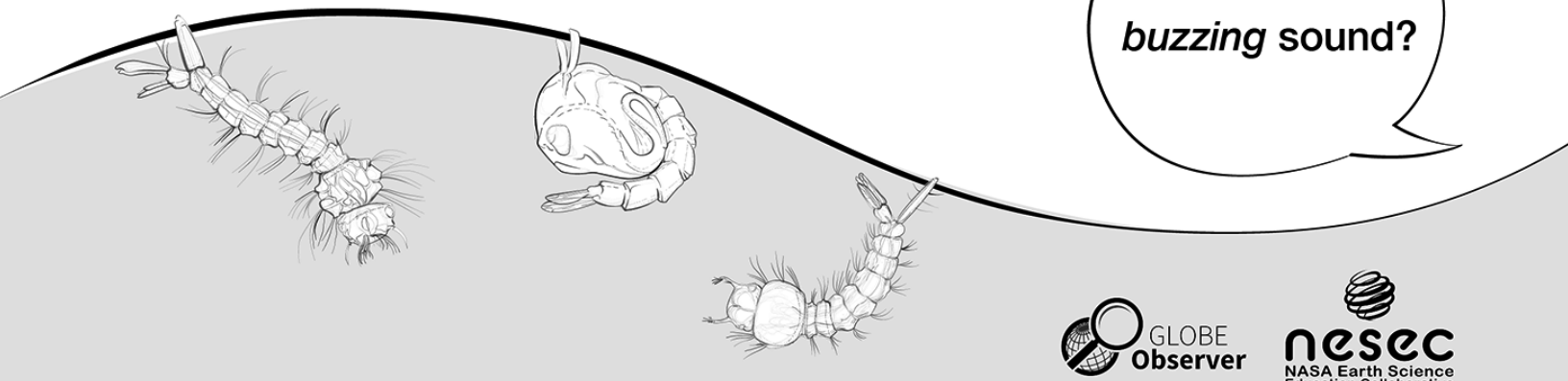
MISSION MOSQUITO
SCIENCE NOTEBOOK

Name

Date



GLOBE Observer

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NASA Earth Science Education Collaborative

Mission Mosquito Science Notebook

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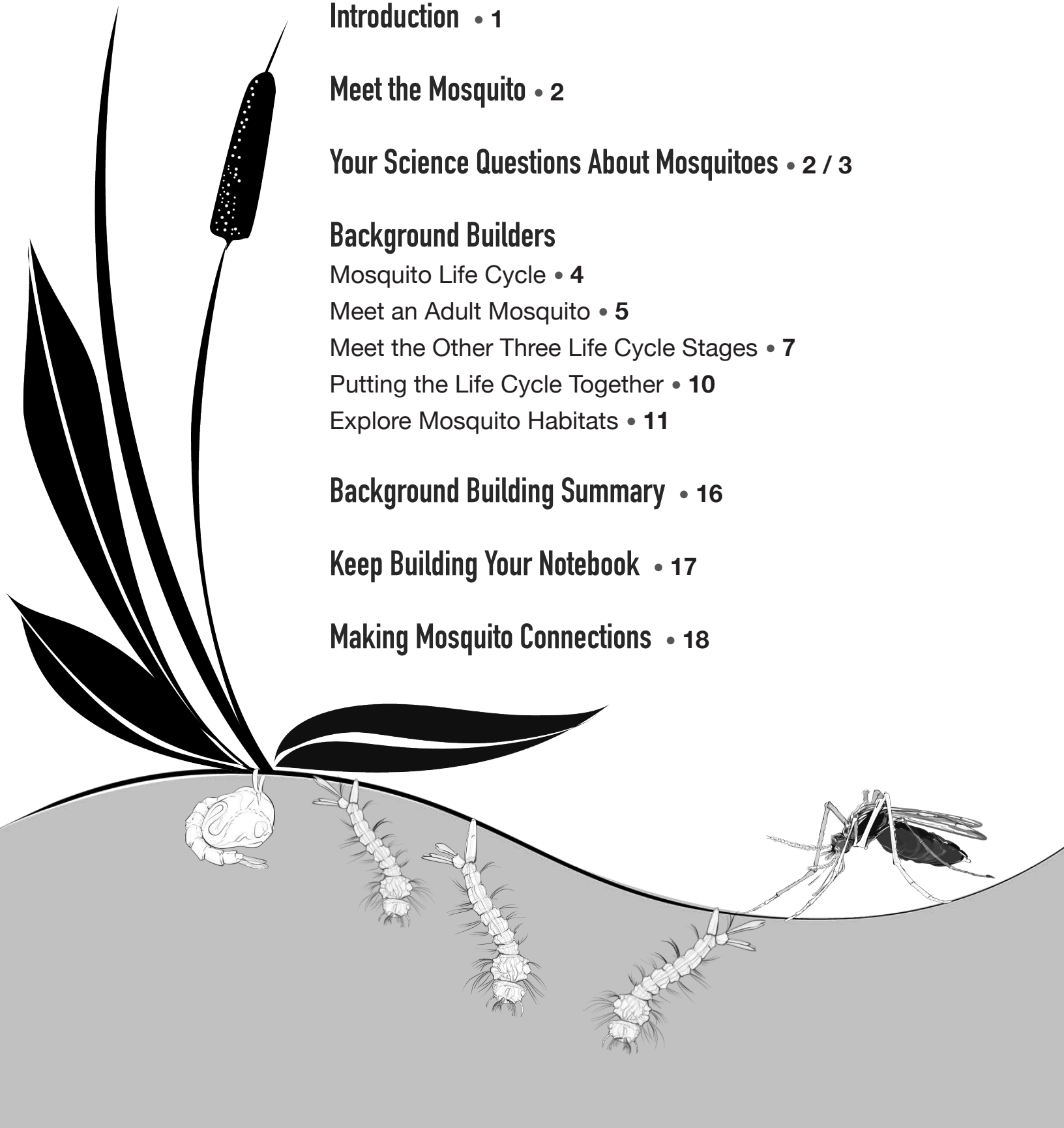


ADD TO YOUR TABLE OF CONTENTS

Topic	Page

KEEP YOUR NOTEBOOK UPDATED!

- **Check** for new notebook sections at: *https://strategies.org/mosquito-notebook*
- **Add** new sections to your notebook.
- **List** new sections and page numbers in the **Table of Contents** on this page.

INTRODUCTION

A notebook is a tool used by professional scientists and volunteer scientists (also called citizen scientists). As a tool, it is used to help accomplish a task. That task involves gathering and organizing observations, information, and data to solve a problem or answer a question.

Photo courtesy Otrell Edwards, Esq.

This is your science notebook

Your mission is to learn about, investigate, and contribute to science research on mosquitoes. To do this, you will need to think and work like a scientist. That means you need a notebook to record your questions and answers, develop and use diagrams and graphs, record and analyze data, write explanations and support your ideas, and gather, evaluate and communicate information.

Your *Mission Mosquito Science Notebook* provides a space to:

- Learn mosquito science
- Collect relevant vocabulary
- Make drawings
- Generate questions
- Write about your ideas and experiences
- Plan investigations
- Record and analyze observations and data
- Construct explanations

Your goal is to begin this important research with some background information on mosquitoes in the front of your notebook. The notebook will grow as your work progresses. There will be many observations, investigations, and activities along the way.

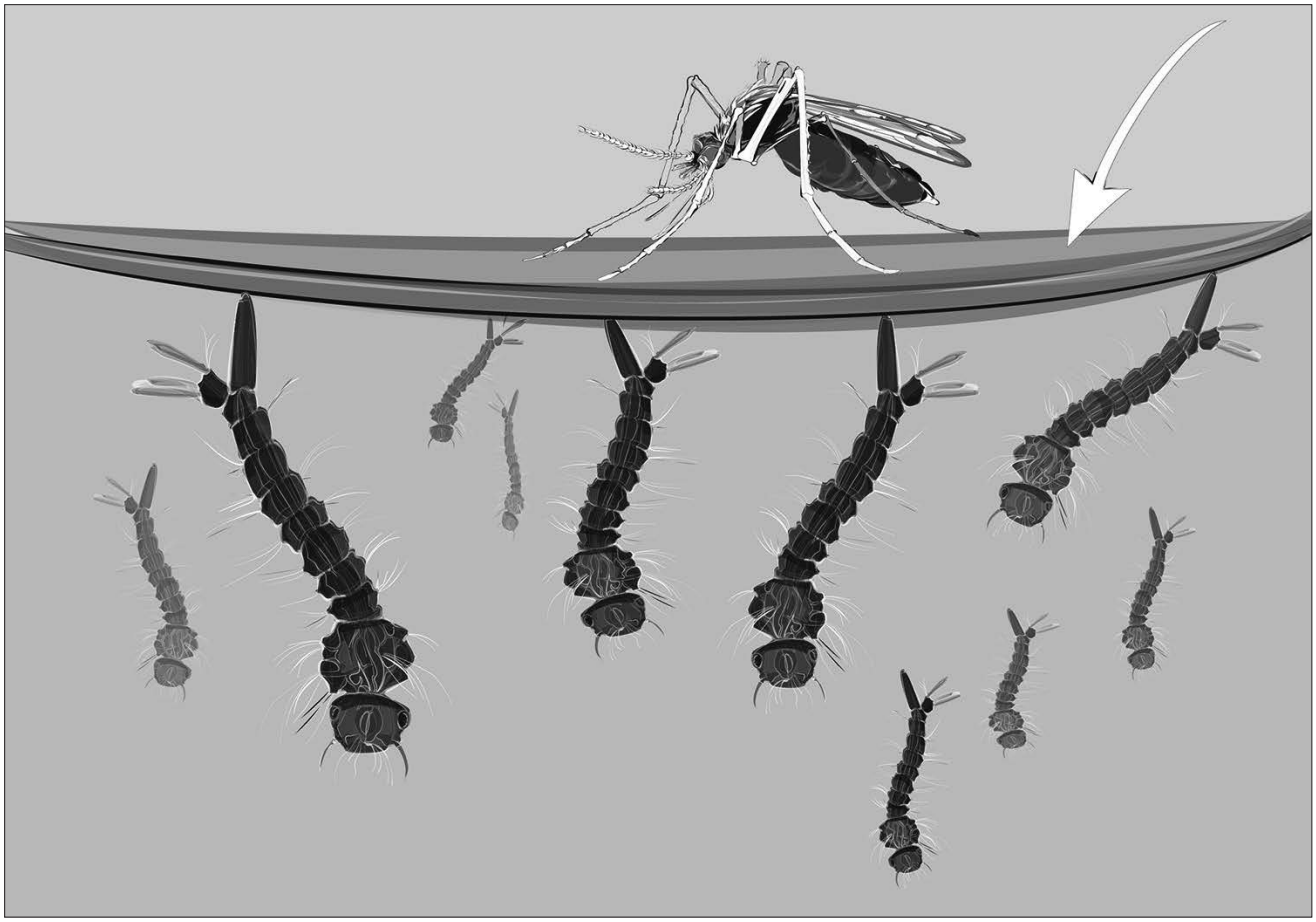
Have fun and be safe!

The one thing about mosquitoes that you probably know from experience is that they bite humans. Anytime you are outside with mosquitoes around:

- Protect yourself by wearing a long-sleeved shirt, long pants, and closed-toe shoes.
- Use an approved insect repellent (for example, one containing DEET or Picaridin).
- Always follow guidelines from your local officials.

For more guidelines on protecting yourself, visit the Centers for Disease Control (CDC) at *https://www.cdc.gov/dengue/prevention/prevent-mosquito-bites.html*

Meet the Mosquito



Do you recognize the creature at the top of this image? It is standing on the surface of the water (the surface is marked by the arrow).

Here is a big hint: it is absolutely the deadliest creature on the planet.

Look at those things hanging down below the water surface. What are THOSE things?

What are your scientific questions about the image?

Write your scientific questions about the image by finishing the following sentences:

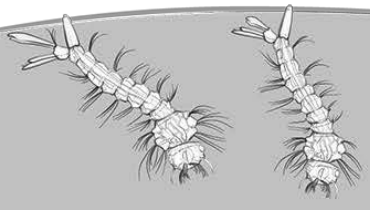
1. I wonder _____

_____

2. I also wonder _____

_____

More questions on Page 3



More scientific questions about the Page 2 *image*

3. What if _____

_____

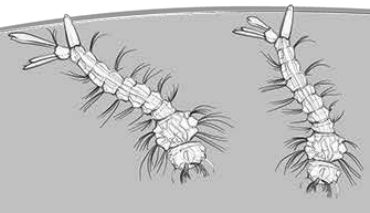
4. Is it possible that _____

_____

5. They remind me of _____

_____

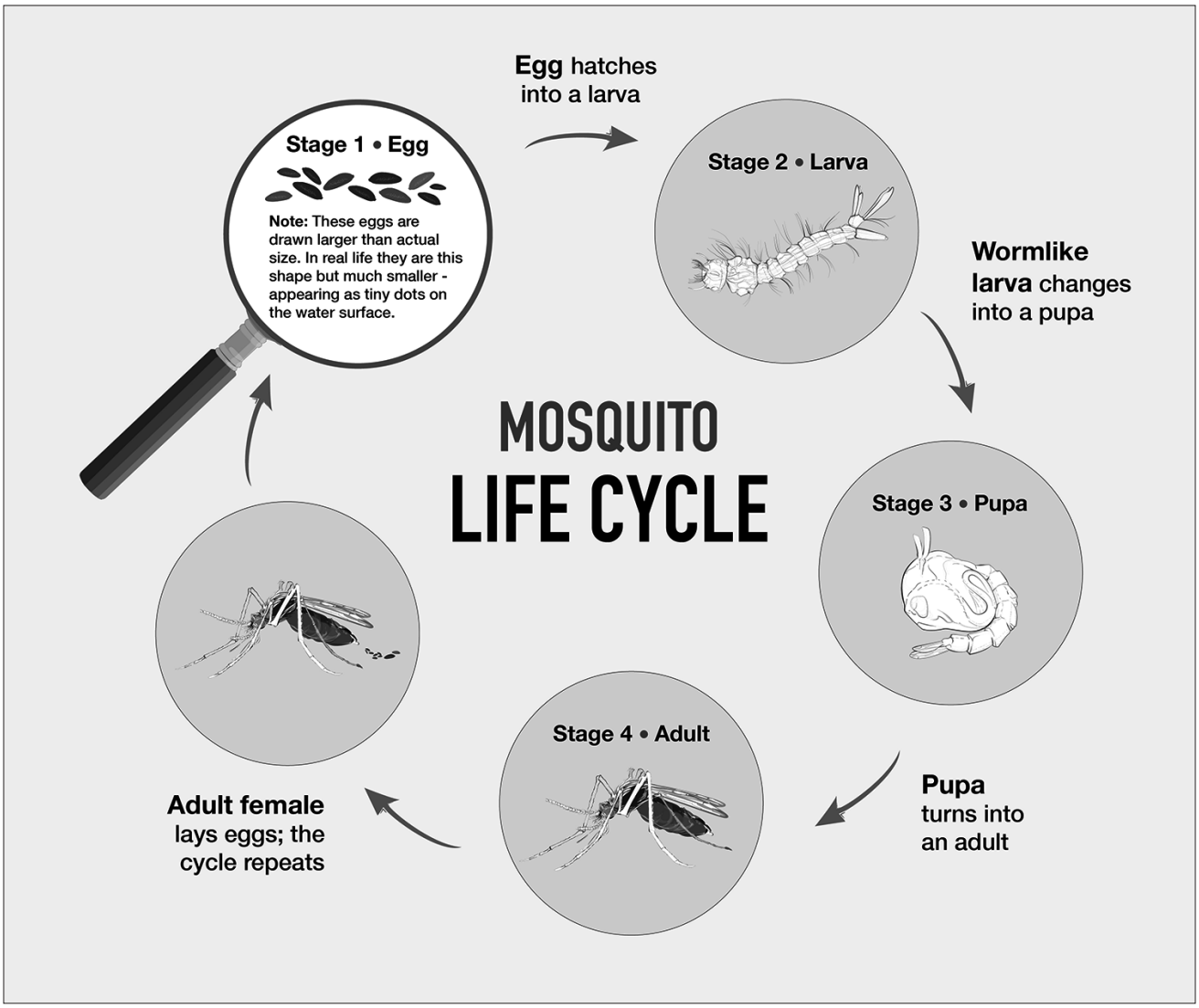
Sketch something inspired by your scientific questions



Background Builders

1. MOSQUITO LIFE CYCLE STAGES

Did you know that mosquitoes go through a multistage (many steps) life cycle?



VOCABULARY ALERT

Larva (pronounced lar-vuh): *The immature form of a mosquito that hatches from the egg. It is long, thin, and segmented (looks more like a worm); it does not have legs or wings. It wriggles through the water. It breathes air. Larvae need lots of energy to grow, so they eat constantly - mostly algae and other microorganisms. The plural form of this word is* ***larvae (pronounced lar-vee or lar-vay)****.*

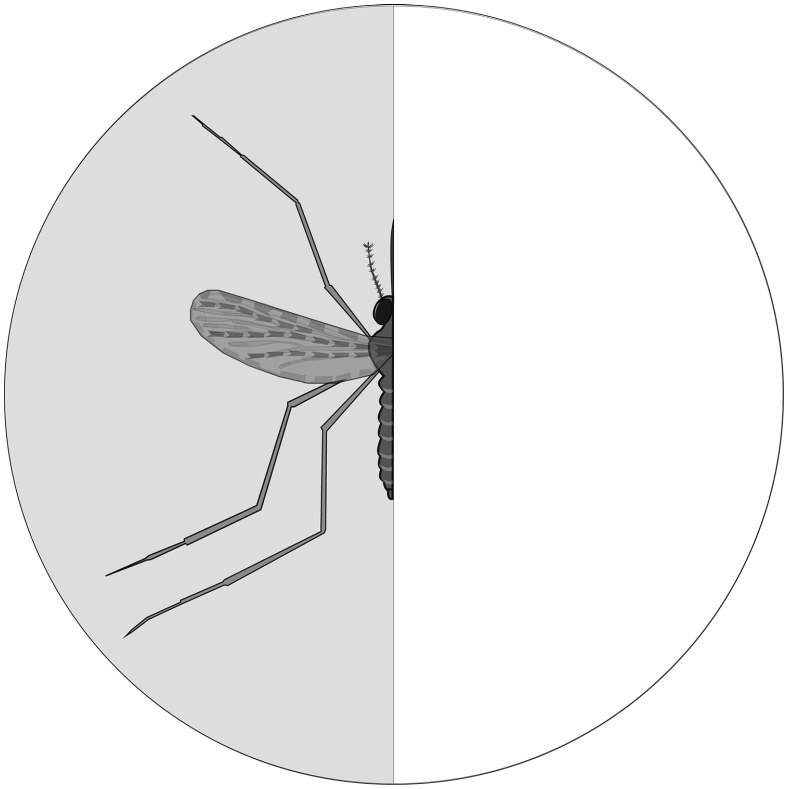
Pupa (pronounced pyoo-puh): *The immature form between larva and adult. The shape of a pupa resembles a comma. During this short stage (1.5 to 4 days long), the pupa changes into the flying adult mosquito. The pupa does not eat, but continues to breathe air, now through two tubes called "trumpets." The plural form of this word is* ***pupae (pronounced pyoo-pee or pyoo-pay)****.*

2. Meet an Adult Mosquito

You are probably most familiar with this stage. We will start here and work our way backwards.

But wait! Only half of the mosquito is shown in the drawing below!

- **Take a few minutes to complete the drawing.** Start by paying close attention to the details of the shapes, sizes, colors, spacing, and origins (places where the part comes out of the mosquito's body.) Take your time to show these details in your drawing.
- **Also note the needle-like attachment** coming out of the top of the mosquito. This is the proboscis. It allows the mosquito to eat and to suck blood. It only has one of those. Although you may wish to make it "fatter" in your drawing, you should not draw a second one (you will learn more about the proboscis in an upcoming section of the notebook).

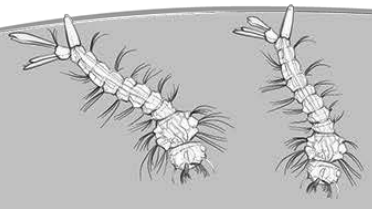


- **The mosquito's body is divided into three** main sections: head, thorax (just behind the head), and the abdomen (long segmented part). **Label the following parts:** wings, antennae, proboscis, legs, head, thorax, and abdomen.

Now that you've observed and completed the drawing, answer the following questions:

- How many wings does a mosquito have? _____
- To what section of the mosquito's body are the wings attached? _____
- How many antennae does a mosquito have? _____
- How many sections (or main body parts) does a mosquito have? _____
- How many legs does a mosquito have? _____
- To what section of the mosquito's body are the legs attached? _____
- Mosquitoes are insects. Therefore, all insects must have this number of these characteristics:

  Antennae = _____ Body sections = _____ Legs = _____



Just like you, mosquitoes must eat to survive.

- What do you think mosquitoes eat? _____
- You might have written that all mosquitoes drink blood. Only some mosquitoes will bite an animal to get blood. Blood is NOT their food. They need blood because it is important for the development of eggs. So, which mosquito gender (male or female) bites to get blood? _____
- All mosquitoes (males and females) must eat or drink something to get the energy they need to survive. What do you think all mosquitoes might eat? _____
- Mosquitoes depend on plants for food; they eat plant nectar. Can you name any other insects that eat nectar? _____

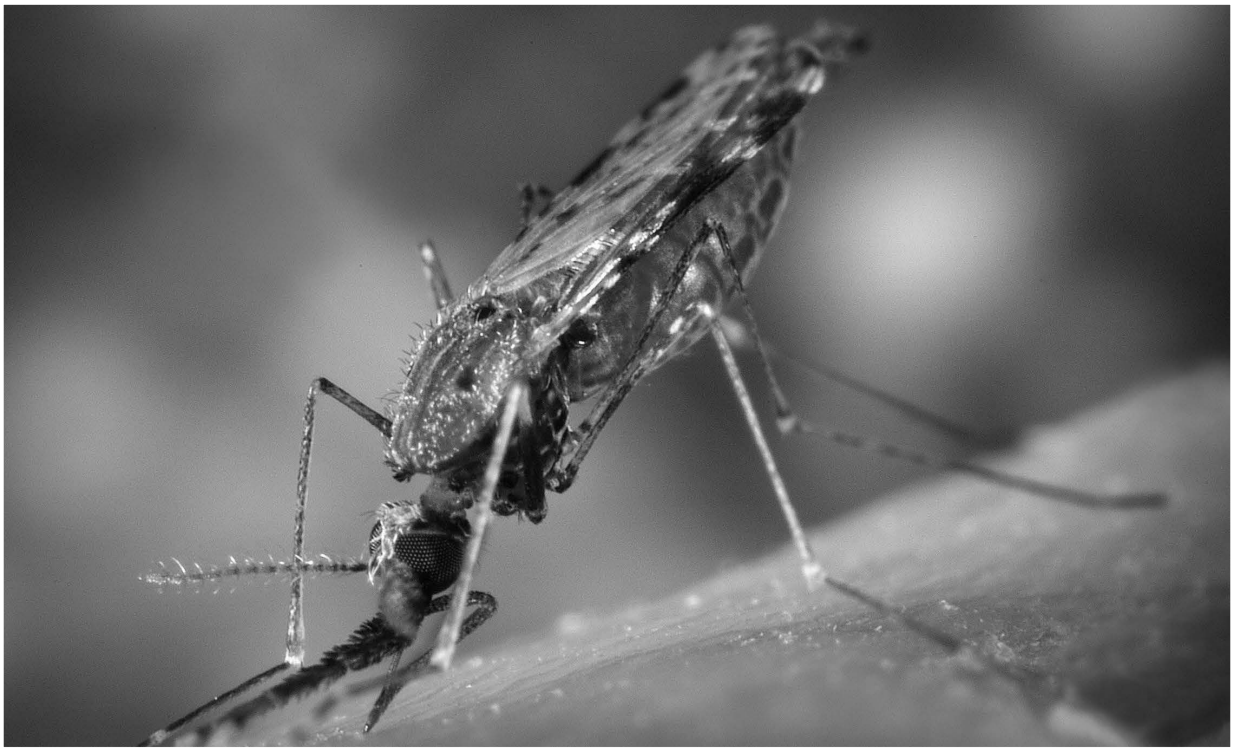


Photo courtesy of James Gathany, CDC Public Health Image Library (PHIL), #7861.
https://phil.cdc.gov/details.aspx?pid=7861.

- Is this an image of a male or female mosquito? _____
- In the space below, explain how you know ***(HINT:** If you printed this notebook in black ink, the colors are missing: the mosquito is standing on something skin-toned, the background is green and the lower abdomen of the mosquito is red.)*

3. Meet the Other Three Life Cycle Stages

More about the life cycle

Mosquitoes go through a complete metamorphosis that includes four stages: egg, larva, pupa, and adult. You just learned about the adult stage, now let's look at the other three.

VOCABULARY ALERT

Metamorphosis: *In biology, the process of changing from an immature form to an adult form in two or more distinct stages (breaking down the word: "meta" means change; "morph" means shape.)*

Answer these questions to learn more about life cycles:

- As with many organisms, the **first stage** of the life cycle of a mosquito begins when an adult female lays an _____.

- Based on the image on **Page 2**, where in the environment do you think she lays them?

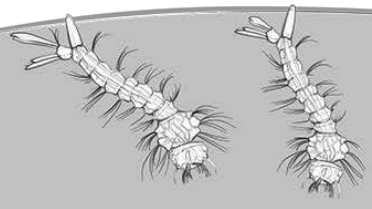
- Why do you think she needs to lay her eggs in that type of environment?

- Most female mosquitoes lay eggs directly in standing water (water that is not flowing) or just above the surface of the water.

  Why do you think the water must be "standing" (not flowing)?

- She can lay up to 300 eggs at a time. Some species lay their eggs one at a time; some species lay them in groups that look like a raft. Either way, mosquito eggs are very small; you would need a magnifying glass to see them.

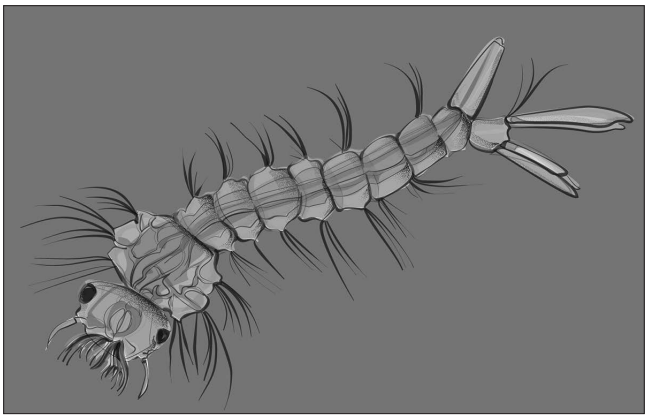
  Why do you think that mosquitoes lay so many eggs at a time?



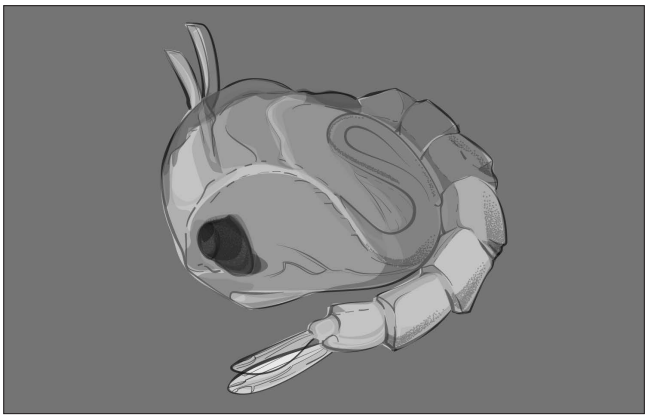
Make some scientific observations

After a few days, the eggs hatch into larvae - the second stage. You have already seen that stage in the first picture in this notebook (**Page 2**). Depending on the species and air/water temperatures, the larvae will soon (within days) turn into pupae, the third stage.

Below is a drawing of a larva (second stage); on the right is a drawing of a pupa (third stage).



Larva



Pupa

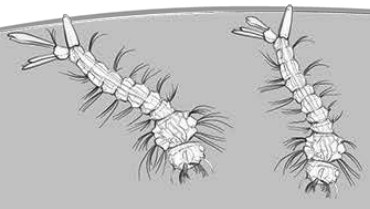
List two ways the larva and pupa look alike	List two ways the larva and pupa look different
1.	1.
2.	2.

A larva needs food to eat and air to breathe. A larva has a mouth; it eats microorganisms that live in the water around it. Most species, or kinds, of mosquitoes have a special tube called a siphon located at the other end of its wormlike body. The siphon looks like a straw; it must be at the surface of the water for the larva to get air.

VOCABULARY ALERT

Siphon: *The siphon is a breathing tube. Because mosquito larvae spend their time underwater, the siphon breaks the surface of the water and allows them to breathe air.*

Trumpet: *The breathing tube used by the pupa. They occur in pairs and are found near the head.*



Make some more scientific observations!

Look again at the image on **Page 2**. Notice that some of the larvae are not floating at the top of the water with their siphon at the surface.

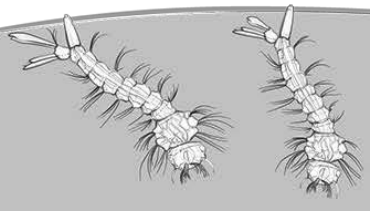
- What do you think would make a larva leave the surface (where it is getting the air it needs to breathe) and go deeper into the water? List two to three ideas.

- After just a few days as a larva, it develops into a pupa. Pupae also live in the water. During this short stage (1.5 to 4 days) it forms the body parts that will allow it to survive in the air as an adult. A pupa does not eat.

  If they do not eat, how do you think they survive?

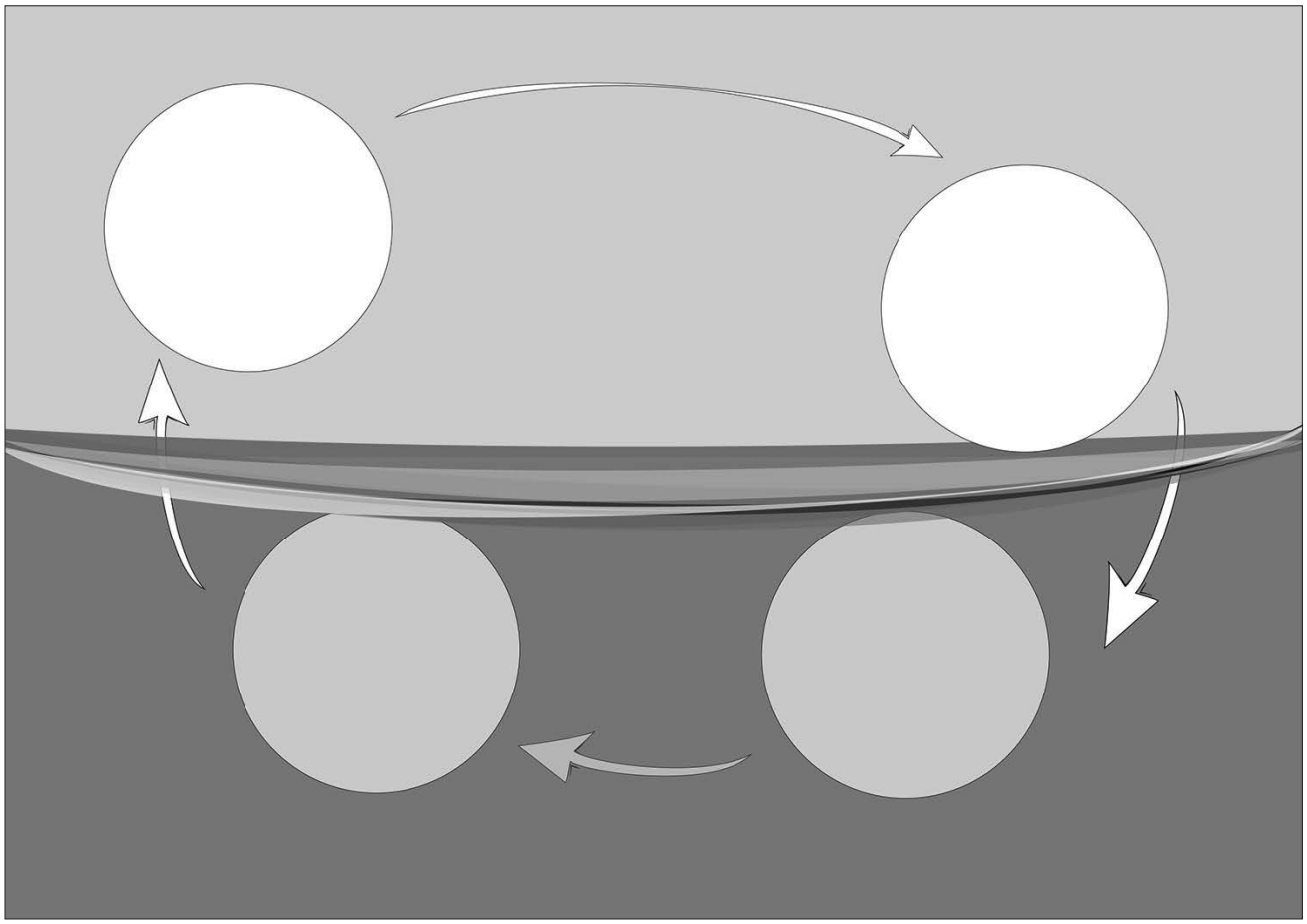
- If you wanted to find out if one of your ideas is the correct reason, what would you do to test it?

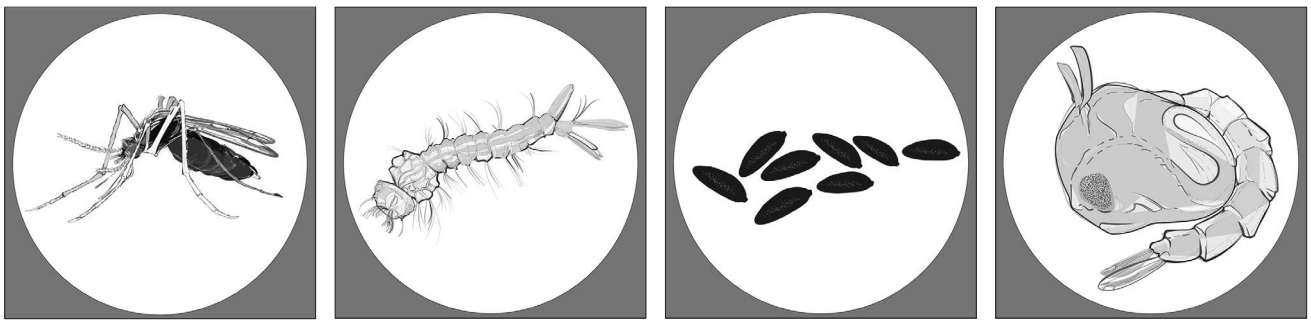
Practice your scientific drawing skills by drawing a pupa and a larva in the box below.



4. Putting the Life Cycle Together

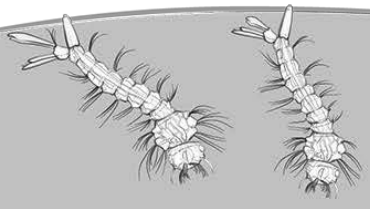
The diagram below represents the mosquito life cycle, with arrows showing the sequence of stages and empty circles representing the actual stages. The four circles below the diagram show what the mosquito looks like in each of the four stages. Put the stages of the mosquito life cycle in order, paying attention to the environment where that stage is found.





Where on land, or in the water, do mosquitoes develop?

Draw a line from the circles at the bottom (with the images of the mosquito) to the empty circle on the diagram in which you would find that stage of the mosquito.



5. Explore Mosquito Habitats

Observing (through multiple senses) is an essential science skill - as well as an essential life skill. Observing can be done from great distances (using satellite instruments) to very up-close (using magnifying lenses). For example, NASA scientists observe and analyze land cover and water resources shown in satellite images to discover locations on Earth that might support mosquito populations. You constantly use ground-level observations to learn about your immediate environment. You will soon use those observations to find a place in which mosquito larvae can live. Even female mosquitoes use observations of their surroundings to pick a good spot to lay their eggs.

Think like a mosquito for a moment.

What would a female mosquito look for in a "good spot" to lay her eggs? List 3-5 characteristics of a place that she might consider.

1. _____

2. _____

3. _____

4. _____

5. _____

Observe the human habitat images on Pages 12, 13, and 14.

On the next three pages are images of three different human habitats. Take a few moments to observe each image carefully. The observation skills that you are practicing will help you in your upcoming research.

To do research on mosquito larvae, you must know where to find them. You are looking for places within each image (on **Pages 12**, **13**, and **14**) where a female mosquito could lay her eggs.

After closely examining all three images (do not answer the questions below each image yet), complete these sentences below:

I wonder ... _____

_____

What if ... _____

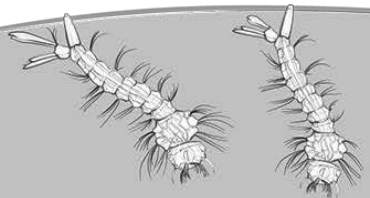
_____

Is it possible that ... _____

_____

Hunt for mosquito habitats.

Now go to the individual images on **Pages 12, 13**, and **14** and answer the questions listed below each image to complete this notebook mission.



Where Might You Find Mosquitoes in this place?

1. **Circle those items or places within the image** that you predict might contain mosquito larvae.
2. **Complete the table below. Note:** At least one of listed must be a natural container, and at least one must be an artificial (human-made) container.

Name of the item or place you circled	Reasons that a female mosquito might choose this place to lay her eggs

Where Might You Find Mosquitoes in this place?

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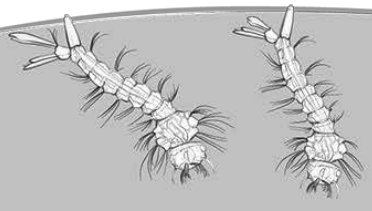
1. **Circle those items or places within the image** that you predict might contain mosquito larvae.
2. **Complete the table below. Note:** At least one of listed must be a natural container, and at least one must be an artificial (human-made) container.

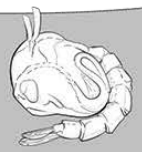
Name of the item or place you circled	Reasons that a female mosquito might choose this place to lay her eggs

How about mosquitoes in your own home?

In the space below, draw pictures of two items around your own home that could be used by female mosquitoes to lay eggs. Explain why she would use that item.

Drawing	Why would she lay her eggs here?
1.	
2.	





Background Building Summary

Your research is just beginning!

You have completed the first stage of your mosquito mission. You have built your background in mosquito biology and related vocabulary. You have analyzed and you have practiced drawing.

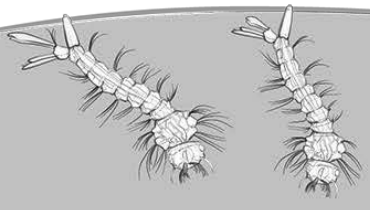
You have recorded some observations, ideas, and questions. All of these should inspire even more questions about mosquitoes.

In the table below, write down your questions to record them. We will return to these later.

What questions do you now have about mosquitoes that you would like to explore?
1.
2.
3.
4.
5.

Share what you've learned!

Be sure to share the work that you've done with others, for example, parents, grandparents, and friends. Check the **GLOBE *Mission Mosquito Science Notebook* page** for additional investigations: *https://strategies.org/mosquito-notebook*



Keep Building Your Notebook

Here are some ways that you can continue to build your *Mission Mosquito Science Notebook*, add to your knowledge, and improve your science skills.

- **Discover** additional mosquito investigations at:
  https://strategies.org/mosquito-notebook
- **Check** the GLOBE Observer website for other resources related to mosquitoes. For additional information, along with educational games and videos, go to:
  https://observer.globe.gov/do-globe-observer/mosquito-habitats/resource-library
- **Build** your background on mosquitoes by reading or listening to books that feature stories and information about mosquitoes. Here are book suggestions to get started; find more at your local public library or on our list at:
  https://www.worldcat.org/profiles/MissionMosquito/lists/3869345

Zika Zine: The Story of Three Aedes Mosquitoes and the Zika Within Them by Lisa S. Gardiner:
https://scied.ucar.edu/zikazine

Mosquitoes Don't Bite Me, by Pendred Noyce

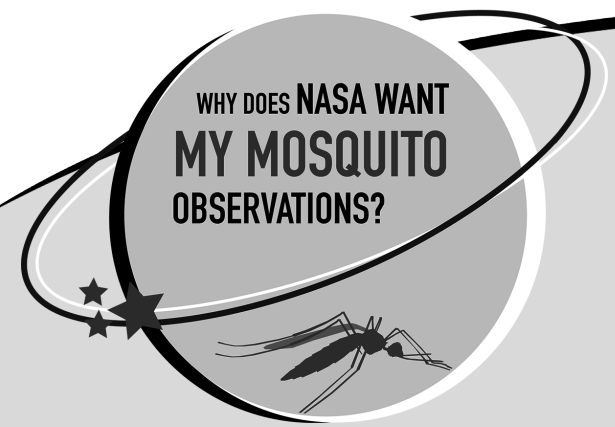
Fever 1793, by Laurie Halse Anderson

The Fever: How Malaria Has Ruled Humankind for 500,000 Years by Sonia Shah

NASA GLOBE Observer: The most important tool in your mosquito research is the GLOBE Observer free mobile app. Future investigations will involve using it to document mosquito habitats. GLOBE Observer is part of the international GLOBE Program and is designed for volunteer scientists (like you) who wish to contribute to Earth system science research. ***Note:*** Those under 13 years old should use the app with an adult.

Download the app: You can get the app, which includes step-by-step instructions, at:
https://observer.globe.gov/about/get-the-app.

You can also learn more by going to:
https://observer.globe.gov/do-globe-observer/mosquito-habitats/taking-observations



Mosquitoes can't be seen from satellites in space ... but the warm, moist conditions they prefer can be observed by NASA satellites. Climate and weather conditions can suggest to scientists where to expect spikes in mosquito populations during the year, but your mosquito observations at ground level can verify those population changes. By reporting possible mosquito habitats using the **GLOBE Observer** app, you are helping NASA scientists doing broad scale satellite-based research with local ground-based observations.

Making Mosquito Connections

Now I understand why _____

_____

_____

I'm changing my mind about _____

_____

_____

I can imagine _____

_____

_____

I'm beginning to think _____

_____

_____

It is worth remembering that _____

_____

_____

The one thing I found most interesting is that _____

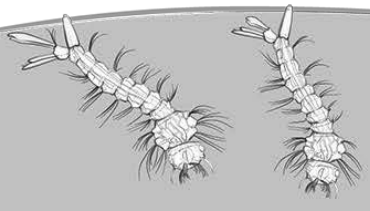
_____

_____

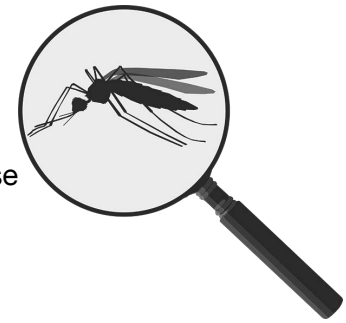
The one thing about mosquitoes that matters to me is _____

_____

_____



Getting Started on Mosquito Research



Today's Mosquito Data Page Header

- Enter **"Mosquito Data Page Header"** in your **Table of Contents** to easily find these instructions again.
- Begin each new entry in your notebook with "Today's Mosquito Data."
- Include the **date, temperature, rainfall, and mosquito observations. The date is important** because mosquitoes appear during certain times of the year in some places, while in others they are present year round. **Temperature is important** because most mosquito species are active between 50°F (10°C) and 100°F (38°C). **Rainfall is important** because it provides water in which female mosquitoes lay their eggs.

Today's mosquito data:

Date: July 17, 2020

Temperature: High: 95 F **Low:** 77 F

Rain today? Yes, it rained in the afternoon

Any mosquitoes observed? Yes, I heard and saw several adult mosquitoes. They were very active just before the sun set.

Tips on how to fill out your data

Daily High and Low Temperature: Wait until early evening or the next day to get this information. Include whether this is Fahrenheit or Celsius.

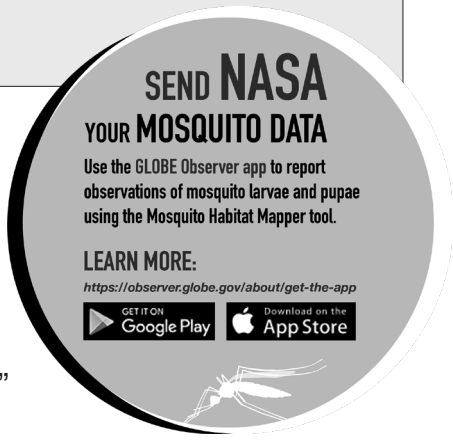
Rain: Note if there was rainfall in the area.

Mosquitoes observed: Did you see, hear, or feel any mosquitoes? You can also include any comments about your observations.

Where can I find daily high and low temperatures?

The following are a few suggestions:

- Weather app on your phone
- Local evening news broadcast or local news website
- **Weather Underground website:** Go to the link below: *https://www.wunderground.com* and **(1)** enter your location in "Search Locations" and **(2)** select "Station History."



Why get high and low temperature late in the day or the next day?

Why should I wait to get the high and low temperatures later in the day or even the next day? You might expect the hottest time of the day to be when the sun is directly overhead (called solar noon). But as you start tracking the daily high temperatures, you'll notice there is a delay between when the sun is at its highest point in your sky (directly overhead) and when the air reaches its warmest temperature of the day. Why is that? As the sun continues to shine throughout the afternoon, there is more heat coming in to Earth than leaving Earth. Therefore, the high temperature may not occur until 3:00 or 4:00 pm.

This same science concept also applies to the day's low temperature. You might expect the lowest temperature to occur just after the sun drops below the western horizon. While it does begin to cool off at that time, cooling will continue all night long as the heat that accumulated during the daytime leaves the surface (more heat is leaving the surface than coming to the surface). Therefore, the coldest air temperature typically occurs right around sunrise in the morning. You may also notice there are times when it is hottest earlier in the day and coolest later in the day. Why do you think that might happen? What do you observe happening on those days?

Conducting a Mosquito Habitat Survey

Introduction

Mosquitoes lay their eggs in or around water. Anything that collects water could become a mosquito habitat - a place in which eggs, larvae, and pupae can live and grow. If you find standing water sources and dump or cover them, you can help reduce the local mosquito population and increase the safety and enjoyment of your outdoor spaces. Report mosquito habitats observed using the **GLOBE Observer app** (***observer.globe.gov***).

Safety

It is important that you follow local guidelines. If you live in an area with outdoor restrictions, please wait to do this activity. **When you do go outside to search for possible mosquito habitats, please:**

- wear long sleeves and long pants.
- bring along water-resistant gloves.
- apply insect repellent.
- always use caution; make observations safely.
- only collect data in places where you have permission to go.

Instructions for filling out the charts below

Go outside and look around for places where water has collected - anything that holds water could become home to mosquito eggs, larvae, and pupae. Use the water sources listed below as suggested places to start looking. Not all of those listed will be in your neighborhood or area. You may find a potential habitat site that is not listed; simply add it under "other." For habitats that you find, carefully examine the water for larvae and pupae, and the surrounding area for adult mosquitoes.

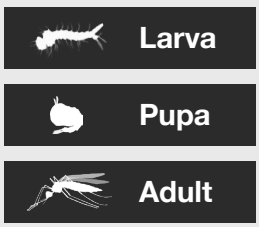
If you find any of the three life cycle stages (larvae, pupae, or adults), check the appropriate column. Repeat your search for mosquitoes in these habitats at least two more times over the next few weeks. Each time you find any of the three life cycle stages, check the appropriate box. Did you find larvae or pupae in places that you did not find them the first time you checked? Did you find them each time in some of the places you looked? If possible, remember to empty, cover, turn over, or throw out any items that hold standing water. Wear your gloves to do this.

Tips on how to fill out your data

Record the date, temperature, rain, and mosquitoes observed

Sheet has room for three separate observation days

Mosquito key



Date:	Sept. 3, 2020	Sept. 14, 2020	Sept. 23, 2020
Temperature:			
High:	75 F	78 F	68 F
Low:	55 F	52 F	50 F
Rain today?	Yes	No	No
Any mosquitoes observed?	Yes	Yes	No

Artificial container								
Animal trough								
Bucket	X		X		X			
Cement, metal, or plastic tank								
Flowerpot	X				X			

SEND NASA
YOUR MOSQUITO DATA

Use the GLOBE Observer app to report observations of mosquito larvae and pupae using the Mosquito Habitat Mapper tool.

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

GET IT ON Google Play | Download on the App Store

Mosquito Habitat Survey Data

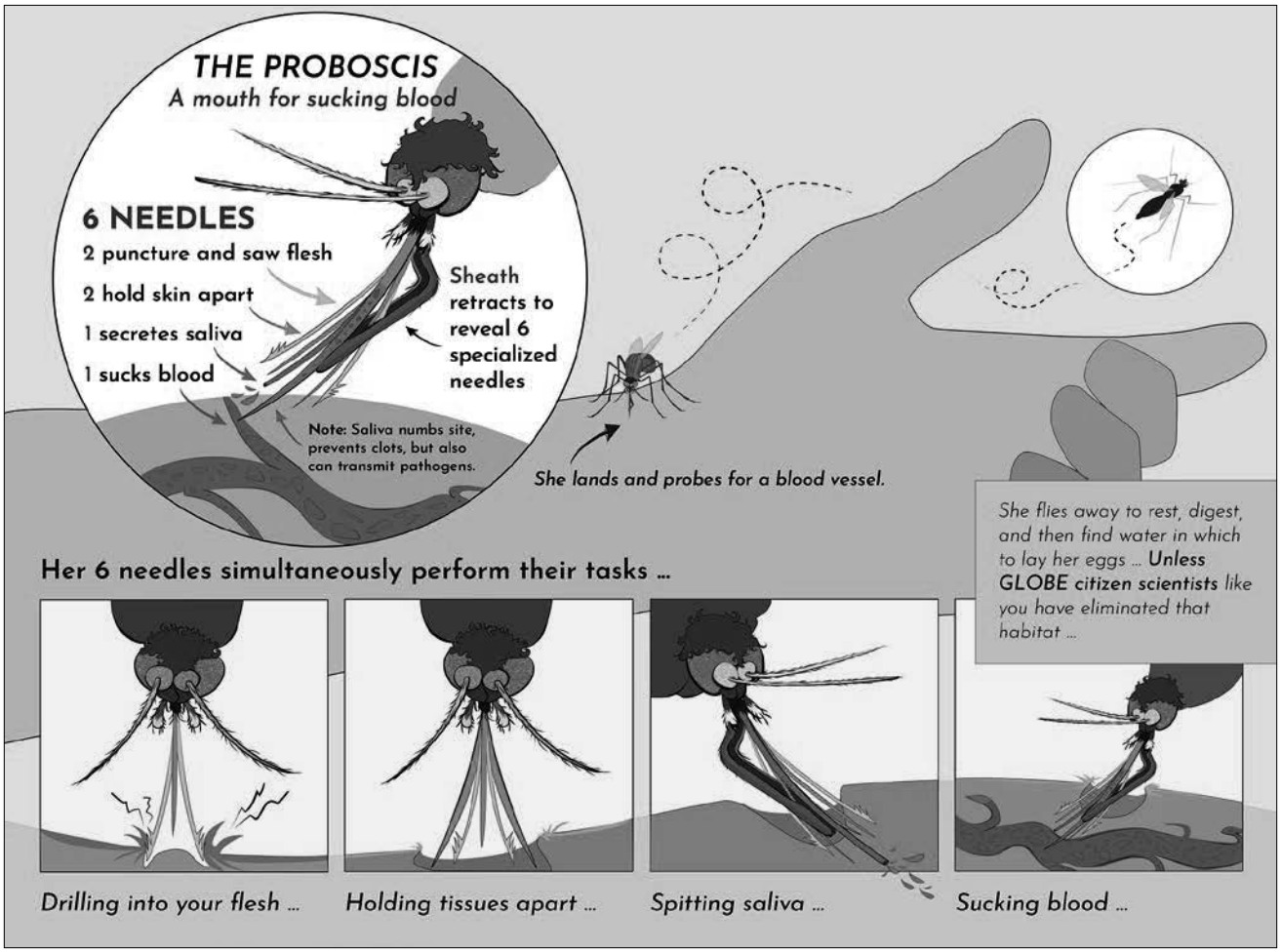
Date: _____ **Date:** _____ **Date:** _____

Temperature:
High: _____ **Low:** _____
Rain today? _____
Any mosquitoes observed? _____

Artificial container								
Animal trough								
Bucket								
Cement, metal, or plastic tank								
Flowerpot								
Fountain or bird bath								
Grill or grill cover								
Pet dish (food or water)								
Plastic wading pool								
Rain gutter								
Toys								
Well or cistern								
Wheelbarrow / wagon								
Other:								
Discarded item or trash								
Food / drink container (cup, can, bottle, bag, box)								
Old car or boat								
Tire								
Trash container / garbage can								
Other:								
Still water								
Bay or ocean								
Ditch								
Lake								
Pond								
Puddle (in vehicle or animal tracks)								
Reservoir								
Swamp or wetland								
Flowing water								
Estuary								
Water beside a stream								
Other:								
Water in natural container								
Animal shell (snail, etc)								
Plant clumps								
Tree hole								
Other:								

KEY: Larva | Pupa | Adult

Mosquito Proboscis: Mechanics of a Bite



VOCABULARY ALERT

Proboscis *(pronounced pro-bah-sis or pro-bahs-kis):* *In insects, the proboscis is the elongated tube-shaped mouthpart used to gather food. The female mosquito also uses the proboscis to gather blood from humans and other mammals, as well as birds, reptiles, and amphibians.*

Breaking down the word: "pro" means "forward" (from the head of an animal); "boscis" means "to feed."

LEARN MORE

Watch "How Mosquitoes Use Six Needles to Suck Your Blood," a video about the structure and function of the proboscis and gain a scientific appreciation for just how amazing it is: *https://www.pbs.org/video/deep-look-mosquitoes/*.

What was the most interesting thing that you learned from this video?

Based on the graphic video and the video:

I wonder ...

What if ...

Is it possible that ...

This reminds me of ...

ODE TO THE PROBOSCIS

Mosquitoes have a mouth
since after all, they need to eat.
But the mouth of every female
poses risks to all she meets.

In her mouth are found six needles.
Wait…SIX NEEDLES?? You may scream!
Why does she need six needles?
Six needles seems extreme!

First, two will hold your skin apart,
two sharper ones will saw,
they're headed for a blood vein–
it's your blood she wants to draw.

She is such a caring mother.
She's not trying to be mean.
But her eggs cannot develop
without using blood protein.

So, needle five sucks up your blood,
to her abdomen it goes.
You will hardly know it's happening
'cause mosquitoes are such pros.

The sixth one spits saliva
that contains a lot of stuff.
Some contents numb the area,
others make blood clotting tough.

The tiny loss of blood
is not at all the greatest threat.
It's the many bad diseases
That a human just might get.

Along with her saliva–
every now and every then–
she may also leave behind
a dangerous pathogen.

A human could be the receiver
of the virus for yellow fever.

Others, meanwhile,
could get West Nile.

Add to the hysteria
the chance of getting malaria.

The diseases are a problem
that YOU can help reduce.
Find the places where she lays her eggs
And turn that water loose.

But how cool is a proboscis?
Pretty cool, you must admit.
Mosquitoes are the only ones
who simultaneously suck and spit.

NOW IT'S YOUR TURN

What is your mosquito poem, story, song, or cartoon? Include any or all of the characteristics that you've learned about mosquitoes:

- **four life cycle stages:** (egg, larva, pupa, adult)
- **habitat for egg/larva/pupa:** standing water
- **anatomy of larva:** siphon
- **anatomy of adult:** two wings, six legs, head, thorax, abdomen, proboscis
- **feeding:** eating plant nectar
- **biting:** obtaining a blood meal