Lesson 2: Staying OUT of Mosquito Food Webs

Overview

Students investigate mosquito food webs, learning about what mosquitoes eat—and what organisms control their population by eating them. Wetland and backyard ecosystems are discussed (with visual aids and/or acting out a food chain), as well as how mosquitoes spread disease. Free Life Cycle Kits from Clackamas County Vector Control help students observe the effect of predators (mosquito fish) on larvae over several days; they record and graph the observed data, comparing it to the data they observed in the mosquito experiment without predators from the previous lesson. Adaptations / extensions are listed at the end of the lesson, including additional projects and games, to help engage all students.

Subjects: Science, Math, Reading, Writing, Speaking & Listening, Health, Art, Social Studies

Grades: Adaptable for K–12

Duration: 40–60 minutes for main lesson; observing, graphing and analyzing mosquito larvae and mosquito fish for 3 days

Vocabulary

- Biodiversity
- Ecosystem
- Food chain / food web
- Habitat
- Host
- Larva / larvae
- Organism
- Pathogens
- Predator
- Prey
- Pupa / pupae
- Stagnant
- Vector
- Wetlands

Lesson Goals

- Increase students' understanding of mosquitoes' role in food webs, as well as in spreading disease
- Provide students with experience in scientific observation, illustration, experimentation, data analysis, and graphing

Objectives

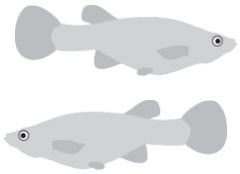
- Students will observe and illustrate mosquitoes and mosquito fish.
- Students will conduct an experiment using live specimens, record data, and graph changes over time.
- Students will reflect on the results of their experiment in writing and in class discussion.

Standards		Middle School (Grades 6-8)
Next Generation Science Standards (NGSS)	**Crosscutting Concepts**	• Systems and system models • Energy and matter • Stability and Change
	Science & Engineering Practices	Obtaining, Evaluating, and Communicating Information
	Disciplinary Core Ideas	LS1.A: Structure and Function LS2.A: Interdependent Relationships in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience
Common Core ELA	**Speaking & Listening**	1, 2, 4, 6
	Language Standards	1, 2, 3, 6
	Writing Standards Science & Technical Subjects	4, 7, 10

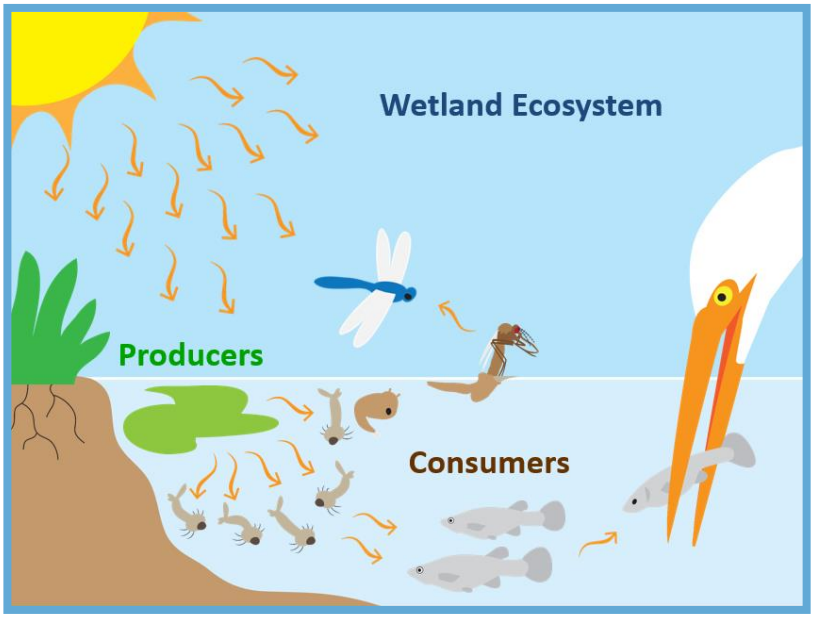
Materials & Preparation

1. Live mosquito larvae in emergence cages and supporting resources in the free Life Cycle Kits from Clackamas County Vector Control: 503.655.8394 or fightthebites.com/service-request
2. Prepare to show the *Staying OUT of Mosquito Food Webs* PowerPoint presentation available at fightthebites.com/education/resources.
3. Two or more mosquito fish *(Gambusia affinis)* from the Life Cycle Kit in a separate container
4. Copies of "Staying OUT of Mosquito Food Webs" handout for each student (at end of lesson)
5. Colored pencils and/or markers for students to share
6. Rulers for students to share when making line graphs
7. *Optional:* Magnification device(s) to magnify larvae, such as "Mpow 3-in-1 Clip-On Lens Kits: xmpow.com/selfie-stick-lens/mpow-fisheye-lens-mfe4.html
8. *Optional:* Document camera for students to more easily present illustrations and graphs to the rest of the class

Suggested Procedure



1. Show students the mosquito fish *(Gambusia affinis)* and ask them how the fish might be able to help stop the spread of disease. Discuss how they can help control mosquito populations and explain that the students will get to do an exciting experient with the fish and mosquito larvae later in the class.
2. Engage students with an interative discussion about moquito food webs using the brief "Staying OUT of Mosquito Food Webs" PowerPoint presentation as a visual aide.
    a. **Mosquito Life Cycle** (slide 2): Review the mosquito life cycle discussed in the previous lesson by asking students about each stage in a mosquito's life—egg, larva, pupa, and adult—before you reveal the stages on screen. Ask students questions to get them thinking, such as, "How does a mosquito begin it's life?" and "What does a mosquito larva need to live?"
    b. **Wetland Ecosystem** (slide 3): Ask the class why the Sun is so important for life on Earth. Discuss how it provides the energy which plants (**producers**) use to make food, and that the plants then become food for animals (**consumers**) like mosquito larvae. Explain that mosquito fish are **predators** which can eat the larvae, and birds like egrets can eat the fish, continuing the **food chain**. Dragonflies are one animal which can eat adult mosquitoes. Discuss how all the living and nonliving things (such as sunlight, water, and air) are interconnected in an **ecosystem**—in this case a wetland ecosystem which is known for having a high

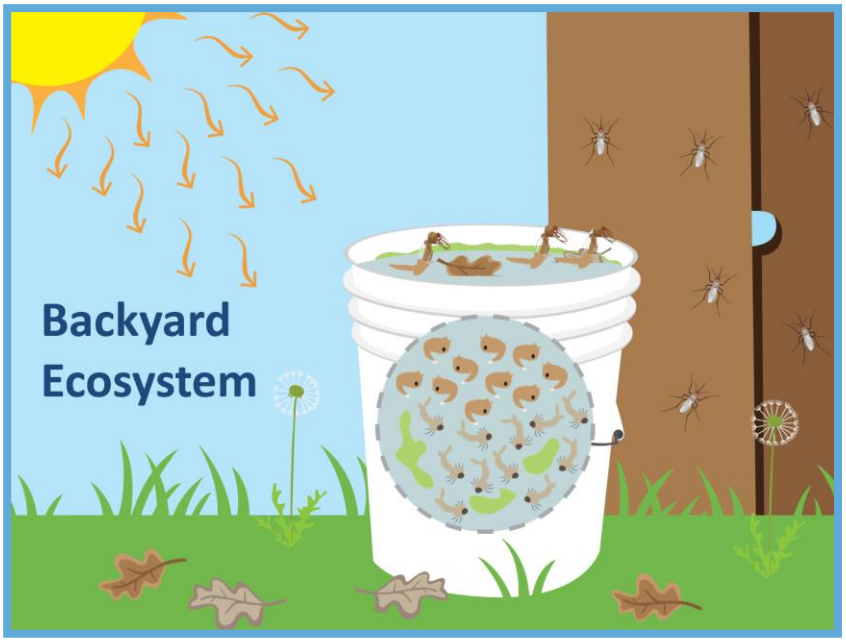


degree of **biodiversity** (different types of living things). Explain that **organisms** (living things) in an ecosystem actually interact in a **food web** (more than just a food chain), because they both eat and are eaten by many other organisms.

Optional: Call on volunteers to act out a food chain for the rest of the class. Start with a volunteer to play the Sun, holding up their arms in a big circle above their head. Then ask for a volunteer to play an organism which can make food from the Sun, followed by mosquito larvae which can eat the producers, fish that can eat the larvae, etc. Ask the students to try to make themselves look and/or act like the organisms they are playing.

c. **Wetland Ecosystem at Night** (slide 4): Discuss how mosquitoes can be most active at dusk, with female mosquitoes who have mated sucking the blood of other animals, such as birds and humans, to get protein to lay eggs. Fortunately, predators such as bats are active at night, too, and they eat tons of insects like mosquitoes!

d. **Backyard Ecosystem** (slide 4): Discuss how backyard ecosystems can be different, including how standing water sources usually don't contain predators like fish to control insect populations. Many adult mosquitoes can be produced in less than a week after eggs are laid, especially in the warmer months, which is why it is so important to dump standing water. Water features like ponds should not have **stagnant** (standing) water, which mosquitoes need to develop. Fortunately, other predators like swallows can eat adult mosquitoes, too, and Clackamas County Vector Control can provide mosquito fish for human-made backyard water features.



e. **Blood-feeding** (slide 5): Explain how mosquitoes can transmit diseases when feeding on blood. Saliva from the mosquito goes into the **host** (the organism being fed on), carrying the **pathogens** which can make people and other organisms sick.

f. **West Nile Virus, etc.** (slide 6): West Nile virus is one pathogen which can make people very sick. A mosquito with the virus can infect a host such as a bird, then another mosquito can transmit the virus from the bird to a human. Mosquitoes

are considered disease **vectors** because they can easily spread diseases from one host to another. Many humans and other animals have died because a mosquito infected them with West Nile virus, malaria, Zika virus, or another disease. Mosquitoes are the deadliest animal in the world to humans.

g. **Staying Safe from Mosquitula!** (slide 7): Discuss the strategies to stay safe listed on the screen and other student ideas, such as:

- ✓ Dumping standing water
- ✓ Being especially careful at dusk and dawn
- ✓ Using an electric fan if sitting outside in the evening
- ✓ Providing bat boxes and bird boxes to help mosquito predators find shelter and reproduce

3. Explain that students will have the opportunity to do an experiment to investigate the role of a predator on mosquito populations. Show them the tank with larvae and explain that, like the first tank in the previous lesson, they will count how many larvae, pupae, and adults are in the tank each day. The difference is that after they do a count on the first day, they will add the mosquito fish to test the role of the predators in determining how many mosquitoes can grow and develop.
4. Pass out copies of the "Staying OUT of Mosquito Food Webs" handout (found at the end of the lesson) and explain to students that they will work with a partner to complete the activities in any order they prefer, taking turns with the other groups to observe the tank. Tell students that they will carefully observe the mosquitoes and fish and record their observations on the handout. They can observe the live larva using a magnification device (if available) when making their observations/illustrations. At the end of the experiment they will graph their data to show how the numbers of mosquitoes changed over time and compare it to the graph from the first experiment which they started in the previous lesson.
5. Students will conduct the experiment over the next several days. Explain that they will be responsible for completing the illustrations, questions, and graphs on the handout over that time, and that they can ask questions as they arise.
6. At the end of the experiment, have groups present their ideas from the questions on the handout, including their illustrations, using a document camera (if available).
7. Results and graphs from the experiment can also be presented and discussed, then you can collect the handouts for assessment.

Adaptations / Extensions

- **Take students outside and have them explore a local ecosystem**, such as a wetland or your school grounds. The organisms they discover can be recorded in student-created field guides or journals and observed to determine how they interact with other organisms in a food web. Back at school, research can be conducted to develop a deeper understanding of the organisms and how they interact in the ecosystem. Research findings could be shared with the rest of the class through oral presentations, student-created videos, etc.
- **Play "Bats & Skeeters,"** a new game inspired by the "Beneficial Insects Game" created by Bob Carlson, former director of the Center for Research in Environmental Sciences and Technology (CREST) in Wilsonville, OR: wlwv.k12.or.us/Domain/12.

Students play "Bats & Skeeters"

    - Choose 2 students to be bats and 6-8 students to play skeeters (mosquitoes) for a group of about 25 students. If possible, use different-colored bandanas (tied to wrists to avoid the chance of spreading lice) to distinguish the bats (red, brown, or black bandanas) from the mosquitoes (any other bright color) from the remaining students, who all play humans.
    - Humans are given a head start to get away from the mosquitoes.
    - Second to be released are the mosquitoes who try to tag the humans (to represent sucking their blood and giving them dangerous pathogens).
    - Once a human is tagged, they must freeze until they are rescued (tagged) by a bat, who are the last 2 students added to the game. The bats have 2 responsibilities:
        1. To unfreeze (tag) the humans
        2. To tag (eat) the mosquitoes before they tag more humans
    - When a mosquito is tagged by a bat, they must leave the game (to symbolize that they have been eaten).
    - Humans may be tagged by mosquitoes and rescued by bats twice. The first time they are tagged by a mosquito they must raise one hand to show that they have been bitten. After the second tag, they raise both hands to show they have been bitten twice. On the third tag from a mosquito they have West Nile virus or another serious disease and must leave the game.
    - Debrief after each round, adjust the number of bats and mosquitoes, if necessary, and play a second or third time so all students get to be a tagger at least once. Point out that not all students can be bats.
- **Students can create food web diagrams** of an ecosystem which includes mosquitoes, such as a wetland or backyard. They can create the diagrams on paper using pencils, markers, etc., or using software such as PowerPoint, Google

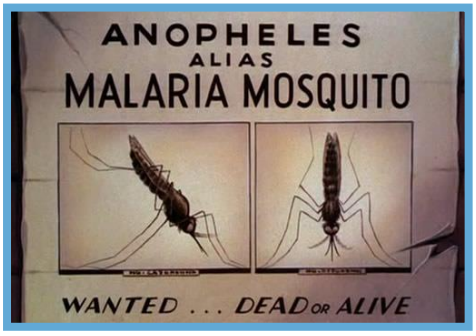
Jamboard, Illustrator, or Explain Everything. Show students one or more examples to help them get started and envision more possibilities for how to present the information, such as:

  - "Aquatic Food Web" from Univ. of Michigan: www.miseagrant.umich.edu/lessons/files/2013/05/Aquatic-Food-Web-GLEP.jpg
  - "Who's Eating Who?": cdas.org.au/sites/all/themes/nexus/images/FoodWeb.png
  - "Wetland Food Web": 1.bp.blogspot.com/-XLXufX-ih8c/U6neytFPyYI/AAAAAAAABMs/N5WyGhg0Is0/s1600/wetland+food+web.jpg

- **Invite students to play the "Fight the Bites!"** video game at fightthebites.com/education/new-fight-the-bites-video-game. They can play individually or with a partner using almost any computer, tablet, or smartphone.

Scene from the "Fight the Bites!" video game

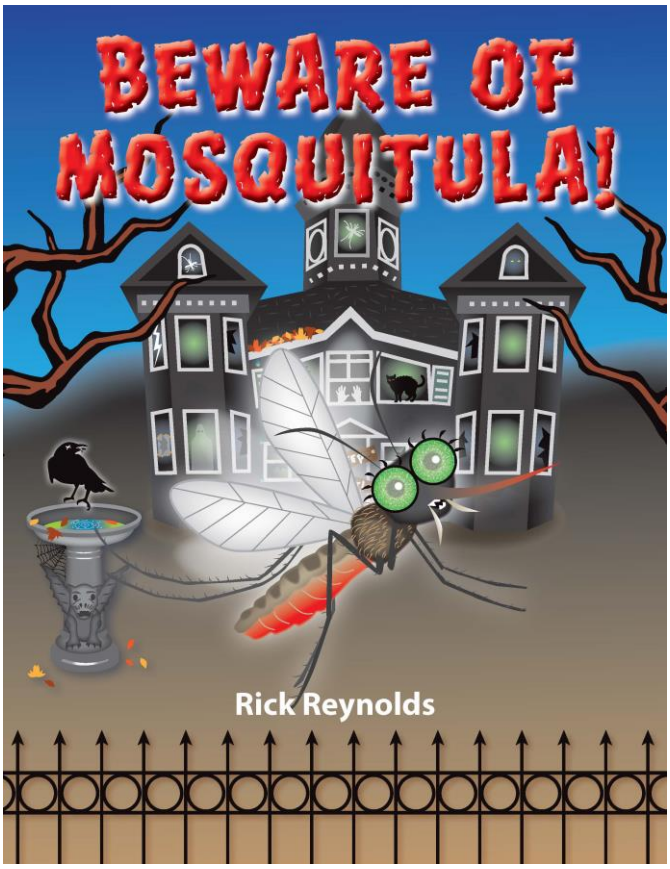
- **At the start of the lesson, ask students to turn to a neighbor and brainstorm what they think the most dangerous animal is to humans and why.** After a minute, ask the groups to share their ideas with the class and discuss why mosquitoes are so dangerous to humans and other animals.
- **Students can work in pairs or small groups to create** about mosquito food webs and/or public service ann about how to stay safe from mosquitoes and vector-borne illness.
- **Play the "Life Cycle Memory Game"** at fightthebites.com/education/resources as an enjoyable way to review concepts. It works like the old memory card game, but with a mosquito life cycle theme. One way to play is to divide the class into two teams and award points when each group gets a match. A group can keep guessing as long they get matches. Good opportunities to review concepts are provided as the various pictures are flipped over.
- **Ask students to compare a mosquito and another organism**, such as a mosquito fish or bat, using a Venn diagram or another method.
- **Show and discuss one or more short videos**, such as:
  - Disney's classic "The Winged Scourge," which was created during World War II to help fight the spread of malaria: youtu.be/y68F8YwLWdg?t=18s
  - PBS' fascinating "Deep Look: How Mosquitoes Use Six Needles to Suck Your Blood": pbs.org/video/deep-look-mosquitoes



- **Lead a student service-learning project** to identify possible sources of mosquito breeding on school grounds and/or in neighborhoods. Students can work to limit areas of standing water and educate their neighborhood and fellow students about staying safe from mosquitoes by reducing standing water, sharing ways to avoid being bitten, etc.

More Resources / References

- More free resources are available on Clackamas County Vector Control District's website, including the children's books *Beware of Mosquitula!* and *Mosquitula Meets the Great Gambusi*: fightthebites.com/education.
- Learn more about West Nile Virus and its transmission from the Mayo Clinic: mayoclinic.org/diseases-conditions/west-nile-virus/symptoms-causes/syc-20350320
- Mosquito Habitat Mapper. GLOBE Observer app discussed fully in Lesson 6 of this curriculum, "Mapping Mosquito Habitats": observer.globe.gov/about/get-the-app
- Pittawalla, Iqbal. How Mosquitoes Are Drawn to Human Skin and Breath: ucrtoday.ucr.edu/19377
- PowerPoint presentation used in the lesson adapted with permission from Eric Engh, Education Program / Insect Identification Specialist with Marin/Sonoma Mosquito & Vector Control District; more resources available from their Mosquito School website: msmosquito.com/mosquito%20school
- See the videos referenced above for more background information. The website "Mosquito Magnet" also has an excellent explanation with images of how mosquitoes bite: mosquitomagnet.com/articles/how-mosquitoes-bite
- "Food Webs" lesson plan. CPALMS, Florida State University: www.cpalms.org/Public/PreviewResourceLesson/Preview/75952
- "The freshwater biome." UC Berkeley: www.ucmp.berkeley.edu/exhibits/biomes/freshwater.php
- More information about the Next Generation Science Standards: nextgenscience.org
- More information about the Common Core State Standards: corestandards.org



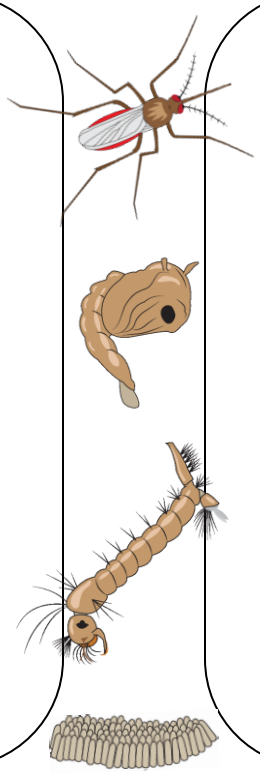
Free print versions of the *Beware of Mosquitula!* and *Mosquitula Meets the Great Gambusi* books are also available from Clackamas County Vector Control.

Name:_____ Period: _____ Date: _____

Staying OUT of Mosquito Food Webs

Draw and label mosquito food sources below . . . and organisms that eat mosquitoes at different life stages.

Mosquito Food Sources



Mosquito Predators

Think About It!

1. List places with **stagnant** (still) water where mosquitoes can grow:

_____

_____

_____

2. What are ways to keep mosquitoes from growing in those places?

_____

_____

_____

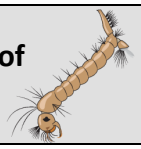
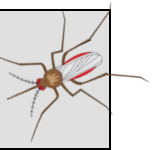
Predator Experiment! Record the number of larvae, pupae, and adults each day.

Hypothesis: What changes do you predict in the habitat with fish compared to one without them?

_____

_____

Mosquito Data – Habitat with Mosquito Fish

Day	Number of Larvae 	Number of Pupae 	Number of Adults 
1 BEFORE Mosquito Fish Added			
1 AFTER Mosquito Fish Added			
2			
3			
4			
5			
6			

Graph it!

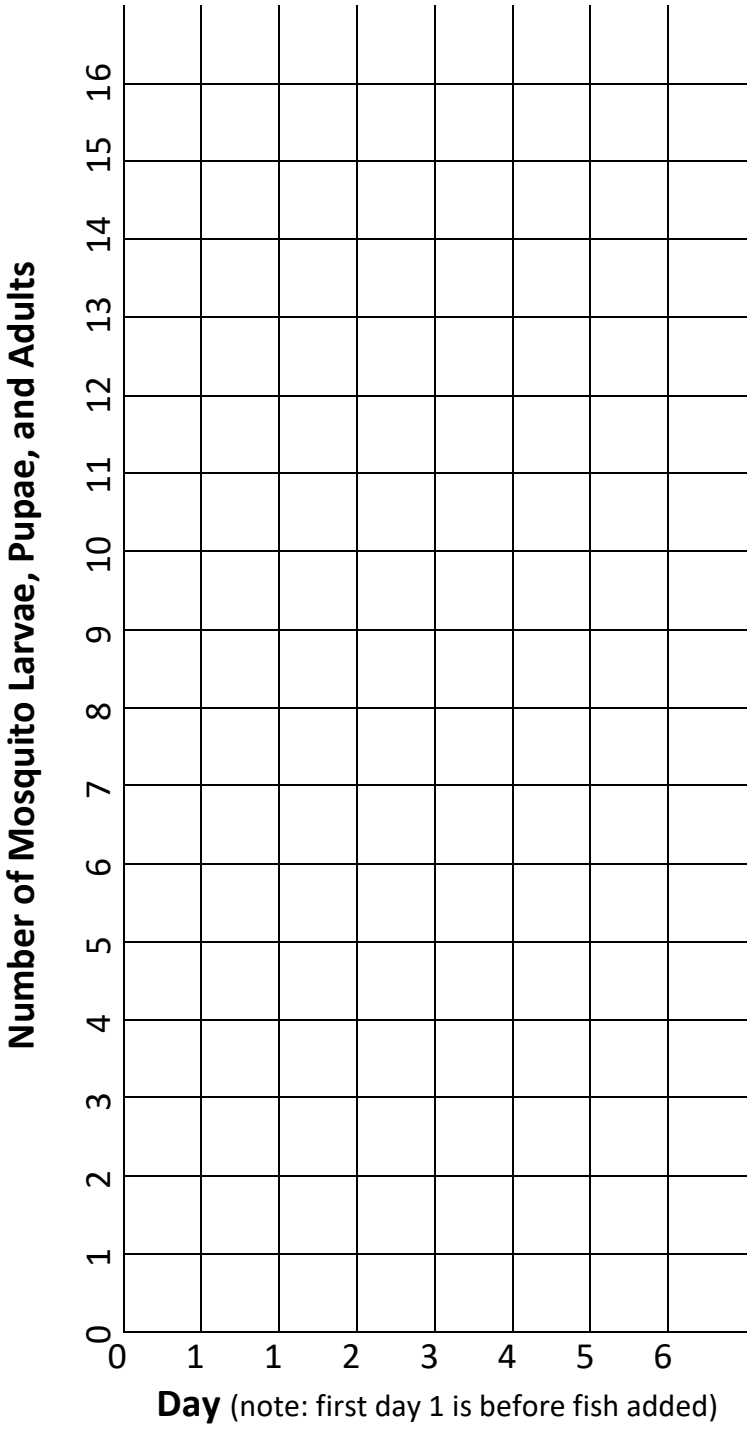
1. Use the data from the table to **create line graphs** on the next page. These will show the number of mosquitoes at each life stage (larvae, pupae, and adults).
   Optional: Use a computer and graphing software to record your data and create line graphs.
2. Compare your line graphs. Was your hypothesis correct? What can you say about how the data changes over time compared to the habitat without predators?

   _____

   _____

Mosquito Growth Graph—with Fish

1. **Add data points from the table** using 3 different colors.
2. **Label the colors** in the legend.
3. **Connect the points** with straight lines of the same colors.



Legend

Choose a color for each data type.

◯ Larvae ◯ Pupae ◯ Adults

Illustrate & Label the Habitat with Fish

Illustrate & Label the Habitat without Fish