Mosquitoes in Your Backyard

Experiments on Mosquito Development and Ecology

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Dr. Martha Reiskind's lesson plans: burfordreiskind.com/outreach/lessons/
Mosquito Outreach: vectorecology.org/outreach/ & Research vectorecology.org/research/

Introduction:

The mosquito is a fun and interesting model organism for teaching about life cycles, ecology, and disease transmission - like butterflies, with a twist. In this lesson plan, students will learn about mosquito development from egg to adult and will utilize the scientific method to learn how different environmental conditions influence mosquito survival. Students will participate in a group discussion to design class experiments, raise microcosms of mosquitoes under different conditions, record and present their findings, and then extend what they have learned to real-life situations and current events. NC Essential Standards: 8.L.1, 8.L.2, 8.L.3

Learning objectives:

1. **Describe** the mosquito life cycle
2. **Apply** the scientific method
3. **Interpret** scientific data and **evaluate** results
4. **Estimate** how environmental conditions influence animal populations

Appropriate grade level:

8th grade

Resources for students:

Scissors, worksheet, pen &/or pencil

Resources for educators:

36 empty water bottles for the entire class, clear tape, either cat/dog/fish food, measuring cup or graduated cylinder, water, mosquito eggs (sent from Reiskind lab at NC State), blackboard, computer & video projector. *Optional: glue gun, organza or tulle, cotton balls, sugar*

Websites:

- Mosquito life cycle https://www.youtube.com/watch?v=VmgoeleVhao
- Rearing container instructional video
- Pandemics & Epidemics https://www.youtube.com/watch?v=CUl87kYHT3I
- Increased West Nile virus cases in California http://www.latimes.com/local/lanow/la-me-ln-california-drought-mosquito-activity-20150408-story.html
- Drought means more mosquitoes http://news.yahoo.com/video/drought-means-more-mosquitoes-central-023300402.html

Appendix:

- Mosquitoes in your Backyard Data Collection Sheet
- Mosquitoes in your backyard assessment

Lesson Activities Overview:

Students will form six groups of 3 to 5; Indoor activity; Two 50 minute class periods spaced 1 week apart, plus 5 minutes per class in between

Lesson Activity

Engagement

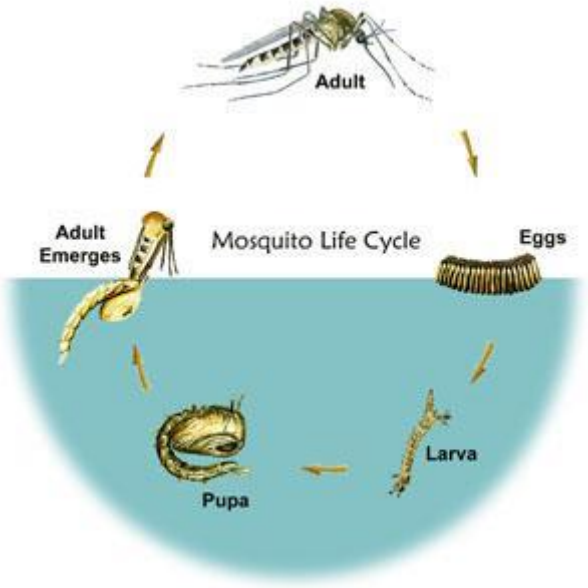
First full class period

Class period goals:
- *Introduce the mosquito life cycle*
- *Choose two variables to test experimentally*
- *Build mosquito rearing containers and start experiment*

This lesson plan will use the Asian tiger mosquito (*Aedes albopictus*) as a model organism. This is a container-breeding mosquito, meaning it breeds in small, water holding containers like discarded tires and litter. These mosquitoes are very common throughout the southern United States and typically occur near human habitation, although they bloodfeed on both humans and animals.

Start the class with a short video on the mosquito life cycle (sound can be low or off):
https://www.youtube.com/watch?v=VmgoeleVhao

Pause shortly after starting the video, about 15 seconds in. Ask the class what they think they are watching (video of mosquito larvae). Continue video, and either throughout the video or after the video is over, summarize the mosquito life cycle for the class:



Pose the following questions to the class to have a short class discussion:

-What do mosquito larvae eat?

Mosquitoes eat bacteria, algae, and other microorganisms, as well as fine organic particles

-What environmental conditions do you think can affect larval development and survival in nature?

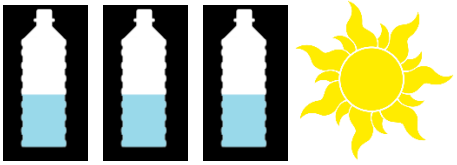
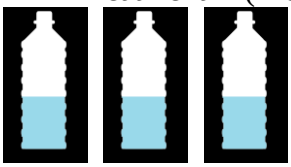
During the discussion, steer students into discussing some of the following factors as those that can influence mosquitoes:

- Mosquito species
    - Different species develop at different rates
- Water type and amount
    - Water type can determine habitat suitability (some mosquitoes like dirty water, some prefer clean), food availability (the presence of leaves and other vegetation can add nutrients and bacteria, on which mosquito larvae feed)
- Food type and amount
- Temperature
    - Hotter temperature speed up development, while cooler temperatures slow development

The class will conduct two experiments that measure the influence of two different **variables** on mosquito development. Break the class into six groups of three to five students. Three of the groups will test the first variable, and the other three groups will test the second variable. Based on the class discussion, the instructor/students will work together to pick two of the following variables to test in an experiment:

- Water level
- Amount of food
- Temperature

Each of the variables will be tested at three different **treatment levels:** high, medium, and low. So, each group will create three replicates for one treatment level. See the table below to see how the class will be broken up:

Variable #1 (ex. Water level)	Variable #2 (ex. Temperature)
Group 1A – Treatment I (High) 	Group 2A – Treatment I (High)  In hot, sunny corner of room
Group 1B – Treatment II (Medium) 	Group 2B – Treatment II (Medium)  Room temperature, out of direct sunlight
Group 1C – Treatment III (Low) 	Group 2C – Treatment III (Low)  Under air conditioner or in refrigerator

Exploration

Ask each group fill out a worksheet in which they hypothesize how their variable will influence mosquito development (see appendix 1).

Each group will make three rearing containers (three replicates). A video on how to make a container can be viewed here. Mosquito eggs can be provided by request from the Reiskind lab at NC State University (kahopper@ncsu.edu).

Daily 5 minute mosquito observations

On a daily basis, students will take five minutes out of class (or after class) to record observations of their rearing containers and record their observations in a worksheet (see appendix 1). Number of larvae, number of pupae, number of adults, plus qualitative information (ex. Larvae are bigger than yesterday, sluggish, tiny, dead larvae, etc.).

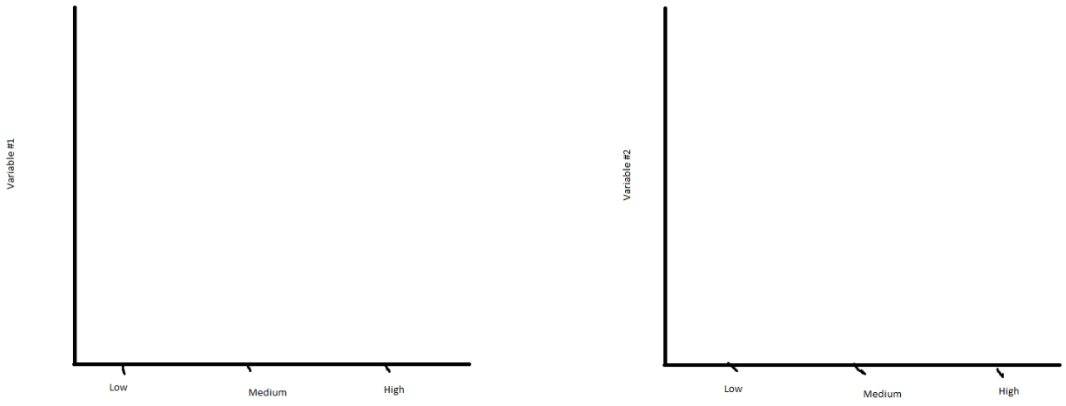
Second full class period

Class period goals:
- *Calculate averages of final data count*
- *Create two charts on board and plot student data*
- *Discuss results with students; ask for their interpretations*
- *Introduce concepts of pandemic/epidemic*
- *Assign mosquito control & global thinking assessment*

After 5-7 days, students will take a final count of their data. In class students will focus on the number of adults that had emerged in the container during the final count. Optionally, on their own, students can also create line graphs of the average number of larvae, pupae, and adults in containers over time.

Students will average their three replicates. Write each group's data on the board.

Draw two charts on the board:



Ask students to assist with filling out charts. Based on the data, choose an appropriate scale and plot the averages in the chart.

Lead a class discussion about the results of the experiment. A few question to discuss include:

-What are the results?
-Do the results match your original hypotheses?
-Did the results make sense?
-What explains the patterns we see?

-How could results be confounded, or what flaws are there in the experimental design?
-What qualitative observations may explain patterns observed?

Explanation & Elaboration

Mosquito development and survival are heavily influenced by environmental factors. Even though your class studied mosquitoes in a small rearing containers, environmental conditions can influence mosquito populations on regional and global scales.

After discussing the class's experimental data, introduce a global thinking approach about how large scale conditions (like climate) can influence mosquito populations, and extend this to the concepts of an **epidemic** and **pandemic**. The terms epidemic and pandemic usually refer to the rate of infection, the area that is affected or both.

Epidemic

An epidemic is defined as an illness or health-related issue that is showing up in more cases than would normally be expected.

Pandemic

In the case of a pandemic, even more of the population is affected than in an epidemic. A pandemic typically is in a widespread area rather than being confined to a particular location or region.

This is a great explanation of epidemics, outbreaks, and pandemics:
https://www.youtube.com/watch?v=CUl87kYHT3I

Extend the concepts of an epidemic and pandemic to mosquito-borne disease. What environmental conditions could cause an epidemic? A pandemic? Based on the mosquito life cycle and its biology, what may be some ways to control mosquitoes and reduce/prevent vector-borne disease outbreaks?

If desired (and time allowing) extend this concept to current events. The drought in California is *increasing* the number of West Nile virus cases this year, even though mosquitoes develop in water. Students can be assigned to read this article: http://www.latimes.com/local/lanow/la-me-ln-california-drought-mosquito-activity-20150408-story.html or watch this video: http://news.yahoo.com/video/drought-means-more-mosquitoes-central-023300402.html.
Why might a drought *increase* the number of mosquitoes and mosquito-borne disease cases?

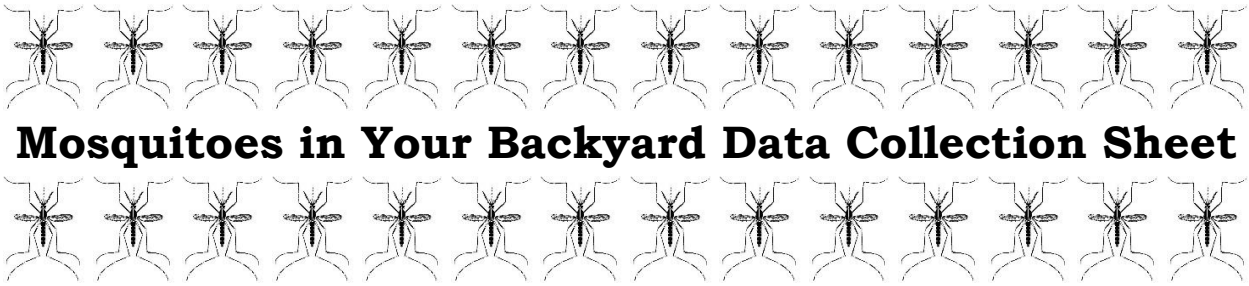
Educator Assessment

1. Was this an effective tool for you?

2. Do you believe it helped you achieve the objectives stated and did it in fact allow you to cover the NC essential standards stated?

3. Please provide any feedback for what did and did not work.

Appendix 1.



Mosquitoes in Your Backyard Data Collection Sheet

Group Member Names:

Variable being tested:

Treatment level (circle one):

High Medium Low

Hypothesis:

Date:	
Number larvae 	
Number pupae 	
Number adults 	

Observations:

Date:	
Number larvae 	
Number pupae 	
Number adults 	

Observations:

Date:	
Number larvae 	
Number pupae 	
Number adults 	

Observations:

Date:	
Number larvae 	
Number pupae 	
Number adults 	

Observations:

Date:	
Number larvae 	
Number pupae 	
Number adults 	

Observations:

FINAL COUNT	
Number larvae 	
Number pupae 	
Number adults 	

FINAL OBSERVATIONS