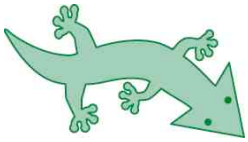
Mosquito Life Cycle Activity

CDC/ James Gathany

About This Activity

This activity complements the 2010 HHMI Holiday Lectures on Science—*Viral Outbreak: The Science of Emerging Disease.*

The activity takes 8 to 14 days to complete. You will need only a few minutes of observation each day, but you will need to make **daily** observations.



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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.

Understanding the mosquito life cycle is essential to effective pest control and disease prevention strategies. In this activity, you will rear mosquitoes, observe their progression through life stages, record how long it takes adults to emerge, and calculate the sex ratio.

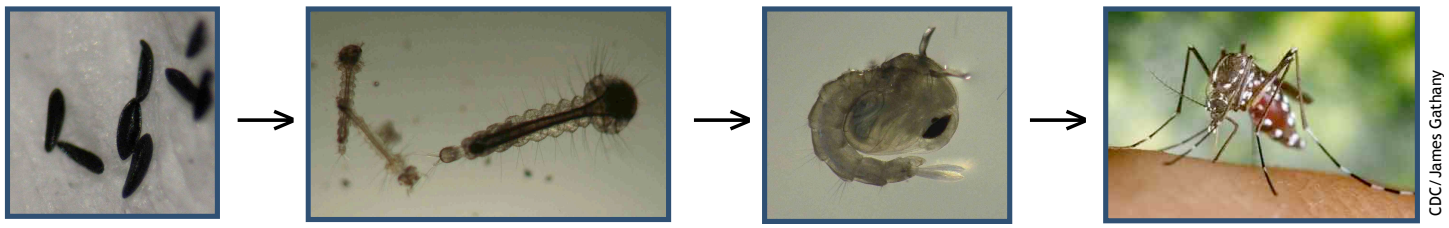
The Mosquito Life Cycle

Mosquitoes have a complex, multi-stage 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. Male antennae have a bushy appearance while female antennae appear sparsely branched.

Refer to the mosquito reference manual at www.BioInteractive.org/activities/mosquito for more information.

Eggs → Larvae → Pupa → Adult



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Aedes albopictus Life Cycle

What You Need

Plastic emergence chamber: Can be purchased from bioquip.com, the "mini mosquito breeder" (left) for about $10/unit, or you can make your own (below). 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: Collected in the wild or obtained from a supplier. Carolina.com sells eggs of *Culex* species. Eggs arrive moist, and should be put into water immediately. Some eggs may even hatch during shipping. In season, you may be able to collect larvae from ponds or other mosquito breeding areas.

Mosquito food: Can be obtained from a supplier like Carolina.com.

Sugar Cube: Food for adult mosquitoes.

Magnifying glass

Make Your Own Emergence Chamber

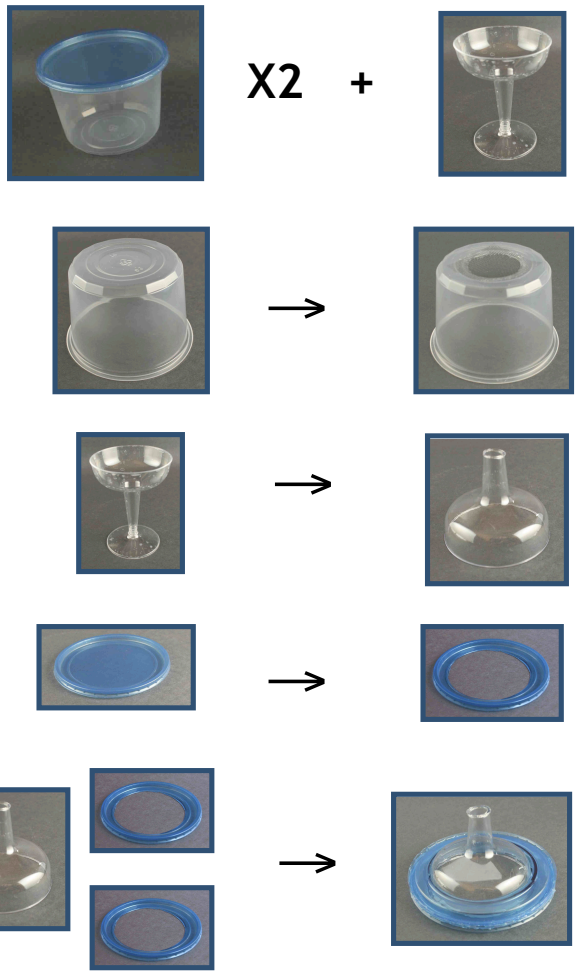
1. Choose a plastic container that is about 4 to 5 inches in diameter, 3 to 4 inches in depth, and comes with a plastic lid that can snap shut securely. Lightweight Ziploc® (pictured) containers work well. You need two for each complete chamber. You also need a disposable plastic champagne glass, a sheet 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 one 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 outwards. Fit and glue the funnel to the center hole.



Assemble and Place Emergence Chamber

1. Place your emergence chamber where it can sit relatively undisturbed for up to two weeks. Avoid temperature extremes.

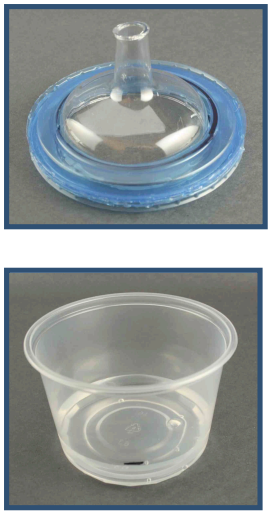
2. The day before you are ready to start the activity (Day 0), fill the bottom container with water to a depth of ½ to 1 inch. Let stand overnight to dissipate chlorine in the water.

3. If you were able to obtain eggs, use a magnifying glass to count and record the number of eggs.

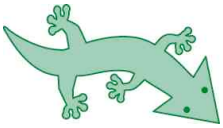
4. Place the eggs or larvae into the water in the bottom container. Add a small pinch of mosquito food. Swirl the water gently to moisten the food. Snap on the connecting funnel piece with the narrow end of the funnel pointing up.

+ food

+



End of Day 1



Record Your Results

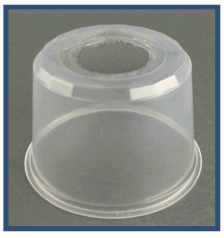
Keep a record of your daily observations. Record the room temperature each day. Every day, count the number of larvae, pupae, and adults. Eggs hatch into larvae in about 1–2 days. Larvae start to form pupae in 4–7 days. It is hard to see the larvae for the first 2 days, so use the magnifying glass. Feed 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.



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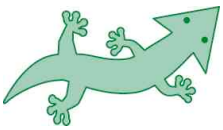

Male *Aedes albopictus* with bushy antennae

Female *Aedes albopictus* with less bushy antennae

Analyze Your Results

Data: Number of days until first adult emerged

Implication: One of the most effective mosquito control methods is to make aquatic habitat unavailable. If you started with eggs, then you can determine how long it takes for a mosquito to develop from an egg to an adult. This is an important number because if water is not left standing this number of days, mosquitoes cannot successfully breed. Even if you started with a moist egg shipment or with wild-caught larvae, you may still be able to estimate a number.

Data: Number of days until first adult emerged, Temperature

Implication: The speed of mosquito development is influenced by temperature. In tropical Nicaragua, adult emergence occurs in about 12 days. How long did it take your eggs to develop into adults?

Data: Number of days until first male emerged, Number of days until first female emerged

Implication: Mosquitoes mate soon after emerging. Test the hypothesis that, in order to compete for mating with females as soon as they emerge, males tend to emerge first.

Data: Number of eggs, number of larvae, total number of adults that emerged

What it means: Using these numbers, you can calculate the successful development rate of mosquitoes under favorable conditions. Even if you started with larvae, you can still determine the attrition rate during larval and pupal stages by monitoring the numbers carefully. If you can find out how many eggs a single female lays in her lifetime, then you can calculate the potential number of mosquitoes that can arise out of a single female.

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As part of its mission to strengthen science education, HHMI presents the Holiday Lectures on Science, an annual series that brings the latest developments in a rapidly moving field of research into the classroom. The lectures are given by HHMI investigators and other leading scientists. The 2010 Holiday Lectures, *Viral Outbreak: The Science of Emerging Disease*, are the eighteenth in the series, which began in 1993.

To complement the Holiday Lectures and enhance their usefulness in the classroom, HHMI produces a variety of free science education materials. Lecture summaries, biographies of the lecturers, and other resources are at www.holidaylectures.org. DVDs and CD-ROMs can be ordered through HHMI's Catalog at http://catalog.hhmi.org.

The BioInteractive website (www.BioInteractive.org) features virtual labs, animations, and other engaging instructional materials. They can be used to supplement the lecture topics or to learn important concepts in the biomedical sciences.

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