# Mosquito Life Cycle Activity

hhmi | BioInteractive

Activity
Educator Materials

## OVERVIEW

This activity is a student investigation of the mosquito life cycle which complements the Click & Learn Stopping Mosquito-Borne Disease.

Studying the life cycles of disease vectors may suggest strategies for limiting, or even stopping, the spread of the diseases they transmit. In this activity, students test variables that might affect the life cycle of the mosquito. Students will rear mosquitoes in chambers that allow them to make observations without risking the release of the insects into the classroom. Although it takes about 2 weeks for the mosquito life cycle, and this activity, to be completed, observations require only a few minutes each day.

## KEY CONCEPTS

- Some vectors are bloodsucking insects, which ingest disease-producing microorganisms from an infected host (human or animal) during a blood meal and then inject those microorganisms into a new host in a subsequent blood meal.
- The life cycles of insect vectors that transmit diseases consist of egg, larval, pupal, and adult stages. In particular, many of these insects undergo complete metamorphosis.

## STUDENT LEARNING TARGETS

- Understand the mosquito life cycle, including the major developmental stages.
- Develop and utilize protocols for a scientific investigation, including making detailed observations and analyzing experimental data.
- Demonstrate how scientific data can be used to design meaningful and executable public policy to prevent disease.

## CURRICULUM CONNECTIONS

| Standards | Curriculum Connection |
|---|---|
| NGSS (2013) | HS-LS2-8 |
| AP Bio (2015) | 3.C.3, SP4, SP5 |
| IB Bio (2016) | 6.3 |
| AP Env Sci (2013) | III.B.3 |
| Common Core (2010) | ELA.RST.6-12.7, WHST.6-12.1, MP2 |
| Vision and Change (2009) | CC2, DP1 |

## KEY TERMS

disease, insect, life cycle, mosquito, vector, viral disease

## TIME REQUIREMENTS

- One 50-minute class period is needed to set up the activity.
- Observing the mosquitoes requires 11 to 14 days, depending on conditions. (For example, cooler classroom temperatures will slow the hatching process.) Although daily observations should be made during this time period, observations should only take 5 to 10 minutes each day.

## SUGGESTED AUDIENCE

- High school biology (all levels)

## PRIOR KNOWLEDGE

Students should

- understand some factors that contribute to the spread of disease
- be familiar with some of the stages of insect development

## BACKGROUND

The following information may be provided to students. Additional information is also available in the mosquito reference document, available at www.biointeractive.org.

### Mosquitoes as Disease Vectors

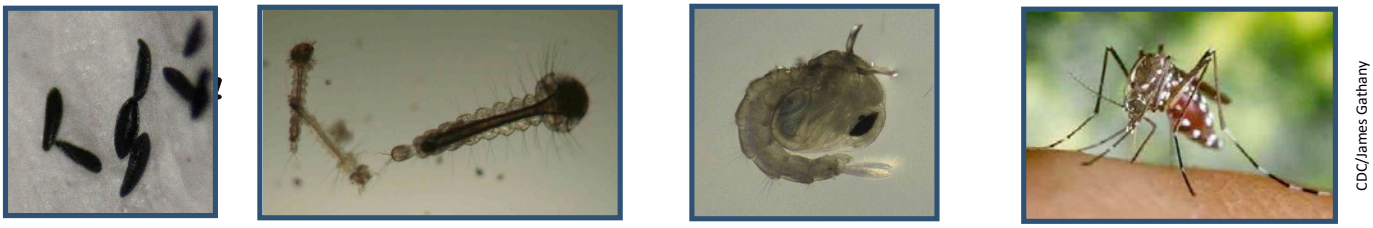
Mosquitoes are important vectors of many diseases, including malaria, yellow fever, dengue fever, West Nile disease, and St. Louis encephalitis. Species of the genus *Culex* are the main vectors of the West Nile virus in the US. In the Eastern US, *Culex pipiens* is the vector species, while in the Southeast, it is *Culex quinquefasciatus,* and in the Midwest and the West, it is *Culex tarsalis.* The Asian tiger mosquito (*Aedes albopictus*) was introduced to the US from Asia and spread to large portions of the country including the Washington, DC, area. In parts of the world that have dengue fever, this species of mosquito can act as a vector for dengue.

### The Mosquito Life Cycle

Mosquitoes have a complex, multistage life cycle. *Aedes albopictus* eggs are laid near water, and *Culex* eggs are laid as floating rafts. The eggs hatch into aquatic larvae about 1 mm in length. The larvae grow over several days, via several molts, to a size of about 5 mm. Final-stage larvae then develop into pupae, which in turn metamorphose into adults in a few days. Aquatic larvae and pupae breathe air at the surface of water, while adults have wings and permanently leave the aquatic environment.

Adult mosquitoes are sexually dimorphic, males being smaller than females. The most striking difference is the morphology of the antennae. The antennae of males have a bushy appearance, while the antennae of females appear sparsely branched.

*Eggs* *Larvae* *Pupa* *Adult*



CDC/James Gathany

*Aedes albopictus* Life Cycle

Male *Aedes albopictus* with bushy antennae

Female *Aedes albopictus* with less bushy antennae

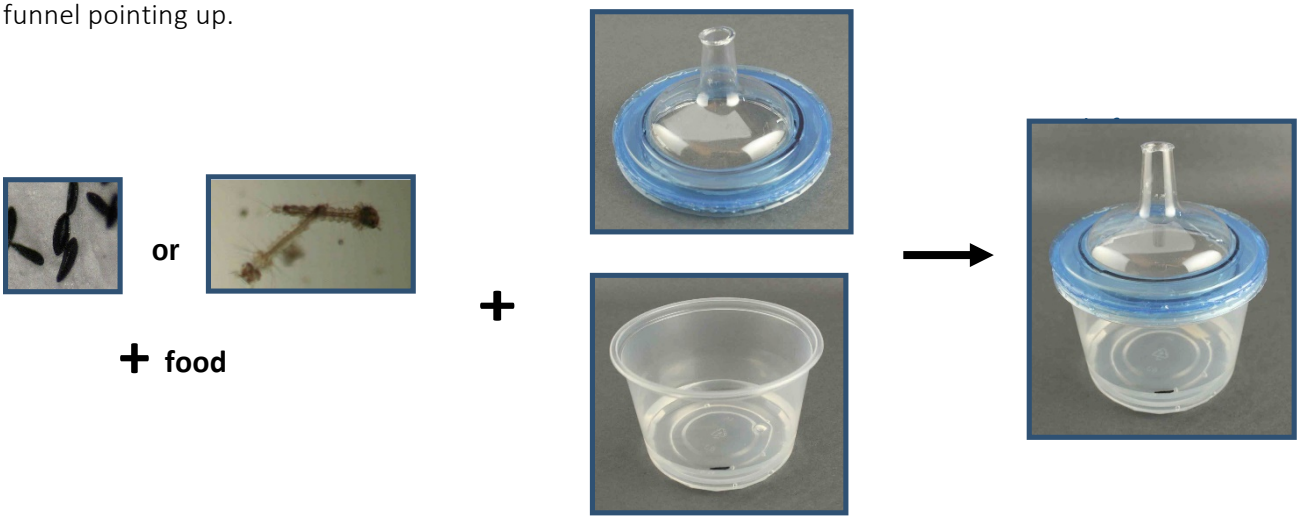
## MATERIALS

- **Plastic emergence chamber:** The "mini mosquito breeder" (picture on the left) can be purchased from bioquip.com, or you can make your own (directions at the end of the document). Make sure that whatever you use closes tightly and has fine mesh to allow air in but will not allow mosquitoes to escape. The chamber consists of three pieces. The bottom container holds water for growing eggs through larvae to pupae. The top container has a mesh center to provide air and to contain adult mosquitoes after they emerge. The "funnel" piece connects to the two containers.
- **Mosquito eggs or larvae:** These can be collected in the wild or obtained from a supplier. In season, you may be able to collect larvae from ponds or other mosquito breeding areas. Carolina.com sells eggs of *Culex* species; eggs arrive moist and should be put into water immediately. Some eggs may even hatch during shipping.
- **Mosquito food:** Can be obtained from a supplier like Carolina.com.
- **Sugar cube:** Food for adult mosquitoes.
- Magnifying glass

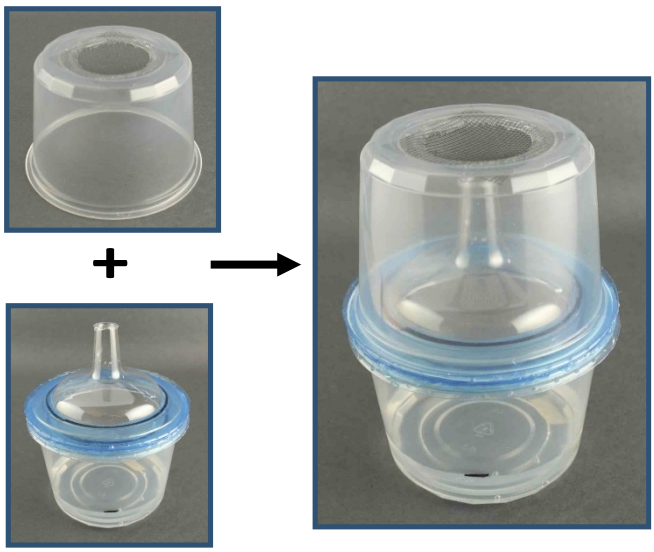
## PROCEDURE

### Assemble and Place Emergence Chamber

1. Place your emergence chamber where it can sit relatively undisturbed for up to 2 weeks. Avoid temperature extremes.
2. The day before you are ready to start the activity (Day 0), fill the bottom container with water to a depth of ½ to 1 inch. Let stand overnight to allow chlorine in the water to dissipate.
3. If you were able to obtain eggs, use a magnifying glass to count and record the number of eggs.
4. Place the eggs or larvae in the water in the bottom container. Add a small pinch of mosquito food. Swirl the water gently to moisten the food. Snap on the connecting funnel piece with the narrow end of the funnel pointing up.



## Record Your Results



- Students keep a record of daily observations, which should include the room temperature each day and the number of larvae, pupae, and adults. Eggs hatch into larvae in about 1–2 days. Larvae start to form pupae in 4–7 days.
- Since it is hard to see the larvae for the first 2 days, students should use the magnifying glass. Feed a small pinch of food on day 3.
- Before the first pupae appear, attach the upper container. Make sure the plastic pieces are snapped on securely. To prevent adult mosquitoes from escaping, do not remove the upper container after this point.
- Place the sugar cube onto the mesh. Adult mosquitoes will feed on the sugar cube.
- Adults will emerge 1–2 days after pupation. Determine the sex of the adults by using the magnifying glass to observe their antennae.
- After all the adults have emerged, put the whole emergence chamber in the freezer overnight. Freezing will anesthetize the adults, and death will follow. **Do not release live mosquitoes, whether purchased or collected.**

## Analyze Your Results

Students should complete the chart in their handout using the information gathered from their daily observations. Observation logs or charts can be included as part of the student handout as well.

## Conclusions and Implications

Students develop a claim to explain how a community could determine how large of a mosquito problem they may have and how they might slow or prevent the spread of mosquito-borne disease. Answers will vary but can be directed to include some of the following factors:

- Mosquitoes cannot successfully breed without standing water. The number of days it takes for a mosquito to develop from an egg to an adult is how long mosquitoes would need access to standing water. One of the most effective mosquito-control methods is to make aquatic habitat unavailable.
- The speed of mosquito development is influenced by temperature. Students might compare emergence rates to those of a tropical location, such as Nicaragua, where adult emergence occurs in about 12 days, to determine how temperature might indicate the prevalence of mosquitoes for a particular year/season.
- The emergence of males before females could be due to mosquitoes mating soon after emerging and ensuring that female attrition is minimized/breeding is maximized.
- Students can calculate the successful development rate of mosquitoes under favorable conditions and determine the attrition rate during larval and pupal stages by monitoring the numbers carefully in order to estimate how many mosquitoes might arise from a single female. These calculations can be used by communities to estimate how large of a mosquito population they might be dealing with.

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**Make Your Own Emergence Chamber**

1. Choose a plastic container that is about 4 to 5 inches in diameter, 3 to 4 inches deep, and comes with a plastic lid that can snap shut securely. Lightweight Ziploc® (pictured) containers work well. You need two for each complete chamber. You also need a disposable plastic champagne glass, a sheet of insect screen or other fine mesh, and hot glue or another flexible bond glue.
2. Cut a hole of 1 to 1.5 inches in diameter in the bottom of one container. Cut a piece of insect screen that will cover the hole with a bit of overlap, and glue the screen in place. Make sure there are no gaps where mosquitoes can escape.
3. Cut off the base of the champagne glass to make a plastic funnel. A hacksaw probably works best. The height of the glass should be at least 1 inch shorter than the depth of the plastic container.
4. Remove most of the center of the two plastic container lids. The diameter of the hole should be a little less than the lip of the champagne glass.
5. Glue the two lids back to back so that the side that snaps onto each container is facing outward. Fit and glue the funnel to the center hole.