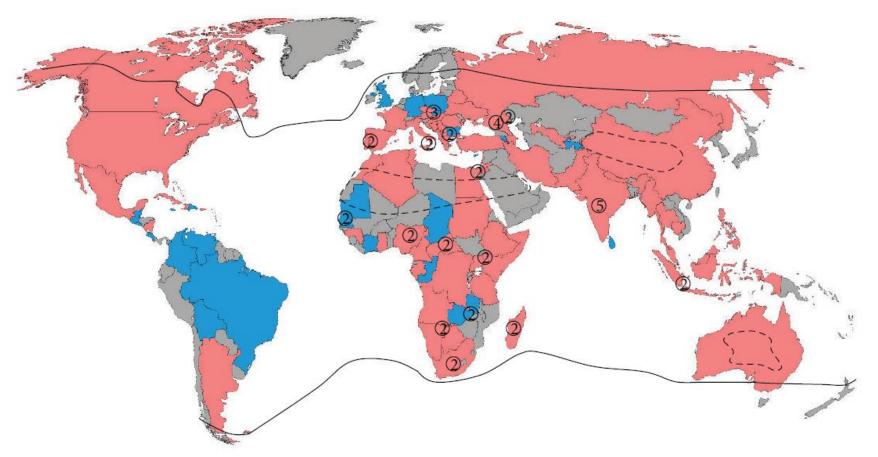


Mosquito! Part 4. Transmission: Task 4-1

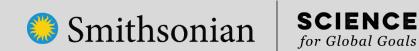


West Nile Distribution – Spread by *Culex* Mosquitoes

Red – Human Cases reported Blue – Nonhuman (birds, horses) and Mosquito Cases reported Gray – No data or no positive cases reported



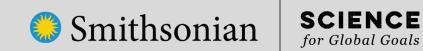
Source: Chancey, Grinev, Volkova, Rios, 2015. The Global Ecology and Epidemiology of West Nile Virus. BioMed Research International





Map 11 Distribution of the Culex mosquito - carrier of the West Nile virus









<u>Task 4-1 – Investigating Mosquito-borne Disease Distribution</u>

Dengue—Frequently Asked Questions

Q: What is dengue?

A: Dengue (pronounced *DEN-gee*) is a disease transmitted to humans by the bite of an infected mosquito. In the Western Hemisphere, the *Aedes* mosquito is the most important transmitter or vector of dengue viruses. It is estimated that there are more than 100 million cases of dengue worldwide each year.

Q: How is dengue transmitted?

A: Dengue is transmitted to people by the bite of an *Aedes* mosquito that is infected with dengue virus. The mosquito becomes infected with dengue virus when it bites a person who has dengue virus in their blood. The person may have symptoms of dengue fever, or they may have no symptoms. After about one week, the mosquito can then transmit the virus while biting a healthy person. Dengue cannot be spread directly from person to person.

Q: What are the symptoms of dengue?

A: The main symptoms of dengue fever are high fever, severe headache, severe pain behind the eyes, joint pain, muscle and bone pain, rash, and mild bleeding (for example, the nose or gums bleed, easy bruising). Generally, younger children and those with their first dengue infection have a milder illness than older children and adults.

Q: What is the treatment for dengue?

A: There is no specific medication to treat a dengue infection. People who think they have dengue should use pain relievers with acetaminophen and medicines containing aspirin. They should also rest, drink plenty of fluids, and consult a physician. If they feel worse (for example, start vomiting and develop severe abdominal pain) in the first 24 hours after the fever declines, they should go immediately to the hospital for evaluation.

Q: Where can outbreaks of dengue occur?

A: Outbreaks of dengue occur primarily in areas where *Aedes* mosquitoes live. This includes most tropical urban areas of the world. Dengue viruses may be introduced into other areas by travelers who become infected while visiting areas of the tropics where dengue commonly exists.





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Q: What can be done to reduce the risk of acquiring dengue?

A: There is no vaccine for preventing dengue. The best preventive measure for residents living in areas infested with *Aedes* is to eliminate the places where the mosquito lays her eggs, primarily containers that hold water.

Items that collect rainwater or store water (for example, plastic containers, 55gallon drums, buckets, or used automobile tires) should be covered or properly discarded. Pet and animal watering containers and vases with fresh flowers should be emptied and cleaned (to remove eggs) at least once a week. This will eliminate the mosquito eggs and larvae and reduce the number of mosquitoes present in these areas.

Using air conditioning or window and door screens reduces the risk of mosquitoes coming indoors. Proper application of mosquito repellents containing 20 percent to 30 percent DEET as the active ingredient on exposed skin and clothing decreases the risk of being bitten by mosquitoes. The risk of dengue infection for international travelers appears to be small. There is increased risk if an epidemic is in progress or if visitors are staying in housing without air conditioning or screened windows and doors.





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Task 4-1 – Investigating Mosquito-borne Disease Distribution

Malaria—Frequently Asked Questions

Q: What is malaria?

A: Malaria is a serious and sometimes fatal disease caused by a parasite that commonly infects *Anopheles* mosquitoes that feed on humans. People who get malaria are typically very sick, with high fevers, shaking chills, and flu-like illness.

Globally, the World Health Organization estimates that in 2015, 212 million clinical cases of malaria occurred, and 429,000 people died of malaria, most of them children in Africa. Because malaria causes so much illness and death, the disease is a great drain on many national economies. Since many countries with malaria are already among the poorer nations, the disease maintains a vicious cycle of disease and poverty.

Q: How is malaria transmitted?

A: Usually, people get malaria by being bitten by an infectedfemale *Anopheles* mosquito. Only *Anopheles* mosquitoes can transmit malaria, and they must have been infected through a previous blood meal taken from an infected person. When a mosquito bites an infected person, a small amount of blood is taken in, which contains microscopic malaria parasites. About one weeklater, when the mosquito takes its next blood meal, these parasites mix with themosquito's saliva and are injected into the person being bitten.Because the malaria parasite is found in the red blood cells of an infected person, malaria can also be transmitted through blood transfusion, organ transplant, orby sharing needles or syringes contaminated with blood. Malaria may also betransmitted from a mother to her unborn infant before or during delivery (knownas "congenital malaria").

Q: Who is at risk for malaria?

A: Anyone can get malaria. Most cases occur in people who live in countries with malaria transmission. People from countries with no malaria transmission can become infected when they travel to countries with malaria or through a blood transfusion (although this is very rare). Also, an infected mother can transmit malaria to her infant before or during delivery.





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Q: What are the signs and symptoms of malaria?

A: Symptoms of malaria include fever and flu-like illness, including shaking chills, headache, muscle aches, and tiredness. Nausea, vomiting, and diarrhea may also occur. Malaria may cause anemia and jaundice (yellowing of the skin and eyes) because of the loss of red blood cells. If not promptly treated, the infection can become severe and may cause kidney failure, seizures, mental confusion, coma, and death. For most people, symptoms begin 10 days to four weeks after infection, although a person may feel ill as early as seven days or as late as one year later.

Q: What is the treatment for malaria?

A: Malaria can be cured with prescription drugs. The type of drugs and length of treatment depend on the type of malaria, where the person was infected, their age, whether they are pregnant, and how sick they are at the start of treatment.

Q: Where can malaria occur?

A: Malaria typically is found in warmer regions of the world—in tropical and subtropical countries. Higher temperatures allow the *Anopheles* mosquito to thrive. Malaria parasites, which grow and develop inside the mosquito, need warmth to complete their growth before they are mature enough to be transmitted to humans. Malaria occurs in more than 100 countries and territories. About half of theworld's population is at risk. Large areas of Africa and South Asia and parts of Central and South America, the Caribbean, Southeast Asia, the Middle East, and Oceania are considered areas where malaria transmission occurs.Yet malaria does not occur in all warm climates. For example, malaria has been eliminated in some countries with warm climates, while a few other countries have no malaria because *Anopheles* mosquitoes are not found there.

Q: What can be done to reduce the risk of acquiring malaria?

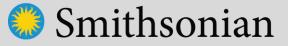
A: You and your family can most effectively prevent malaria by taking all three of these important measures.

- Take antimalarial medication to kill the parasites and prevent becoming ill.
- Keep mosquitoes from biting you, especially at night.
- Sleep under insecticide-treated bed nets, use insect repellent, and wear longsleeve clothing if you're out of doors at night.





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Task 4-1 – Investigating Mosquito-borne Disease Distribution

West Nile Virus—Frequently Asked Questions

Q: What is West Nile virus?

A: West Nile virus is a disease most commonly spread by infected *Culex* mosquitoes. West Nile virus can cause fever, encephalitis (inflammation of the brain), or meningitis (inflammation of the lining of the brain and spinal cord).

Q: How is West Nile virus spread?

A: Most people get infected with West Nile virus from the bite of an infected *Culex* mosquito. Mosquitoes become infected when they feed on infected birds. Infected mosquitoes can then spread the virus to humans and other animals. In a very small number of cases, West Nile virus has been spread through blood transfusions, organ transplants, and from mother to baby during pregnancy, delivery, or breastfeeding.

Q: What are the symptoms of West Nile virus disease?

A: Most people (70 to 80 percent) who become infected with West Nile virus do not develop any symptoms.

About one in five people who are infected will develop a fever with other symptoms, such as headache, body aches, joint pains, vomiting, diarrhea, or rash. Most people with this type of West Nile virus disease recover completely, but fatigue and weakness can last for weeks or months.

Less than 1 percent of people who are infected will develop a serious neurologic illness, such as encephalitis or meningitis (inflammation of the brain or surrounding tissues). The symptoms of neurologic illness can include headache, high fever, neck stiffness, disorientation, coma, tremors, seizures, or paralysis.

Q: What is the treatment for West Nile virus?

A: There are no medications to treat or vaccines to prevent West Nile virus infection. Over-the-counter pain relievers can be used to reduce fever and relieve some symptoms.

People with milder symptoms typically recover on their own, although some symptoms may last for several weeks.





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Mosquito!

In more severe cases, patients often need to be hospitalized to receive supportive treatment, such as intravenous fluids, pain medication, and nursing care.

Q: Who is at risk for infection with West Nile virus?

A: Anyone living in an area where West Nile virus is present in mosquitoes can get infected. The risk of infection is highest for people who work outside or participate in outdoor activities, because of greater exposure to mosquitoes.

Q: How soon do people get sick after getting bitten by an infected mosquito?

A: The incubation period is usually two to six days, but ranges from two to fourteen days. This period can be longer in people with certain medical conditions that affect the immune system.

Q: Where can outbreaks of West Nile occur?

A: West Nile virus transmission has been documented in Europe and the Middle East, Africa, India, parts of Asia, and Australia. It was first detected in North America in 1999, and has since spread across the continental United States and Canada.

Q: How can people reduce the chance of getting infected?

A: The most effective way to avoid West Nile virus disease is to prevent mosquito bites.

- Use insect repellents when you go outdoors. Repellents containing DEET, picaridin, IR3535, and some oil of lemon eucalyptus and para-menthane-diol products provide longer-lasting protection.
- Wear long sleeves and pants from dusk through dawn, when many mosquitoes are most active.
- Install or repair screens on windows and doors. If you have it, use your air conditioning.
- Help reduce the number of mosquitoes around your home. Empty standing water from containers such as flower pots, gutters, buckets, pool covers, pet water dishes, discarded tires, and birdbaths.



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Task 4-1 – Investigating Mosquito-borne Disease Distribution

Zika—Frequently Asked Questions

Q: What is Zika?

A: Zika virus disease is caused by the Zika virus, which is spread to people primarily through the bite of an infected *Aedes* mosquito. The illness is usually mild, with symptoms lasting up to a week, and many people do not have symptoms or will have only mild symptoms. However, Zika virus infection during pregnancy can cause a serious birth defect called microcephaly, and other severe brain defects.

Q: How is Zika spread?

A: Zika is spread to people primarily through the bite of aninfected *Aedes* mosquito. A pregnant woman can pass Zika to her fetus duringpregnancy or around the time of birth. Also, a person with Zika can pass it to hisor her sex partners. People who have traveled to or live in places with a risk of Zika are encouraged to protect themselves by preventing mosquito bites and sexual transmission of Zika.

Q: What are the symptoms of Zika virus disease?

A: The most common symptoms of Zika virus disease are fever, rash, headache, joint pain, red eyes, and muscle pain. Many people infected with Zika won't have symptoms or will have mild symptoms, which can last for several days to a week.

Q: What health problems can result from getting Zika?

A: While people infected with Zika will have no symptoms or mild symptoms, Zika infection during pregnancy can cause a serious birth defect called microcephaly (an abnormally small head) and other severe fetal brain defects. Once someone has been infected with Zika, it's very likely they'll be protected from future infections. There is no evidence that past Zika infection poses an increased risk of birth defects in future pregnancies.

Q: What is the treatment for Zika?

A: If you have symptoms of Zika (fever, rash, headache, joint pain, red eyes, or muscle pain) and you live in or recently traveled to an area with a risk of Zika, you should see your doctor or health care provider and tell him or her about your



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symptoms and recent travel. There is no specific medicine for Zika, but you can treat the symptoms.

If you are diagnosed with Zika, protect those around you by taking steps to prevent mosquito bites and to prevent sexual transmission of Zika. Because Zika can generally be found in blood during approximately the first week of infection, and can be passed to another person through mosquito bites, help prevent others from getting sick by strictly following steps to prevent mosquito bites during the first week of illness.

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Q: If I am traveling to an area with a risk of Zika, should I be concerned about Zika?

A: Travelers who go to places with a risk of Zika can become infected. Many people will have mild or no symptoms. However, Zika can cause microcephaly and other severe birth defects. For this reason, pregnant women should not travel to any area with a risk of Zika, and women trying to get pregnant should talk to their doctor before traveling to an area with a risk of Zika. Those traveling to areas with a risk of Zika should take preventive steps during and after they travel.

Q: What can people do to prevent Zika?

A: The best way to prevent Zika is to protect yourself and your family from mosquito bites.

- Use Environmental Protection Agency (EPA)-registered insect repellents.
- Wear long-sleeve shirts and long pants.
- Sleep under a mosquito bed net if air conditioned or screened rooms are not available, or if you are sleeping outdoors.

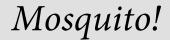
Zika can be spread by a person infected with Zika to his or her sex partners. Condoms can reduce the chance of getting Zika from sex. Condoms include male and female condoms. Pregnant couples with a partner who traveled to or lives in an area with a risk of Zika should use condoms every time they have sex or not have sex during the pregnancy.



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Zika Awareness and Prevention (ZAP) Game

The Zika Awareness and Prevention (ZAP) Game was developed to strengthen students and communities in their ability to stop Zika virus disease. Zika virus is a mosquito-borne virus, spread primarily by the bite of an infected *Aedes* species mosquito. Through simulation, this game educates students about Zika virus, common mosquito breeding sites, Zika virus disease symptoms, and pregnancy risks associated with Zika. Practices that help to prevent mosquito bites are also covered such as using an EPA registered insect repellent with DEET, the importance of wearing long sleeved shirts and long pants when outdoors, and treating clothing with permethrin. Multiple choice and matching games are provided to gauge how much you learned about Zika.

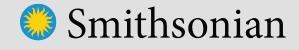
Use the following link to access the game, and have fun! http://zika.vmasc.odu.edu/zap/

Computer WebGL Compatibility: Chrome 64 bit Version 57 and newer, Microsoft Edge version 16 or newer, Safari version 11 or newer, and Firefox version 52 or newer. Firefox users check your privacy settings.

For more information about the ZAP Game or for any other concerns please email us at <u>Zapzika@odu.edu</u> or contact:

Bridget Giles PhD Virginia Modeling Analysis and Simulation Center Old Dominion University 1030 University Blvd. Suffolk, VA 23435 Email: <u>bgiles@odu.edu</u> Phone: 757-638-4436









Team New Articles for Task 4-1

Zika ZAP Game News Article https://www.odu.edu/news/2017/6/zika_game#.WzE7aadKiUk



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Part Four. Transmission

Task

4

О

4-5) Collecting Local Transmission Histories

In previous tasks, the team learned about some factors that affect the spread of mosquito-borne diseases. These factors include temperature, precipitation, disease hosts, and income.

In this task, the team will explore some other factors that can affect the spread of mosquito-borne diseases in a community. The team will also work to understand how these factors have changed over time in the community. These factors include urbanization, natural disasters, deforestation, and changes in population. To understand how these factors have changed in your community, the team must talk to local people of various ages.

In this task, the team will be focusing on the following questions from the question map.

- What factors influence how mosquitoes develop and reproduce?
- What factors influence how mosquitoes spread disease?
- Who are local people, organizations, associations that can provide valuable information related to this problem?
- 1. Go to the Task 4-5 folder and get the Meet the Team reading. This reading includes the interview questions.
- 2. As a team, read the Meet the Team reading.
- 3. Outline three to five very important points from the reading. Share as a team.
- 4. Use the resources in the Learning Lab task folder to learn more about the effects of natural disasters and urbanization on mosquitoes.
- 5. Read the interview questions provided.
- 6. Decide which questions you will use during your interview.
- 7. Create any additional interview questions as a team.
- 8. Identify various people in your community that team members could interview.

59

Objective





- 9. Determine how you will document the responses of the people you are interviewing.
- 10. Conduct interviews with these people.
- 11. As a team, share and compile the results of these interviews.

Research Tip

Use the field safety tips in the safety documents on Learning Lab before going out into the community to survey or interview people. Be polite, never go alone, and always be aware of your surroundings.

- 12. As a team, discuss the following:
 - Based on your interviews, how has the urbanization of your community changed over time?
 - Has it become more crowded? Have many people moved there or moved away? Has human contact with animals increased or decreased?
 - Have any natural events, such as large storms, tornadoes, or hurricanes, happened in the area?
 - Have people become more or less healthy? How has their living situation changed for better or worse?
 - What are some limitations of these types of interviews?
 - How are interviews about the past different than data or evidence from the past?
 - How did the interviews shed light on the present? Write a few examples of current things that make more sense now than before you heard about the past.
 - How might these things, or other parts of what you heard, tie into the community's health?
 - How can the information from these interviews be useful when considering the problem question and other questions from the map?
 - What factors influence how mosquitoes develop and reproduce? What factors influence how mosquitoes spread disease?
 - Who are local people, organizations, associations that can provide valuable information related to this problem?
 - How can we ensure health for all from mosquito-borne diseases?

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Task 4-5 Collecting Local Transmission Histories – Interview Questions

Use these questions to interview different people in your local community to learn more about its history.

- 1. Was our community always as crowded as it is now?
- 2. In your opinion, how has the community's health changed as a result?
- 3. Have many people moved here or moved away during your life? Were there ever any large events of immigration or emigration?
- 4. Has the community become more urban over time? How do you think the community's health has changed as a result?
- 5. Has the community built more homes or buildings over your life?
- 6. What roles do animals play in the community and how has this changed over time?
- 7. Have people been in contact with wildlife in your community during your life?
- 8. Has this contact changed over time?
- 9. Has the way land is used in the community changed during your life?
- 10. Has wild land in the community been cleared for agriculture during your life?
- 11. Have any unusual natural events, like large storms or strange seasons, occurred during the time that you have been here, and did they cause any changes in the community's health or the amount of mosquitos you noticed?
- 12. When you were younger, do you remember being bitten by mosquitoes more or less often than now?
- 13. Could you please describe any changes in your lifestyle or in the community that could be responsible for this?
- 14. Have guests always visited the community and where do they usually come from?
- 15. Has access to clean drinking water, electricity, and roads always been the same?
- 16. Create your own questions:



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Meet the Team

Mosquito! Task 4-5 Collecting Local Transmission Histories

Learning about the changes to a place from the local people



community.

Kelly Bennett - Biologist - Smithsonian Tropical Research Institute (Panama)

Mosquito-borne diseases like dengue, Zika, and yellow fever are emerging and reemerging all over the globe. The emergence of these diseases can be connected to urbanization and changes in land use over time. Urbanization is an increase in the number of people and a change in the way land is used in an area over time. As the number of people in a location changes, things like land use and contact with wildlife can change. These changes can affect the spread of mosquito-borne diseases in a

The problem of mosquito-borne disease has also been affected by increased human movement and trade around the world. Over time, this movement allows mosquitoesto travel and establish new populations. In addition, urbanization can increase contact people have with the surrounding forests. Over time, this contact is where diseases can switch from using animals as hosts to using humans as host. Increasing urbanizationof communities means we must work together when thinking about this problem. Mosquitoes can be highly adaptive. New mosquito-borne diseases are emerging and spreading rapidly. A recent example is Zika virus. This disease has been around for along time. However, it has only recently become a worldwide problem. This is likely due to the adaptive nature of *Aedes* mosquitoes, which are able to take advantage of their association with humans.

To fully understand urbanization and changes in a community over time, we have to start to uncover its history. For some things, this can be hard to do. Big histories, like those of nations, are often written down and are easy to find. Smaller histories, on the other hand, like those of towns, families, or events, are usually recorded in our memories and passed

down through stories. This gives personal stories of the past, passed from one generation to the next, big value. They help us understand our current situation in ways that other methods cannot.

In this task, you will interview elderly members of your community to learn about the past. From this history, your will work to better understand the urbanization and changes of your community over time.

When you do your interviews, try to interview some people your parent's age, and some who are even older. The point is to see how things have changed over time.



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Meet the Team



In your interviews, try to listen much more than you talk, but still remain an active listener. Keep an ear out for themes like urbanization, globalization, contact with wildlife, natural events, health, and development. Understanding how these things have become the way they are will help you keep your community healthy.

Below are some questions to use in your interviews. Feel free to come up with more, especially ones that are specific to your area, but see these as a framework to follow.

How you set up an interview is your choice. If you aren't sure what to do, simply explain the project you are working on and politely ask your interviewee if they would be willing to tell you about the past of this place. It is best to meet someone in a space where they feel comfortable, and to start with some simple questions to let them warm up. Then, when they seem open to sharing stories, you can ask them the following interview questions.

- Was our community always as crowded as it is now?
- In your opinion, how has the community's health changed as a result?
- Have many people moved here or moved away during your life? Were there ever any large events of immigration or emigration?
- Has the community become more urban over time? How do you think the community's health has changed as a result?
- Has the community built more homes or buildings over your life?
- What roles do animals play in the community and how has this changed over time?
- Have people been in contact with wildlife in your community during your life?
- Has this contact changed over time?
- Has the way land is used in the community changed during your life?
- Has wild land in the community been cleared for agriculture during your life?
- Have any unusual natural events, like large storms or strange seasons, occurred during the time that you have been here, and did they cause any changes in the community's health or the amount of mosquitos you noticed?
- When you were younger, do you remember being bitten by mosquitoes more or less often than now?
- Could you please describe any changes in your lifestyle or in the community that could be responsible for this?
- Have guests always visited the community and where do they usually come from?
- Has access to clean drinking water, electricity, and roads always been the same?





Articles for Task 4-5

Harvey's Next Danger: Massive Mosquito Clouds

Description:

After the catastrophic devastation of hurricane Harvey, the people of Texas are now facing a slew of problems from contaminated floodwaters to toxic mold to giant alligators sneaking into homes to floating rafts of fire ants. But as Joe Hanson at *Texas Monthly* reports, Harvey victims have yet another galling problem to add the mix: giant clouds of mosquitoes.

http://www.smithsonianmag.com/smart-news/harveys-next-disaster-giantclouds-mosquitoes-180964786/

The World's Megacities Are Making Dengue Deadlier

Description:

While the world's attention is focused on the Zika virus spreading through the Americas, large urban areas in Southeast Asia are fighting off outbreaks of dengue fever.

http://www.smithsonianmag.com/science-nature/worlds-megacities-are-makingdengue-deadlier-180958009/

Protecting Land in Brazil Reduces Malaria and Other Diseases

Description:

In the Brazilian Amazon, getting back to nature may really be the healthiest option. Data covering hundreds of municipalities show that people who live near areas under strict conservation protection experience lower incidences of common diseases and infections such as malaria.

http://www.smithsonianmag.com/science-nature/protecting-land-brazil-reducesmalaria-and-other-diseases-180955604/





Understanding Mosquito Habitats

Welcome to Part Five: Habitats, and Task 5-1. In Part Four you learned more about how the mosquito spreads diseases. Now, the team will begin learning more about the specifics of where mosquitoes like to live and breed in your community.



In this task, the team will be focusing on the following question from the question map.

• Where do mosquitoes live and breed?

Mosquitoes can live and breed in a variety of human and natural habitats. A habitat is the home or environment of an animal, plant, or other organism. The first step is understanding all the different types of habitats and breeding sites of mosquitoes. Then, in Task 5-2, you can start looking for these habitats and breeding sites in your local community. This information will be useful when creating your management plan at the end of your research.

1. Go to the Task 5-1 folder and get the Habitat Bingo game. There is only one version of this task.



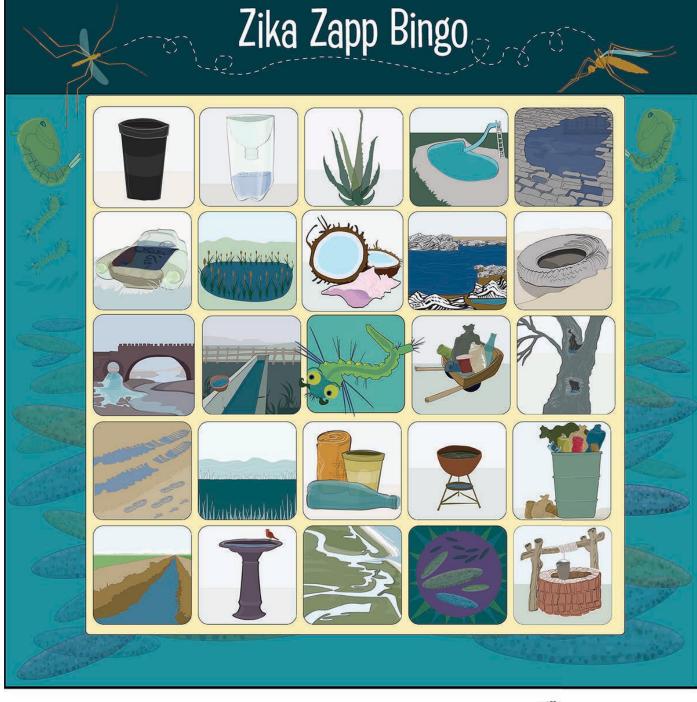
- 2. To get familiar with different mosquito habitats, go through each so the team knows what they are. These are places where mosquitoes may live and lay their eggs.
- 3. Play a few games of Zika Zapp Bingo.
- 4. As a team, discuss the following questions.

• Which habitats from the bingo game do you think might exist in your research site or community?

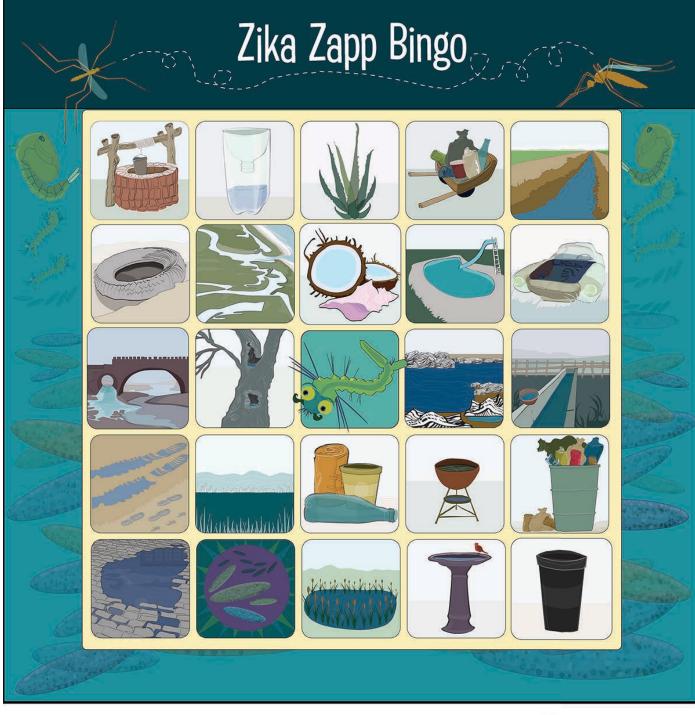
• How does understanding which habitats exist in your community help when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?

Hooray! You completed Task 5-1. Check it off the task list. Go to Task 5-2!

ZIKA ZAPP BINGO



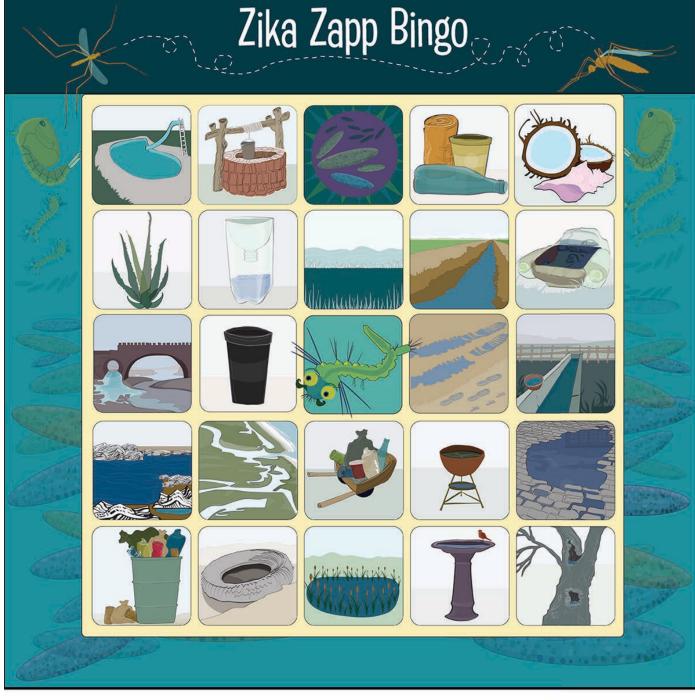






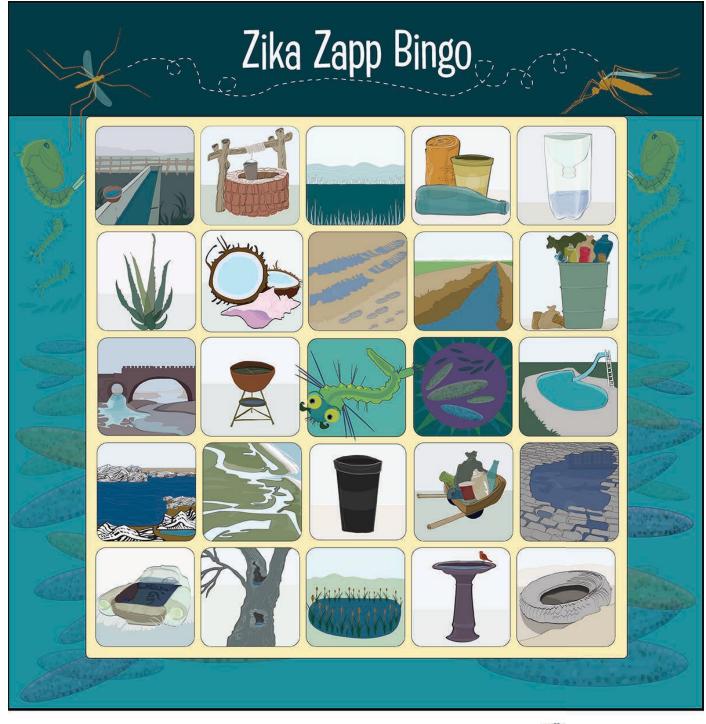


COMBATING ZIKA AND FUTURE THREATS





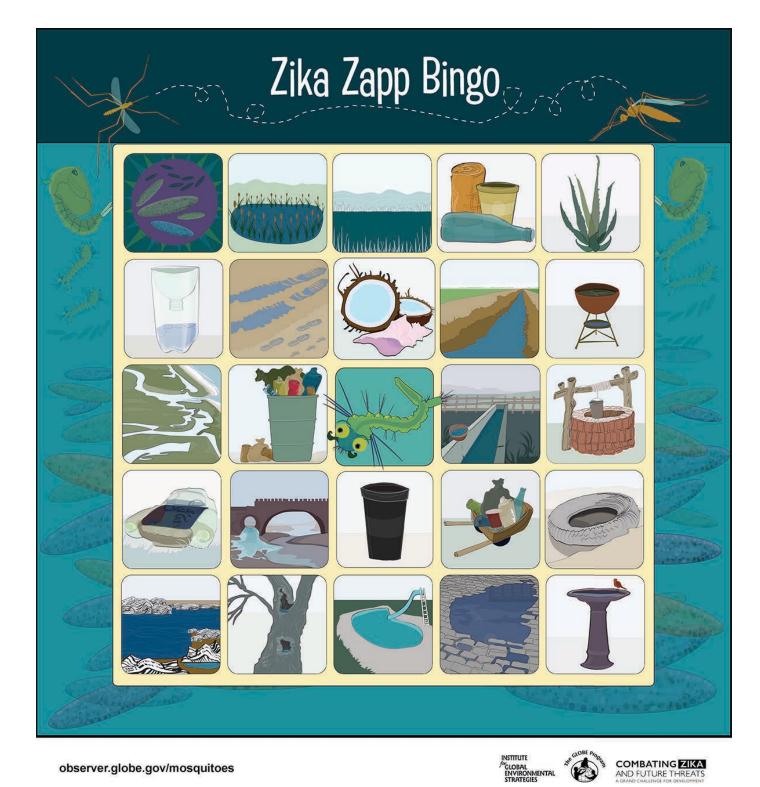


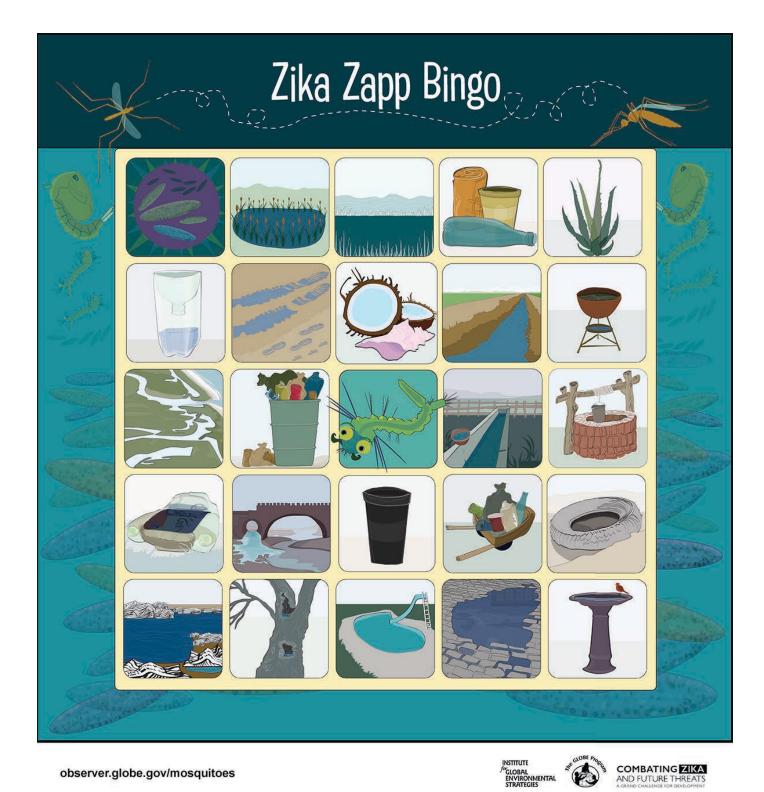


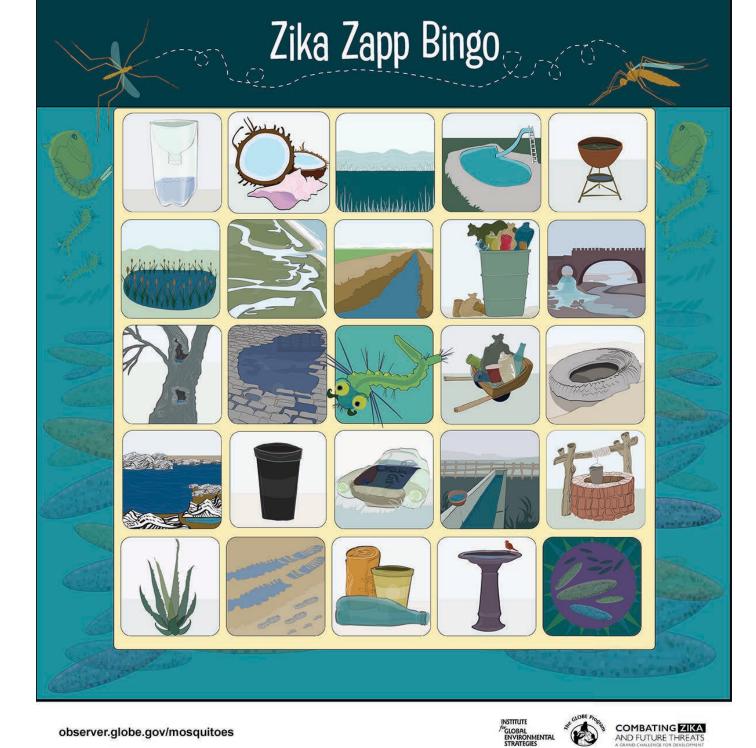


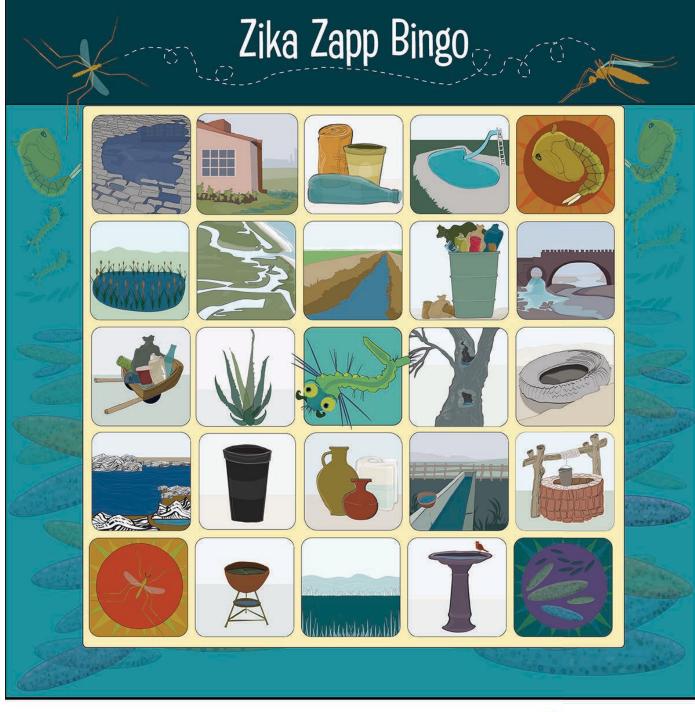


COMBATING ZIKA AND FUTURE THREATS





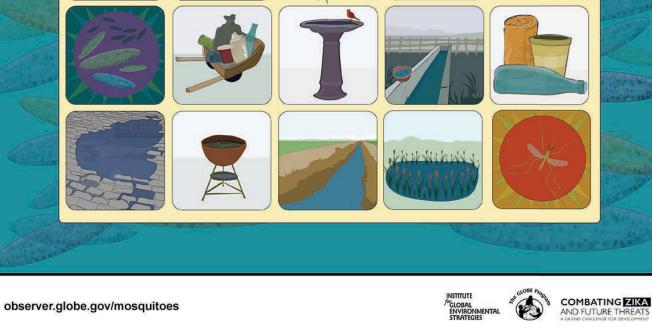


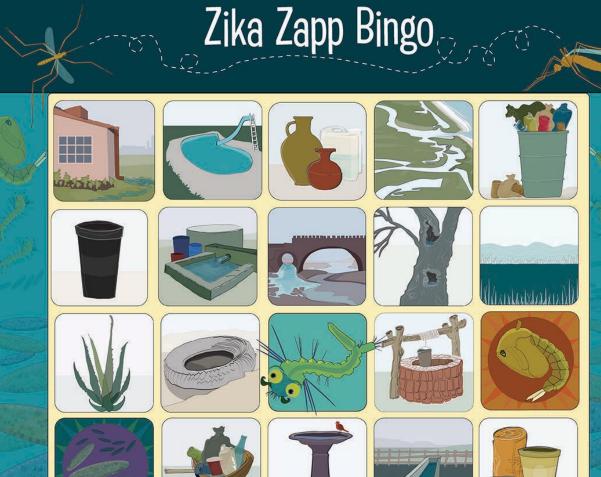


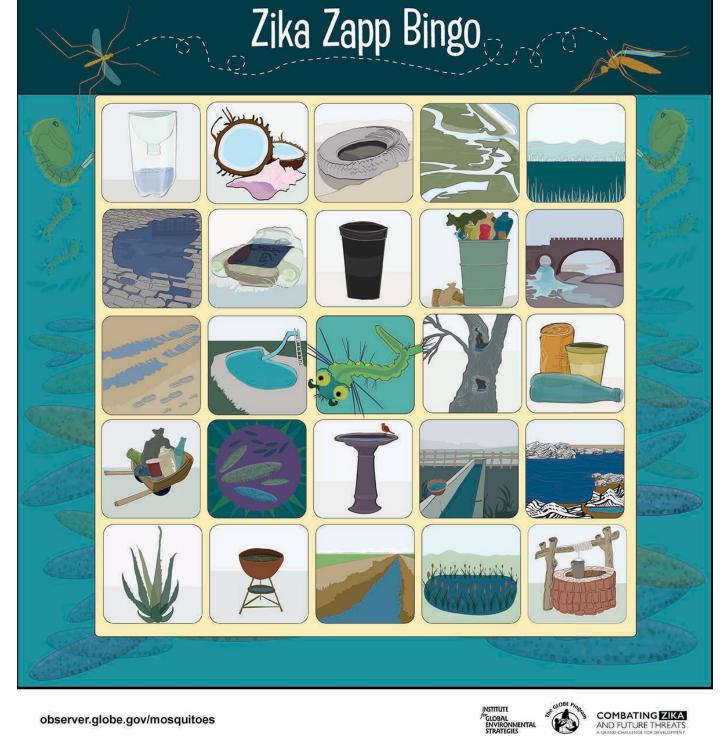




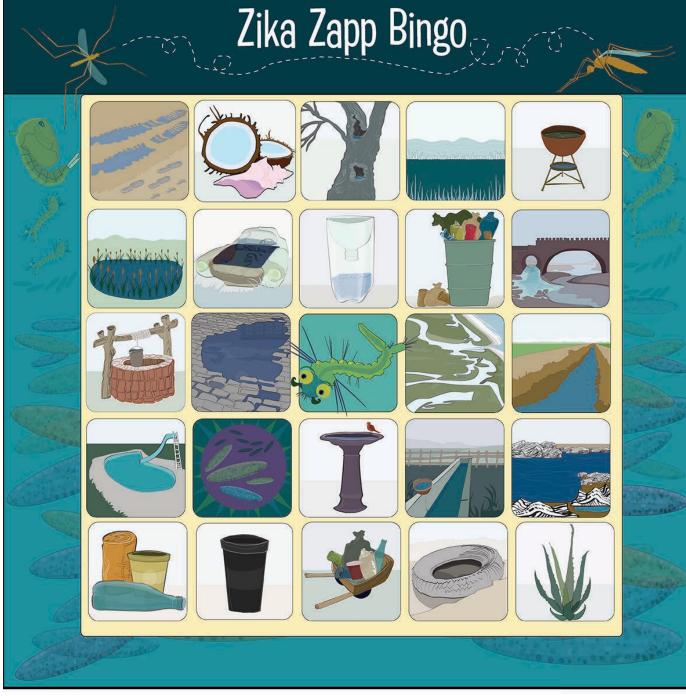
COMBATING ZIKA AND FUTURE THREATS







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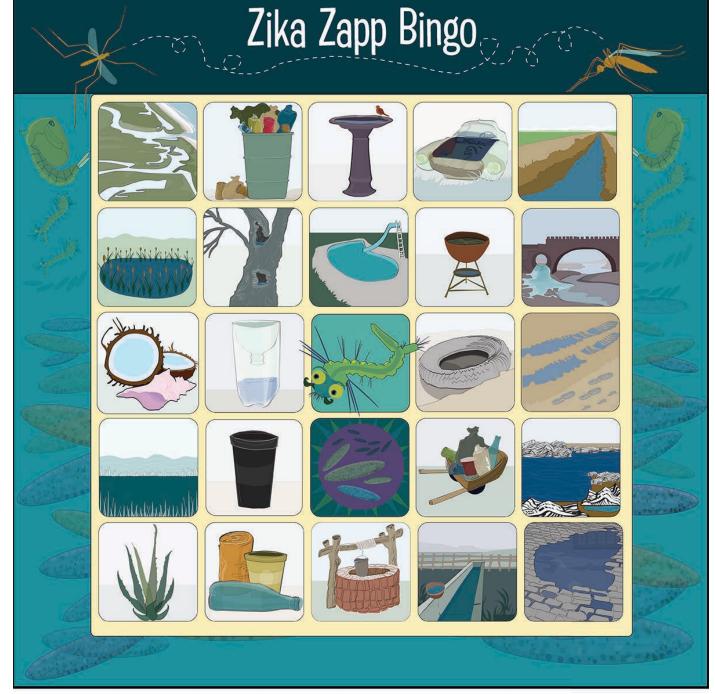


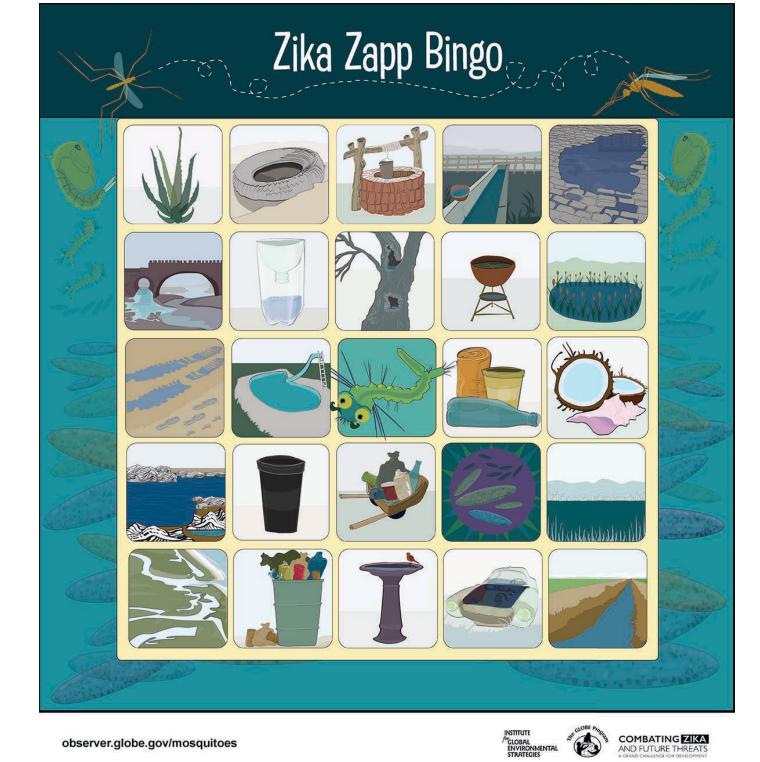




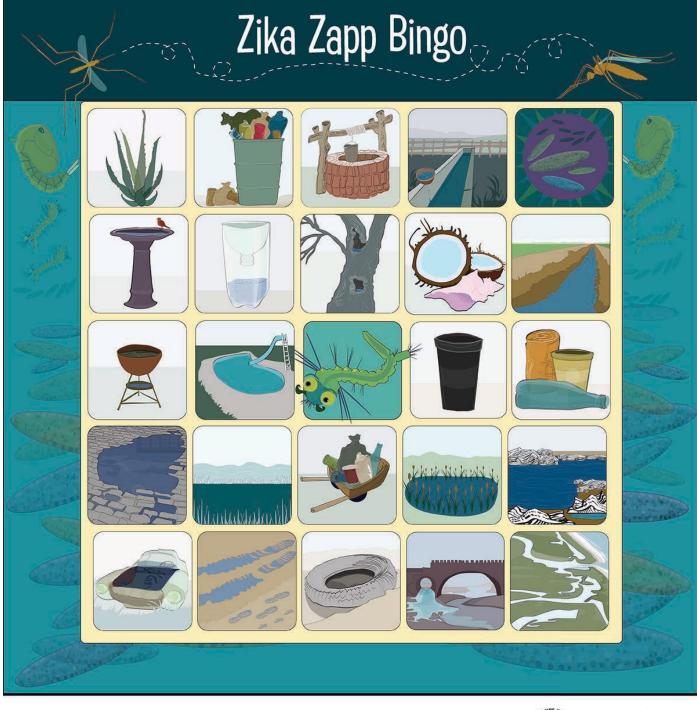
















COMBATING ZIKA AND FUTURE THREATS

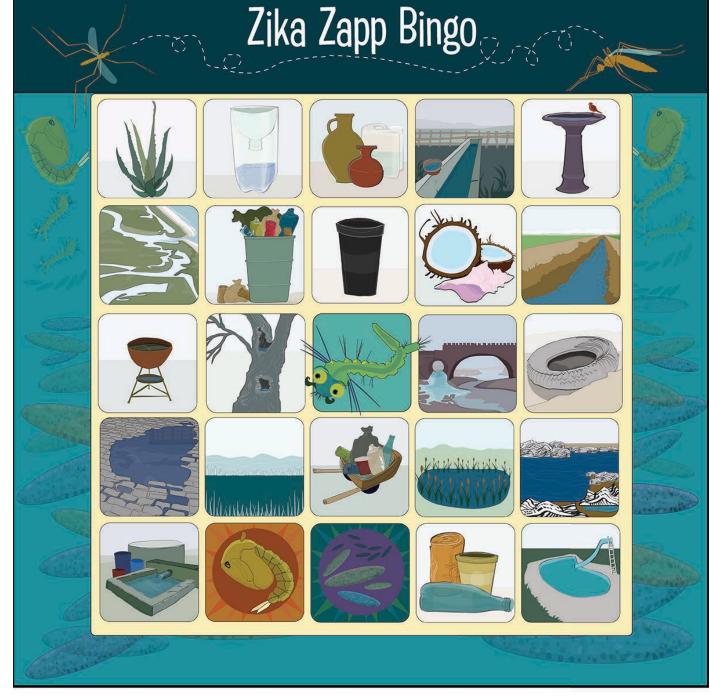


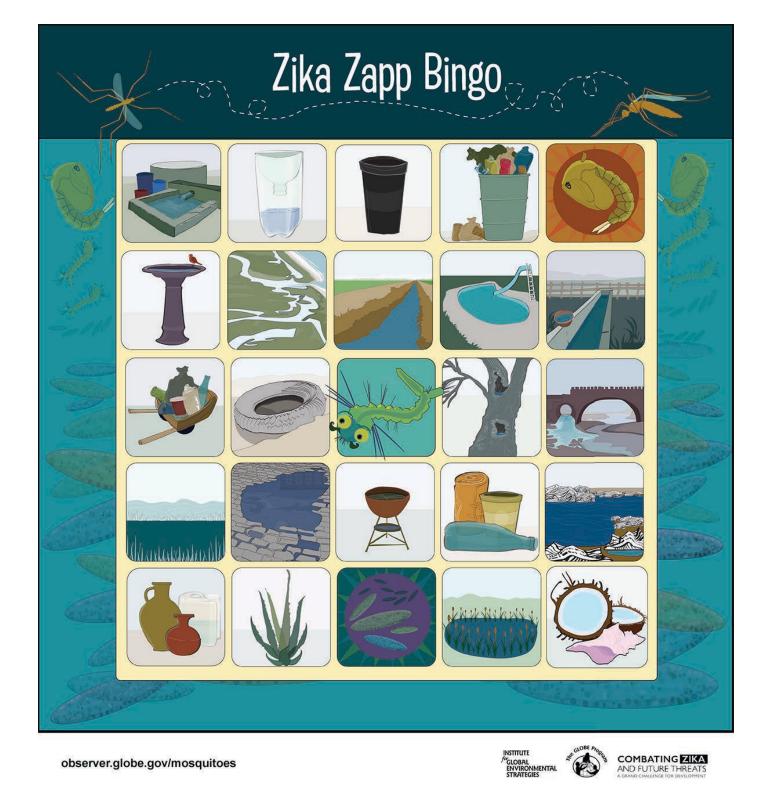


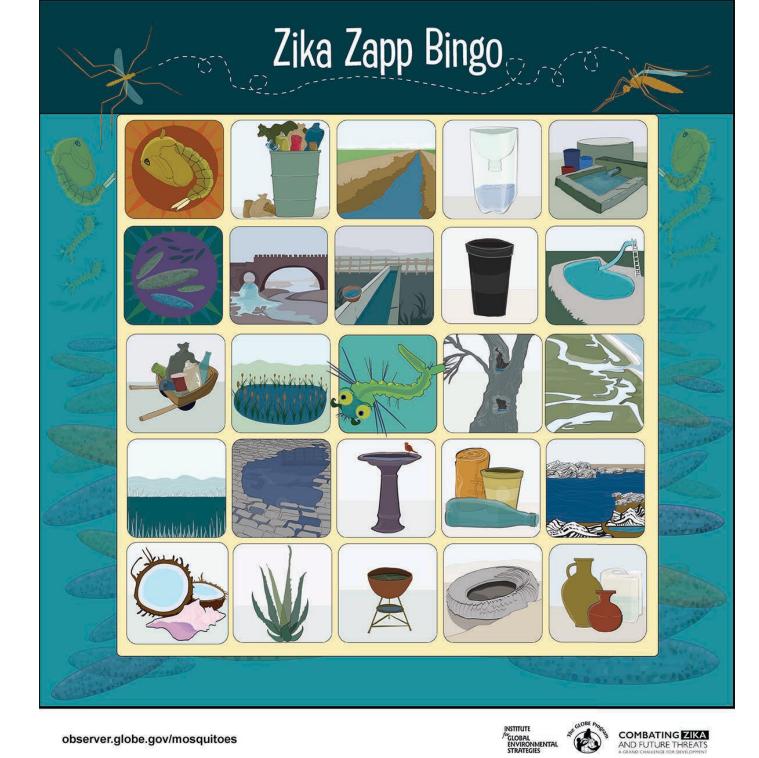


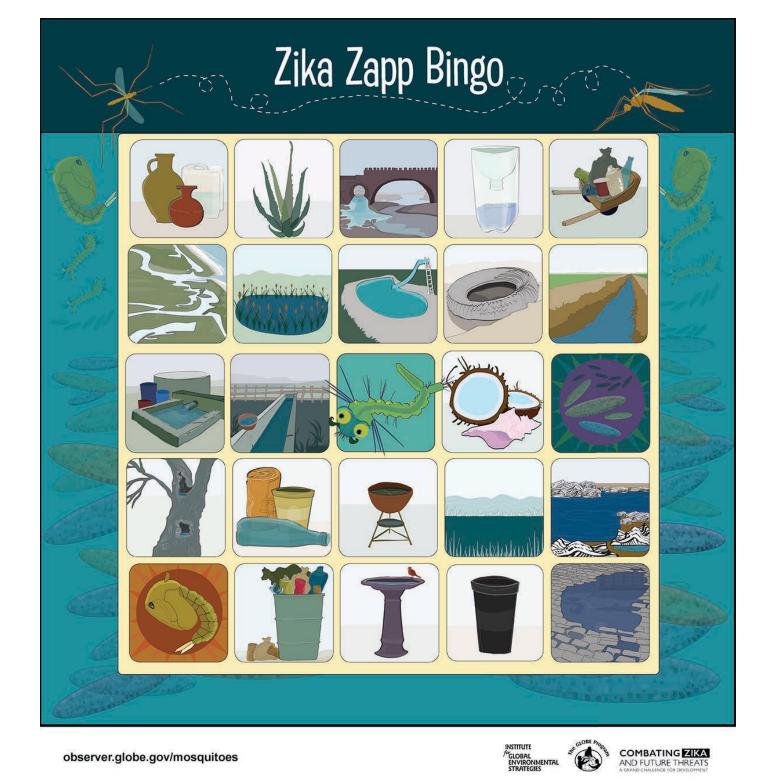










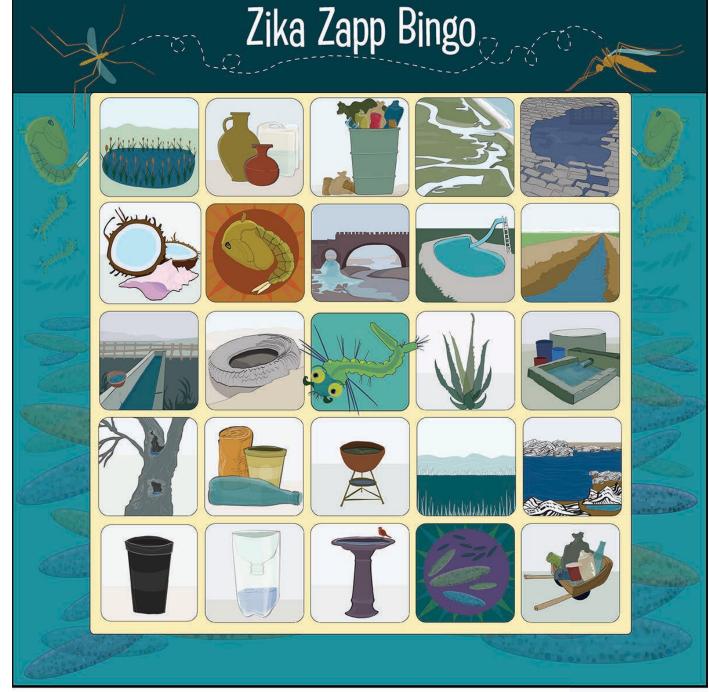


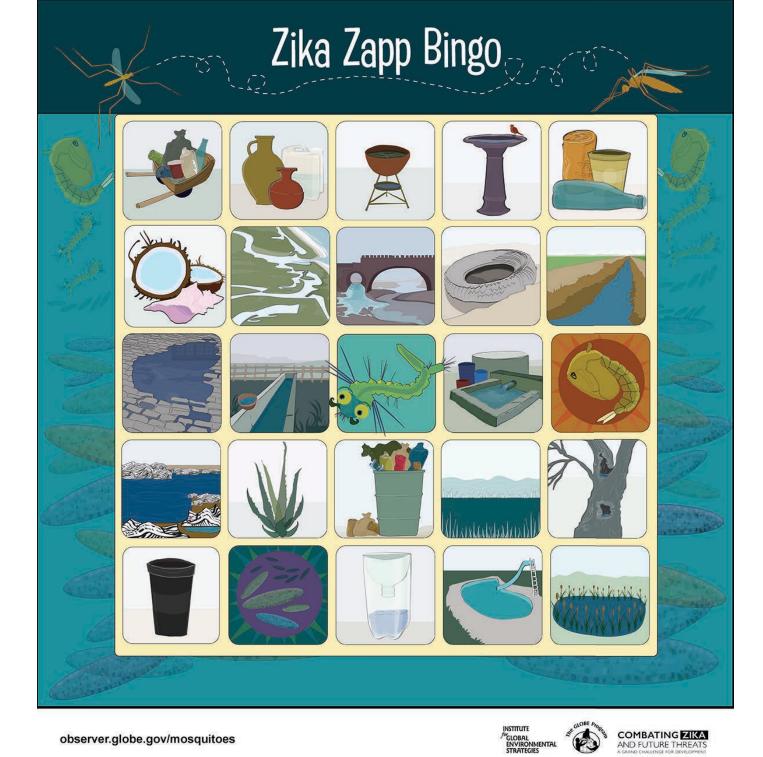




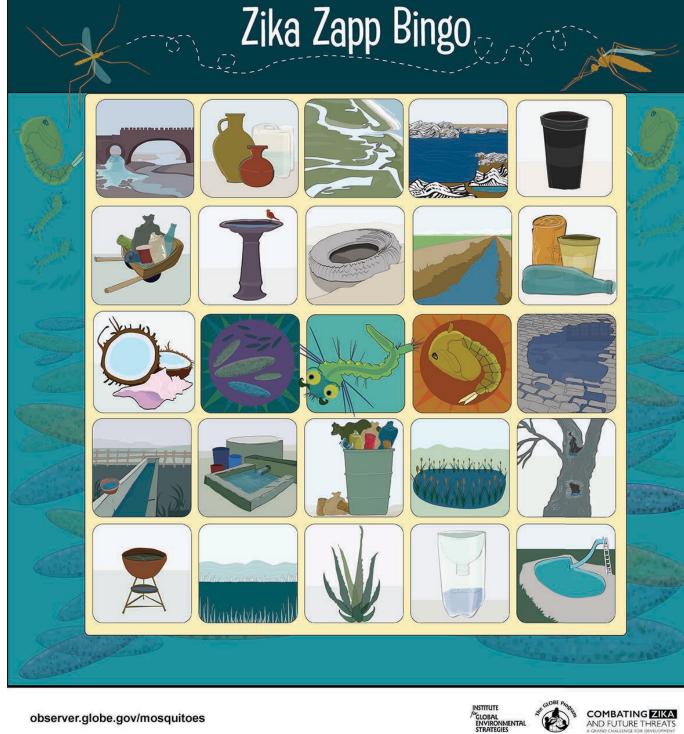




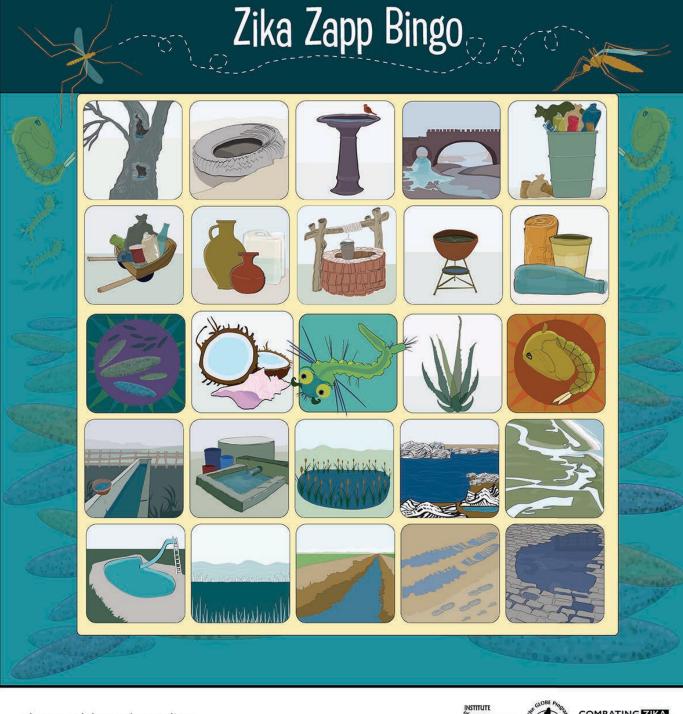












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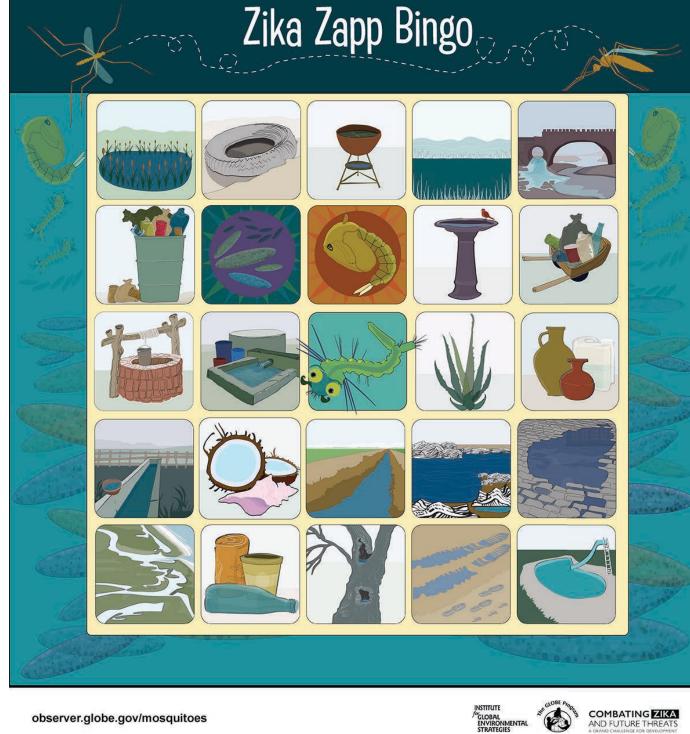
INSTITUTE ^{for}GLOBAL ENVIRONMENTAL STRATEGIES

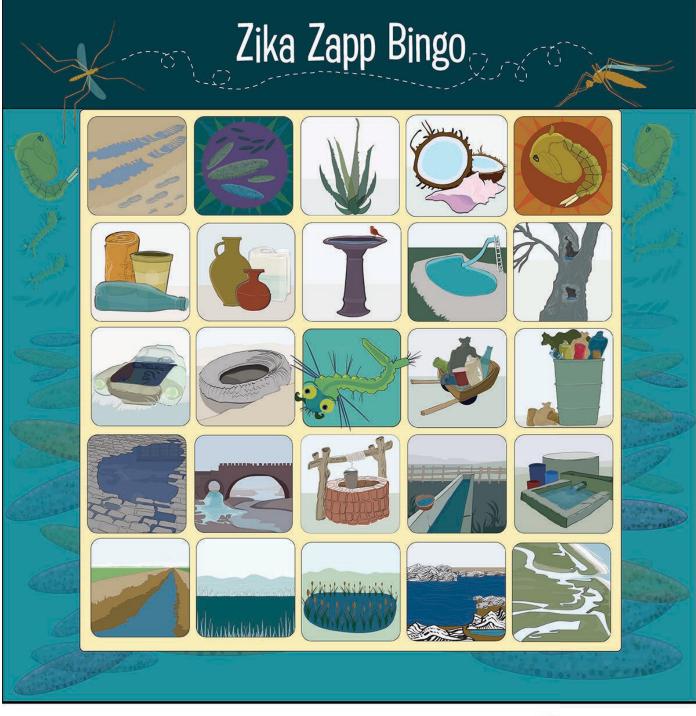








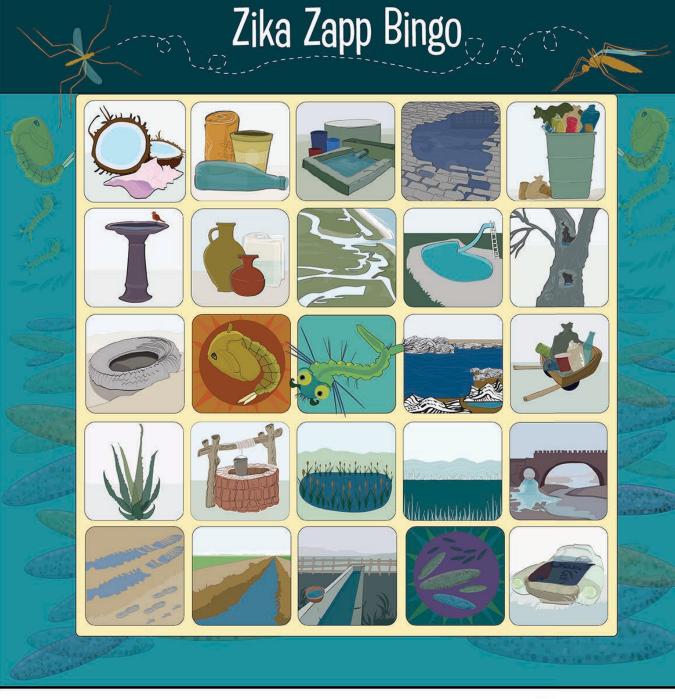








COMBATING ZIKA AND FUTURE THREATS









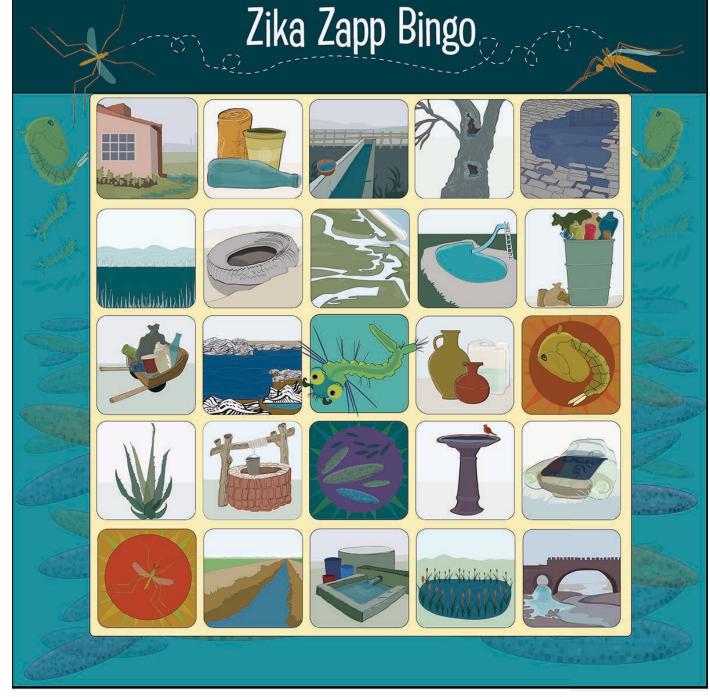


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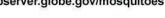




COMBATING ZIKA AND FUTURE THREATS



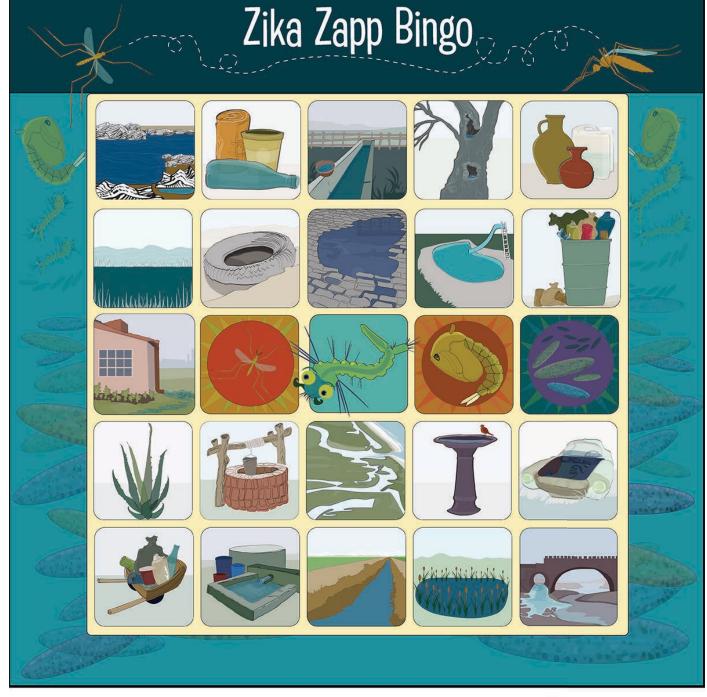


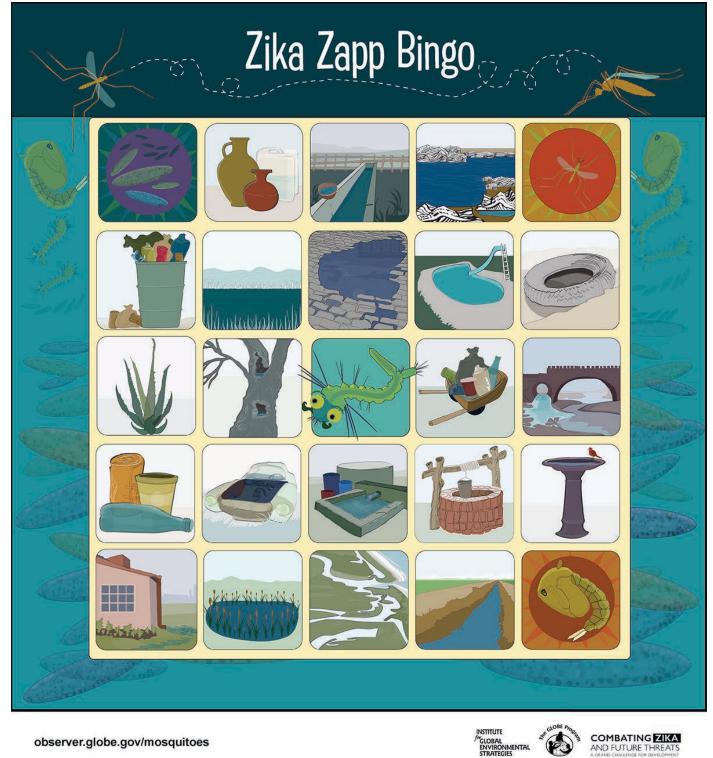


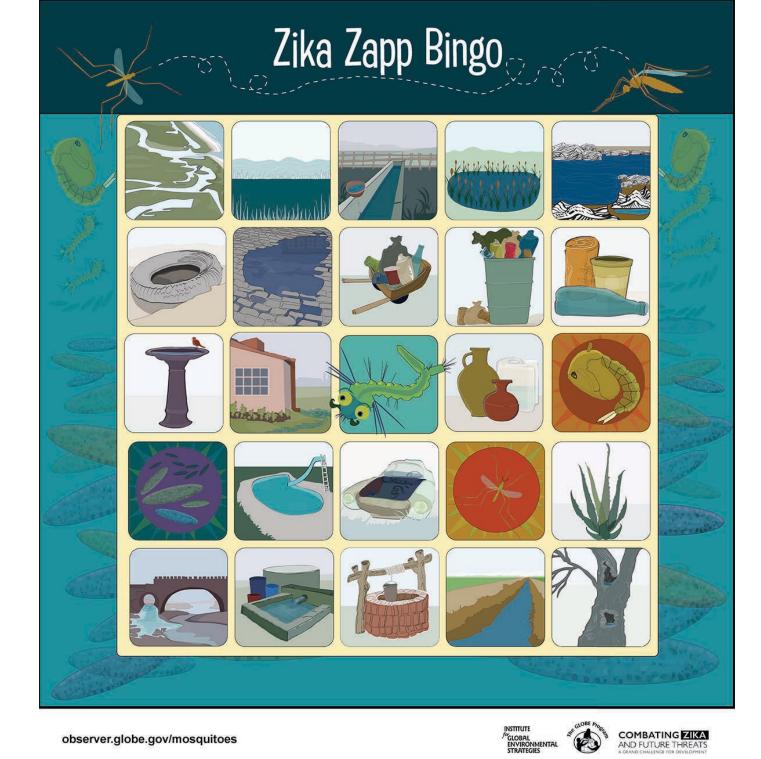


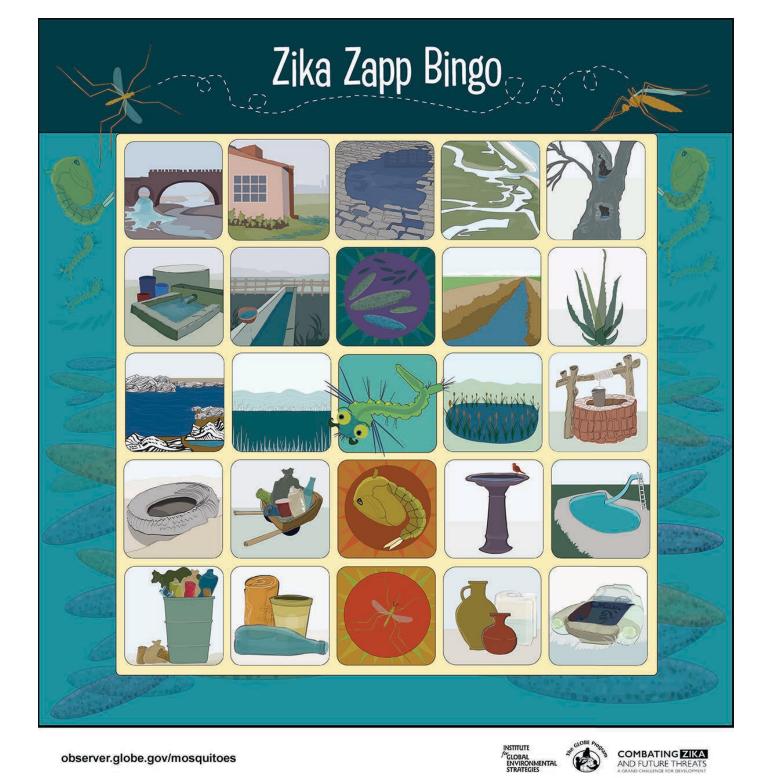










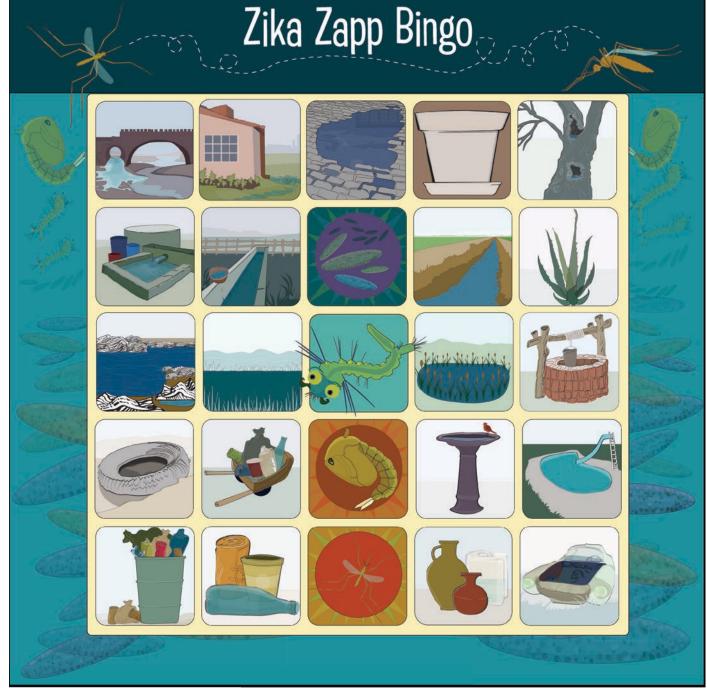


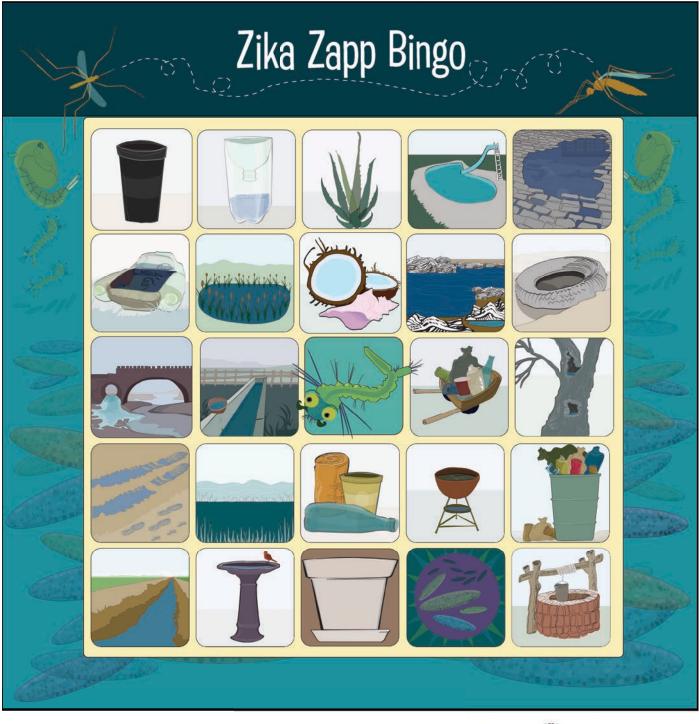






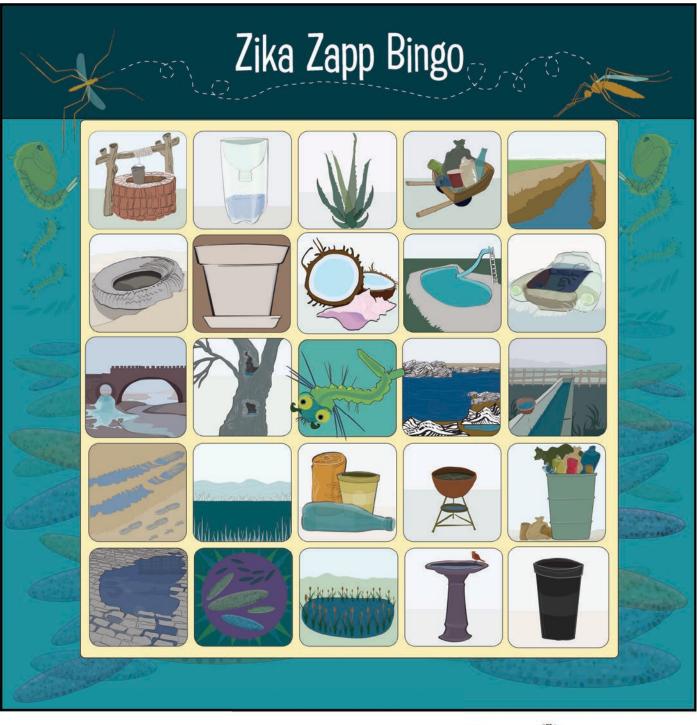








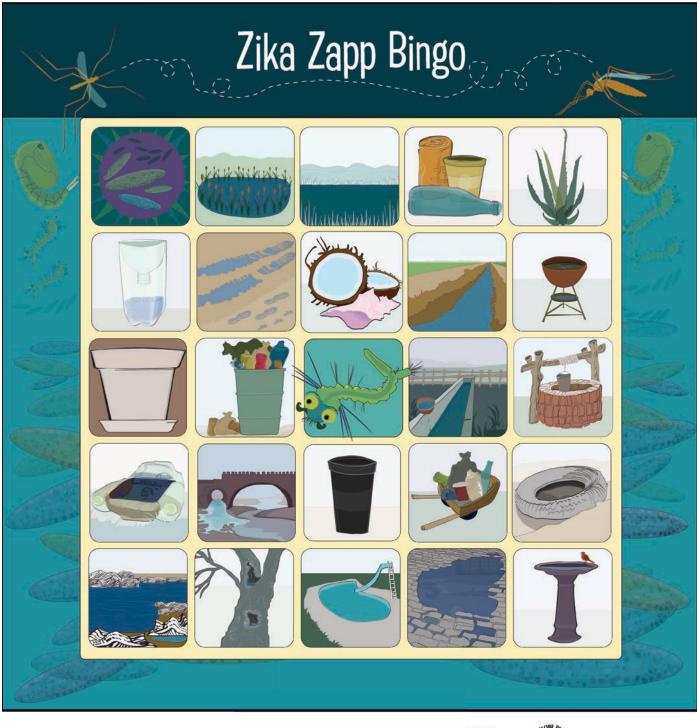






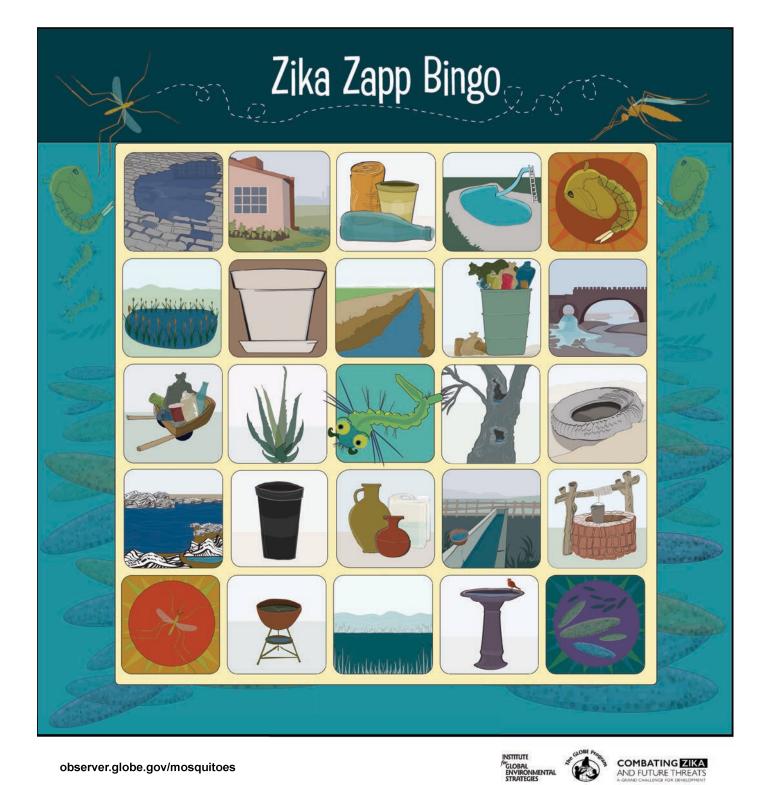


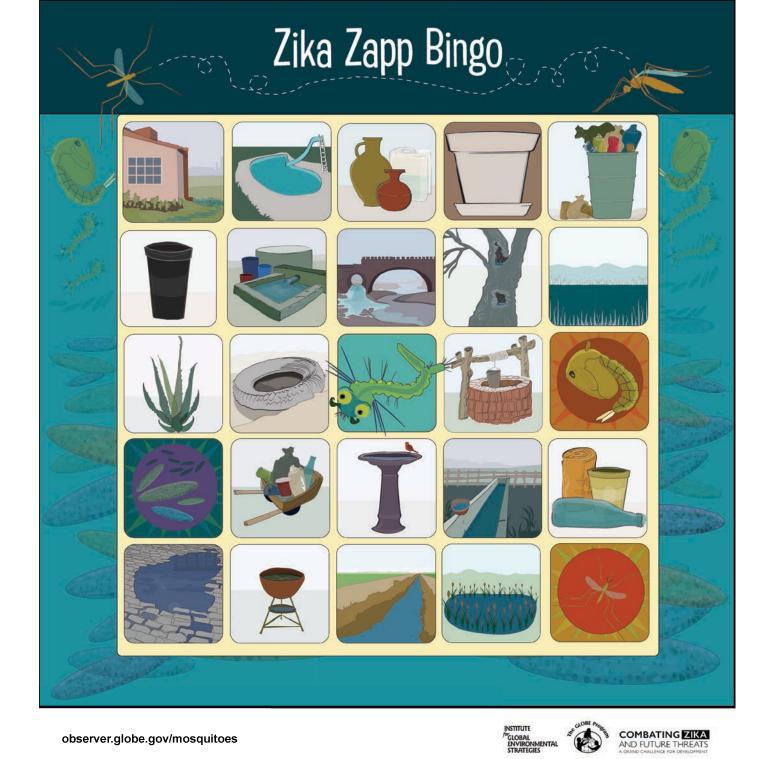


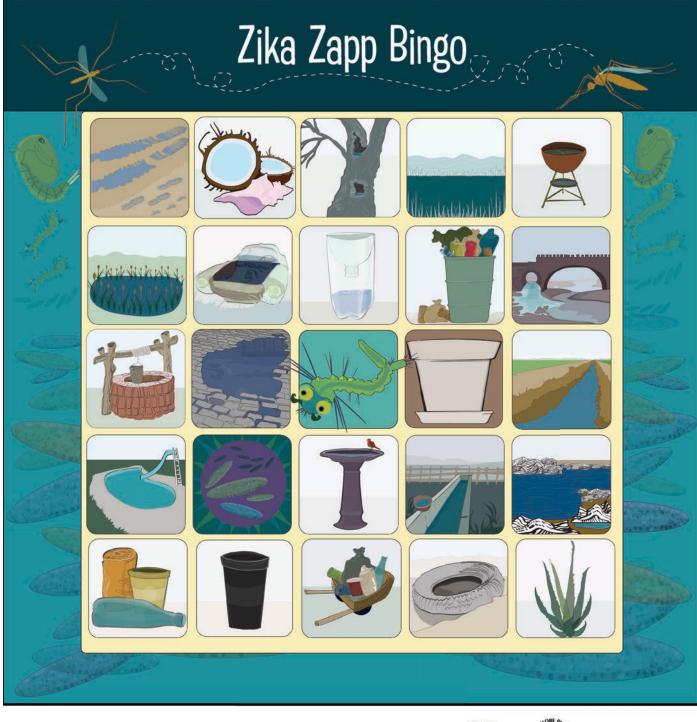






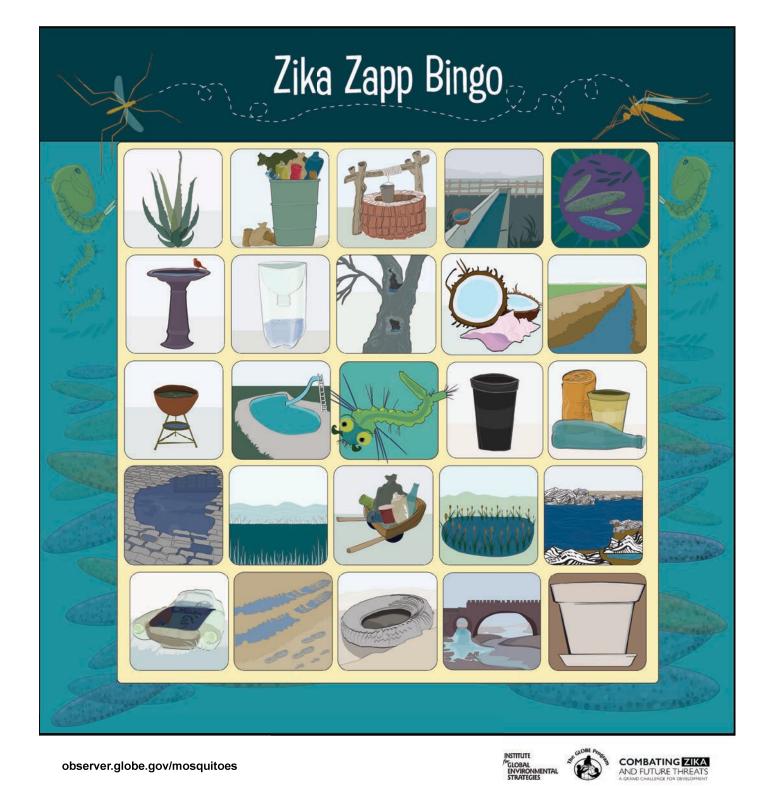


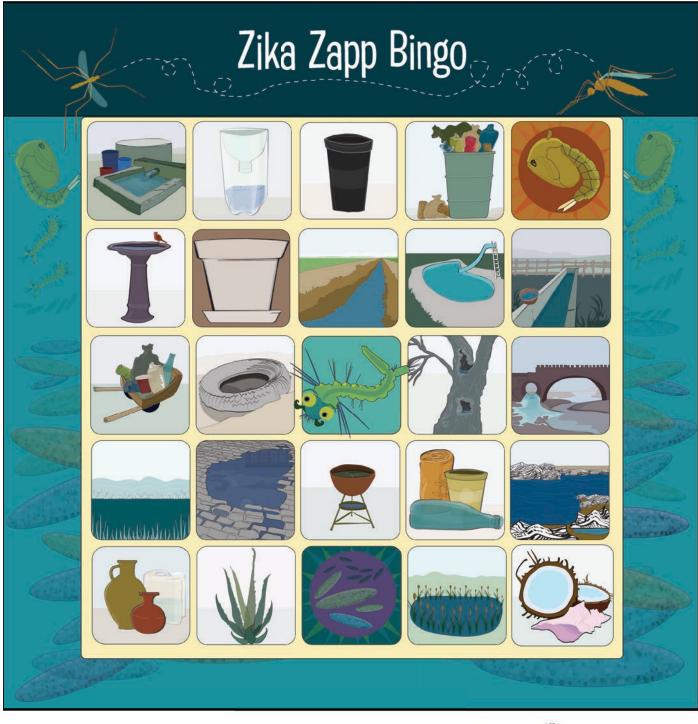








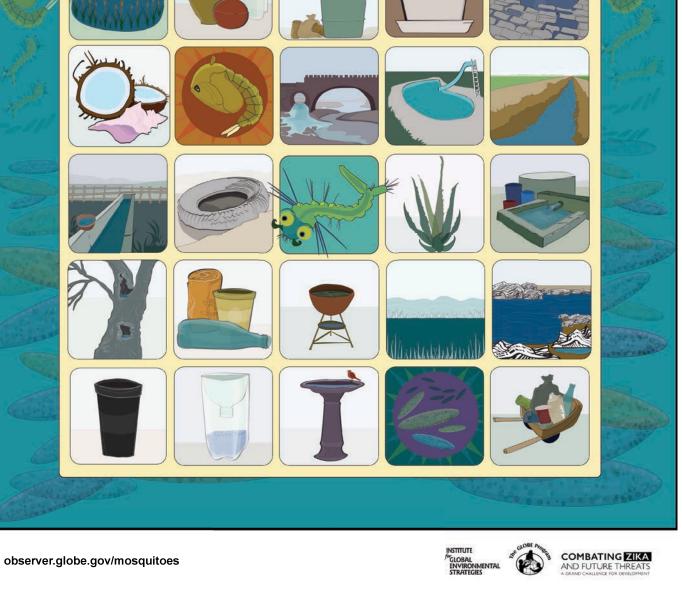








COMBATING ZIKA AND FUTURE THREATS



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Zika Zapp Bingo

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Zika Zapp Bingo Game

LEARNING OBJECTIVES

Build awareness of

- 1. The many different breeding habitats used by container mosquitoes. There are 30 categories used in the GLOBE Observer Mosquito Habitat Mapper App.
- 2. The 4 life cycle stages of a mosquito (egg, pupa, larva and adult). The Mosquito Habitat Mapper focuses on the larval stage, but asks when taking a sample if mosquito eggs, pupae or adult mosquitos are also found in the sample or nearby.

PREPARE:

- Print out different Zika Zapp bingo cards for each learner or team, plus one call sheet (images of mosquito breeding sites and life cycle stages with names)
- Cut up the call sheet and put individual pieces into a container (e.g., bowl, box, bag, or hat).
- If playing in small teams (e.g., 2-3 players per team), divide the group into teams.
- Collect or create markers (xx per player or group) these could be pennies, small rocks, or other markers for players to use (see also template that can be used to create markers) For paper markers, there could be printed or pasted onto cardboard before cutting out to make them sturdier.

PLAY

- Hand out a different card to each learner or team
- The center square is a "free" space players should mark.
- The "caller" draws one of the mosquito habitat sites or life cycle stages and says the name.
- Players place the marker over the image for the habitat or life cycle stage if it is on their card.

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WINNING

- A player or team covers a row of spaces in any direction (vertically, horizontally, or diagonally) and calls out "ZikaZapps." (see also variations on next page)
- The caller checks the card and if they are correct they win the round, if not, they are disqualified from that round (or continue to play?)
- Continue until a specific number of winners have called "ZikaZapps" (e.g., a round can have 1 or more winners)

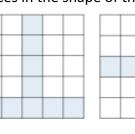
VARIATIONS

Blackout – Cover all the squares on a playing card.

Square – Fill all 4 outside rows - top, right, bottom, and left)

U-Shaped – Cover 3 outside rows to form a letter "U"

T-Shaped – Cover spaces in the shape	of the letter "T" – I	right-side-up, left,	right or upside down



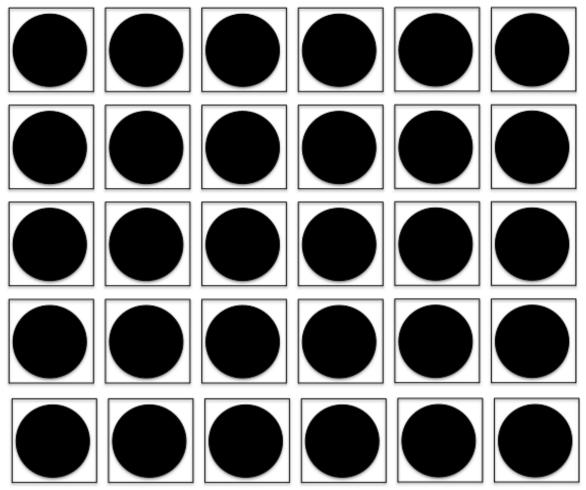
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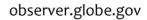






Marker Templates





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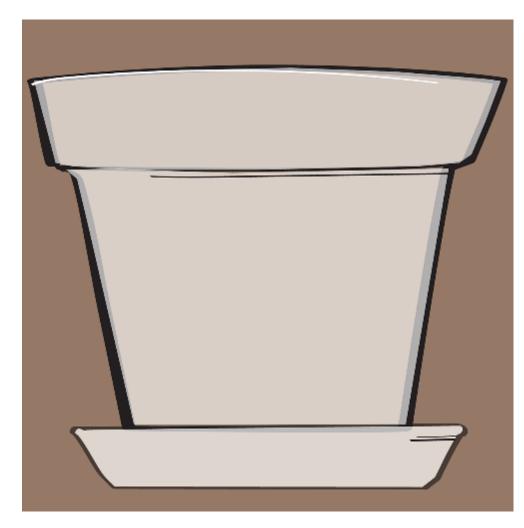


Abandoned car_1	Animal Tracks_2	Animal Trough or dish_3	Birdbath_4	Can, bottle or cup_5
Discarded objects / trash_6	Ditch_7	Estuary_8	Grill_9	Hollows in trees_10
Hollows in plants_11	House structures_12	Lake or pond_13	Mosquito adult_14	Mosquito eggs_15
Mosquito larva_16	Mosquito pupa_17	Ovitrap_18	Pool_19	Puddle_20
Public works_21	River / stream edge_22	Shells_23	Stadium cup_24	Swamp_25
Tank_26	Tire_27	Trash container_28	Water storage jars_29	Well or cistern_30
Plant pot _26				



• Before playing game, mix up the order of the slides!





Flower pot or other container



GLOBE Observer mosquito habitat

mapper

Discarded tire





Can or bottle





Water storage container



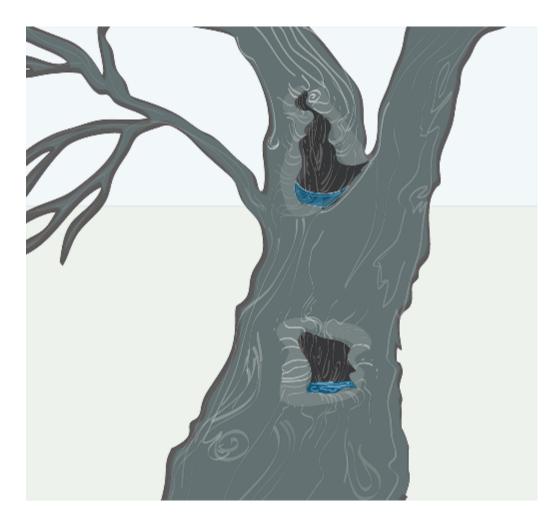
Stagnant water on plant, such as bromiliad, bamboo, puddle on leaf





trash can





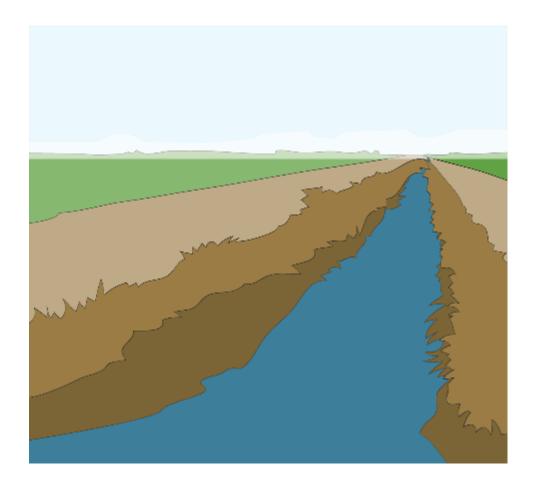
Tree holes or natural hollows in wood





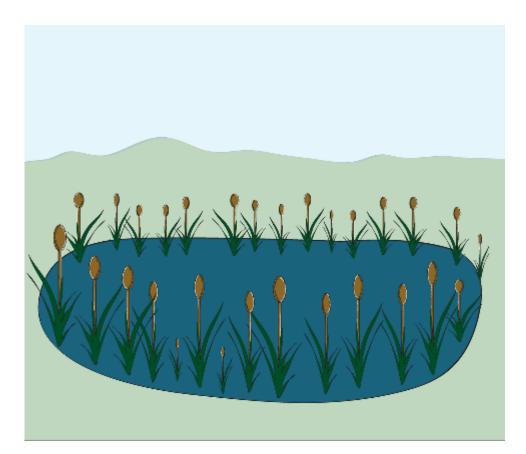
Mosquito trap- adult mosquito trap





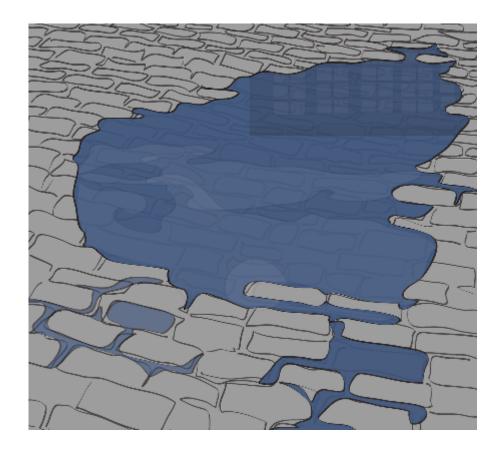
curbside or irrigation ditch in field





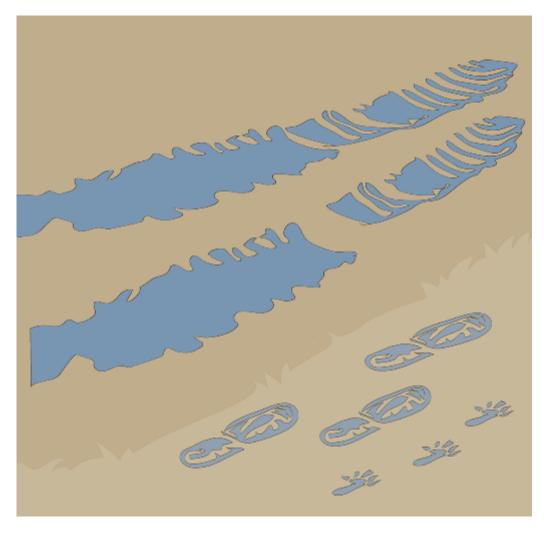
Wetland or swamp



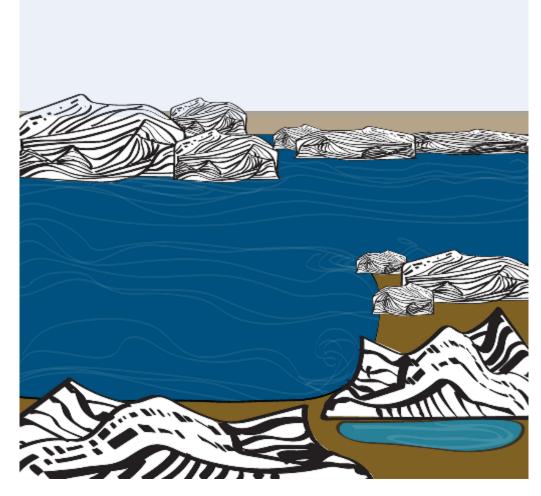


puddle





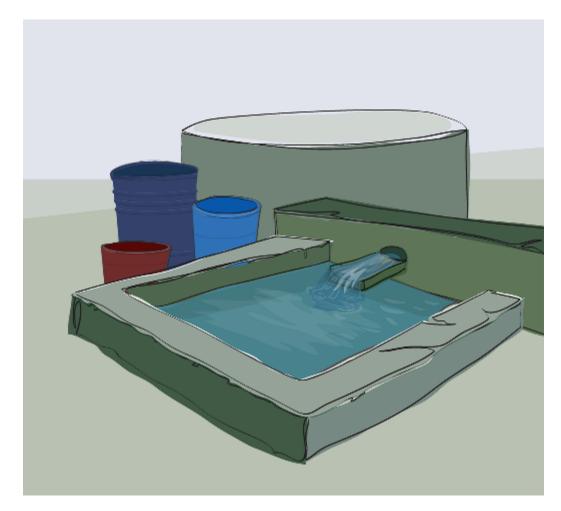
Animal, people or tire tracks



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Pooled still water next to flowing stream





Cistern or built water storage



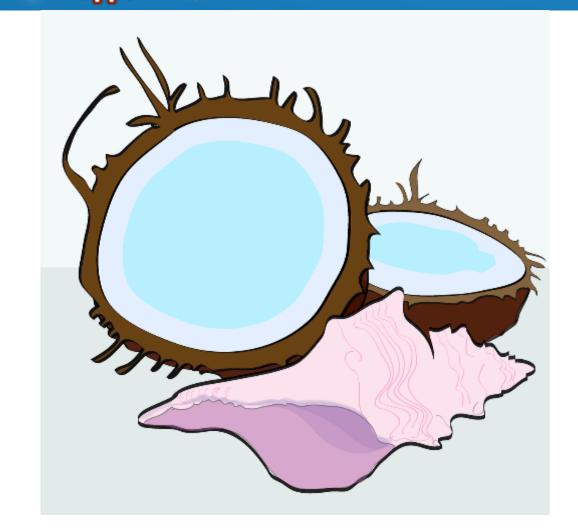




GLOBE Observer

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Abandoned vehicle, like a car or boat



GLOBE Observer

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plant or animal shells





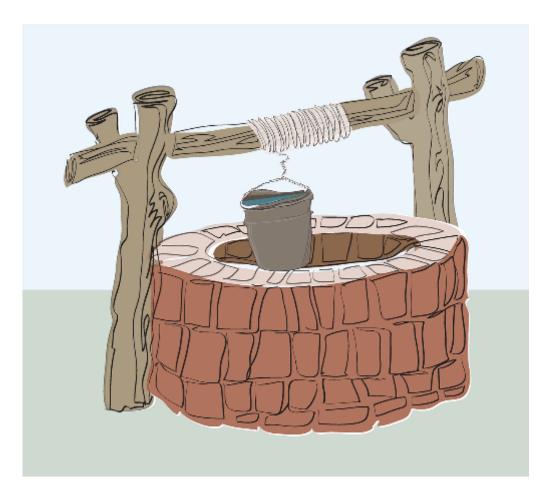
birdbath



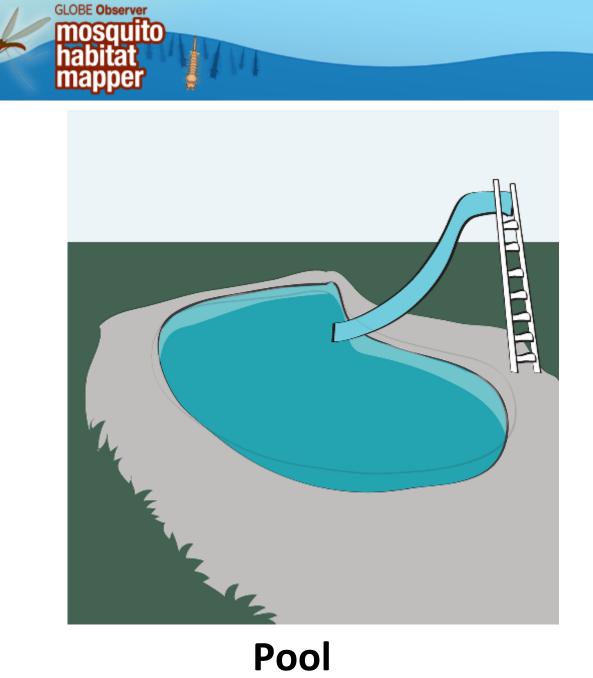


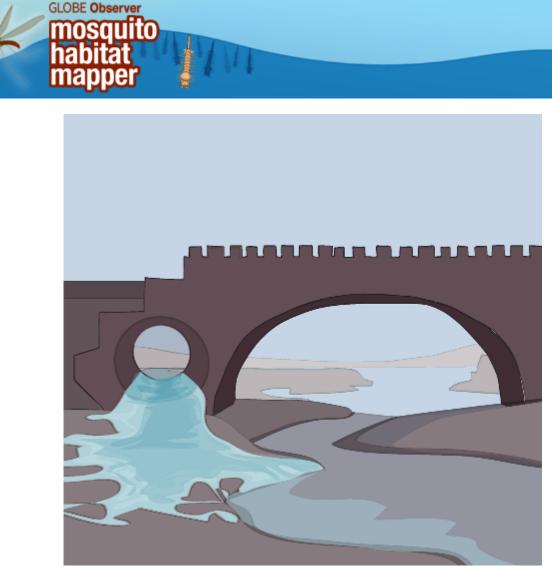
Animal trough or water bowl





well





Bridges, culverts, public works structures





Gutters, downspouts





Grill, outdoor appliance



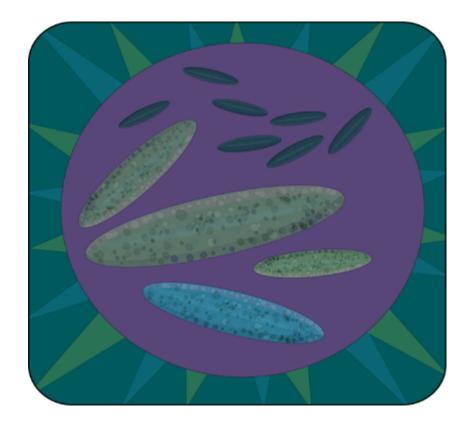






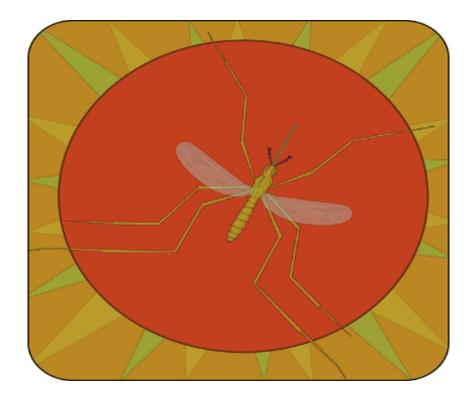
estuary





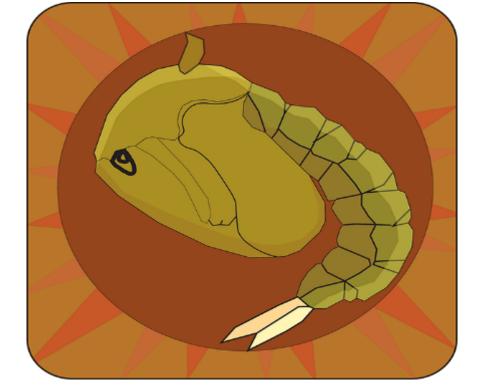
Mosquito eggs





Mosquito adult

Mosquito pupa



mapper

7



GLOBE Observer

The **GLOBE Observer Mosquito Habitat Mapper** is a NASA-sponsored project that is the result of the combined efforts of an extended team that includes the Institute for Global Environmental Strategies (IGES); NASA Goddard Space Flight Center, Langley Research Center, and Jet Propulsion Laboratory; Space Science Applications, Inc. (SSAI); the GLOBE Implementation Office (GIO), GLOBE DIS and Brooklyn College.

The **Mosquito Challenge Community Campaign (MCCC)** is focused on demonstrating the usefulness of citizen science data collected using the GO Mosquito Habitat Mapper for combating Zika in Brazil and Peru. MCCC is led by IGES in partnership with the University Corporation for Atmospheric Research (UCAR), and leverages the NASA App, and the GLOBE Program networks of scientists, teachers, students, and citizen scientists. The MCCC project is made possible through the generous support of the Combating Zika and Future Threats Grand Challenge through the United States Agency for International Development (USAID).

This presentation was prepared by the Institute for Global Environmental Strategies (IGES) and does not necessarily reflect the views of the NASA or USAID. For more information, contact the MCCC Principal Investigator, Dr. Russanne Low:

Rusty_low@strategies.org

www.globe.gov

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Identifying and Mapping Local Habitats

In this task, the team will identify potential mosquito habitats in and around your research site. The team should look for both human and natural potential habitats. Opportunities to engage in the Citizen Science program GLOBE Mosquito Habitat Mapper are provided. Participate if you can.

In this task, the team will be focusing on the following questions from the question map.

- Where do mosquitoes live and breed?
- What influences this?

Objective

- Go to the Task 5-2 folder and get the Identifying and Mapping Local Habitats instructions and GLOBE. You will also need your research map from Task 2-1. There are two versions of this task. Mosquito A involves collecting data by hand. Mosquito B involves using the Citizen Science GLOBE Mosquito Habitat mapper app. Choose the version that works for you. It might also be helpful to do both if you can. In that case, start with Mosquito A and then do Mosquito B.
- 2. As a team, read the Meet the Team reading.
- 3. Conduct a research site evaluation.
- 4. As a team, discuss the following.
- How could your habitat survey of your research site be useful when thinking about where mosquitoes live and develop in your local community?
- How could this information be useful when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?
- How could this information be useful when developing solutions to manage mosquitos in your local community?
- Changes in habitats can affect mosquitoes in your local area. How could you monitor habitat changes in your research site in the future? How could this information be useful to address the problem question in the future?

Continue to Task 5-3





If your team has access to technology, such as a smart phone or tablet, consider how you could use the GLOBE Mosquito Habitat Mapper app to share your local data with scientists around the world.



Part Five. Habitats

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Task 5-2 Tutorial

Mosquito Habitat Mapper

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This presentation:

- Provides background information to prepare citizen scientists to use the GLOBE Observer Mosquito Habitat Mapper
- Provides the step by step instructions for obtaining a mosquito sample for analysis

Overview

Learning Objectives

After reviewing these slides, you will be able to:

- Recognize potential mosquito breeding sites
- Sample water for mosquito larvae
- Identify mosquito larvae and differentiate between *Aedes, Anopheles,* and *Culex* larva.
- Understand the importance of removing extraneous containers with standing water from around your neighborhood and community

GLOBE Observer is an international network of citizen scientists and scientists working together to learn more about our global environment, including our changing climate and its impacts.

Mosquito Habitat Mapper

GLOBE Observe





GLOBE Observer is part of The GLOBE Program. Data collected by citizen scientists through GLOBE Observer encourages student research, strengthens science education, and supports the work of scientists.

GLOBE Stats

117 Countries30,776 Schools28,193 Teachers

141,856,866 Measurements 518,056 Measurements this month

- The goals of the MHM app are to SEE increased mosquito awareness and decreased mosquito-borne disease risk through:
- Scientific data collection and analysis: Identifying locations of mosquito taxa of interest to participants, communities, public health authorities
- Empowerment: Actively reducing mosquito risk- by dumping containers and monitoring environment
- Education: Learning opportunistic breeding habits used by Aedes aegypti/albopictus in human built environments and about vector borne disease risk communities

Our investigation focuses on mosquito larvae- an immature developmental stage that lives in water, doesn't bite and doesn't pose a health hazard to humans!

BE Obse



The Mosquito Habitat Mapper supports you through **4** data collection steps:

GLOBE Observer



Equipment Needed for habitat mapping and sampling:

• GO Mosquito Habitat Mapper on a mobile device (e.g., phone or tablet) for recording and submitting data.

GLOBE Observer

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 Mosquito dipper, ladle, cup or bulb syringe (or a net, bucket, and wash bottle) for sampling. (Contact your local mosquito control authority for any recommendations)





Equipment needed for Identification

- Macro lens attachment for mobile device (35x) or microscope. (Some features can be seen with a good magnifying glass.)
- Toothpicks, tweezers or forceps to move larvae for viewing
- White plastic or paper plate
- Paper towels
- Ethanol for euthanizing specimens or preserving samples (optional)
- Plastic or glass vials for specimen storage (optional)





Citizen Scientist Safety

Note: most mosquitoes do not transmit pathogens to humans or cause disease.

• Protect against mosquito bites:

Wear long sleeves, pants, socks and shoes. Apply an effective insect repellent to exposed skin.

• Protect from polluted or unsafe water:

Wear gloves and/or goggles.

• Avoid sampling on private property:

Sample in your own yard or in public areas. Do not take samples on private property unless you have obtained permission.

Recommended: goggles and gloves for safety

Data Collection using the GO Mosquito Habitat Mapper

GLOBE Observer

mapper





Choose your protocol:





Step 1. Locate Breeding Sites

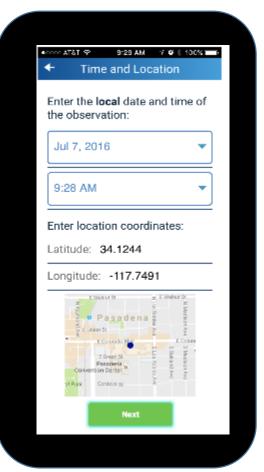
GLOBE Observer

Open GLOBE Observer Mosquito Habitat Mapper.

The app will automatically download the date, time and the latitude / longitude of your location.

You will be able to verify the location by the map that is provided.

Note: You can use the app whether or not there is Wi-Fi at your sampling location. All recorded data will automatically be sent when Wi-Fi becomes available!



Locate sources

Locate sources of standing water. Check the surface of the water for mosquito larvae.

GLOBE Observer







Indoor containers



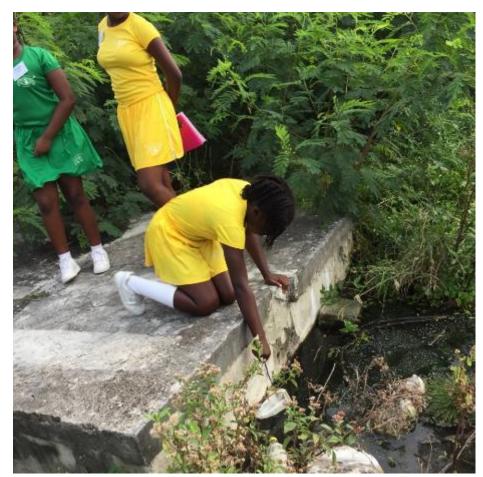


Outdoor containers

Step 2: Sample and Count

Use your sampling tool (whether a cup, syringe, dipper, net/wash bottle) to obtain a water sample containing larvae.

Protocols for gathering samples vary according to the tool used. Use the one that works best for your situation.



Importance of taking multiple dips

But no matter which tools you use, GLOBE recommends sampling each source 5 times. Because the larvae are not evenly distributed on the surface, so you may need several dips to obtain a sample with larvae in it.

Wait a couple minutes between each dip. Why? When you disturb the surface of the water, the larvae will swim below for safety. However, they will soon return to the surface because they have to breathe.



Technique for using a net or a mosquito dipper in a small pond

Sampling Method 1: Bulb Syringe

This method is appropriate for all environments and sampling sites.

Steps:

1.Press and collapse bulb.

2. Place syringe tip near the top of the water surface.

3. Release bulb so bulb inflates and water enters the syringe.

4.Transfer sample to plastic bag by holding tip and then releasing the sample into the bag.







Sampling Method 2: Dipper

You can use a mosquito dipper, a soup ladle, or even a plastic cup when sampling either a container or a non-container site.

Steps:

- 1. Skim the upper most surface of the water with the dipper at an acute angle with respect to the water surface.
- Transfer your sample to a sample bag. (You can put all your samples in the same bag.)



Sampling Method 3: Net sample from large container

Large water containers are those that hold 500 L or more of water. Examples include large water jars, water pools, and cement tanks.

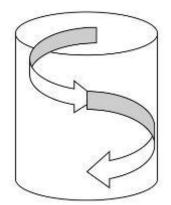
Steps:

1. Dip the net in at the surface of the water.

2. Start at the top of the container by swirling the net around the edge.

3. Continue to the bottom in a swirling motion- sampling all edges of the container.





Sampling Method 4. Net sample from small container

Steps:

- 1.Pour water from the container holding the sample through collection net into a separate bucket.
- 2. Use a squirt bottle filled with water to wash any trapped debris into the bucket.
- 3. Pour sample from bucket into a plastic bag(s).





Handling Samples

- You may want to take your sample inside to identify your specimen
- Leave air in bags so that larvae can breathe.
- Keep bags cool and in the shade (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.

Step 2: Sample and Count

Count the number of larvae in your sample. You can provide an exact number or an estimate.

For example, in the sample to the right, the larvae count is estimated to be 75-100.

Using this same sample photo, it is important to note that not all of the larvae look the same. Why do you think they are different?



(Answer)

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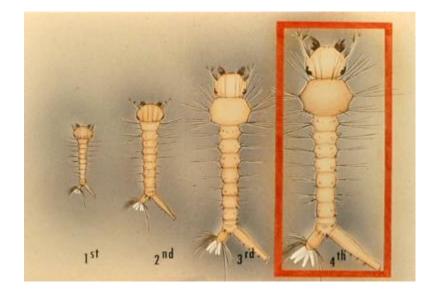
This sample has larvae from different stages of development.

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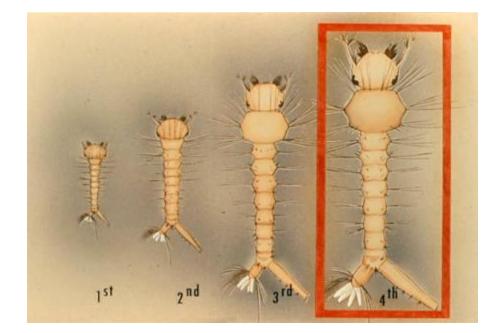
We will show you what we mean in the next few slides.



After hatching from its egg, the larva is in its first **instar** (stage between molts). It eventually outgrows its exoskeleton and molts (loses its outer covering) to become a second instar. It does this two more times to reach the fourth instar. The fourth instar is the larval stage that is most visible, reaching a length of one-half inch.

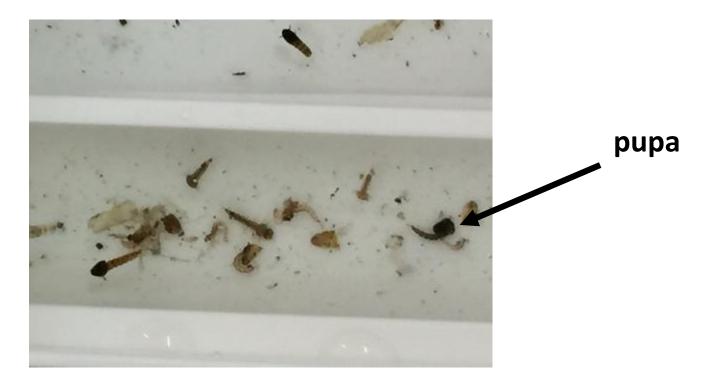


The features used to identify your specimen are seen on the 4th instar larva- so look for the biggest larvae in your sample. If you can't distinguish any features, it is possible that the larvae are still in an earlier instar stages. If that is the case, you can count your larvae, but you will not be able to identify features.





The 4th instar will molt to become a pupa, another stage in the lifecycle of a mosquito. Pupa are distinguished by their appearance- they look like a comma. You may find pupae in your sample.





Step 3. Photograph and Identify-1

In order to examine and photograph the larvae, they must be removed from the bag.

To begin:

 Pour part of the sample containing larvae onto a white tray or plate.





- Use a dropper or spoon to isolate one larva.
- Make sure each larva is suspended in a small drop of water.



It is important that the drop of water just covers the larva. Too much water will allow the larva can swim- making it difficult to examine and photograph.

You can remove most of the water by blotting it up using the corner of a paper towel.

If the larva is still moving too fast to see, you can euthanize it with a drop of alcohol.





 Use a probe or toothpick to position the larvae so you can see the diagnostic features.



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 Attach a macro lens to a mobile device so that you can take a picture and upload it to the app.

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GLOBE Observe

 Clip the macro lens over the lens of the camera and line it up so that you see a perfect circle of light on your phone screen.



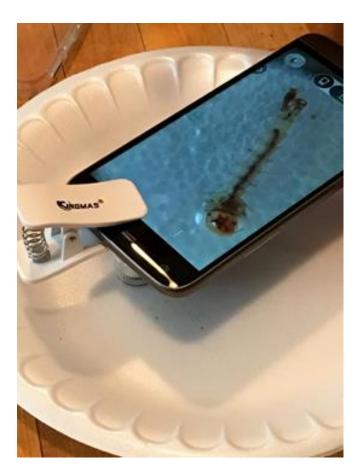


 Line up the lens so that the specimen is in the circle of light on the viewer.



Note that many clip-on devices have a clear collar on them at the end of the lens. You can rest the collar of the lens on your plate.

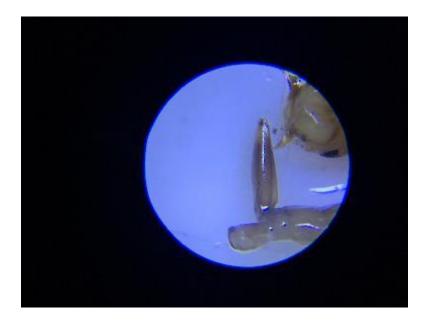
The collar helps you find the focal length that is ideal for looking at your specimen.



Once you have a mosquito larva in view, closely examine the diagnostic features.

Now you are ready to identify your specimen. Use the MHM app or a local mosquito larva key to determine the types of mosquitoes in your sample.

Submit photograph and identification to MHM, following instructions in the app.



If the larvae you found are "other," it is probable you have found one of the many mosquitoes that play an important role in the ecosystem. These mosquitoes are occasionally referred to as "nuisance" species, with respect to humans, but they also serve as food for other organisms and as pollinators for plants.

Step 4: Decommission the breeding site

Where possible, decommission (eliminate) container breeding sites by:

- Tipping the container and tossing the water
- Covering the container
- If you locate a breeding site that you can't or shouldn't decommission by yourself, contact a public health official.
- Don't worry about removing a breeding site from use unless it is a natural or artificial container. Birds, frogs and other living things will thank you!

Visualize and Retrieve Data-1

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GLOBE provides the ability to view and interact with data measured across the world. Use our <u>visualization tool</u> to map, graph, filter and export data that have been measured across GLOBE protocols since 1995. The Mosquito Protocol is new- so we look forward to seeing your data!

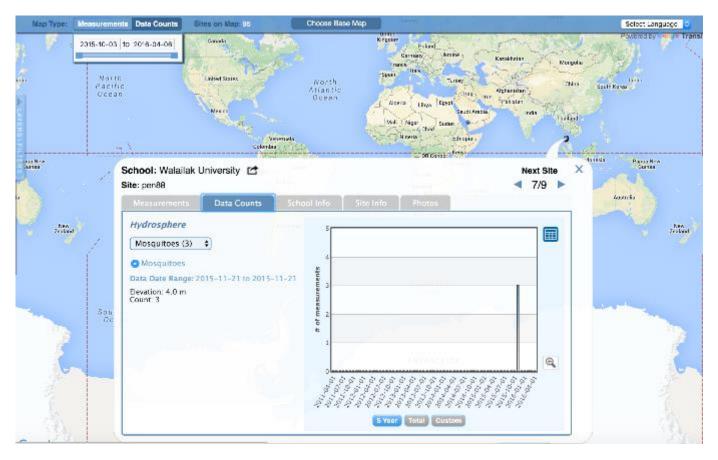


Link to step-by-step tutorial on using the GLOBE Data Visualization Tool



Visualize and Retrieve Data-2

Select the date for which you need pH data, add layer and you can see where data is available.



Additional educational materials for formal and informal education contexts



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Educational Resources

Training Protocols

Frequently Asked Questions (FAQs)

What is the mosquito life cycle?

It is variable, based on species and environmental conditions- so this is approximate! Adult \rightarrow eggs (2 -3 days) \rightarrow larvae (4 -5 days) \rightarrow pupae (1- 2 days) \rightarrow Adult

How do you differentiate between the *Anopheles, Aedes* or *Culex* larvae (identify with unaided eyes)?

We can see the characteristics of mosquito larvae: In the water, *Anopheles* larvae cling parallel with the water surface. On the other hand, *Aedes* and *Culex* larvae cling at an angle of 45° with the side of the container. *Aedes* larvae have shorter siphons, *Culex* larvae tend to have have longer siphons. However, there are 3,500 species of mosquitoes, so you should consult a key for your area to be sure.

What do adult mosquitoes feed on?

Adult mosquitoes feed on any sugar source, including flowers, fruit, nectar and other insects. Some mosquitoes are important pollinators, like bees!

At what time of the year are greater percentages of mosquito larvae found? Most often they are found in the rainy season or shortly after the end of the rainy season.

Frequently Asked Questions (FAQs-2)

When should I use the GLOBE Observer App or the GLOBE Data Entry App to enter my data?

If you are going to also conduct water quality measurements at the same time or return to the same study site periodically, you will want to follow the GLOBE Mosquito Larva Protocol and GLOBE Data Entry App. This will allow you to look at mosquito density and population change in conjunction with other environmental variables at your GLOBE Hydrosphere study site.

The GLOBE Observer Mosquito Habitat Mapper is designed to support identification of breeding sites around your neighborhood and school, especially those that are in containers. Where possible you will be removing the opportunistic breeding site from use by dumping the container and removing trash. This reduces risk of disease in communities. For some sites, you may be returning to the site- such as a water storage container or drain- but these sites do not need to be identified as GLOBE Hydrosphere study sites.

Acknowledgements

GLOBE Observer

The **GLOBE Observer Mosquito Habitat Mapper** is a NASA-sponsored project that is the result of the combined efforts of an extended team that includes the Institute for Global Environmental Strategies (IGES); NASA Goddard Space Flight Center, Langley Research Center, and Jet Propulsion Laboratory; Space Science Applications, Inc. (SSAI); the GLOBE Implementation Office (GIO), GLOBE DIS and Brooklyn College.

The **Mosquito Challenge Community Campaign (MCCC)** is focused on demonstrating the usefulness of citizen science data collected using the GO Mosquito Habitat Mapper for combating Zika in Brazil and Peru. MCCC is led by IGES in partnership with the University Corporation for Atmospheric Research (UCAR), and leverages the NASA App, and the GLOBE Program networks of scientists, teachers, students, and citizen scientists. The MCCC project is made possible through the generous support of the Combating Zika and Future Threats Grand Challenge through the United States Agency for International Development (USAID).

This presentation was prepared by the Institute for Global Environmental Strategies (IGES) and does not necessarily reflect the views of the NASA or USAID.

Educators: If you modify these slides for your own use, please retain this last slide and put your name and contact information below, thank you!

For more information, contact the MCCC PI, Dr. Russanne Low, IGES, <u>rusty_low@strategies.org.</u> <u>www.globe.gov</u>

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Task 5-2 Identifying and Mapping Local Habitats—Mosquito A

Instructions

- Listed below are some places where you might find mosquito eggs, larvae, and/or pupae in your research site.
- Look in your research site for each item in the list and check it for water. If you find any water, describe it and then collect what you find for research purposes, or dump it out so the mosquito eggs, larvae, and pupae cannot grow there.
- Document on your research map the location of each mosquito habitat.

Habitat	Number	Found	Description	Description	Habitat	Found
Παριται	found	water in	of water	of water	exposure	
	Touria	habitat				eggs,
			clarity (clear	movement	(sun,	larvae or
		(yes or	to dirty)	(still or	shade,	pupae in
		no)		stagnant to	semi-	water
				fast-	shade)	
				moving)		
Cans, bottles,						
jars						
Pots and						
containers for						
flowers or plants						
Old tires						
Bird baths						
DILU DALIIS						
Roof gutters						
Drainage pipes						
around buildings						
Trash						











Tarps, plastic bags			
Old cars			
Boats, canoes			
Dripping			
outdoor faucets or window air conditioners			
Wheelbarrows			
Garbage cans, recycling bins,			
other barrels			
Low spots on ground			
ground			
Tree stumps			
Tree holes			
Rain barrels			



Go back to Research Guide now



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Task 5-2 Identifying and Mapping Local Habitats—Mosquito B

Citizen Science Project Instructions

- Below are some resources to help you take part in the GLOBE Mosquito Habitat Mapper app citizen science project. You will need a smartphone or tablet to do this. Use the resources in the Learning Lab task folder to learn more about the app, how to use it, and how to collect data about your research site.
- Look in and around your research site for various potential mosquito habitats and check it for water. If you find any water, describe it and then dump it out so the mosquito eggs, larvae, and pupae cannot grow there. Follow the instructions in the app.
- If you're able, identify any mosquito larvae found.
- Document on your research map the location of each mosquito habitat.

GLOBE Mosquito Habitat Mapper App Resources

To get the GLOBE Observer app (includes mosquito habitat mapper):

https://observer.globe.gov/about/get-the-app

Look over the GLOBE Mosquito Habitat Mapper App Overview and Instructions PowerPoint.

View the video resources about the GLOBE Mosquito Habitat app in Learning Lab:

http://learninglab.si.edu/q/ll-c/RW29tFCHPHv9tjDB



Go back to Research Guide now







Mosquito! Task 5-2 Identifying + Mapping Local

The Importance of Local Mosquito Monitoring



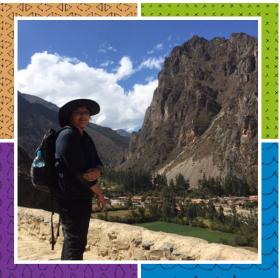
Rusty Low - Senior Earth Scientist -Institute for Global Environmental Strategies

I have focused on many different things in my research and career. However, there has been a theme throughout. This theme concerns how humans and societies address the impact of and are impacted by the environment and climate change.

I am interested in how the climate is changing. We are now learning that mosquitoes and other disease vectors are responding to these climate changes. Climate changes are causing mosquitoes to expand their habitats. It is also causing them to invade new areas. Many of these are areas they have not been found in before.

I read about the history of mosquitoes and the efforts to eradicate disease in places like the United States at the turn of the century. There are many success stories, all before we had pesticides to kill mosquitoes. So I wondered if we could use the power of the "crowd in the cloud" to better get a handle on the transmission of diseases like Zika and dengue.

There are not enough pesticide to cover the entire world. We are also learning about pesticide resistance. In many places we have already tried managing mosquitoes, with serious consequences to the environment. So I wondered if local monitoring could have a role in better identifying areas prone to disease.





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Meet the Team

I know that cities with many resources have mosquito control teams. Many of these teams do a terrific job of monitoring their community. However, I was wondering about the areas that do not have the money, people, or resources. Many of these communities are not prepared or do not have the money for mosquito control. Many times these places have had mosquito problems before.

So we started to build the GLOBE Observer Mosquito Habitat Mapper app. It is an app for smartphones and mobile devices. The app allows kids and adults to locate sites in their community that mosquitoes might like. People can share this information with one another. Then they can find out if the mosquitoes are the type that transmit diseases. The data are shared with the science community to help make decisions around the world. It is a fun way to use science to make a difference locally!

Building the app has been interesting work. I like working on a team. Our

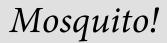
core team includes scientists in Colorado, Kansas, and New York City. We have program managers at NASA and computer programmers to build the app in California. We then work with communities in Brooklyn (New York) and New Orleans, USA, and in Barbuda to test the app concept. Then we work with communities in Brazil and Peru to test the app in the field.



Be creative and think about how you could

use this technology to help your community, now and into the future!





Videos for Task 5-2

GLOBE Mosquito Habitat App Overview Video

Description: This is a good overview video of the citizen science project using the GLOBE Mosquito Habitat App. https://youtu.be/CupKTlql1vc

GLOBE Mosquito Habitat App - Classroom Example

Description:

This video shows a team working together using the GLOBE Mosquito Habitat App to collect information about their research site and share it using the app. Watch this to get ideas for how you can engage in this citizen science program if you have the resources. https://youtu.be/ENoalx26Llk

NASA Using Satellite Data

https://www.nasa.gov/feature/goddard/2017/using-nasa-satellite-data-topredict-malaria-outbreaks





Understanding Management Options

Welcome to Part Six: Management, and Task 6-1. In Part Five you learned more about where mosquitoes live and breed. Now, the team will begin learning more about the different mosquito management and control strategies.



- In this task, the team will be focusing on the following question from the question map.
- What are the social, environmental, economic, and ethical considerations of various mosquito management and control plans?

There are many different methods to manage mosquitoes in your community. Not every method is appropriate for your location. There are many arguments for and against each strategy. You must consider all of the options before making decisions about what you think a community should do. In this task, the team will be learning about different mosquito management options. The team will also start to determine the social, environmental, economic, and ethical considerations of the different options.

- 1. Go to the Task 6-1 folder and get the Meet the Team reading. There is one version of this task.
- 2. Each team member can read the entire reading, or you can form groups and split the reading up. Each group should read about one researcher. Then, each group will share information on the management method discussed by the researcher they read about.





- 3. When reading and presenting to the team, complete the following.
 - Briefly describe the management method and any Very Important Parts (VIPs),
 - Describe some arguments for and against each method.
 - Are there any social, environmental, economic, or ethical perspectives that should be considered when thinking about this management option?
 - ٠
- 4. As a team, discuss the following questions:
 - Imagine you are creating a mosquito management plan for a city. This city has a certain amount of money to spend. Do you think it is better to spend all the money on just one management method or spread the money across a variety of different methods? Why?
 - How does understanding different management methods help when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?

Hooray! You completed Task 6-1. Check it off the task list. Go to Task 6-2!

79





Mosquito! Task 6-1 Understanding Management Options

What are different options for managing mosquitoes?



David Pecor - Research Technician -Walter Reed Biosystematics Unit (WRBU)

There are many different strategies to consider when managing mosquitoes in your community. Not every strategy is appropriate for your location. There are many arguments for and against each strategy. You must consider all of the options before making decisions about what you think the community should do.

One strategy to consider is **conducting regular surveillance**. Conducting surveillance means tracking the number and types of mosquitoes throughout the year in your location. You may have noticed that the number of mosquitoes in your location changes from month to month. Conducting surveillance throughout the year can help you understand how these numbers change. Surveillance must also be conducted on the local habitats mosquitoes are known to use for living and breeding. You can then use this information to make decisions about when to take action, such as using pesticides, cleaning streets, or draining water from storage containers.

By conducting surveillance, you can monitor the actual situation as it changes. Then you can identify the appropriate time to take action. This targeted action can possibly save your community money over time.

However, the people conducting the surveillance need a certain level of background knowledge on mosquitoes. If local people are not trained, then you will have to spend time and money training these people. Also, if the surveillance is not good, it may delay the appropriate action until it is too late. This could lead to more problems. There are many ways surveillance can be a helpful method. Think about how this could be useful for your local community.



Lee Cohnstaedt - Research Entomologist -United States Department of Agriculture (USDA)

There are many different strategies to consider when managing mosquitoes in your community. Not every strategy is appropriate for your location. There are many arguments for and against each strategy. You must consider all of the options before making decisions about what you think the

community should do.

One strategy to consider is **trapping and collecting mosquito eggs and adults**. Trapping and collecting mosquito eggs and adults involves luring them to a place where they can be captured. There are many different methods and designs for luring and trapping mosquito eggs and adults. New designs are always being created. Traps can be used around homes, buildings, or habitats to traps mosquito eggs and adults before they get to humans. The traps could also be used as part of research or surveillance of your community. Be creative and think about ways you can trap mosquitoes in your area.

Then, think about what you could do with the mosquitoes after they are captured. Traps can be used to collect and track the number and types of mosquitoes throughout the year in your location. This information could also be used to create a map of your community showing where the mosquitoes like to live. Experiment with different trap designs to see what works best in your location at different times of the year. Think about how these collected eggs could be used to manage the problem in your community.

However, it is important to know that it is currently not possible to trap all of the mosquitoes in a large area. It requires many traps to get mosquitoes. Maintaining and surveilling these traps is also very laborintensive. This can make trapping more expensive for a community. You must weigh all of your options when making decisions about what you think a community should do.



Meera Venkatesan - Malaria Technical Advisor - President's Malaria Initiative United States Agency for International Development (USAID)

There are many different strategies to consider when managing mosquitoes in your community. Not every strategy is appropriate for your location. There are many arguments for and against each strategy. You must consider all of the options before making decisions about what you think the community should do. Two strategies to consider are **government policy** and **individual/household prevention methods**.

Individual/household prevention methods are things a person can do for themselves or their home and family. These methods will help prevent people from being bitten by mosquitoes. An example of an individual prevention method is using insect repellent when you are outside. Insect repellent will reduce the number of mosquitoes that want to bite you. Another method is wearing clothes that cover your skin when outside. Reducing the amount of skin exposed helps reduce the number of mosquito bites.

Household prevention methods include covering windows and doors with screening to prevent mosquitos from entering. Reducing the number of mosquitoes inside the home can reduce the number of mosquito bites. Another prevention method is using netting over all beds in the home. Since many mosquitoes like to bite during the night, this can prevent the number of mosquito bites as you sleep. Using insecticide-treated bed netting is also another option to consider to further prevent mosquito bites.

New prevention methods are being researched every day. All of these individual and household prevention methods are intended to keep mosquitoes off of a person. However, these methods depend on each person being responsible for doing the method. If not everyone in a home or community participates, it can be an unreliable method for prevention. These methods also do not control the mosquitoes, they only work to prevent being bitten. This is why it is important to think about developing a plan that has both prevention and control methods.

Government policy concerns the role of government programs in maintaining public health and safety from mosquito-borne diseases. Policies outline the course of action the government provides to make decisions about mosquito-borne diseases. Government policies help determine how the government will work and spend money with other local government agencies or health organizations. New policies can be created. Current policies can be updated and changed.

According to the local problem, the local government or organization uses guidance from policies to make decisions on the front lines of the problem. Policies on mosquito control and prevention can be created to help local communities get resources and money to carry out better individual/household prevention programs. Policies are also created on how to educate people about mosquitoes or how to control the number mosquitoes in a community. Policies can help bring resources and money to a community to address the problem.

However, creating policy can take time. Creating policy requires large amounts of research and discussion. This research and discussion helps determine the decisions to be made in the policy. This process can take longer if everyone does not agree on the policy. Also, the economic considerations of the policy must be discussed. All of this takes time, research, and effort. What suggestions could you make to local policy makers about the mosquito problem in your community?



Rusty Low - Senior Earth Scientist -Institute for Global Environmental Strategies

There are many different strategies to consider when managing mosquitoes in your community. Not every strategy is appropriate for your location. There are many arguments for and against each strategy. You must consider all of the options before making decisions about what you think the community should do. Two strategies to consider are **disrupting mosquito habitats** and **education and public outreach**.

Disrupting mosquito habitats concerns focusing on the many ways to manage and control places where mosquitoes live and breed. By disrupting potential mosquito habitats, you can reduce the number of ideal places for mosquitoes to breed. There are many ways to disrupt the habitats of mosquitoes. Removing or dumping out standing water in habitats is one way. Cleaning streets and picking up garbage is another. Improving water storage and supply can also help disrupt potential habitats. Many of these control methods are easy for a community to start doing. Many of them are also nontoxic to the environment and safe for people in the community. They are also very effective if done correctly.

However, the effectiveness of these methods depends on the quality of participation by people in the community. If not everyone is participating, they are not very effective. Also, in many places it is not possible to drain all breeding areas, such as large natural water bodies. Recent research has also shown that draining natural water bodies can cause great harm to these environments. So we must think about the effects of each method before we do it. There are many ways to disrupt mosquito habitats. Think about which ways could work in your community.

Education and public outreach means public programs to teach the local people about the mosquito problem in your community. Understanding what your local community knows about mosquitoes is the first step. What have you learned about your community's understanding of mosquitoes from the surveys you did? What types of things do you think they need to understand better? How could you communicate and teach local people about the importance of different management strategies?

Creating education programs for the public can be a very effective way to manage the mosquito problem. Teaching people about personal and home protection is one way. Educating people on the importance of different management strategies is another. For many of the methods to be successful, such as disrupting mosquito habitats, the entire community must be involved.

However, if everyone is not educated on the method, it will be very difficult to get all of the community to participate. Think about how you could educate or communicate the problem or methods with your community. How could you build awareness about parts of the problem in your community? Be creative. There are many ways to educate the public. Think about how you could combine this management method with others to address the problem of mosquito-borne diseases.



Bridget Giles - Research Assistant Professor -Virginia Modeling Analysis & Simulation Center (VMASC) at Old Dominion University

There are many different strategies to consider when managing mosquitoes in your community. Not every strategy is appropriate for your location. There are many arguments for and against each strategy. You must consider all of the options before making

decisions about what you think the community should do.

One strategy to consider is **using pesticides**. Using pesticides is a common chemical method to control mosquitoes in a community. Pesticides are chemicals that kill mosquito larvae and adults before they can bite humans. Pesticides are usually sprayed in the air or water, or applied to the surfaces of buildings or outdoor areas. In many places, pesticides are easy to apply and can cover large areas, such as entire homes or buildings. This means they can protect large areas and large groups of people from getting sick.

However, some pesticides kill all insects and other animals in the area they are applied. This can include other insects and animals that do not harm humans. Depending on how they are sprayed, some pesticides can also drift into untargeted areas. These areas may contain people, food, or things that could be negatively affected by these chemicals or get into the food chain.

Being educated on how to use these chemicals is very important. In some places, the mosquitoes are now becoming resistant to the pesticides. This means the pesticides do not kill them. This can happen when too many pesticides are used in a community. Over time, these chemicals no longer are effective on mosquitoes. In addition, pesticides can be very expensive for many communities.

These are all things we must consider when making decisions about using pesticides or not. Communities must consider all options before making decisions about how to effectively create a plan.



Kelly Bennett - Biologist -Smithsonian Tropical Research Institute

Using biological controls involves introducing other live organisms into the community to control the mosquitoes. These organisms will help control mosquitoes in many different ways. For example, some fish and copepods eat mosquito larvae. These organisms can be put into water storage containers or wells. They will eat the larvae before they can become adult mosquitoes.

However, introduced of these organisms must be done regularly to maintain effectiveness. There is also concern of introducing organisms that are not native into the local water habitats. If non-native organisms are used there is a risk these organisms could possibly cause other local problems. Using local, native organisms is preferred. Conducting research to understand the possible local effects will help communities make decisions about what to do.

Another biological control introduces modified mosquitoes into the community. One kind of mosquito is genetically modified. In a research lab, a gene is inserted into the mosquitoes. These genetically modified mosquitoes are then released into the community. The modified mosquitoes then mate with local, wild mosquitoes. The offspring of these two mosquitoes will also have the gene from the lab. This gene will cause the offspring to die before becoming adults. This will potentially reduce the mosquito population in that place.

Another version of biological control is mosquitoes modified with bacteria. *Wolbachia* is a natural bacteria found in up to 60 percent of insect species. This bacteria can affect disease transmission in mosquitoes. The bacteria does not kill the mosquito. It only reduces the chance that disease will be transmitted between people.

However, it is not commonly found in some of types of mosquitoes that cause problems for humans, like *Aedes*. In a lab, the *Wolbachia* bacteria is put into *Aedes* mosquitoes. These mosquitoes are then released into the wild. The lab mosquitoes mate with thewild mosquitoes and pass the bacteria on to the next generation. Over time, the number of mosquitoes with *Wolbachia* in them grows. These mosquitoes with *Wolbachia* are less able to transmit diseases to people.

However, we do not completely understand the possible effects of these biologically modified mosquitoes on the whole environment of a place. Releasing them into the wild could possibly cause other problems that we do not know.

Consider all of the arguments for and against a method when making decisions about what to do.



Developing Integrated Management Plans

In Task 6-1, the team learned about different management options. These are all things a community can do to manage mosquitoes and mosquitoborne diseases. However, every location is different. It is important to create a management plan that is specific to your location. It is also important to create a management plan that combines a variety of methods. Combining multiple methods helps to address all of the different perspectives of the problem (social, economic, environmental, ethical). A plan that combines many different methods is called an integrated management plan.

Objective

In this task, the team will practice making integrated management plans. The team will be provided a variety of city scenarios and budgets (which we'll express in wealth units). From these scenarios and budgets, groups will make suggestions for how each city should develop their integrated management plan.

In this task, the team will be focusing on the following question from the question map.

- What are the social, environmental, economic, and ethical considerations of various mosquito management and control plans?
- Go to the Task 6-2 folder and get the Meet the Team reading and the list of city scenarios and management options. There is only one version of this task, but there are many ways to customize it. Think about how you could break up the reading or scenarios, if needed.



- 2. As a team, read the Meet the Team reading.
- 3. From the reading, make a list of important things to consider when making a mosquito management plan.
- 4. Read through each city scenario and the list of management options.

Task

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- 5. Note the wealth units each management option costs and how many each city has in its budget.
- 6. Using the information in the scenario and the budget (wealth units), create a suggested integrated management plan from the list of options. Remember to add up the wealth units for each method. You cannot have a plan with more wealth units than the budget allows.
- 7. Consider how your plan will address all perspectives of the problem (social, economic, ethical, environmental).
- 8. As a team, discuss the following:
 - Share and discuss your integrated management plan for each city scenario.
 - Provide the reasoning for why you selected those methods for each city.Compare and contrast plans from different groups.
 - Identify and share how your plan addresses each perspective of the problem (social, economic, ethical, environmental).
 - Based on your plans, how could this information be useful when thinking about creating an integrated management plan for your community?
 - How could this information be useful when thinking about the problem question: How can we ensure health for all from mosquitoborne diseases?

Hooray! You completed Task 6-2. Check it off the task list. Go to Task 6-3!

81







Task 6-2 Developing Integrated Management Plans

City Scenarios

City One Scenario

Our city currently has a large mosquito problem. Many people in all parts of the city are getting sick from mosquito-borne diseases each year. The city is near the equator, so it is warm throughout the year. The city has only two seasons during the year. One season is very wet and one is very dry. Also, the majority of the residents in our city have religious beliefs that do not promote killing animals. This religion teaches that any wrong behavior to animals will be paid for in a future life, so cruel acts to animals should be avoided. This includes mosquitoes. As the city government, we would like to reduce the number of people getting sick in our city. Can you develop a management plan for our city that does not include killing mosquitoes at any stage of their life? We are also interested in helping people learn more about managing mosquitoes. This will help us create an integrated management plan that respects the local culture while working toward a solution that will help everyone. Our city has 80 wealth units to spend on this project. Thank you for the help developing a suggested integrated management plan!

City Two Scenario

Our city has a large mosquito population but we are not currently dealing with any mosquitoborne diseases. The city also has big changes in temperature throughout the year. It gets very cold in the winter and very hot in the summer. Mosquitoes are only out during the summer. Recently, cities near us have reported new cases of mosquito-borne diseases in their communities. We are concerned that these diseases will move into our city in the future. Can you suggest an integrated management plan to help prevent mosquito-borne diseases from moving into our city? We have 60 wealth units to spend on this project. Thank you for the help developing a suggested integrated management plan!

City Three Scenario

Our city has a large mosquito population. Areas of high poverty are currently experiencing high numbers of people with mosquito-borne diseases. Outside of these areas of poverty there are a small number of cases. In addition, since the climate in our city is warm all year, mosquitoes are always a problem. Many residents who live outside the areas that are experiencing the problem are very opposed to the use of chemicals (larvicides and adulticides) to reduce mosquitoes in any part of the city. They think these chemicals are harmful to people, drinking water, and the environment of the entire city. We are concerned about the diseases continuing to effect these areas of poverty in our city, but we are also interested in making people in other parts of the city happy. Can you suggest an integrated management plan for our city that addresses these concerns? We have 75 wealth units to spend on this project. Thank you for the help developing a suggested integrated management plan!





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City Four Scenario

Our city currently has many mosquito management strategies in place. However, the local government has informed us that the budget for mosquito management will be decreasing next year from 75 wealth units down to 45. The reason for this decrease is that we currently do not have a mosquito problem. Mosquitoes are also very seasonal here. This means they are only out at certain times of the year. The local government wants to spend the money on other things. In a recent vote, 60 percent of the local people said they are not concerned about mosquitoes. Since 40 percent of the local people are still concerned about mosquitoes, we still want to have a management plan in place. Can you help us develop an integrated plan for our city that only uses 45 wealth units? Thanks!

City Five Scenario

Our city is currently experiencing very high levels of mosquito-borne diseases in all parts of the city. Malaria is the primary disease affecting our city. Due to the warm weather part of the year and the wet climate the rest of the year, we need to monitor the problem all the time. The city is very poor in terms of money, so we have not had management plans in place before. However, the city recently received money from the government and other humanitarian programs from around the world to help us deal with the problem. A majority of the people in the city are in extreme poverty with low levels of education. We are concerned the public will not understand why they all need to help. We currently do not have any mosquito controls in place. Can you help us develop an integrated management plan? We now have 100 wealth units to spend on this work.

City Six Scenario

Our city is on a small island with no mosquito vector populations currently, due to successful eradication campaigns in the past. Many people visit the island as tourists, and some come from places where mosquito-borne diseases are common. The government recently built several major seaports across the country to begin importing manufactured goods such as used tires, water storage basins, and disposable plastic containers. The island is located near the equator, so it is warm throughout the year and has one very wet and one is very dry season. As the community, we would like to reduce the potential introduction of mosquito vector populations on the island and therefore reduce the likelihood of people getting sick with mosquito-borne diseases. Can you suggest an integrated management plan to help prevent mosquito-borne diseases from moving into our country? We have 65 wealth units to spend on this project. Thank you for the help developing a suggested integrated management plan!





Mosquito Management Options

(Create your integrated management plan from the items on this list.)

Spray Pesticides

- Use larvicides to target mosquito larvae in water storage containers and other manufactured and natural habitat sites (cost = 15 wealth units)
- Use adulticides to target adult mosquitoes (cost = 15 wealth units)

Conduct Surveillance

- Regularly monitor water storage containers and identified mosquito habitats throughout city (10 wealth units)
- Regularly monitor mosquito population numbers and types throughout city (5 wealth units)
- Regularly monitor mosquito eggs on imported manufactured goods (such as used tires, water storage basins, and disposable plastic containers) across major seaports of the country (10 wealth units)
- Regularly monitor water storage containers and identified mosquito habitats throughout human neighborhoods located near major seaports of the country (10 wealth units)

Disrupt the mosquitoes' ability to breed

- Improve street cleaning and garbage services throughout the city (5 wealth units)
- Improve water storage and supply services throughout the city (15 wealth units)
- Regularly clean identified mosquito habitats throughout the city (10 wealth units)

Use biological controls

- Introduce mosquito-eating fish and copepods into water storage containers 10 wealth units)
- Introduce genetically modified mosquitoes into the city (15 wealth units)
- Introduce *Wolbachia*-infected mosquitoes into the city (10 wealth units)





Trap mosquitoes

- Set out and maintain mosquito traps throughout the city (10 wealth units)
- Set out and maintain mosquito traps throughout the major seaports (10 wealth units)

Individual and household control

- Install window and door screens on all buildings (10 wealth units)
- Cover all beds with mosquito netting (15 wealth units)

Education and public outreach

- Increase public education programs throughout the city to teach about personal protection and city-wide management strategies being used to control mosquitoes (15 wealth units)
- Increase communication with the public throughout the city using educational billboards, social media campaigns, and public service announcements to build mosquito awareness (5 wealth units)

Government and Policy Updates

- Create new government policies to help poverty-stricken areas affected by mosquito-borne diseases in the city (5 wealth units)
- Develop tax incentives for people, organizations, and companies that help clean up mosquito habitats around their properties (10 wealth units)
- Create or update policies on education and research about mosquitoes in the local community (10 wealth units)

<u>Research</u>

- Fund new research on mosquitoes and new mosquito management technology for the city (5 wealth units)
- Fund increased research on the social and economic components of the mosquito problem in the city (5 wealth units)



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Mosquito! Task 6-2 Developing Integrated Management Plans

What things should people consider when making an integrated management plan?

David Pecor - Research Technician - Walter Reed Biosystematics Unit (WRBU)



All mosquito problems are local problems. This is because each location and population of mosquitoes is different. Mosquito behavior varies greatly across the globe. So it is important to learn about the mosquitoes living in your local area when developing an integrated management plan. Knowing what species are present is the first step in managing mosquitoes. So collecting mosquitoes is a good starting point. Then you can identify the vectors of

disease and compile what is known about each. Common questions about the mosquitoes should include, what type of habitat will they use to lay eggs? Does this mosquito prefer to bite humans or will it feed on other animals as well? When this species does take a blood meal, does it prefer to bite inside or outside, at dusk or the middle of the night? Our motto here at WRBU is, 'Know the vector, know the threat.' This means that to fully understand the problem and develop a solution, we need to know exactly what we are dealing with. Then we can make a plan using this information.

Meera Venkatesan - Malaria Technical Advisor - President's Malaria Initiative -United States Agency for International Development (USAID)



We are lucky to have some solid evidence on what types of solutions work against different mosquitoes and diseases. However, integrated management plans need to be adapted to the local context. Some things to consider are mosquito behavior as well as human behavior, and the social and ethical factors that influence people's exposure to potentially infectious bites. Some solutions will not work if they have requirements for things like roads or are only

effective in certain types of water. You must think about whether the methods will work in that location. Will they be acceptable to the people living there and be cost-effective? With limited resources and money, we always need to make sure they are being applied to have the maximum impact on reducing disease and saving lives.





Meet the Team



Rusty Low - Senior Earth Scientist -Institute for Global Environmental Strategies

Solutions are not one size fits all when making an integrated management and action plan. This is why it is necessary to understand the kinds of mosquitoes and where they are found in a community. This environtal and social knowledge enables each community to develop a targeting approach for their unique situation.



Kelly Bennett - Biologist - Smithsonian Tropical Research Institute

Whether solutions to a mosquito-borne problem works in one location over another depends on many different things. This is because of the specific differences of the mosquitoes and people in that area. Therefore, any integrated management plan to control mosquitoes needs to be modified to address the local differences. Different

mosquito populations around the world can have different behaviors. In many places they adapt to their local environments. Depending on the plan, such factors must be considered for success. Furthermore, the opinions of different cultures toward particular control methods should be considered. Getting the support of the local communities will be required for any plan to succeed.



Bridget Giles - Research Assistant Professor -Virginia Modeling Analysis & Simulation Center (VMASC) at Old Dominion University

The same integrated management plans for mosquito related problems do not work in every location around the world. Here in the United States, for example, we are very fortunate to have sanitation programs and access to clean water. However, there are communities around

the world that lack proper sanitation, access to safe drinking water and a wastewater system. As a result, drinking water may be left sitting in buckets or containers. So measures to address those situations may be different than what is being done in another place. Creating an integrated management plan with diversity may help it be more successful.

Meet the Team





Lee Cohnstaedt - Research Entomologist -United States Department of Agriculture (USDA)

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There is no silver bullet or single solution that will halt all mosquito-borne diseases. This is why making an integrated management and action plan is needed. Vaccines for diseases are excellent, but expensive and slow to develop. Sterile insects are safe and effective, but to date difficult to deploy efficiently

with mosquitoes. Chemical control is efficient, but expensive and time consuming, not to mention unsustainable. Habitat removal is extremely useful and the most basic, but the most costly initially and difficult to maintain. Community action can reduce larval mosquito habitats, but it's difficult to coordinate. Therefore, no single solution can address mosquito problems in a single location, let alone the limitless variety of communities. All solutions are tools that can be used to solve the problem of mosquito control and all tools have their purpose. Similarly, a carpenter cannot build a house with only a hammer. The carpenter needs many tools and possibly special tools to work in a variety of locations, such as a city, the suburbs, or out in the country. However, a carpenter must be smart and adaptable to build in some conditions. Therefore, if given the knowledge and materials, the carpenter can undoubtedly make or achieve what is needed to construct any house in any situation. Mosquito control is a similar situation, where one tool is not sufficient for all situations Hopefully, individuals can introduce or create other tools needed for the local community and situation to best address mosquito-borne diseases.

Creating Local Integrated Management Plan

In Task 6-2, the team created integrated management plans for simulated cities. These plans outlined ways for a community to manage mosquitoes and mosquito-borne diseases. It is important to create a management plan that is specific to your location. It is also important to create a management plan that combines a variety of methods. Combining together multiple methods helps address all the different perspectives of the problem (social, economic, environmental, ethical). A plan that combines many different methods is called an integrated management plan (IMP).

Objective

In this task, the team will create a variety of integrated management plans for your local community. Using the list of management methods from Task 6-2, the team will develop a variety of IMPs for different budgets (wealth units). From these scenarios and budgets, groups will make suggestions for how the local community should develop their integrated management plan.

In this task, the team will be focusing on the following question from the question map.

- What are the social, environmental, economic, and ethical considerations of various mosquito management and control plans?
- Go to the Task 6-3 folder and get the list of management options. There is only one version of this task.
- 2. Read through the list of management options.
- 3. Note the wealth units for each management option.
- 4. Divide the team into groups, individuals, or work together as a whole team.







- 5. Using the list of management options, create three integrated management plans for your local community, using the following budgets.
 - 150 wealth units
 - 100 wealth units
 - 50 wealth units
- 6. For each plan, determine how you are addressing the different perspectives of the problem (social, economic, ethical, environmental).
- 7. As a team, discuss the following:
- Share and discuss your integrated management plans for your community.
- Provide the reasoning for why you selected the methods for each budget level.
- Compare and contrast plans from different groups.
- Based on your plans, how could this information be useful when thinking about the problem question: How can we ensure health for all from mosquito-borne diseases?
- How could you best communicate this plan to local community members? Be creative and think about a communication plan that you think would work for local people.

Hooray! You completed Task 6-2. Check it off the task list. Go to Task 6-3!

83



Task 6-3 Creating Local Integrated Management Plans

Mosquito Management Options

(Create your integrated management plan from the items on this list.)

Spray Pesticides

- Use larvicides to target mosquito larvae in water storage containers and other manufactured and natural habitat sites (cost = 15 wealth units)
- Use adulticides to target adult mosquitoes (cost = 15 wealth units)

Conduct Surveillance

- Regularly monitor water storage containers and identified mosquito habitats throughout city (10 wealth units)
- Regularly monitor mosquito population numbers and types throughout city (5 wealth units)
- Regularly monitor mosquito eggs on imported manufactured goods (such as used tires, water storage basins, and disposable plastic containers) across major seaports of the country (10 wealth units)
- Regularly monitor water storage containers and identified mosquito habitats throughout human neighborhoods located near major seaports of the country (10 wealth units)

Disrupt the mosquitoes' ability to breed

- Improve street cleaning and garbage services throughout the city (5 wealth units)
- Improve water storage and supply services throughout the city (15 wealth units)
- Regularly clean identified mosquito habitats throughout the city (10 wealth units)

Use biological controls

- Introduce mosquito-eating fish and copepods into water storage containers 10 wealth units)
- Introduce genetically modified mosquitoes into the city (15 wealth units)
- Introduce Wolbachia-infected mosquitoes into the city (10 wealth units)





Trap mosquitoes

- Set out and maintain mosquito traps throughout the city (10 wealth units)
- Set out and maintain mosquito traps throughout the major seaports (10 wealth units)

Individual and household control

- Install window and door screens on all buildings (10 wealth units)
- Cover all beds with mosquito netting (15 wealth units)

Education and public outreach

- Increase public education programs throughout the city to teach about personal protection and city-wide management strategies being used to control mosquitoes (15 wealth units)
- Increase communication with the public throughout the city using educational billboards, social media campaigns, and public service announcements to build mosquito awareness (5 wealth units)

Government and Policy Updates

- Create new government policies to help poverty-stricken areas affected by mosquito-borne diseases in the city (5 wealth units)
- Develop tax incentives for people, organizations, and companies that help clean up mosquito habitats around their properties (10 wealth units)
- Create or update policies on education and research about mosquitoes in the local community (10 wealth units)

<u>Research</u>

- Fund new research on mosquitoes and new mosquito management technology for the city (5 wealth units)
- Fund increased research on the social and economic components of the mosquito problem in the city (5 wealth units)



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Assembling Part One of the Community Action Plan: Research Area Background

Welcome to Part Seven: Action Plan. In Parts One through Six you learned many things about mosquitoes and mosquito-borne diseases. Now, the team must finish their work. To do this, you must create an action plan for your community. In Task 1-7, you learned about the action plan focused on creating solutions to the problem question: How can we ensure health for all from mosquito-borne diseases?

There are many possible solutions to this question. This is why you conducted research to learn more about the problem in your community. Now you must suggest decisions and actions you think people should take in the community. The community action plan will help communicate your solutions. All of the team research was done to help you complete this action plan.



In this task, the team will assemble the first part of your community action plan. This part involves assembling and organizing all of the research you have already completed.

1. Go to the Task 7-1 folder to read the details about assembling part one of the action plan: Research Area Background. There is only one version of this task.



- 2. Read through the details of the first part of the action plan again as a team. Ask questions about any parts that are not clear. Remember not to worry.
- 3. Use all of the work you have completed up to this point to assemble and organize this part of your action plan for the community.

Hooray! You completed Task 7-1. Check it off the task list. Go to Task 7-2!

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Task 7-1 Assembling Part One of the Community Action Plan: Research Area Background

The team will now begin developing your action plan. Overall, this action plan will outline how you will address and communicate the problem question: How can we ensure health for all from mosquito-borne diseases?

The Community Action Plan will have three parts. Tasks 7-1, 7-2, and 7-3 will help you complete each part of the plan.

- 1. Task 7-1: Research area background, evidence collected, integrated management plan developed (This part involves organizing what you have already completed during your research.)
- 2. Task 7-2: Action goals (This part involves figuring out what you will do now, after your research is completed.)
- 3. Task 7-3: Communication strategy (This part involves telling people about your research, action goals, and plan.)

This task will focus on assembling the research area background of the Community Action Plan. This involves assembling and organizing the information you have already collected about your research area. Complete the following, based on the research you have conducted.

Provide a brief overview of your location and research site. This will help other people who are looking at your plan now and in the future. This involves organizing what you did during your research. Include the following.

- 1. **Research location physical description:** Provide a brief description of your physical location. Include your position within your community, country, and the world.
- 2. **Team and local culture description:** Provide a brief description of your team and any local culture your team identified during your research. Include your team's identity map from Task 1-5 as part of this description.
- 3. **Map of research site:** Provide a map of your research site and any important information you collected concerning the site that would be useful to understanding your plan. If possible, include pictures of your research site.
- 4. **Evidence and claims:** Organize and share all of the evidence you collected during your research and any claims you developed.
- 5. Local integrated management plan: An integrated management plan outlines all of the different management strategies you think your location should consider to address the problem question: How can we ensure health for all from mosquitoes? Tasks 6-2 and 6-3 will help you outline an integrated management plan for your community.





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Developing Part Two of the Community Action Plan: Action Goals

In Task 7-1, you assembled and organized all of the research you have already completed. It is one thing to do research and another to set local goals to help people take action on that research. It will be important to use the information you collected to figure what your future actions will be to help address the problem question: How can we ensure health for all from mosquito-borne diseases?

There are many possible solutions to this question. This is why we must now develop action goals for what to do next.



In this task, the team will assemble the second part of their community action plan. This part involves developing actions you think people should begin taking in the community to address the problem question.

- 1. Go to the Task 7-2 folder to read the details about assembling part two of the action plan: Action Goals. There is only one version of this task.
- 2. Read through the details of the second part of the action plan again as a team. Ask questions about any parts that are not clear. Remember not to worry.
- 3. Use all of the work you have completed up to this point to assemble and organize this part of your action plan for the community.

Hooray! You completed Task 7-2. Check it off the task list. Go to Task 7-3!

91

Task

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Task 7-2 Developing Part Two of the Community Action Plan: Action Goals

The team will continue developing your action plan. Overall, this action plan will outline how you will address and communicate the problem question: How can we ensure health for all from mosquito-borne diseases?

The Community Action Plan will have three parts. Tasks 7-1, 7-2, and 7-3 will help you complete each part of the plan.

- 1. Task 7-1: Research area background, evidence collected, integrated management plan developed (This part involves organizing what you have already completed during your research.)
- 2. Task 7-2: Action goals (This part involves figuring out what you will do now, after your research is completed.)
- 3. Task 7-3: Communication strategy (This part involves telling people about your research, action goals, and plan.)

This task will focus on assembling the action goals of the Community Action Plan. This involves developing the actions you think people should begin taking to address the problem question in your community. Complete the following, based on the research you have conducted.

It is one thing to have an integrated management plan and another to set local goals to help people act on that plan. For example, part of your plan could be to empty the water from all containers in an area. Another part of the plan could be to educate various people in your community about the problem. Setting local action goals will help you determine what actions need to be taken now and in the future, who is responsible for taking them, and how the actions will be monitored to determine their effectiveness over time.

- Develop a list of action goals that could be carried out by various people in your community to work toward different parts of your integrated management plan. Consider the following when creating your action goals: What type of action is needed and what is the action meant to address? Provide a description of the action. Some examples include:
 - a. Education action goals: Create and hand out brochures to educate the community about mosquitoes. This action will increase local knowledge and actions of community members concerning mosquitoes and mosquito management.
 - **b.** Advocacy action goals: Create posters to advocate for a group of people at risk from mosquitoes. Write letters to local officials and community leaders concerning mosquitoes and the effect on different people and groups in your community.
 - **c.** Physical action goals: Conduct weekly monitoring of your research site for standing water where mosquitoes could breed. This action will reduce the





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Mosquito!

number of possible breeding sites mosquitoes can use in the community. Document and remove any standing water found in the site every week throughout year.

- d. Be creative and develop your own goals for your community!
- **2.** Who is responsible for the action: yourself, team member, team, specific community member(s), all community members?
- 3. Action schedule or timeline: When and how often does the action need to take place?
- **4.** Action monitoring: How will the action goals be documented or monitored over time to determine their effectiveness? How will you determine whether the action is working effectively? Create a strategy to monitor these goals over time.
- 5. Order the actions: If you have a list of action goals, which ones would you recommend be done first, second, and third? Create an order for all of your actions, so the team knows where to start.





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Creating Part Three of the Community Action Plan: Communication Strategy

In Tasks 7-1 and 7-2, you assembled and developed parts one and two of your plan. However, if no one outside of your research team knows about your plan, can it make an impact? No way! Next, you will need to develop a plan to creatively communicate your action plan with your community.

There are many possible ways you can communicate with your community. Be creative!



In this task, the team will assemble the third part of their community action plan. This part involves creating a communication strategy to communicate your plan to others.

- 1. Go to the Task 7-3 folder to read the details about assembling part three of the action plan: Communication Strategy. There is only one version of this task.
- 2. Read through the details of the third part of the action plan again as a team. Ask questions about any parts that are not clear. Remember not to worry.
- 3. Use all of the work you have completed up to this point to assemble and organize this part of your action plan for the community.

Hooray! You completed Task 7-3. Check it off the task list. Go to Task 7-4!

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Task 7-3 Creating Part Three of the Community Action Plan: A Communication Strategy

The team will continue developing your action plan. Overall, this action plan will outline how you will address and communicate the problem question: How can we ensure health for all from mosquito-borne diseases?

The Community Action Plan will have three parts. Tasks 7-1, 7-2, and 7-3 will help you complete each part of the plan.

- 1. Task 7-1: Research area background, evidence collected, integrated management plan developed (This part involves organizing what you have already completed during your research.)
- 2. Task 7-2: Action goals (This part involves figuring out what you will do now, after your research is completed.)
- 3. Task 7-3: Communication strategy (This part involves telling people about your research, action goals, and plan.)

This task will focus on creating a communication strategy for the Community Action Plan. This part involves communicating any and all parts of your plan with your community. Complete the following, based on the research you have conducted.

If no one outside of your research team knows about your plan, can it make an impact? Of course not! So you will need to develop a plan to creatively communicate parts of your action plan to your community. Make sure you include Social, Ethical, Economic, and Environmental perspectives on the problem. How will you educate others about your evidence, claims, decisions, and action goals?

Be creative. This plan can include:

- Making posters or art projects to communicate parts of your plan.
- Writing a song or a one-act play to communicate parts of your plan.
- Writing and recording a public service announcement (audio or video) to communicate parts of your plan.
- Creating a social media campaign to communicate parts of your plan.
- Come up with your own ideas!



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After you have developed your communication strategy, you will need to share with and present this information to local community members. This group can include parents, educators, administrators, residents, and other team members.

Each group should include the following when communicating with community members.

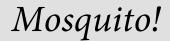
- Present Social, Ethical, Environmental, and Economic considerations for the community.
- Support all claims with evidence (data and statistics, expert opinion, personal and secondhand experience) within the plan.
- Support all suggested actions using claims and evidence.
- Clearly explain, demonstrate, and illustrate parts of your integrated management plan.
- Clearly explain, demonstrate, and show all aspects of your action goals.
- Clearly outline how the plan would be monitored for effectiveness over time. Discuss how the plan can be adjusted if it is not working or needs to be improved.





Go back to Research Guide now





Zika Awareness and Prevention (ZAP) Game

The Zika Awareness and Prevention (ZAP) Game was developed to strengthen students and communities in their ability to stop Zika virus disease. Zika virus is a mosquito-borne virus, spread primarily by the bite of an infected *Aedes* species mosquito. Through simulation, this game educates students about Zika virus, common mosquito breeding sites, Zika virus disease symptoms, and pregnancy risks associated with Zika. Practices that help to prevent mosquito bites are also covered such as using an EPA registered insect repellent with DEET, the importance of wearing long sleeved shirts and long pants when outdoors, and treating clothing with permethrin. Multiple choice and matching games are provided to gauge how much you learned about Zika.

Use the following link to access the game, and have fun! http://zika.vmasc.odu.edu/zap/

Computer WebGL Compatibility: Chrome 64 bit Version 57 and newer, Microsoft Edge version 16 or newer, Safari version 11 or newer, and Firefox version 52 or newer. Firefox users check your privacy settings.

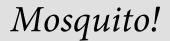
For more information about the ZAP Game or for any other concerns please email us at <u>Zapzika@odu.edu</u> or contact:

Bridget Giles PhD Virginia Modeling Analysis and Simulation Center Old Dominion University 1030 University Blvd. Suffolk, VA 23435 Email: <u>bgiles@odu.edu</u> Phone: 757-638-4436









Team News Articles for Task 7-3

Zika ZAP Game News Article https://www.odu.edu/news/2017/6/zika_game#.WzE7aadKiUk

Rusty Low News Article -USAID <u>https://medium.com/usaid-2030/arming-citizen-scientists-with-an-app-to-</u>identify-zika-carriers-f8af4ff7391d

Kelly Bennett STRI News Article https://newsdesk.si.edu/releases/smithsonian-scientists-track-aedes-mosquitoinvasions

Lee Cohnstaedt USDA News Article 1 http://www.fox5dc.com/news/local-news/md-students-taking-part-in-researchproject-to-help-track-mosquitos-that-may-carry-zika

David Pecor WRBU News Article https://insider.si.edu/2016/06/smithsonians-mosquito-collection-weapon-battlezika/

Lee Cohnstaedt News Article 2 https://www.denverpost.com/2016/05/16/usda-wants-citizen-scientists-to-helpfight-zika/

Invasive Mosquito Project Link http://www.citizenscience.us/imp/



-5 Thinking About Your Future Actions

Congratulations!

You have completed all parts of this research guide.

Give yourself a pat on the back.

But this does not mean we are finished.

Mosquitoes are still a major problem for many people in large parts of the world. Your research has really just started.

Think about this:

- Are there any questions that are still not answered about mosquitoes?
- Is there anything else we still need to learn to help more people protect themselves from these diseases?

There is always something new to learn to help others.

This new understanding will continue to change the decisions we make.

We must think about how we can continue to make things better for the world.

Hopefully, the issue is clearer to you now.

How can you help it become clearer to other people around you?

How can you help someone in a different community learn more about this problem? Just remember, every community is different.

The same answer is not always right for every place in the world.

But the question remains the same:

How can we ensure health for all from mosquito-borne diseases?

Be creative.

Ask questions.

Make a plan.

Explore the world around you.

Be open-minded.

And most important, think about how we can work together to make the world a better place.

Mosquito!