American Museum of Natural History

Center for Biodiversity and Conservation
Network of Conservation Educators and Practitioners

What is Community Science, and How Do I Get Involved?

Author(s): J. Stephen Gosnell

Source: Lessons in Conservation, Vol. 13, Issue 1, pp. 38-43

Published by: Network of Conservation Educators and Practitioners, Center for Biodiversity and Conservation, American Museum of Natural History

Stable URL: ncep.amnh.org/linc

This article is featured in ***Lessons in Conservation***, the official journal of the Network of Conservation Educators and Practitioners (NCEP). NCEP is a collaborative project of the American Museum of Natural History's Center for Biodiversity and Conservation (CBC) and a number of institutions and individuals around the world. Lessons in Conservation is designed to introduce NCEP teaching and learning resources (or "modules") to a broad audience. NCEP modules are designed for undergraduate and professional level education. These modules—and many more on a variety of conservation topics—are available for free download at our website, ncep.amnh.org.

Note to educators: access presentations, teaching notes, exercise solutions, and associated files for these modules by registering as an educator, and searching for module by title.

To learn more about NCEP, visit our website: ncep.amnh.org.

What is Community Science, and How Do I Get Involved?

J. Stephen Gosnell[i,ii]

[i]Department of Natural Sciences, Baruch College CUNY, New York, NY, USA; [ii]The Graduate Center of the City University of New York, New York, NY, USA

ABSTRACT

Community science allows individuals who are not professional scientists to contribute to active scientific research. In this exercise, students learn about the history and growth of community science efforts and how they connect participants to data. Defining traits of community science are discussed, along with examples and potential future directions. Students then have the opportunity to contribute as community scientists by working with projects hosted on the Zooniverse site. Follow-up questions have them reflect on this experience and relate their activity to the larger field.

LEARNING OBJECTIVES

After completing this exercise, students will be able to:
1. Identify key characteristics of community science.
2. Provide examples of how the public may be involved in community science through data collection.
3. Describe how the public may contribute to community science through data analysis, with a focus on participating in projects hosted on the Internet.
4. Contribute to a community science project hosted on Zooniverse.com.
5. Reflect on the project they participated in and consider how it exemplifies the characteristics of community science.

INTRODUCTION

The act of collecting and analyzing data in an attempt to answer questions about the natural world has long included individuals that are not trained or employed in scientific fields (Miller-Rushing et al. 2012). For example, many farmers and hunters have traditionally kept data on pest outbreaks and harvests. Members of the public have also contributed directly to research by providing observations and samples to scientists and collections (Miller-Rushing et al. 2012). These efforts allowed for data collection that would have not have been possible for anyone alone to accomplish and were early examples of what we now call community science.

Community science can be defined in multiple ways (National Academies of Sciences 2018; see Box 1 for more information on the term and related terms). Here we focus on efforts where individuals who are not professionally trained and are not employed by traditional research institutions, and who are often volunteers, play a vital role in the production of scientific knowledge (Miller-Rushing et al. 2012; National Academies of Sciences 2018). In other words, a "core feature" of these efforts is "nonscientists engaging in doing science"(National Academies of Sciences 2018). This focus on producing new scientific knowledge differentiates these activities from those focused purely on scientific outreach or training (Miller-Rushing et al. 2012), though community science efforts do serve to increase awareness of scientific issues and spread knowledge of scientific approaches (Bonney et al. 2016).

Community science projects may allow participants to engage in science by collecting or contributing data [Box 2]. This may take place in multiple ways. In some cases, project leaders may furnish community scientists with materials and/or instructions so they can conduct experiments and collect

Box 1. Community science: What's in a name?

Community science may also be known as citizen, neighborhood, or civic science. Here we use the term "community science" to define this range of efforts with a noted requirement that activities are connected to active research (National Academies of Sciences 2018), although others (Cooper et al. 2021) have noted potential issues with this "rebranding". Different groups have used these related terms in different, but often overlapping, ways (Eitzel et al. 2017; Cooper et al. 2021). While all involve projects where individuals without formal scientific training contribute to scientific activities (Miller-Rushing et al. 2012; National Academies of Sciences 2018), they may differ in goals, leadership, scale, and scope. For example, some efforts are led by professional scientists or affiliated institutions who are involving the public in data collection or analysis focused on traditional scientific products (e.g., articles, presentations); others, including those more historically known as community science, focus on efforts that are not led by scientists affiliated with professional research institutions that may have goals that are more community-focused (Cooper et al. 2021). However, over the past several years multiple groups [e.g., Audubon ("Why We're Changing From 'Citizen Science' to 'Community Science'" 2018)], Great Smoky Mountains Institute at Tremont (Staff 2019) have specifically changed the name of their volunteer-focused efforts to "community science" in an effort to become more inclusive. This is in response to issues regarding the geographic and political connotations associated with the term "citizen" and the fact that most participants in community-science endeavors are white, college-educated adults (National Academies of Sciences 2018; Cooper et al. 2021). Similarly, the use of the term "amateur" or "project-relevant" (National Academies of Sciences 2018) scientist creates a power imbalance that may be inappropriate, especially as many of these projects would not be possible without the public's participation. Also, while most projects rely on volunteers, some projects do financially compensate participants (Kaartinen et al. 2013).

data. For example, efforts to consider oyster enhancement potential of three sites in North Carolina were aided by community members (Anderson et al. 2019). Community members grew oysters on their docks for 6-12 months before transporting them to one of the three sites. Oysters were deployed within 2 hours of collection, enabling community members to observe the full experimental process, and subsequently monitored for eighteen months as part of a pilot program. As another example, in Chicago, community scientists deployed and monitored a playback experiment kit to study the impacts of predator calls on bird behavior (Zuckerberg et al. 2022).

Other projects may have community scientists collect observations in focused efforts. In New York, volunteers help monitor oyster growth and reef biodiversity at restored sites (McCann 2019). Other examples include the Christmas Bird Count and North American Breeding Bird Survey, both organized events where volunteers collect data on bird diversity, and bioblitzes, where volunteers work in teams alongside taxonomic experts to rapidly document diversity in multiple groups during a specified period at a focal site (Parker et al. 2018).

Volunteer connections with data may also include opportunistic efforts where collected data (e.g., observations of species) are not directly connected to a research project but are later harnessed by researchers. For example, websites and apps such as iNaturalist, where members can post geo-tagged photos of organisms they have observed, or eBird, where birders can submit bird checklists, may be used to provide data for future scientific studies (Bonney 2021). All of these efforts may increase the temporal and spatial range of observations (Cohn 2008).

Box 2. Examples of community science

Although community science projects go beyond outreach, civic engagement, or training, they all do offer chances for education and outreach. As a result, many efforts are focused on or include children or young adult contributors.

Measuring manure

Student members of 4H Federation of Finland, a youth organization with a focus on agriculture, helped with a project focused on determining the importance of invertebrate communities to waste removal via decomposition (Kaartinen et al. 2013). For each focal farm, students collected manure from a cattle barn and formed it into 15 standardized "pats". Five pats were used to sample dung beetle diversity, with students sending samples to scientists leading the project. The remaining ten were assigned to five treatments that limited access by different decomposers.

Restoring oysters in New York Harbor

The Billion Oyster Project of New York, United States, is a group committed to restoring oyster reefs in the New York Harbor in order to improve water quality and protect shorelines. Many of their projects involve volunteers. School-age participants and teachers from the local area are directly involved in data collection as they deploy and monitor oyster research stations, or floating mini-reefs containing approximately 300 oysters. Students check the research stations regularly and collect and share data on oyster growth, water quality, and biodiversity (see related NCEP exercise in Gosnell and Schreiber in review). Other community members can join similar efforts at several community oyster reefs throughout the city. Volunteers also help in building and filling the cages and other structures used to house oysters at restoration sites, and local restaurants can contribute discarded oyster shells for use in future restoration work.

Students across Finland conducted field experiments focused on quantifying dung beetle diversity and impacts of beetle communities on decomposition. Photo credit: Timo Marttila.

Students measure oyster growth and invertebrate diversity in an oyster research station. Photo used with permission of Billion Oyster Project. Photo credit: Billion Oyster Project.

Community scientists may also engage with data synthesis or analysis. For example, multiple websites such as Zooniverse now allow participants to contribute to projects by processing records or samples. Volunteers may transcribe data from handwritten notes to digital format or analyze camera trap data. These projects take advantage of the fact humans are innately good at tasks that are hard to automate, such as pattern and hand-writing recognition.

In order for community science efforts to be used towards the production of scientific knowledge, projects must use systematic approaches in regard to data collection, synthesis, and analysis. For example, projects posted on Zooniverse typically have clear instructions and tutorials to train volunteers, and projects that ask community scientists to deploy experiments and/or collect data must provide clear guidance [e.g., species identification information (Pavía et al. 2023)]. Since community science projects are producing real research, these projects must also meet widely recognized standards of scientific integrity. Community science efforts now play a key role in many studies published in academic journals and may also be used to construct reports or management plans. The integrity of these outputs requires ensuring the data used are of the highest quality.

Quality checks and assurances may be carried out in multiple ways. Projects may have data-based efforts randomly checked by staff, or the same data may be analyzed or transcribed by multiple participants in order to ensure accuracy (Gura 2013). Projects relying on opportunistic data, like that generated by iNaturalist, also need to consider how human behavior may influence collections (Knape et al. 2021). For example, weekend increases in sightings of organisms are more likely due to observer schedules than organism traits or phenology. Evidence indicates, however, that opportunistic data may be useful for research and management, especially alongside (and not as a replacement for) other biomonitoring tools and approaches employed in planned, standardized surveys (Rapacciuolo et al. 2021; Zulian et al. 2021; van Tongeren et al. 2023)

One reason for the recent growth of community science projects is the availability of technology. Internet access and smartphone prevalence give many people the ability to collect, share, and analyze data (Bonney et al. 2014; Bonney 2021). Advances in technology will only continue to increase these connections. For example, recent advances have been developed that allow photos of footprints to be automatically matched to individual organisms using software; this technology, known as Wildtrack, combined with community scientist input via photos of footprints, has the potential to allow large carnivores and other organisms to be monitored at greatly reduced costs (Alibhai et al. 2017).

Involving community scientists in projects can also allow projects to grow beyond boundaries that might be set by traditional research ventures due to constraints related to finances or human resources. Volunteer contributions at any point may make a project less expensive (Kaartinen et al. 2013), and in many cases will actually make a project feasible. In fact, estimates suggest volunteers may be providing value to science that rivals that of major funding agencies (Theobald et al. 2015). These projects have other benefits as well. For example, they may increase effort on topics related to local concerns (Miller-Rushing et al. 2012).

The ability to focus on local concerns and involve a large number of participants also means community science projects may play a key role in diversifying who participates in science. These projects may expand the public's perception of who can be a scientist and what science looks like. Integrating community science projects into early (e.g., K-12 or primary and secondary) educational settings may be especially useful. Researchers are also considering how community science projects can be structured to offer maximal learning outcomes or other benefits for participants (National Academies of Sciences 2018; Bonney 2021; Peter et al. 2021) while also minimizing negative environmental impacts related to habitat visitation or reliance on personal vehicles and associated fuel usage (Gillings and Harris 2022).

EXERCISE

Zooniverse (https://www.zooniverse.org/) is one of the world's largest portals for community science projects. You can learn more about the site by looking at the FAQ (https://www.zooniverse.org/about/faq) and information (https://www.zooniverse.org/about) sections. Although Zooniverse has projects on topics ranging from history to astronomy, for this exercise you'll select one project from the Climate or Nature tab. You may register for the site so you can track your work, but few projects require it.

First, survey the range of projects available for the public to participate in. Go to the Projects tab and select "Climate" or "Nature".

1. Use the tabs to learn more about 3 projects. Briefly describe each.
2. How do they differ, and how are they similar? List at least 3 similarities and 3 differences among the projects.

Choose one that you find the most interesting and would like to contribute to.

3. Which project did you choose and why?
4. What are the goals of the project, and why do you think it is important?

Spend at least 30 minutes collecting or analyzing data for the project.

5. Save a screenshot showing what you did as a community scientist and include in the submission of your assignment. Explain what the image shows and briefly describe what you did for the project as a community scientist.
6. How did the project exemplify the use of "systematic approaches" (clear, standardized methods) to data collection or analysis?
7. What is a hypothesis that could be tested using the data that you worked with?
8. Did you find working on the project interesting? Why or why not?
9. Were you surprised by what research can look like? What did you expect, and how did your experience meet your expectations?
10. Would you volunteer your time on the site again? Why or why not?

EXTENDED ACTIVITIES

- Use the information you find on Zooniverse to prepare a short "commercial" or social media post for the project you worked on. You should focus on what the project is trying to accomplish, what you did, and why someone should want to contribute.
- Identify a local opportunity to contribute to data collection as a community scientist and take part!

ACKNOWLEDGEMENTS

This exercise was originally developed with funding provided by Baruch College as part of New York's Open NYS initiative. Module development was further supported by a grant from the National Science Foundation (Award # 1839656).

REFERENCES

Alibhai, S., I.Z. Jewel, and J. Evans, J. 2017. The challenge of monitoring elusive large carnivores: An accurate and cost-effective tool to identify and sex pumas (*Puma concolor*) from footprints. PLOS ONE 12:e0172065. Public Library of Science.

Anderson, L., P. Sacks, M. Donnelly, V. Barker, S. Anderson, and L. Walters. 2019. Oyster reef enhancement utilizing gardened oysters in a subtropical estuary. Restoration Ecology 27:966–973.

Bonney, R. 2021. Expanding the impact of citizen science. BioScience 71:448–451.
Bonney, R., T.B. Phillips, H.L. Ballard, and J.W. Enck. 2016. Can citizen science enhance public understanding of science? Public Understanding of Science 25:2–16.
Bonney, R., J.L. Shirk, T.B. Phillips, A. Wiggins, H.L. Ballard, A.J. Miller-Rushing, and J.K. Parrish. 2014. Next steps for citizen science. Science 343:1436–1437.
Cohn, J.P. 2008. Citizen science: Can volunteers do real research? BioScience 58:192–197.
Cooper, C.B. et al. 2021. Inclusion in citizen science: The conundrum of rebranding. Science 372:1386–1388.
Eitzel, M.V. et al. 2017. Citizen science terminology matters: Exploring key terms. Citizen Science: Theory and Practice 2017:1–20.
Gillings, S., and S.J. Harris. 2022. Estimating the carbon footprint of citizen science biodiversity monitoring. People and Nature 4:996–1006.
Gosnell, J.S., and K. Schreiber. In review. Using data to support oyster restoration in New York City. Lessons in Conservation. Network of Conservation Educators and Practitioners, Center for Biodiversity and Conservation, American Museum of Natural History, New York, NY.
Gura, T. 2013. Citizen science: Amateur experts. Nature 496:259–261.
Kaartinen, R., B. Hardwick, and T. Roslin. 2013. Using citizen scientists to measure an ecosystem service nationwide. Ecology 94:2645–2652.
Knape, J., S.J. Coulson, R. van der Wal, and D. Arlt. 2021. Temporal trends in opportunistic citizen science reports across multiple taxa. Ambio 51:183–198.
McCann, M. 2019. Restoring oysters to urban waters: Lessons Learned and Future Opportunities in NY/NJ Harbor. The Nature Conservancy, New York, NY. Available from: https://www.nature.org/content/dam/tnc/nature/en/documents/new-york-city-restoring-oysters-lessons-learned-2019.pdf (accessed December 2, 2023).
Miller-Rushing, A., R. Primack, and R. Bonney. 2012. The history of public participation in ecological research. Frontiers in Ecology and the Environment 10:285–290.
National Academies of Sciences E. 2018. Learning through citizen science: Enhancing opportunities by design. Available from: https://nap.nationalacademies.org/catalog/25183/learning-through-citizen-science-enhancing-opportunities-by-design (accessed July 3, 2022).
Parker, S.S., G.B. Pauly, J. Moore, N.S. Fraga, J.J. Knapp, Z. Principe, B.V. Brown, J.M. Randall, B.S. Cohen, T.A. Wake. 2018. Adapting the bioblitz to meet conservation needs. Conservation Biology 32:1007–1019.
Pavía, C.E.C., F. Mascareño Suárez, J. Brunetti, M. Eliceche, and K.A. Ayres. 2023. Seasonal occurrence and environmental drivers of pelagic shark species in Los Cabos, Mexico, assessed using citizen science. Environmental Biology of Fishes. Available from https://doi.org/10.1007/s10641-023-01434-w (accessed June 22, 2023).
Peter, M., T. Diekötter, K. Kremer, and T. Höffler. 2021. Citizen science project characteristics: Connection to participants' gains in knowledge and skills. PLOS ONE 16:e0253692.
Rapacciuolo, G., A. Young, and R. Johnson. 2021. Deriving indicators of biodiversity change from unstructured community-contributed data. Oikos 130:1225–1239.
Staff, T. 2019, October 8. Why we are changing "Citizen Science" to "Community Science." Available from: https://gsmit.org/why-we-are-changing-citizen-science-to-community-science/ (accessed July 3, 2022).
Theobald, E.J. et al. 2015. Global change and local solutions: Tapping the unrealized potential of citizen science for biodiversity research. Biological Conservation 181:236–244.
van Tongeren, E. et al. 2023. Unstructured citizen science reduces the perception of butterfly local extinctions: The interplay between species traits and user effort. Biodiversity and Conservation. Available from: https://doi.org/10.1007/s10531-023-02721-9 (accessed October 11, 2023).
Why we're changing from "Citizen Science" to "Community Science." 2018, May 3. Available from: https://debspark.audubon.org/news/why-were-changing-citizen-science-community-science (accessed July 3, 2022).
Zuckerberg, B., J.D. McCabe, and N.A. Gilbert. 2022. Antipredator behaviors in urban settings: Ecological experimentation powered by citizen science. Ecology and Evolution 12:e9269.
Zulian, V., D.A.W. Miller, and G. Ferraz. 2021. Integrating citizen-science and planned-survey data improves species distribution estimates. Diversity and Distributions 27:2498–2509.

NCEP materials are meant to be modifiable for each educator's specific classroom or training needs; adaptable Microsoft Word versions of modules are available for download through the NCEP module collection at https://ncep.amnh.org along with any available accompanying data files, appendices, presentations, teaching notes, and exercise solutions.