

CITIZEN SCIENCE

EVERYDAY OBSERVATIONS THAT COUNT

by Elizabeth Heubeck

“DURING ALL THESE YEARS THERE EXISTED WITHIN ME A TENDENCY TO FOLLOW NATURE IN HER WALKS.”

—JOHN JAMES AUDUBON

Long before there was a term for it, John James Audubon (1785-1851) practiced citizen science—research conducted by amateur scientists that can be as simple as recording the number of birds in one’s yard at a certain time of year, or noting the types of clouds that form before a rain storm.

Prior to the late 19th century, science was not considered a reasonable career option; therefore, intense observation of the natural world was pursued only as a hobby by curious individuals like Audubon. Famous for *Birds of America*, a revered collection of 435 life-size watercolor portraits of North American birds, Audubon is also considered a forefather of modern conservationism: He warned about the destruction of birds and their habitats.

Fast-forward to the 21st century, and citizen science has burgeoned into a popular activity undertaken by countless members of the general public, from young students to retirees. There are now thousands of citizen science projects in which millions of people participate.

At its core, citizen science remains an activity similar to that in which Audubon engaged. But today, rather than painstakingly drawing detailed observations as Audubon did, citizen scientists can record and submit their sightings using a few quick strokes of a finger via a Smartphone app. Further, today’s citizen scientists are often engaged in formal research endeavors initiated by professional scientists or research institutions rather than random observations based solely on personal interests. This modern twist on citizen science makes it dually beneficial: Citizen scientists get to make valuable contributions to “real” science, while researchers significantly increase the pool of data they can analyze.

Here we take a look at four active citizen science projects that explore an array of questions both scientists and citizens are pondering.

Rockiology

What would life beyond Earth be like? It's a question that Johns Hopkins astrobiologist Jocelyne DiRuggiero grapples with regularly.

She knows, for starters, that extraterrestrial life might have to tolerate extremely harsh environmental conditions, like those found in the Earth's hottest, driest deserts. She also knows that single-cell microbes, which have inhabited the Earth for over three billion years, sometimes colonize between the cracks in desert rocks here on Earth. That is why DiRuggiero, a biology professor in Hopkins' Departments of Biology and Earth and Planetary Sciences, is on a quest to collect as many microbe specimens as she can from dry, dusty remote places on our planet. These microbes, she explains, may teach us more about our own biosphere and how to better protect it from climate change. They may also offer hints about life beyond Earth. "These rocks are similar to those on Mars, and potentially to some outside of our solar system," DiRuggiero says.

Already, she and her colleagues have combed deserts around the world—including in South America, Africa, the Middle East, and Antarctica—searching for samples of these colonized rocks. They've been to the Atacama Desert, the driest nonpolar desert in the world. But they can't go everywhere. So she started Rockiology, a crowdsourcing citizen science project funded by the National Science Foundation, whose purpose is two-fold. "It's not just for us to get samples, but also to educate the public," DiRuggiero says.

The Rockiology website includes a detailed tutorial on how to spot desert rocks that have been colonized by microbes. People who find an interesting-looking specimen can participate in the project by putting the rock in a Zip-lock bag to prevent contamination, recording the GPS coordinates of the location, and photographing the rock. Dr. DiRuggiero asks people to submit the photos, and she will let them know if she wants them to send the rock itself. In her lab, DiRuggiero uses molecular methods to identify the microbes inhabiting them.



She's found eager participants like the Harlands, a family that lives in the small New Mexico town of Truth or Consequences. Darci Harland is a biology teacher by training who homeschools her two sons, Caleb, 10, and Corban, six. "We have amazing rock history here in New Mexico and my boys are naturally interested," says Harland, whose sons take pictures of their findings and send them electronically to DiRuggiero. "Rockiology was a good fit for us because we'd studied abiotic elements related to rocks but never learned about microbes growing inside rocks. So it was a new way to look at rocks that we see everyday," Harland says.

DiRuggiero says she's always been interested in extreme environments, which led her to study life in deserts. This project, she explains, is a natural extension of that intrigue. "I began to ask: 'What are the limits for life? What can this teach us about finding life elsewhere?'"

To learn more about Rockiology, visit bit.ly/2nsfKyq.



NASA GLOBE OBSERVER

View of southern portion of the United States at night

Globe at Night

Some of us step outside our door at night, look up at the sky, and see endless stars that appear close enough to touch. Others can barely make out anything other than the moon and a couple of the brighter planets, even on a clear night. Light pollution—artificial light from street lamps, etc.—is to blame for these less-than-starry skies.

Globe at Night, an international citizen science project, is raising public awareness of the impact of light pollution by inviting participants to measure and submit their observations about night sky brightness in their area via a smartphone or computer. With more than a half-million people participating since its inception in 2006, Globe at Night has proved an excellent way of involving citizen scientists from all over the world in this important educational and scientific endeavor.

Constance Walker, Ph.D., a scientist at the National Optical Astronomy Observatory who directs Globe at Night, explains the multiple purposes of the project. “Globe at Night allows people to monitor levels of light pollution around the world, as well as under-

stand light pollution’s effects on energy consumption, plants, wildlife, human health, and our ability to enjoy the night sky,” she says.

While many citizen scientists who participate in the project do so independently, group efforts have reaped some interesting results. Case in point: There are two national parks on either side of Tucson, Arizona. As Walker tells it, one night, a group of citizen scientists scattered strategically between the two parks—Boy Scouts in the western end, park rangers in the eastern end, and amateur astronomers and the general public on four major streets in between. “What resulted was a map of the night sky brightness that showed the city center was 100 times brighter than the eastern edge of the Rincon Mountains, where there is a pristinely dark night sky. 100 times—wow!” Walker says.

To learn more about Globe at Night, check out globeatnight.org and scistarter.com/p/globe-at-night. Find information on light pollution issues and solutions at the International Dark-Sky Association: darksky.org.

eBird

Just how much of an impact can citizens make on a science project? A whole lot! Consider the citizen science project eBird, launched in 2002 by the Cornell Lab of Ornithology. This sophisticated, data-driven project lets users explore bird sightings around the world and create individual bird lists, photos, and sounds—all while ultimately contributing to science and conservation efforts.

Though less than 20 years old, the project has already recorded data from every single country in the world, on almost every bird species. In 2017 alone, eBird recorded more than 100 million observations. “We’ve even gotten data on some of the super-rare species in the middle of the rainforest in tropical Asia,” says Jennifer Fee, manager of K–12 Programs at the Cornell Lab of Ornithology, who adds, “Submitting data helps us understand bird distribution and abundance, and what their populations are doing from year to year.”

And it’s so easy to contribute. Fee points out that students, many of whom normally carry their cell phones in their back pockets, can simply pull them out to snap a picture or record the voice of a bird they happen to see. “Birds are everywhere; the most rural environment, the most urban environment. They’re year-round,” Fee says. “This puts you in touch with the planet.”

Learn more about eBird: ebird.org/home

Project Squirrel

What makes an ideal citizen science project? To Steven Sullivan, Project Squirrel, which began in 1997 and is still going strong, comes pretty darn close in its accessibility and relative simplicity.

“We chose [to study] squirrels because people do see and interact with them,” says Sullivan, director of Miami University’s Robert A. Hefner Museum of Natural History, who oversees the project.

Ease of accessibility also extended to the project design. “We tried to make it [the project] really simple. We wanted it to be rigorous enough for useful data, but simple enough so that everyone can participate,” Sullivan says.

Initiated in a one-by-four-mile radius within the Chicago suburbs, the project was originally designed to answer the question: What influences the diversity and abundance of tree squirrels, specifically fox and gray squirrels, in a given habitat?

Since then, the project has expanded across the nation to include at least 5,000 unique observers, with some participants coming from outside the U.S., particularly Canada and England.

Expanding the project’s reach has reaped benefits. Years of data collection from citizen scientists confirm that gray squirrels prefer urban areas in which humans and oak trees are found in abundance (think urban parks and campuses and established neighborhoods). On the contrary, findings show that fox squirrels gravitate toward areas of lower human population and single-family homes, such



CORNELL LAB OF ORNITHOLOGY

eBird participants in Sapsucker Woods in Ithaca, New York

as the suburbs, where there are trees like walnut and oak and less human food (think garbage cans and handouts.)

In addition to shedding light on the habitat preferences of gray and fox squirrels, Project Squirrel has heightened everyday citizens’ awareness of their natural surroundings. “I want people to be involved with the nature in their neighborhood. To be connecting with these organisms. To get people to understand biodiversity,” Sullivan says. ■

Joining Project Squirrel is easy. You simply need to live in an area where tree squirrels exist and to have access to a computer for your data collection. Learn more: bit.ly/2DG36Fv



Gray squirrel (*Sciurus carolinensis*)

STEVEN SULLIVAN