Lesson 1: Investigating the Mosquito Life Cycle

Overview

Students investigate the mosquito life cycle and learn that mosquitoes require water to develop. Larvae are observed under magnification and a simple interactive multimedia presentation helps provide an overview of the important concepts and terms. Free Life Cycle Kits from Clackamas County Vector Control enable students to safely observe the mosquito metamorphosis over the course of 2 weeks, including the four stages in the life cycle: egg, larva, pupa, and adult. Changes can be documented and analyzed with the support of a handout at the end of the lesson. Numerous adaptations / extensions are listed at the end of the lesson to help meet the needs of all learners.

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

Grades: Adaptable for K–12

Duration: 40–60 minutes for main lesson; observing, graphing and analyzing mosquito metamorphosis over 2 weeks

Vocabulary

- Hypothesis
- Larva / larvae
- Life cycle
- Metamorphosis
- Pupa / pupae
- Scientific method
- Vectors
- Vector-borne disease

Lesson Goals

- Increase students' understanding of what mosquitoes need to reproduce and how their adaptations help them to survive and transform
- Provide students with experience in scientific observation, illustration, experimentation, data analysis, and graphing

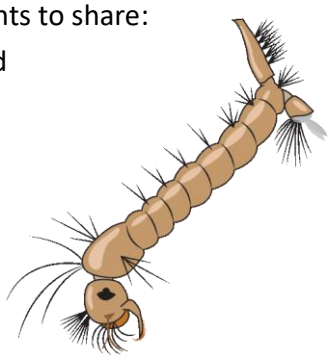
Objectives

- Students will observe and illustrate mosquitoes at all four stages of their life cycle.
- 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**	• Structure and Function • Stability and Change
	Science & Engineering Practices	Obtaining, Evaluating, and Communicating Information
	Disciplinary Core Ideas	LS1.A: Structure and Function LS1.B: Growth and Development of Organisms
Common Core State Standards	**Speaking & Listening**	1, 2, 4, 6
	Language Standards	1, 2, 3, 6
	Writing Standards Science & Technical Subjects	4, 7, 10
	Math Geometry (Grade 5)	1, 2

Materials + Preparation

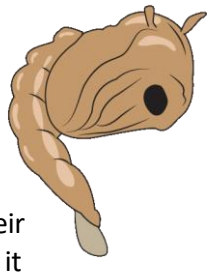
- Prepare to show the *Mosquito Life Cycle* PowerPoint presentation available at fightthebites.com/education. Two versions of the presentation—with and without a game—are explained below, so decide if you will play the game with the class before starting the other activities. You could also do the game with the class after completing the class experiment as a review and/or a quiz.
- Be ready to explain the terms/concepts in the presentation and the rest of the lesson, including:
    - **hypothesis**: a guess made based on what is known
    - **larva**: young wingless form of an insect (such as a mosquito)
    - **larvae**: more than one larva
    - **life cycle**: stages in the life of an organism (egg, larva, pupa, and adult for many insects, such as mosquitoes)
    - **metamorphosis**: a major change some animals make between life stages to become adults
    - **pupa**: the stage of an insect's life when it is changing from a larva into an adult
    - **pupae**: plural of pupa; pupae do not eat or move while they are transforming
    - **vectors**: animals which can spread disease, such as mosquitoes, flies, and ticks
    - **vector-borne disease**: sickness spread by a vector, such as West Nile virus and Zika virus
    - **Clackamas County Vector Control District**: government agency that controls vectors in our county and educates the public about how to stay safe from them
- Copies of "Life Cycle of a Mosquito" handout for each student (at end of lesson)
- These resources available in free Life Cycle Kits from Clackamas County Vector Control (503.655.8394 or fightthebites.com/contact-us) for groups of about 4 students to share:
    - Live mosquito larvae in safe emergence cages; powdered larvae food
    - Dried mosquito specimens and enlarged photographs of mosquitoes at all 4 life stages
    - Rulers for students to share when making line graphs
    - Magnifying device(s): Be ready to magnify live mosquito larvae and/or larvae of another insect.
        - Hand lenses (ideally for each student)
        - The most cost-effective, high-quality alternative to a microscope we have found is a macro lens attachment for a tablet or smart phone with 20x or better magnification. One great option is the AMIR Phone Camera Lens: amazon.com/AMIR-Upgraded-Compatible-Attached-Smartphone/dp/B06XWZJ56Z
    - Mosquito anatomy chart
    - Pipettes (ideally with wider openings to remove larvae from emergence cages without hurting them)
    - Petri dishes



- Colored pencils and/or markers for students to share
- *Optional:* Document camera for students to more easily present illustrations and graphs to the rest of the class

Suggested Procedure

1. Use a magnifying device connected to a computer and/or data projector to show the class live mosquito larvae in water. (Another type of larvae, such as *daphnia magna*, can be used if mosquito larvae are not available: carolina.com/daphnia/daphnia-magna-living).
2. Ask students to turn to a neighbor and brainstorm ideas about what they are looking at and how they might have gotten in the water. After about a minute, ask the groups to share their ideas with the class. If necessary, clarify that the students are looking at young mosquitoes (or another organism) that started out as tiny eggs.
3. Show students the brief "Mosquito Life Cycle" PowerPoint presentation to help explain the life cycle to students and how mosquitoes get what they need to develop. Both versions of the presentation can be used with any class, grade 1 and up, but we suggest using Version 1 (which includes the game explained below), in grades 3 and up, and Version 2 (without the game), for most younger groups. The game is a fun way to reinforce the important concepts and terms, but it may make the introductory mini lesson longer than necessary for some classes.

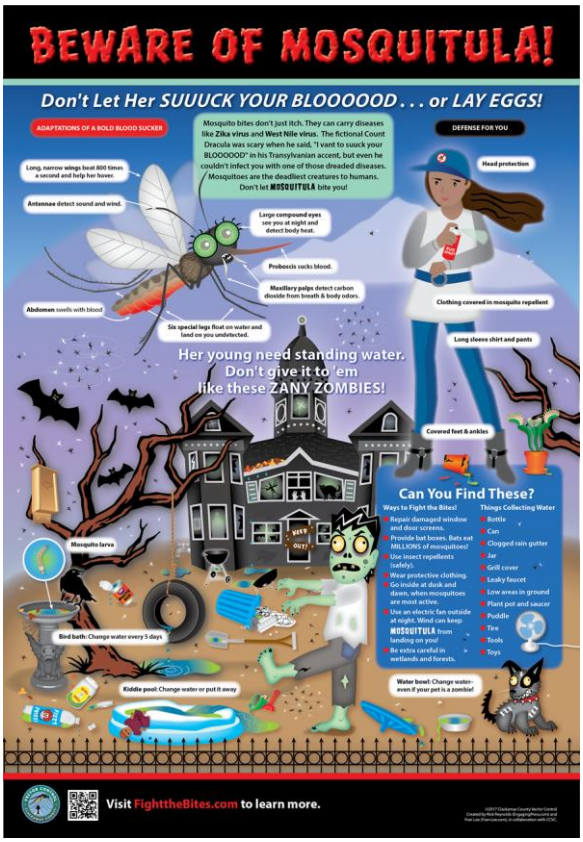


4. In the course of the presentation, explain that if the mosquitoes meet their needs of water, food, and warmth, there will be a **metamorphosis** as they transform from **larvae** into **pupae** and pupae into adults.
5. *Optional:* For the Scrabble game section in Version 1, ask students to work with a partner to decide on answers to the questions before you reveal them. Pairs can raise their hands when they agree on the answer, and when the majority of students seem to know it you can call on a student to say the answer—or ask all of the groups to say it all together!

6. At the "Your Classroom Experiment" slide, explain that students will be doing an experiment to count how many larvae, pupae, and adults are in the tank each day. They will take care of the mosquitoes so their habitat will help them grow and develop. But they will NOT have to let the adult females suck their blood!
7. Advance to the "Mosquito Growth Graph" slide and explain that students will record the data for how many larvae, pupae, and adults there are in the container each day. They will create line graphs with the data to show how the numbers changed over time.
8. Pass out copies of the 3-page "Life Cycle of a Mosquito" handout (found at the end of the lesson) and explain that students will carefully observe and illustrate mosquitoes at all four stages of their life cycle throughout the experiment. Point out the spaces on the handout where they will add their illustrations, and that they can observe the live larva again using a microscope and/or hand lens, as well as dried specimens and/or enlarged photographs when making their observations/illustrations.
9. Direct students to turn to the second page of their handout and explain what a hypothesis is, if necessary. Point out the table in which they can record the data which will test their hypothesis, and finally direct their attention to the last page of the handout where they will graph the data using 3 different colored pencils or markers. Give students the option of using a spreadsheet such as Microsoft Excel or Google Sheets to record and graph the data.
10. Students will conduct the experiment over the course of about 2 weeks. Explain that they will be responsible for completing the illustrations, questions, and graphs in the handout over that time, and they can ask questions as they arise.
11. At the end of the experiment, discuss the results and student ideas. A document camera (if available) can be use to more easily share student illustrations and graphs.

- Were their hypotheses correct?
- How can they describe the data changes over time?
- Was there anything surprising about the mosquito metamorphosis, such as how quickly it occurred?
- What can they do around their own home and school to reduce the number of mosquitoes that develop into dangerous, blood-sucking adults?

12. *Optional:* Share the "Beware of Mosquitula!" poster with students—and the important concepts presented. Free posters are available from the Clackamas County Vector Control District and online at fightthebites.com/education. Leave the poster up in the classroom and/or elsewhere in the school as a daily reminder of how students can help keep themselves and their community safe from vector-borne illness.



13. Collect the handouts for assessment. Clackamas County Vector Control can pick up the adult mosquitoes to return them to the colony used for education, or you can put the container in the freezer overnight to kill them humanely. The mosquitoes are native to Oregon, but they will bite and are therefore not to be released into the environment. Dead mosquitoes can be disposed of in the trash or compost.

Adaptations / Extensions

- **Start the experiment in lesson 2, "Staying OUT of Mosquito Food Webs," on the next class day.** It is a parallel experiment in a different tank with mosquito larvae and mosquito fish *(Gambusia affinis)* available free from Clackamas County Vector Control. Students can compare the data on the numbers of mosquito larvae, pupae, and adults in the two tanks over time.
- **At the start of the lesson, ask students to think about what they think is the most dangerous animal in the world to humans and why.** After a moment they can turn to a neighbor and brainstorm all of the possibilities, recording their ideas on paper in words and pictures. It might be surprising to students that tiny mosquitoes are the deadliest animals to humans, so that can provide an excellent springboard for the lesson and unit.
- **Discuss the scientific method** with your students before doing the experiment. It is the way scientists—like them—can better understand the world. It uses these steps:
    1. Start with a **question** to investigate, such as "How long does it take a mosquito pupa to change into an adult at room temperature?" Questions may arise from an **observation**, such as, "Mosquitoes change throughout their life cycle."

2. Formulate a **hypothesis**—an educated guess—based on the available information.
3. **Test** the hypothesis: Conduct an **experiment** and/or make more observations.
4. Collect **evidence** from the experiment: make **observations** and record **data**.
5. **Evaluate** the hypothesis based on the evidence. Was it correct? Why or why not? Conduct the experiment again to verify the data and/or refine the hypothesis and experiment based on the evidence from the first experiment. Repeat the process until the results of the experiment can be reliably predicted.

- **Students can engineer insect enclosures** to gain engineering/design experience and help them better study an insect. For example, small habitats can be created using plastic bottles, but be very careful if you decide to try this with dangerous insects, such as mosquitoes: wevideo.com/view/464164823.

- **Show and discuss PBS' short video "Deep Look: How Mosquitoes Use Six Needles to Suck Your Blood"**: pbs.org/video/deep-look-mosquitoes. It is a fascinating examination of the complex structures that mosquitoes use to bite—and why that is such a serious threat to human health

- **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.

- **Ask students to compare the life cycle of a mosquito with that of another organism.** For example, a Venn diagram could be used to compare its life cycle with that of another potential disease vector, such as a fly, tick, or flea. A general comparison could also be made between a mosquito and another organism, such as a mosquito fish or a human.

- **Play the "Mosquito Memory" game** at fightthebites.com/education 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.

- **Introduce the use of juvenile hormones as one method of insect (and mosquito) control.** Teachers can add a small pellet of Altosid (trade name for a juvenile hormone product used by Clackamas County Vector Control) to a second larval container and students can follow and compare the two treatments (no Altosid vs Altosid). They should observe that no adults emerge from the pupal stage (the product stops the metamorphosis from completing). The same concept could be introduced for the bacterial products used by Clackamas County Vector Control: the teacher can introduce a few grains of bacterial product into a third larval habitat. Students should observe larval death within 24 hours.

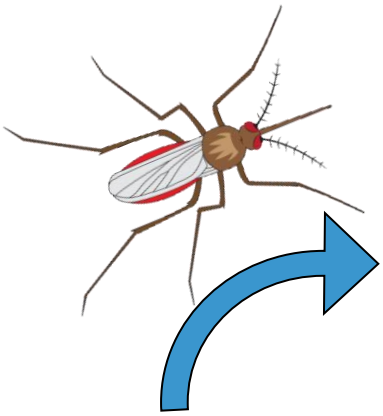
More Resources / References

- Visit Clackamas County Vector Control District's website for more resources and background about our education program: fightthebites.com/education
- "Hypothesis Lesson for Kids: Definition & Examples" with video. Study.com: study.com/academy/lesson/hypothesis-lesson-for-kids-definition-examples.html
- "Mosquito Biology." Maryland Dept. of Agriculture: mda.maryland.gov/plants-pests/Pages/mosquito_biology.aspx
- "The Scientific Method." Explained by Khan Academy with visuals: khanacademy.org/science/biology/intro-to-biology/science-of-biology/a/the-science-of-biology
- The PowerPoint presentation was adapted with permission from Eric Engh, Education Program / Insect Identification Specialist with Marin/Sonoma Mosquito & Vector Control District. More resources are available from their Mosquito School website: msmosquito.com/mosquito%20school
- More information about the Next Generation Science Standards, including a link to the *Framework for K-12 Science Education* to which this lesson was aligned: nextgenscience.org/framework-k%E2%80%9312-science-education
- More information about the Common Core State Standards and links to the complete documents: corestandards.org

Name: _____ Period: _____ Date: _____

Life Cycle of a Mosquito

Draw one or more mosquitoes at each life stage.
Observe them carefully to create scientific illustrations.



Adult

Egg Raft

Larva

Pupa

Think About It!

1. What is one thing mosquito larvae, pupae, and eggs all need to live? _____
2. What else did you observe about the mosquitoes?

   _____

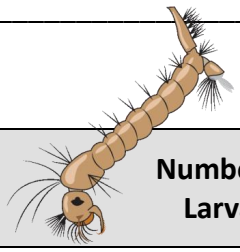
   _____
3. Could mosquito larvae and pupae be living near your home or school? If so, where?

   _____

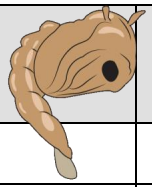
Experiment! Count the number of larvae, pupae, and adults each day. Record the data below.

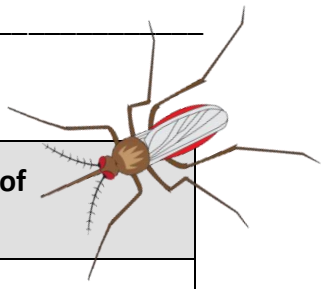
Hypothesis: What changes do you predict? _____

_____



Mosquito Data Table





Day	Number of Larvae	Number of Pupae	Number of Adults
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Graph it!

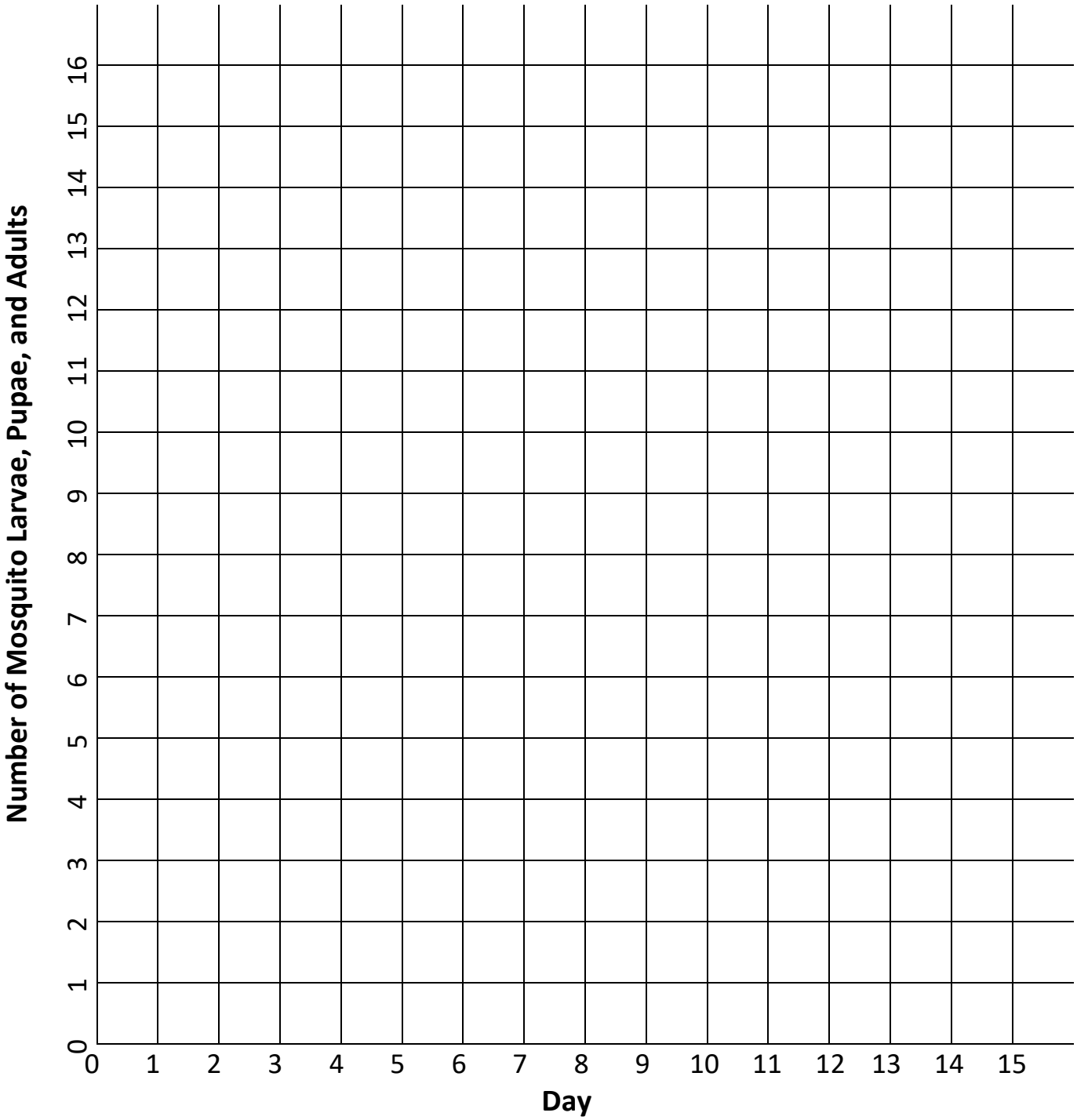
1. Use the data from the table to **create line graphs** on the next page. These will show the number of mosquitoes at each life stage (larvae, pupae, and adults). ***Optional:*** Use a computer and software such as Microsoft Excel to record your data and create line graphs.
2. Compare your line graphs. Was your hypothesis correct? What can you say about how the data changes over time?

_____

_____

Mosquito Growth Graph

1. **Add data points from the table** using 3 different colors.
2. **Label the colors** in the legend.
3. **Connect the points** in the 3 sets of data with straight lines of the same colors. This will create **line graphs** which show the changes over time.



Legend

Color for each life stage: ◯ Larvae ◯ Pupae ◯ Adults