

2018 Grants: UK4H

4-H Cockroach Program

Concept Statement: The 4-H Cockroach Program uses live insects and hands-on labs to teach STEM topics including Anatomy/Physiology, Physics, Evolution, and Ecology to Middle School youth.

Concept Description: The 4-H Cockroach program includes monthly hands-on science labs for the 618 youth (6th-8th grade) at Breckinridge County Middle School in collaboration with the local 4-H Youth Development program. In addition, each science classroom hosts a hissing cockroach colony. The teachers and youth care for their colony and use their cockroaches during each month's lab. Lab topics range from anatomy/physiology, to Evolution and Ecology. The 2017 post-surveys indicated a lack of understanding of stimuli and Neurobiology. We aim to expand the program to include Neuroscience lessons in 2018 using the Hissing Cockroaches as an insect model. This would provide students a hands-on opportunity to see action potentials in real time. The program incorporates STEM related careers and real life problem solving. Our goals include the development of STEM knowledge and skills among Middle School youth, increased interest in Entomological related professions, and increased confidence of Middle School youth in pursuing higher education and STEM careers. Additionally, we aim to instill a passion for learning and Entomology while increasing youth's confidence interacting with live insects.

Project Goals and Objectives: The 4-H Cockroach program includes monthly hands-on science labs centered around the Madagascar Hissing Cockroach. The program follows Next Generation Science Standards and incorporates problem solving, teamwork,

communications / presentations, and STEM careers connections. In addition, the science classes take care of the hissing cockroach colonies throughout the school year. The goals of the program include the following: 1) youth gain a better understanding of Entomology and STEM content, 2) youth develop skills related to Entomology and STEM, 3) youth develop confidence in pursuing higher education, advanced STEM classes, and STEM related careers including Entomology, and 4) youth develop confidence handling and interacting with live insects. The KY 4-H Standard Evaluations / Surveys will be used to indicate any changes in STEM and Entomological knowledge, skill development, or behavior over the course of the 2018-2019 school year. The following are examples of labs created or adapted for the Mystery of the Madagascar Hissing Cockroach program:

1. Cockroach Races Lab: Students race the hissing cockroaches on race tracks constructed from pool noodles. Lab groups must calculate the velocity of the cockroach and determine the point on the track where the insect has the greatest potential and kinetic energy. Students must also calculate the chemical energy (e.g. number of food calories) burned by the racing cockroaches and discuss a cockroach's nutritional needs.
2. The Mystery of the Musical Menace: Using knowledge about the relationship between frequency, wavelength, and musical notes, youth must determine the frequency of different hissing cockroach suspects as well as different musical instruments. Matching sound frequencies to those recorded at the crime scene, students identify the musical menace.
3. Cockroach Cold Case Files: Students must solve a 20,000 year old crime: Which cockroach criminal (now fossilized) stole Carl Cockroach's beloved jar of peanut butter? Students use evidence in

the fossil record, the law of superposition, carbon dating, and physical evidence left at the crime scene to narrow down the suspects.

4. Insecticide Resistance Lab: Students learn how insecticides and evolution can change a population of cockroaches. In this lab, students are insecticide resistant or non-resistant cockroaches and silly string represents insecticide sprays. Youth must track the cockroach population over time, graph the population, and look for trends.
5. Colony Dissection: Students learn about cooperation and the roles insects play in a colony as well as symbiotic relationships with other insects. In addition to observing the cockroach colonies and the relationship they have with mites, students also dissect mud dauber nests and identify prey and parasites found in the nests.
6. Nitrogen Cycle Lab: This lab is adapted from the Nitrogen Cycle passport activity created by UCAR and NESTA in 2007. In the adaptation, students travel through the nitrogen cycle as an atom of nitrogen and see the importance of bacteria in the gut of a cockroach on the cycling of nitrogen.
7. Insect Dissection Lab: By dissecting a preserved hissing cockroach and comparing it to human anatomy, students learn how structure and function are different or similar among insects and humans.
8. Carbon Cycle Lab: Adapted from Project Wet, students travel through the carbon cycle as a molecule of carbon. Reservoirs of carbon include living animals such as hissing cockroaches. Students see the importance of decomposers such as cockroaches in cycling this important element.
9. NEW Neuroscience Lab: Students learn about the insect nervous system and measure the action potentials of hissing cockroaches. Students compare/contrast their results with those of other insects, as well as, human data.
10. Scientific Method: Students develop their own scientific questions and carry out an experiment with the hissing cockroaches. This includes collecting data and sharing the results with the class. In

this lab, youth gain experience problem solving and communicating their scientific findings.

Project Budget: In total, the program is requesting \$494 to support and expand the 4-H Hissing Cockroach Program for Middle School youth. The expenses include items for colony maintenance, as well as, the Neuroscience lesson. Below are details regarding the budget: In order to have live insects for the educational labs, the following items are needed to maintain the colony of hissing cockroaches:

1. Bags of loose fiber bedding for the tanks (8 quarts), quantity = 4, Expense = \$40
2. Logs for the tank, quantity = 4, Expense = \$32
3. Vaseline, quantity = 4 containers, Expense = In Kind Donation
4. Sponges, quantity = 4, Expense = In Kind Donation
5. Water Dishes (Petri Dishes), quantity = 4, Expense = In Kind Donation
6. Tank, quantity = 4, Expense = In Kind Donation
7. Heat Lamp, quantity = 2, Expense = \$32

The following items are required for the Neuroscience lab with the Hissing Cockroaches:

1. Spiker Box Bundle Kits, quantity = 3, Expense = \$390
2. Batteries, quantity = 1 pack, In Kind Donation
3. Alligator Clips, quantity = 1 pack, In Kind Donation

2018 Funding: Requested amount \$494. Partially funded at \$458

Entomological Foundation 2018 Micro Grant Report

Grant Awarded: 4-H Cockroach Program (\$465)

Contact: Alexandria Bryant, Breckinridge County Extension Agent for 4-H Youth Development Education

Organization: Breckinridge County 4-H Council, 1377 S Hwy 261 Hardinsburg, KY 40143

Project Report

During the 2018-2019 school year, the 4-H Cockroach program included monthly hands-on science labs for the 618 youth (6th-8th grade) at the Breckinridge County Middle School in collaboration with the local 4-H Youth Development program. In addition, each science classroom hosted a hissing cockroach colony. The teachers and youth cared for their colony and used their cockroaches during each month's lab. Lab topics ranged from anatomy/physiology, to Evolution and Ecology. Thanks to the generous funding from the Entomological Foundation micro grant, all the science classrooms were able to continue hosting and maintaining hissing cockroach colonies in 2019, with much needed supplies (e.g. bags of loose fiber bedding, logs, and heat lamps) and expanding colonies. The funding also provided a brand NEW science lab experience for the 192 8th grade youth. The NEW Neuroscience lab allowed students to learn about the insect nervous system and measured the action potentials of hissing cockroaches using the Spiker Box Bundle Kits and real cockroach legs. It was an exciting way to teach youth about neurons and signaling in the insect nervous system, while exploring how real-life scientists use this information for Entomological research and human research. We explored topics ranging from insecticide resistance to human medical implications. The program incorporated STEM related careers and real life problem solving. Our goals included the development of STEM knowledge and skills among Middle School youth, increased interest in Entomological related professions, and increased confidence of Middle School youth in pursuing higher education and STEM careers. Additionally, we aimed to instill a passion for learning and Entomology while increasing youth's confidence interacting with live insects. Following the NEW Neuroscience Lab, youth completed a Kentucky 4-H Standard post-survey. The evaluation indicated that 92% of the students gained a better understanding of neuroscience. The confidence of students were also enhanced with 85% of participants confident in their ability to plan and carry out a neuroscience experiment, 81% of youth were more comfortable handling and interacting with insects, and 67% of both male and female participants were confident in their ability to pursue a STEM related career in the future including Entomology. Behavioral changes have been observed with 75% of students participating in STEM activities outside of school and 92% making scientific observations in their daily life. This program has successfully introduced youth to Entomology and neuroscience, providing an impactful and memorable experience for the youth. We aim to incorporate the Neuroscience Lab every year into the 4-H Cockroach Program. This program would not have been possible without the generous micro grant from the Entomological Foundation.

Photos (See Following Pages)



