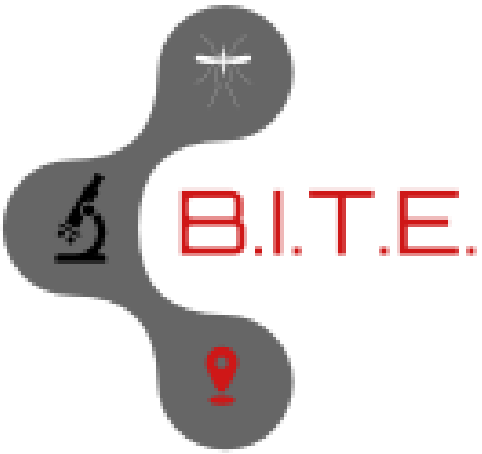
PROGRAM MANUAL



Biology Investigations using Technology and Engineering

THE BITE MANUAL

SECTION 1 – PROGRAM OVERVIEW

WHY DOES THE BITE PROGRAM MATTER?

Mosquitoes transmit some of the deadliest diseases globally (e.g., malaria), and are responsible for the spread of many new and emerging infectious pathogens in human populations worldwide and in the US (e.g., Zika, Dengue and Chikungunya viruses). Thus, mosquito control remains one of the most important public health challenges especially in urban areas. The control of mosquito populations is particularly critical for Atlanta, a city that has the dubious distinction of topping Orkin's list of Top 50 Mosquito Cities for past four years. It has long been recognized that environmental hygiene and sanitation are the foundation for successful and sustainable mosquito control in urban environments. It has also been recognized that the broad adoption of good practices related to hygiene and sanitation require the active participation of local communities. We propose that empowered children can be the most effective catalysts of change in their own communities. Thus, educating students in the broader public health issues related to mosquito control and actively engaging them in mosquito monitoring and control programs can bring about rapid and lasting social change to support ongoing mosquito control efforts by local communities, as well as Federal, State and Local government agencies.

CITIZEN SCIENCE

What is Citizen Science?

The term "Citizen Science" has had several definitions over the years. For the purposes of this project we will define it as scientific work undertaken by members of the public, often in collaboration with or under the direction of professional scientists and scientific institutions. This collaborative work can be related to data collection, data analysis, and decision making.

How can Citizen Science help researchers?

Obtaining data on mosquito abundance at fine spatial (e.g., neighborhood) and temporal (e.g., weekly) scales is a critical need for local communities and mosquito control authorities. Students can help by monitoring mosquitoes in their own school grounds, backyards and neighborhoods using established methods (e.g., mosquito oviposition traps) and/or novel techniques developed by the students themselves (see below). The student-collected data will be uploaded to a centralized database which will be used to map spatial and seasonal mosquito dynamics in Atlanta.

What role do schools play in citizen science?

We believe that schools should play a vital role in Citizen Science (CS). Schools provide a structured environment in which students are introduced to the scientific principles and practices needed for effective CS. By engaging students in CS projects schools bring relevance to the classroom environment and enable students to visualize the impact of their individual contribution to the world. Furthermore, in many communities, students are the bridge between their families and current scientific inquiry. The best way that we can keep families current and active is through their children.

What impacts do we expect from BITE?

The BITE program is expected to positively impact both students and their communities. These benefits include:

- Empowerment: We believe that empowered kids are potent agents of social change at local and global scales. Thus, the first step towards effective and sustainable mosquito control depends on empowering kids with the knowledge of mosquito biology, the public health implications of mosquito-borne diseases and mosquito control strategies.
- Innovation: There is a critical need for the development of innovative, effective, low cost and sustainable technologies for improved mosquito control in urban areas. We hope to harness the innate curiosity, creativity and "out-of-the-box" thinking characteristic of the young mind, and help them develop these ideas into working models.
- Outreach: The youth of today live within a highly connected global village, and can thus efficiently leverage social networks to enhance public outreach programs. Students enrolled in this project will produce novel outreach material in the form of posters, fliers and short videos to spread information on mosquito control actions that can be undertaken by individuals and communities. These media can be broadcasted through the school system (e.g., parent-teacher organizations and science fairs), community-based organizations (e.g., neighborhood groups), public media (e.g., television and YouTube) and social media (e.g., Facebook, Instagram and Twitter)

What is our long-term vision?

Our long-term vision is to continue to expand the network of schools participating in BITE so as to create a city-wide mosquito index for the media similar to a pollen index and UV index to keep the public better informed about public health risks in their locality. In order to do this the student-collected data will be validated with independent data collected from 30 sites across the city by SREL personnel using established "gold-standard" methodologies. These validated data will then be translated into spatio-temporal maps that can be easily interpreted by the public. These maps and data will be made freely accessible to the public and public health professionals to aid in planning strategic mosquito control activities.

PARTNERSHIP WITH BITE

The BITE Program is currently seeking new partners in science. Partnership is free and occurs on a rolling basis.

There are currently have three different participation paths the schools and organizations can engage in.

- Field Technician- Monitor mosquito populations through data collection.
- Material Innovator- Design a better mosquito trap for scientists to use.
- Digital Innovator- Use emerging technology to create a digital mosquito map and BITE Index.

Visit our website for more information and to access our online partnership form at https://eduhanced.com/bite-program.

SECTION 2 – THE TEAM

PARTNER INSTITUTIONS

Tucker Middle School, is a Title I school whose mission is to develop independent thinkers who are conscientious, compassionate, and embrace the diversity of the world around them. The state-certified STEM program at TMS exposes students to new STEM careers, equips them with the skills needed to advance in these careers, and engages students in solving real world problems through collaboration with local community partners.

The University of Georgia, a land-grant and sea-grant university with statewide commitments and responsibilities, is the state's oldest, most comprehensive, and most diversified institution of higher education. The Savannah River Ecology Laboratory, a research unit of the University of Georgia, pursues basic and applied research at multiple levels of ecological organization, from atoms to ecosystems. Established in 1951 by Prof. Eugene Odum, the "father of modern ecology", SREL is located on the Savannah River Site – a Department of Energy facility, and the first national environmental research park. The research at SREL primarily focuses on environmental stewardship and the preservation of sustainable ecosystems at local, regional and global scales.

THE TEAM

Eric Knapp, is the STEM Education Coordinator at Tucker Middle School. He believes that the key to education is collaboration between classrooms, communities, and corporations. His students have won several awards in robotics, engineering, and environmental sustainability. Additionally, he is a Northrop Grumman Teacher Fellow, ITEEA Program of Excellence recipient, and STEM education speaker. He is the founder of Education Enhanced and is passionate about discovering symbiosis within K-12 education.

Pacifico J. Perea, is the Outreach Program Manager, at SREL. Pacifico develops and maintains the strategic plan for SREL Outreach programs, provides guidance and supervision for SREL outreach and public relations personnel, assists with the delivery of SREL outreach and public relations content, including social media, and serves on the SREL management team.

Guha Dharmarajan, is a scientist at SREL. Guha's research focuses on the ecological and evolutionary dynamics of disease in natural populations. His research program uses both empirical field-based research and theoretical modeling to improve our understanding of, and thus ability to control, disease in human and animal populations. Originally from India, Guha obtained his PhD in 2008 from Purdue University. He then worked as a post-doctoral researcher at Purdue and the National Institutes of Health, and subsequently joined as a faculty at the Indian Institute of Science Education and Research Kolkata, India. Guha joined SREL in 2016.

SECTION 3: BITE ACTIVITY SCHEET

Using ovitraps is a simple and effective method for monitoring mosquito populations

MATERIALS:

1. Oviposition cups: Black stadium cups (16 oz.)[a]. Alternatives: Any small dark colored container that is taller than wide can be used (e.g., Coke Zero bottles with the top 1/3rd cut off).
2. Ovipaddle: 6" craft sticks[b]. Alternatives: Tongue depressors and/or popsicle sticks
3. Ovipaper: 8" unbleached paper towel
4. Water: Regular tap water will work. To de-chlorinate the water collect the tap water and allow it to aerate for several days before the experiment. Optional: Improved performance can be obtained by using a hay infusion (see link to a paper below if you are curious[c]).

FIELD METHODS:

1. Preparing the ovicup: Take the cup and carefully drill a quarter inch hole 2/3rd of the way up from the bottom. This hole is to prevent the cup from overfilling with water.
2. Preparing the ovipaddle: Cut a section of the paper towel and fold in half. Wrap the towel around the craft stick. Secure the top and the bottom with office staples.
3. Select a good shady spot and mark the location of the spot on a map of the school ground. Ensure you don't forget where you put your trap (or you will be contributing to the mosquito problem!). Optional: What happens if the trap is left in the sun? DO you get more or less mosquitoes laying eggs?
4. If the ground is uneven you may need to secure it so it does not fall over using a stone on the bottom or wiring it to a tree.
5. With a permanent marker, label the top of the ovipaddle with your initials, location information and date
6. Check on the water levels in the cups once a day. If the water is below the hole, refill water to the 2/3rd level. If by any chance the cup has filled with water, carefully drain the water (ensure you do not lose any eggs that may be in the container). Allow the cup to remain in the same location for 1 week.
7. After a week the ovipaddles can be collected and replaced with a new paddle. Take the old paddle back to the lab to count the eggs (see below).

LAB METHODS:

1. Count the eggs on the ovipaddle in the lab
2. Counting can be done with a magnifying glass or under a microscope. If you have a high quality digital camera, you can also take a picture of the ovipaddle and count the eggs on the computer.
3. Make sure you examine both sides of the ovipaddle for eggs

[a] Ovicup: An example of an stadium cup that can be used is here: https://www.amazon.com/CSBD-Blank-Plastic-Stadium-Tumblers/dp/B073WHN2RP/ref=pd_yo_rr_bia_t_8?_encoding=UTF8&psc=1&refRID=WA58KHWHB3G6QMC2GWVW

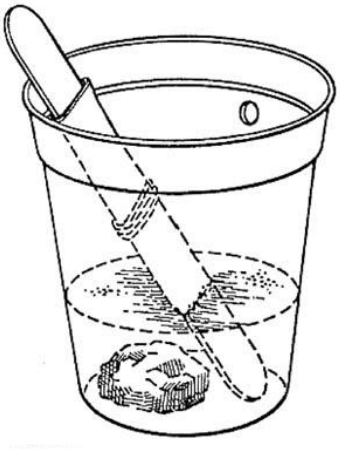
[b] Popsicle sticks: AN example of craft stick that can be used is here: https://www.amazon.com/gp/product/B001VDKHNO/ref=oh_aui_detailpage_007_s01?ie=UTF8&psc=1

[c] A paper about hay infusions can be found here: http://onlinelibrary.wiley.com/doi/10.1111/j.1948-7134.2010.00086.x/pdf

SAFETY

- To avoid contact with the egg-laying mosquitoes, protect yourself from mosquito bites
- Use insect repellents (such as DEET or oil of lemon eucalyptus)
- Wear long-sleeved shirts and long pants.
- Try to time your field activities for times when mosquitoes are less active. *Aedes* mosquitoes are active throughout the day. However, there is reduced activity in the middle of the afternoon, especially when it is hot outside.
- More information on protecting yourself from mosquitoes can be found at: https://www.cdc.gov/zika/prevention/prevent-mosquito-bites.html

OVITRAP PHOTOS



1. A diagram of a constructed ovitrap.
2. This is a picture of the ovipaddle after use. Note the black "specks" which are egg clusters.
3. This is a close-up of the ovipaddle. Note the egg clusters, especially on the dimples of the paper towel.

Courtesy of Timothy D. DeSchamps, Executive Director Central Mass. Mosquito Control Project
111 Otis Street Northborough, Massachusetts 01532. http://www.cmmcp.org/2005ovitrap.htm

DATA ENTRY/UPLOAD

Once the eggs have been counted students should upload these numbers using the BITE Data Upload Form on the website or by using the following link:
https://goo.gl/forms/5Wsw5iGew1IVglDW2

WHAT ROLE CAN STUDENTS PLAY?

Field Technician: Monitor mosquito populations through data collection and field work. Using the field methods above, students should commit to monitoring traps for a 6+/- week period and uploading data via the BITE website.

Material Innovator: Design a better mosquito trap for citizen scientists to use with the BITE program. Designs should be effective, sustainable, and affordable. New designs should be compared to the ovitrap described in the program manual and designs submitted to BITE program for evaluation.

Digital Innovator: Use emerging technology to create a digital mosquito map and BITE Index. Participants interested in this path should contact BITE in order to get access to the data base and discuss mapping methods.

SECTION 4: TEACHER NOTES

CONTACT US

This project is always open to feedback from participants. Please reach out and let us know what you like or how we can help. If you have new ideas for the program don't keep them to yourself, let's find a way to bring them to life.

For mosquito and research methods related feedback contact Guha Dharmarajan.

Guha Dharmarajan, Ph.D., Assistant Research Scientist, Savannah River Ecology Lab:: Phone: 803-725-3241; Email: guha@uga.edu

For classroom implementation and resources related feedback contact Eric Knapp.

Eric Knapp, STEM Education Consultant, Education Enhanced: Phone: 828-507-6817; Email: Eric@eduhanced.com

DATA COLLECTION

What is data?

Data are numbers, words or images that have yet to be organized or analyzed to answer a specific question. For example, the number of eggs on a single ovipaddle are data.

Importance of data collection

Data is important because when it is processed correctly it becomes information. Thus, if you collect data on the number of eggs on ovipaddles for a whole year and analyze the data, you can obtain the information that the number of eggs peaks at a certain time of the year. This information can be interpreted directly to improve our knowledge. For example, the information that mosquito number peak at a certain time of the year gives us the knowledge that risk of mosquito borne-disease is likely to highest at that time of year. Information from multiple sources can also be gathered together to improve our knowledge further. For example, if we combine the information on egg numbers with temperature or rainfall data, we improve our knowledge of the factors that could affect mosquito numbers in an area. This knowledge is critical in helping to reduce our exposure to mosquito-borne diseases. Science is a formal way of collecting good data to produce information and thus improve our knowledge.

What is good data?

Good data has two main characteristics: it is precise and it is true (see figure on the right). For example, when counting eggs on the ovipaddle: if you don't count the eggs carefully and make repeated counts of the eggs, you will get highly variable data. This type of data has poor precision. However, even if you count the eggs very precisely, but you always only count one side of the paddle, your counts will be very precise but will always be lower than the actual number of eggs. This, type of data is precise but not true. For good accuracy we need to ensure data is both precise and true.

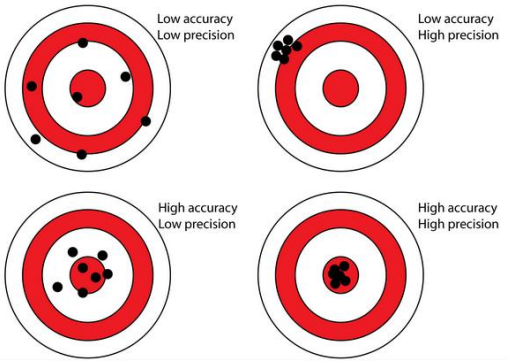


Image from: Researchgate.net

PROJECT EXTENSIONS

Aside from engaging in the three participation paths we encourage classrooms to expand the data collection efforts by allowing students to collect their own data at home. Students can continue to report data using the BITE Data Upload Form but will need to include approximate addresses for additional collection sites in the collection notes.

Another extension of this project is for students to create an informational media campaign to inform families and communities about mosquito-borne illness and prevention. This can be a brochure, PSA, video, or poster. Please share anything that your students create so we can display their work on our website!

ADDITIONAL RESOURCES

Mosquito Resources

- www.orkin.com/press-room/orkin-releases-top-50-mosquito-cities-list/
- https://www.cdc.gov/zika/prevention/prevent-mosquito-bites.html
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Citizen Science Resources

- http://www.citizensciencecenter.com/about-citizen-science/
- https://www.nationalgeographic.org/idea/citizen-science-projects/
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