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Kaitlyn Yee

Loyola Marymount University

Maria Curley

Loyola Marymount University

Lisa Fimiani

Loyola Marymount University

Emily Simso

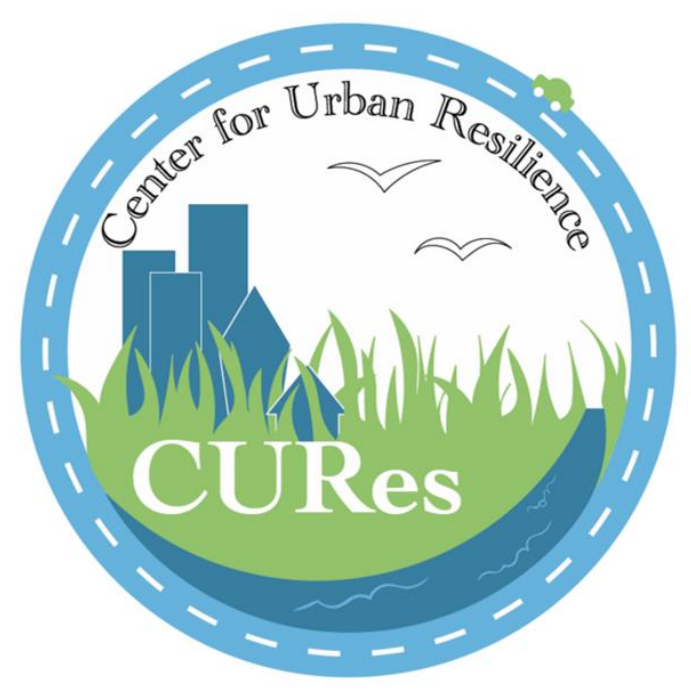
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INTEGRATION OF HUMMINGBIRD RESEARCH INTO PUBLIC SCHOOL SCIENCE

Kaitlyn Yee and Maria Curley; Lisa Fimiani, Emily Simso, Dr. P. Auger, Dr. E. Strauss
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Abstract

Hummingbirds are beautiful, acrobatic and mysterious synanthropes in urban ecosystems, providing important benefits to humans such as pollination, insectivory, and biophilia. However, environmental factors that affect behaviors that lead to such services are largely unknown, and could be altered by urbanization and climate change. Though their extremely high metabolism can make detailed observations of hummingbird behavior difficult, simple and low-cost methodologies, such as remote monitoring equipment deployed at feeders and nests, allow students at all levels of education to closely observe hummingbirds directly from their school sites. The Center for Urban Resilience (CUREs) and the Center for Equity for English Learners (CEEL) at Loyola Marymount University (LMU) have partnered, to implement CUREs urban ecology curricula Urban EcoLab in various Los Angeles area schools and classrooms. With support from the Daniel and Susan Gottlieb Foundation, internet protocol (IP) cameras have been installed as a key element in the curriculum that will allow participation in worldwide hummingbird research in the classroom. Beyond enriching the understanding of how animals thrive in urban environments, we propose to develop a model that will facilitate the investigation of complex scientific questions through collaboration with citizen science and integration of the Urban EcoLab curricula into primary and secondary-level public school curricula.

Introduction

Inquiry-Based Learning

- Model that encourages students to ask complex questions and solve them using a hands-on approach, with tools provided by an instructor.
- Students will formulate their own questions, make their own hypotheses, and then begin their research and observation.
- Inquiry-based learning allows students to not only 'learn', but also 'do' science.

Hummingbirds as a model for inquiry-based learning

- These synanthropes are often overlooked, but on closer inspection, students find them fascinating and begin to formulate all sorts of questions about them.
- Hummingbirds are common and easily observable from classrooms and school yards.
- Integrating field technology into classrooms will allow students to explore the physical and behavioral aspects of hummingbirds in an urban environment.

Resources provided to teachers

- Hummingbird feeders (for on-site investigations).
- Remote access to IP cameras deployed at 5 hummingbird feeders across the globe.

Sample Investigation Using the Inquiry Based Model

Question: What will the rate of resource depletion be at six hummingbird feeders deployed within the same general area?

Materials

- hummingbird feeders (6)
- window hangers
- pure cane sugar (white)
- milliliter measuring cups
- water
- data sheet

Controls

- sugar water solution
- feeder type
- feeder location remained constant
- frequency of solution changes (every 5th day)

Methods

- Fill each feeder with 400 mL of sugar-water solution every five days.
- Measure volume of solution remaining in each feeder before each refill.

Data Sheet

Resource Depletion Rates at Supplemental Hummingbird Feeder Sites near the LMU Research Annex						
Date	Volume of Solution in Each Feeder in mL					
	F1	F2	F3	F4	F5	F6
26-Jan-18	400	400	400	400	400	400
31-Jan-18	59.15	0	2	147.87	1	1
5-Feb-18	162.65	0.5	2	162.65	1	1
10-Feb-18	192.23	221.08	0.25	2	0.25	0.25
15-Feb-18	205	145	0.25	1	0.25	0.01
20-Feb-18	220	180	0	0.01	0	0

Observations

- Feeders 3, 5, & 6 had the greatest resource depletion rates.

Independent variables that could be affecting outcome

- location of feeders
- sun/shade exposure (effect on evaporation)
- proximity to flowers
- human foot traffic
- presence of other animals
- human activity near windows
- hummingbird species

Follow-up Research

- What effect do the various independent variables have on the resource depletion rate?



Male Allen's Hummingbird



Dr. Auger and Susan Gottlieb with the IP camera on the Gottlieb property.



Hummingbird feeder on the Gottlieb property

Progress

- The Ellen Ochoa Learning Center in Cudahy, California, taught the hummingbird module in the 2016-2017 academic year.
- Teachers who attended the Urban EcoLab workshops have been provided with curricula to facilitate investigations around hummingbird feeders and pollinator gardens which they already have been implementing at their school sites.
- The Los Angeles Unified School District (LAUSD) has continuous access to the Hummingbird Module and teachers have been facilitating investigations at their schools.

Future Plans

- CUREs will provide Urban EcoLab and LAUSD educators with remote access to IP cameras at hummingbird feeders.
- This sample investigation will also be shared with teachers as an example.

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