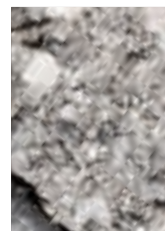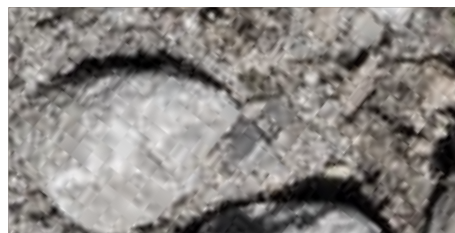# CITIZEN SCIENTISTS

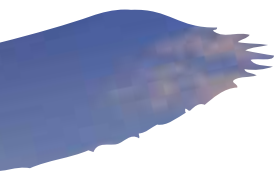## INVESTIGATING SCIENCE IN THE COMMUNITY

Providing meaningful contexts for students to engage in the processes of science

Gail Jones, Gina Childers, Vanessa Stevens, and Blake Whitley

Citizen science programs are becoming increasingly popular among teachers, students, and families. The term *citizen scientist* has various definitions. It can refer to those who gather information for a particular science research study or to people who lobby for environmental protection for their communities (Bonney et al. 2009; Holohan and Garg 2005). *Citizen science* has been called "community-centered science," "community science participatory community-action research," "street science," "traditional ecological knowledge, social justice, scientific literacy, and humanistic science education" (Mueller, Tippins, and Bryan 2012, p. 12).

Below are numerous examples of citizen science projects that provide meaningful, authentic contexts for students to engage in the processes of science. These examples all include the task of collecting and sharing data with scientists and others. They cover a myriad of topics. Teachers can use these or others as part of a laboratory, field, or supplemental learning experience, or as an independent investigation.

is well suited for the science curriculum, its investigations serving as extended lab experiences. Students find it inherently exciting to compare data from their school site with that of other schools from such faraway places as Australia and Africa.

Some schools involve science clubs and after-school programs in citizen science projects. For example, Meghan, a high school senior in Raleigh, North Carolina, and an avid bird-watcher, has participated in the Audubon Society's Christmas Bird Count with some of her biology classmates. Audubon's bird count, started in 1900, is the longest-running citizen science survey in the world (see "On the web"). Meghan records the bird species she sees and submits her data to the state and national Audubon offices for use by ornithologists who study bird population dynamics.

Meghan's biology teacher has been tracking the resident and migratory bird population trends from one year to the next. Meghan returned from the winter holidays thrilled that she had identified a brown creeper, a species the local Audubon club had never before recorded during the annual count. Meghan said she will continue to participate in the bird counts while in college.

Nick, another high school student in Raleigh, collects data to share with scientists, as Meghan did. But Nick gathers data on light pollution, posting it online with a citizen science program called Globe at Night (see "On the web"). Nick also analyzes radio telescope data on his home computer through another citizen science program known as SETI@home (see "On the web"). Nick used his light pollution data in his science fair project and was awarded first prize for his research. Nick has developed a passion for astronomy and plans to major in astrophysics in college.

Examples of citizen science programs

Some citizen science projects address nationwide data collection, such as Firefly Watch, hosted by the Museum of Science in Boston (see "On the web") to track the geographic distribution and activity of fireflies. Other projects are more local in scope, such as NC CRONOS (see "On the web"), in which North Carolina residents submit information to a website that monitors severe weather.

Another community-based program is the Neighborhood Box Turtle Watch (see "On the web"), in which students who encounter a box turtle photograph it, document its physical attributes, note its location, and then submit the data to the citizen science program.

Teachers and students around the world have joined in the Global Learning and Observations to Benefit the Environment (GLOBE) program (see "On the web"). GLOBE participants collect data on the atmosphere, water, soil, and land cover and share their data with other students over the internet, while scientists use this data in research. GLOBE
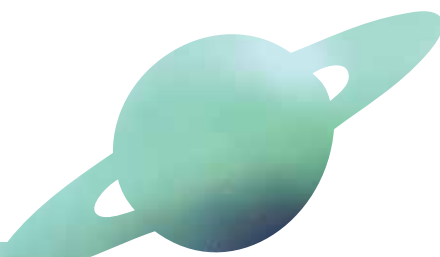
FIGURE 1

Astronomy Citizen Science Programs and the National Science Education Standards

Citizen Science Program	Description	National Science Education Standards
Globe at Night	Globe at Night is a citizen science program designed to measure the night sky's brightness to understand the impact of light pollution.	1. *Science as Inquiry:* K–12.
Lunar Impact	Lunar Impact is a citizen science program that allows users to record the rates and sizes of meteoroids based on observations of the Moon's surface.	2. *Physical Science Standards:* Properties and changes of property of matter. 3. *Earth and Space Science Standards:* Objects in the Sky: Structure of the Earth System; Earth's history; Energy in the Earth System; Geochemical Cycles; Origin and Evolution of the Earth System; Origin and Evolution of the Universe.
SETI@Home	SETI@Home allows individuals to run a free computer software program on their home computer that analyzes radio telescope data to search for extraterrestrial intelligence.	4. *Science and Technology Standards:* Abilities to distinguish between natural objects and objects made by humans.
Planet Hunters	Planet Hunters is a citizen science program designed to search for planets in the galaxy.	5. *Science in Personal and Social Perspectives: Science and Technology in Society:* Natural Resources and Environmental Quality; Natural and Human-Induced Hazards.
Solar Stormwatch	Solar Stormwatch wind allows individuals to observe and record spot explosions on the Sun, which may help in determining the direction of dangerous solar radiation projected from the Sun.	

Some of the earliest and most widely used citizen science projects have arisen out of bird-watching and astronomy programs. Figure 1 shows the diverse array of astronomy citizen science programs available to teachers as well as related investigations that teachers can use to integrate the program data into classroom instruction. Figure 1 also lists which of the National Science Education Standards (NRC 1996) are addressed by such programs.

Teachers can choose among many more citizen science projects serving a range of goals, including conserving natural habitats, promoting educational opportunities within the community, as well as developing scientific inquiry, observational techniques, and data collection. Such are the experiences that we as science teachers want our students to have in and out of school. Particularly gratifying is having students get so interested in a citizen science project, such as box turtles or light pollution, that they extend their involvement to weekends and summers.

love of bird-watching with her students and get families involved. Extending the science to the home engages parents and promotes a sense of community.

Citizen scientists as partners

Citizen scientists make outstanding guest speakers and field trip leaders. Our research suggests that many people who participate in citizen science programs also volunteer to advocate for and share their interests with schools. These engaged and interested citizens can play an important role in raising funds for school science programs. Whether you want to host an astronomy star party, set up an environmental monitoring station, or create a school garden, seek out citizen science programs with volunteers willing to share their interests with teachers. These individuals are a largely undiscovered resource. ∎

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On the web

Audubon Christmas Bird Count: *http://birds.audubon.org/christmas-bird-count*

Climate Retrieval and Observations Network Of the Southeast (CRONOS): *http://naturalsciences.org/research-collections/citizen-science*

Firefly Watch: *www.mos.org/fireflywatch*

Globe at Night: *www.globeatnight.org*

Neighborhood Box Turtle Watch: *http://naturalsciences.org/research-collections/citizen-science/neighborhood-box-turtle-watch*

SETI@home: *http://setiathome.ssl.berkeley.edu/*

The GLOBE Program: *globe.gov*

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Holohan, A., and A. Garg. 2005. Collaboration online: The example of distributed computing. *Journal of Computer-Mediated Communication* 10 (4): article 16.

Mueller, M., D. Tippins, and L. Bryan. 2012. The future of citizen science. *Democracy and Education* 20 (1): 1–12.

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.

Wiersma, Y.F. 2010. Birding 2.0: Citizen science and effective monitoring in the web 2.0 world. *Avian Conservation and Ecology* 5 (2): 1–8.

Because citizen science programs are managed by agencies outside the school system, additional work for participating teachers is minimal. But the programs' independence suggests that teachers should monitor and clearly define when activities are school related and when they are not. Virtually all the programs involve internet use and have social networking components. Students and parents should be cautioned about communicating with strangers over the internet. Some programs, including GLOBE, offer teachers professional development and secure passwords for the class to log onto the program, adding a level of security.

Citizen science programs may sustain student interest long into the future, furthering science teachers' goal of creating lifelong learners. The authors, who study citizen scientists, have found that many adult participants devote from two to 40 hours a week to their projects. One amateur astronomer who monitors light pollution commented: "Light pollution is a horrible problem. Anything I could do to contribute to understanding its advance [could help promote] legislation." A teacher and citizen scientist noted that participating in bird counts was a way to share her