Guide to Choosing Locally Relevant

Citizen Science Projects for the Classroom

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This guide will help users to critically examine potential citizen science projects to determine whether they are easily adapted for use in a classroom curriculum and schoolyard setting.

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Acknowledgments

This guide was developed as a resource for the Schoolyard SITES Project, bringing citizen science to schools through teacher-volunteer partnerships. This project brought together two groups of educators — elementary school teachers (formal) and University of New Hampshire Cooperative Extension science volunteers (informal) to create a community-based professional development partnership to improve educators' self-efficacy, science content knowledge, and instructional practice. Together, with an interdisciplinary team of education experts, the teachers and UNH Extension science volunteers learned how to design and implement appropriate, NGSS-aligned science lessons with elementary school students through locally relevant community-based, citizen science projects. A companion resource to this guide, The Schoolyard SITES Curriculum Workbook: A Design Process for Engaging Students in Citizen Science in their Schoolyard, provides additional guidance on integrating citizen science projects into school curriculum. More information can be found at extension.unh.edu/ programs/schoolyard-sites.

We gratefully acknowledge our colleagues who led and collaborated on the Schoolyard SITES Project – Lara Gengarelly, Erik Froburg, Megan Glenn, and Sameer Honwad. We also extend our gratitude to the Schoolyard SITES advisory board members – Dr. Jade Lee, Ian Fleischer, Molly Jones, and Dr. Susan Jurow. For the clarity and appearance of this guide, we thank UNH Cooperative Extension's Emma Joyce and Sandra Hickey. Finally, we would like to express our sincere appreciation to the teachers and volunteers who have participated in Schoolyard SITES over the years, resulting in inspiring examples of using citizen science in the classroom.

The citizen science projects mentioned in this guide are not coordinated by or affiliated with the University of New Hampshire.

Suggested Citation: Andreozzi, H., Clyde, M. (2023). Guide to choosing locally relevant citizen science projects for the classroom.

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What is citizen science?

A process by which both professional and volunteer scientists collaborate to investigate the world around them.

Citizen Science 101

An introduction to Citizen Science

Citizen science (sometimes called community science) occurs when both professional and volunteer scientists collaborate to investigate the world around them.

The field of citizen science has exploded in recent years. You'll find projects based out of nature centers, universities, research institutions, federal and state agencies, zoos, and more. Efforts to make science more accessible, and worldwide interest in improving science learning of the next generation likely contribute to the expansion, but advances in technology – the internet, crowd-sourcing platforms, and the availability of powerful mobile technology in the hands of people across the world – is making the doing of science by all of us easier and more widespread.

Non-scientists making careful observations of the world around them – what we would call citizen science today – isn't a new thing. Humans have been recording observations of the world around them for thousands of years. Records from China show outbreaks of locusts from 3,500 years ago; French farmers recorded annual grape harvests 650 years ago; and Henry David Thoreau recorded observations of plants and animals around Walden Pond 150 years ago[1]. The rise of citizen science in recent years is really a return to our observational roots.

Citizen science is valued by the scientific community because it can answer bigger questions than is possible by professional scientists alone. With many observers over large time scales, rare events or occurrences (such as the presence of a rare species) have a better chance of being detected. Cellphones and the internet make it easy to collect and share accurate observations, including photos, with scientists and other observers.

Many involved in the field of citizen science are also excited by the potential to get more people involved in science, in effect to democratize science, so that more people will appreciate, enjoy, connect to, or believe in science as a way of understanding the world.

Finally, citizen science is increasingly used to support science learning in both informal and school settings. For example, Schoolyard SITES uses citizen science so that the science learning done in the classroom not only supports the students' learning, but also benefits the wider scientific community. This means the citizen science conducted by students will be authentic, supporting science research or community decision-making in the world outside the classroom.

It's important to remember that behind all citizen science there is some research, question, or crowdsourcing going on. It's not just collecting information – it's driven by a question, often posed by a researcher, but sometimes posed by a community, government agency, or non-profit organization.

Some citizen science projects have well-established existing protocols (processes or steps for collecting information). For some projects, the protocols aren't as obvious. Instead, protocols might be built into the crowdsourcing and technology platforms used by the project. Many projects provide infrastructure like species identification help, data download and visualization, and other resources. You can use these tools to answer your own additional science questions.

This guide will help users to critically examine potential citizen science projects to determine whether they are easily adapted for use in a classroom curriculum and schoolyard setting.

[1]Miller-Rushing, Abe, Richard Primack, Rick Bonney. 2012. The history of public participation in ecological research. Frontiers in Ecology and the Environment, 10(6), pp. 285-290.

10 Principles of Citizen Science

FROM THE EUROPEAN CITIZEN SCIENCE ASSOCIATION

Citizen science is a flexible concept that can be adapted and applied within diverse situations and disciplines. The statements below were developed by a working group of the European Citizen Science Association, led by the Natural History Museum London with input from many members of the Association, to set out some of the key principles of good practice in citizen science.

1. Citizen science projects actively involve citizens in scientific endeavors that generate new knowledge or understanding. Citizens may act as contributors, collaborators, or as project leaders, and have a meaningful role in the project.
2. Citizen science projects have a genuine science outcome. For example, answering a research question or informing conservation action, management decisions, or environmental policy.
3. Both the professional scientists and the citizen scientists benefit from taking part. Benefits may include the publication of research outputs, learning opportunities, personal enjoyment, social benefits, satisfaction through contributing to scientific evidence (e.g. to address local, national and international issues), and, through that, the potential to influence policy.
4. Citizen scientists may, if they wish, participate in multiple stages of the scientific process. This may include developing the research question, designing the method, gathering and analyzing data, and communicating the results.
5. Citizen scientists receive feedback from the project. For example, how their data are being used and what the research, policy or societal outcomes are.
6. Citizen science is considered a research approach like any other, with limitations and biases that should be considered and controlled for. However, unlike traditional research approaches, citizen science provides opportunity for greater public engagement and democratization of science.
7. Citizen science project data and meta-data are made publicly available and, where possible, results are published in an open access format. Data sharing may occur during or after the project, unless there are security or privacy concerns that prevent this.
8. Citizen scientists are acknowledged in project results and publications.
9. Citizen science programs are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.
10. The leaders of citizen science projects take into consideration legal and ethical issues surrounding copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities

September 2015, London

Where to Find Projects

There are many existing projects available for teachers and volunteers looking to implement locally relevant, community-based citizen science projects in the classroom or schoolyard. The sample projects and programs included later in this guide reflect those with topics and resources that address important science concepts, can be applied in a variety of settings, and have local relevance. Below are some additional resources for finding citizen science opportunities.

SciStarter

SCISTARTER.COM

SciStarter is a large, international database with thousands of citizen science projects. Users can search by many criteria (topic, age-appropriateness, use in schools, etc.). SciStarter collects projects by an extremely wide range of organizations leading to large variability in project scope, type and scientific rigor.

Nature Groupie

NATUREGROUPIE.ORG/CITIZEN-SCIENCE

Nature Groupie is a website, run by UNH Cooperative Extension, that pulls together citizen science projects that are hosted by organizations based in New England. Projects have undergone assessment by UNH Extension for place-based credibility and use of data by local decision-makers or scientists.

Local Conservation Organizations

Some conservation groups organize local citizen science projects out of nature centers, zoos, and science museums. These may involve collecting observations at the facility, but there may be opportunities to contribute observations collected at home, schools, or in a natural area near you. If you have a national park nearby where you can bring students, the park may have a citizen science project that collects observations made during park visits.

Will It Work at My School?

CRITERIA FOR SELECTING A CITIZEN SCIENCE PROJECT

The field of citizen science is expanding, with new research projects developed every day. A quick glance at SciStarter.org shows over 1,500 projects that cover topics as diverse as ecology, transportation, archeology, food, physics, and human health. It's easy to get excited to participate! In fact, researchers work hard to make the projects interesting, fun, and engaging to the public, since they rely on voluntary participation to collect useful data.

We encourage you to get excited about citizen science projects as you begin to explore. However, keep in mind that many projects have not been designed with classrooms in mind. They may be designed for adult volunteers or require complex equipment or supervision. They may only work at certain times of the year when school isn't in session. Many projects are place-based, and might only be suitable for schools in a certain region. For example, Aurorasaurus is a crowdsourcing project for sightings of the aurora borealis. It's an exciting and dynamic project, but only those living in northern regions who can see the northern lights are able to contribute.

Below we offer criteria to be used to assess citizen science projects to determine if they will work in your classroom or schoolyard.

Curriculum Essentials

Before searching for citizen science projects to use in a school setting, first identify the curriculum requirements of the classroom involved. What are the topics that align with the Next Generation Science Standard (NGSS) requirements? Are there school requirements that make some topics better than others? If your district requires your grade level to cover Earth science, for example, look for a compelling Earth science citizen science project so it meets your curricular needs.

Selecting projects that align with the content and curriculum requirements of the classroom are more likely to be successful and sustainable in the long term.

To help focus and refine your citizen science project selection, identify the NGSS standards you need to consider:

- What are the Disciplinary Core Ideas (content) you want to emphasize?
- What are the Science Practices you want to incorporate?
- What are the Cross-Cutting Concepts you want to highlight?

For additional guidance on incorporating citizen science into school curriculum, see *The Schoolyard SITES Curriculum Workbook: A Design Process for Engaging Students in Citizen Science in their Schoolyard.*

School Site Characteristics

While some citizen science projects will work anywhere because the phenomenon is universal – think investigating clouds or rainfall – others won't be feasible in certain classroom or school settings. Visit the schoolyard, neighborhood, and area around the school to catalog the characteristics of the site. This is the time to consider factors that will help you select "locally relevant" projects, meaning they are investigating phenomena that are present in – and characteristic of – a specific place.

Inventory the schoolyard, neighborhood, and area around the school to identify characteristics and features that could be examined with a scientific lens:

- Are there trees or wooded areas nearby?
- Is there a waterbody?
- A school garden?
- A place to erect a bird feeder that is visible from the classroom window?
- Different types of ground surface that might affect temperatures differently?
- A busy intersection with vehicles or people passing regularly?
- Anything interesting that is regularly observable can work!

Geography, Seasons & Timing

Geography, climate, and phenology (nature's timing) play a very large role in what will be possible to study in a classroom or schoolyard setting. Citizen science projects usually require participants, including students and teachers, to be engaged in authentic, hands-on data collection. This means you'll have the best success choosing a citizen science project that relates to an accessible, observable part of the school setting. For example, studying pollination and garden growth is a great topic in regions where gardens and plants grow during the school year, but may be too difficult in northern regions where the start of school (fall) means the end of the growing season. Similarly, contributing to a citizen science project focused on marine pollution works well for schools that have access to the ocean, but a more general litter-based project such as Litterati would work better for schools not located on the coast.

Time Requirements

Some citizen science projects use a model of "crowdsourcing," allowing participants to contribute as little as one observation. Student commitments can be modest and flexible enough to fit most science curricula and, depending on the protocols (see below), students could contribute observations over days, weeks, or the entire school year.

Other citizen science projects are structured so that volunteers commit to larger or longer involvement. For example, collecting daily observations for several weeks in winter, or weekly observations throughout an entire year. Since participation in these projects is voluntary, there is usually some flexibility, but it's important to find a project where the level of commitment required of the project fits the classroom's availability and schedule.

Cost & Equipment

Some projects require an investment in equipment or have fees to participate. Projects may require construction of rain gauges, installation of bird feeders, purchase of plants or food, or require each participant to have a separate account or use personal mobile devices. In the classroom setting this can mean creating logins and passwords for

individual students or teams of students – or in some cases, for the class as a whole. Furthermore, some mobile apps or websites limit registrants to those 18 or older. While these may not be insurmountable issues, the costs and equipment requirements of some citizen science projects may make it more difficult for students and classrooms to participate than others.

Protocols

A protocol is a detailed plan of a scientific procedure – how data is to be collected, reported, and delivered. Following a protocol is a key part of science, and is also important in citizen science, where data is often collected by hundreds or thousands of volunteers. However, citizen science projects vary widely in how well – or how obvious – the protocol is explained.

In many projects, the protocol is invisible, and is in fact integrated into the technology platform used to collect citizen observations. For example, the data requirements of nature observations submitted to iNaturalist (an ecology citizen science project) are built into the geolocation, timestamp, and accuracy of each photo submitted and the system for review of each photo by other members of the community who must agree on the species identification before the observation becomes "research grade."

Even citizen science projects without an obvious protocol can be appropriate for use in the classroom. The project may be flexible enough to serve as a tool for many possible protocols, and it may be adapted to use your own protocol. For example, a class may contribute nature observations from the schoolyard using iNaturalist – data which will be shared with and used by the global community of ecology researchers. At the

same time, the class can be conducting a study of their schoolyard using their own protocol more specific to the research question they want to answer and using iNaturalist to collect that data (e.g., collecting insect observations during each season to answer a question about seasonal changes in insect diversity). For guidance on developing protocols that work for your classroom, refer to the "Identifying Procedures to Carry Out the Project" section of *The Schoolyard SITES Curriculum Workbook: A Design Process for Engaging Students in Citizen Science in their Schoolyard.*

Participant Benefits

One of the key elements of citizen science is the relationship between the organizers of a project (researchers, non-profits, government agencies, etc.) and the volunteers who lend their time, observations, or expertise to help. It's worth looking at a citizen science project to assess whether it specifies the benefits of the volunteer work. Will students be recognized in some way for their contributions? How will student data contribute to real science? Will the results be shared back to volunteers? If so, how? For most volunteers, seeing how their contributions make a difference – and how their data is helping scientists discover new things – is a strong motivator. Scientists and volunteers both get excited by new discoveries, and students participating in citizen science are no different. Look for programs that share data and results back with volunteers regularly.

Citizen Science: More Data for Bigger Questions

Many citizen science projects make their data available for use by others, including volunteers and students. This process of sharing data and results can come in many forms:

- Data visualizations (e.g., charts of global bird distribution available through eBird)
- Data maps showing geographic spread of data (e.g., global litter maps on Litterati)
- Annual reports of compiled data or communication from coordinators sharing seasonal results
- Open data repositories where anyone can query and download citizen science data (e.g., data download function on iNaturalist).

These larger data sets can help you prepare for citizen science work in the classroom by providing some sense of what might be found in the region based on data collected by others. Larger data sets may also be useful as comparisons for student data – "How does our schoolyard data compare with that collected in other nearby – or far away – sites?" In most cases citizen science projects don't have sufficient data at a fine enough scale to be used as direct comparisons, but exploring available data might offer opportunities to ask new questions.

Use the Citizen Science Project Selection Worksheet

Use the worksheet on the following pages to help you evaluate the goals, requirements, and resources associated with individual citizen science projects found on SciStarter.org, or through other local resources such as NatureGroupie.org. You will likely need to research multiple projects until you find one that works for your curriculum, school, and needs. Combine information from the worksheet with curriculum needs and consider classroom dynamics and logistics in choosing a citizen science project.

Citizen Science Project Selection Worksheet

Citizen Science Project

Website and/or Contact Information

Purpose of the project

What do the researchers hope to discover?

Time commitment

Setting required

Equipment or costs required to participate?

Different science questions you could ask and answer within this project's protocol

What are the benefits to this study for me (participant)? To the researcher(s)? To the wider community?

How will we participate as citizen scientists?

Design study, collect data, submit data, analyze results, etc. What are the basic protocols?

How are the data shared or communicated?

Is data available that you can use for comparison or to supplement the data you collect? Is it easy to find, access, and use?

Other resources available?

Get Started

SAMPLE CITIZEN SCIENCE PROJECTS

Given the diversity of citizen science projects available online, the following list may be helpful to get started. The Schoolyard SITES team has supported teachers and volunteers in using these projects to conduct classroom investigations that engage students, contribute data to a larger community, and meet NGSS standards. All these projects have websites to help you learn more:

Project Feederwatch

Sponsored by the Cornell Lab of Ornithology, this project collects observations of birds in winter that visit installed bird feeders. Users can use the same login credentials for all Cornell Lab Account projects (eBird, Project Feederwatch).

Nature's Notebook

Sponsored by the National Phenology Network, this project collects phenology information (observations of the timing of nature) to help scientists understand and predict threats to people and the environment such as climate change, flooding or drought.

iNaturalist

iNaturalist is a mobile app that allows anyone to collect nature observations with their phone or tablet that are shared with fellow naturalists around the world. Data are available to scientists and the entire community. Species identification is assisted through both digital and real-world corroboration. Users can create "projects" or join existing ones. Often used in Bioblitz events.

SPARCnet

SPARCNet (Salamander Population and Adaptation Research Collaboration Network) is a citizen science project sponsored by the USGS Northeast Amphibian Research and Monitoring Initiative. The project helps researchers understand the effects of climate change and land use on red-backed salamander populations in the northeastern U.S.

Journey North

Hosted by the University of Wisconsin-Madison Arboretum, Journey North collects observations of migrating animals and seasons, including monarch butterflies, robins, hummingbirds, eagles, earthworms, swallows, gray whales, and more.

CoCoRaHS

Community Collaborative Rain, Hail and Snow Network is hosted by a national network of weather scientists. The project collects daily precipitation data including rain, snow, and hail from citizen scientists who have installed rain gauges in backyards and schools across the U.S. Data is used by the National Weather Service, among others.

GLOBE

The Global Learning and Observations to Benefit the Environment (GLOBE.gov) is sponsored by NASA and other federal agencies. GLOBE is specifically designed for schools to contribute to scientific understanding of the Earth system and global environment. GLOBE projects cover all elements of Earth and natural science with protocols that directly feed into Earth systems research.

Celebrate Urban Birds

Organized by the Cornell Lab of Ornithology, Celebrate Urban Birds is a year-round project that collects bird observations of 16 target bird species that are common to urban and suburban environments. The project includes educational materials on target bird species.

Ant Picnic

Hosted at North Carolina State University, Ant Picnic helps scientists understand which ants live in what settings and their food preferences. Students can use food lures to attract and collect data on ants.

eBird

Organized by the Cornell Lab of Ornithology, eBird is an online (and app) platform that collects bird sightings from the entire globe. Data from other Cornell bird projects (Feederwatch, Celebrate Urban Birds) also feed into eBird.

BioBlitz

A bioblitz is more of a do-it-yourself event that focuses on finding and identifying as many species as possible in a specific area over a short period of time to get a snapshot of an area's biodiversity. Used with the iNaturalist app, participants can easily collect photographs, gather biological information, and share observations with others. See NH BioBlitz

Litterati

Litterati collects data on the world's litter. A non-profit that has garnered support and attention from federal agencies and the press, Litterati maintains a world-wide leaderboard of active countries and most tagged litter items collected.

Schoolyard Sites was made possible by the National Science Foundation (NSF Grant No. 1721133) and in partnership with the UNH Leitzel Center and UNH Cooperative Extension. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Original release: July 2019. Updated May 2023.