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Healthy Students Learn Better

Students and teachers can play an important role in supporting their school's physical environmental health through citizen science and civics projects. These projects bring real-world learning into the classroom. They are also a great way to spark student curiosity. Teachers can use social networks and educational tools to identify and address school environmental health issues. These networks and tools can benefit student attendance and achievement and staff retention.¹

This **Healthy Students Learn Better Practice Guide** series gives you resources, tips, and tools to create a healthy school physical environment.



PRACTICE GUIDE 2

Get Students Involved in Citizen Science Projects for School Environmental Health

PRACTICE GUIDE 2 includes an overview of the citizen science process and its benefits; tips for investigating school environmental issues; ideas for citizen science and civics projects for students in preK through grade 12; and curriculum resources on topics related to school environmental health projects.

Other Practice Guides in This Series



PRACTICE GUIDE 1 provides practical strategies and resources to measure, improve, and track school environmental health.



PRACTICE GUIDE 3 provides resources to support school environmental health.



PRACTICE GUIDE 4 gives tips to engage partners and your community in your effort.

Why use a classroom citizen science approach?

Citizen science, sometimes called “community science” or “participatory science,” is a field of work in which members of the public volunteer to participate in scientific inquiry to address complex problems in the real world.² This approach to scientific learning aligns with the eight science and engineering practices of the Next Generation Science Standards (NGSS).

Through these practices, students build science knowledge by asking questions, planning and carrying out investigations, analyzing data, and obtaining and communicating information.³ Citizen science is accessible to the public. So, students and the broader community of school advocates can engage in practical, interest-driven learning that can improve the environmental health of their school community.

There is no single way to participate in citizen science, but the process generally involves five key phases:

1. Observe, learn, and discuss
2. Ask questions
3. Identify your focus and create a plan
4. Put your plan into action
5. Communicate what you find



The Value of Citizen Science in the Classroom

You can enhance your school’s environmental health knowledge by engaging students and school advocates in citizen science. You can do this in several ways:

- ◆ Prompt them to gather and analyze environmental data, which can bring about new discoveries and insights.⁴
- ◆ Encourage them to collect data in understudied locations that professional researchers may not be able to reach.^{5,6}
- ◆ Increase their awareness of environmental health issues and inspire action to support a healthy environment.⁷
- ◆ Foster civic engagement in environmental initiatives and policies and integrate instructional content that reflects issues relevant to children’s lives.⁸
- ◆ Spark critical thinking, increase student engagement, and highlight the value of a multidisciplinary, solution-oriented approach to learning.⁹

Citizen science can be an affordable approach to learning about the school environment. When students, teachers, parents, school leaders, and other school advocates conduct the research and do the reporting, school leaders can focus on planning, developing, and funding school environmental health programs (see [PRACTICE GUIDES 1](#) and [3](#)).

Student Citizen Science Environmental Research Projects and Activities



Phase 1: Observe, Learn, and Discuss

The citizen science approach begins with discussing the importance of environmental health in different places. This includes school buildings and school grounds, residential areas, and green spaces.

Students can then choose an environmental health problem that they would like to study, develop a project research plan, carry out the plan, and share their findings. The students' age will affect project flexibility, but sparking student curiosity is key to science learning.



Start by sparking classroom discussion with the informational videos listed below. These videos cover different aspects of environmental health and the effects they can have.

Table 1. Prelearning Videos for Discussion

VIDEO TITLE	PreK– GRADE 2	GRADES 3–5	GRADES 6–8	GRADES 9–12
Water pollution Water Contamination (Learning Junction)				
Air Pollution Video for Kids Causes, Effects & Solution (Learning Junction)				
This is what happens to your body when you breathe polluted air (Project Planet)				
This is what happens to your body when temperatures soar (CNN Health)				
How Climate Affects Community Health (Centers for Disease Control and Prevention [CDC])				
Global Weirding What About the Ozone Hole? (Public Broadcasting Services [PBS])				
Flint's water crisis, explained in 3 minutes (Vox)				

Even a simple class discussion can become a citizen science project. Students can ask questions about their school's environmental health and carefully document and analyze their answers to these questions. Students can look for themes and patterns in environmental health based on locations in their school. They can also look for patterns in the different effects on students and staff. Students can use the resources in **PRACTICE GUIDE 1** to explore how their school compares to other schools around them, both throughout their state and across the nation.



Discuss the videos or engage in similar prelearning activities. Then use the anchoring questions in table 2 to explore the environmental health in your school and community. These questions serve as a launchpad for scientific thinking and investigation. They may be used in content areas such as geography, Earth science, and social studies. They can even be used for writing assignments in English language arts classes.

The following table shows which grade bands these questions would be most appropriate for. The questions can prepare students for citizen science projects and identifying school environmental health issues.

Table 2. Prelearning Anchor Questions for Discussion

ANCHORING QUESTIONS	PreK– GRADE 2	GRADES 3–5	GRADES 6–8	GRADES 9–12
What can we do to keep our school and playground or outdoor recreational spaces safe and healthy?				
What can we do to make sure our classrooms have clean air to breathe?				
How can we make sure the water we drink at school is clean?				
What questions do you have about environmental health?				
What questions do you have about keeping our school safe and healthy?				
How do the air, water, temperature, and other aspects of environmental health in your school affect you?				
What is the difference between weather and climate?				
What are the different aspects of environmental health?				
What are some of the leading causes of air pollution in your community or region, including indoor and outdoor environments?				
What are some of the leading causes of water pollution in your community or region?				
How might air pollution be worse in urban versus rural areas? How might it be worse in poor versus wealthy areas?				
How might water pollution be worse in urban versus rural areas? How might it be worse in poor versus wealthy areas?				
What are possible health and educational risks of the greater frequency of extreme weather and climate events (for example, heat waves, hurricanes, droughts)?				
How do you think the environmental health of your school or community compares to others in the region, state, and nation?				



Have students break into small groups to prepare for their citizen science projects. Ask them to think about the *what, who, how, and why* questions below. Teachers can tailor these questions to make them appropriate for students in grades preK–5.

BREAKOUT GROUP QUESTIONS

Students in middle and high school can discuss questions like the following in breakout groups:

1. What is the environmental health topic or problem that you want to examine?
2. What is your school currently doing about this problem? Does your school building have guidelines or regulations that address this problem?
3. Who does this problem affect? Who is most vulnerable?
4. How serious is this problem in your school? Has this problem caused illness, or could it possibly cause illness? Could this problem make learning and achieving harder for the students and staff at your school?
5. Why does awareness of this problem matter to your school community? Who can you interview to gather more information about this problem?
6. What other data can you collect to investigate this problem?

After students have completed these discussion exercises, they should have a better understanding of the environmental conditions in their school and community, what topics interest them, and what conditions may need improvement. This will prepare teachers and students to select topic areas for their projects.



After you have identified your focus, explore the following examples of citizen science projects related to indoor air quality, water quality, and heat. These projects cover science, technology, engineering, arts, and math (STEAM) standards as well as standards for English language arts (ELA), health, and social studies, including civics and geography. These examples may point you to resources for other environmental health topics that interest students and teachers. Students may even choose to design a project of their own. They may be inspired by class discussions and these examples to address specific environmental issues that affect their school and community.



Get inspired to take action based on the following examples of citizen science projects.



AIR QUALITY

PreK–Grade 2

- ◆ [Playing Hide and Seek...with Pollution!](#) (ELA, Health, Science)—Idaho Department of Environmental Quality

Grades 3–5

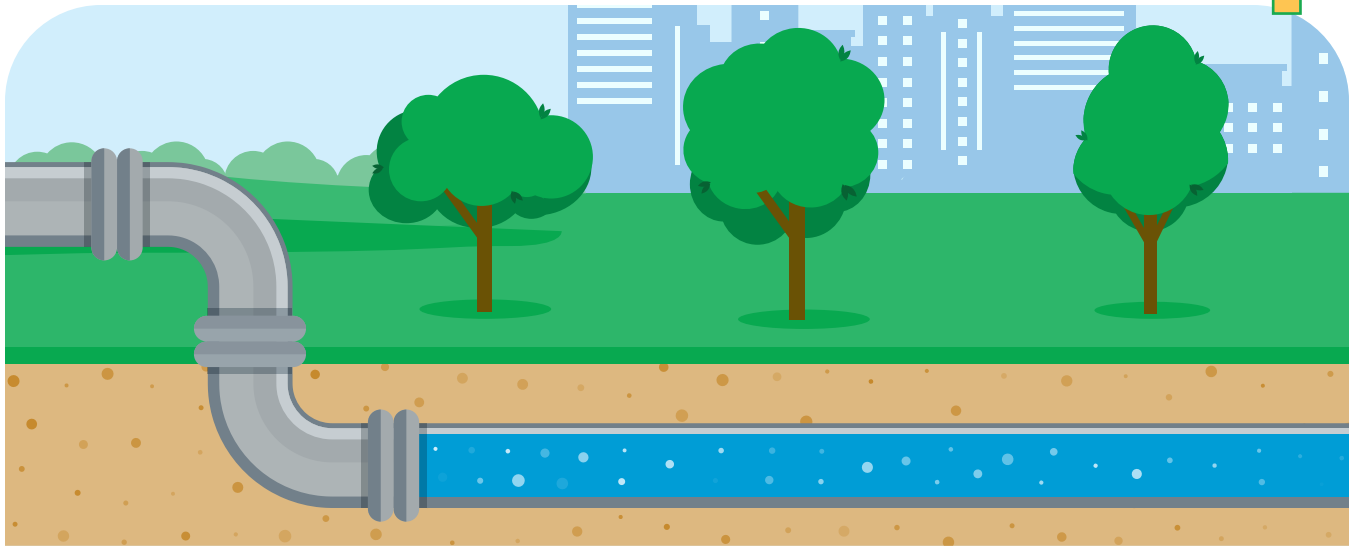
- ◆ [Air Particles and Air Quality project](#) (Science)—Science Buddies
- ◆ [Air Quality Lesson: No Idling Campaign](#) (Social Studies/Civics, Science)—SubjectToClimate
- ◆ [Earth Cleaning: “Dusting” the Air](#) (Health, Math, Science)—Idaho Department of Environmental Quality

Grades 6–8

- ◆ [Clean Air Zone: Putting it to the Test](#) (Math, Earth Science, History, Biology)—Idaho Department of Environmental Quality
- ◆ [Earth Cleaning: “Dusting” the Air](#) (Health, Math, Science)—Idaho Department of Environmental Quality
- ◆ [Mapping Air Pollution in Oakland, CA, worksheet](#) (ELA, Health, Geography, Social Studies/Civics, Science)—SubjectToClimate

Grades 9–12

- ◆ [Near-Ground Level Ozone Pollution](#) (Science)—Teach the Earth
- ◆ [Mapping Air Pollution in Oakland, CA, worksheet](#) (ELA, Health, Geography, Social Studies/Civics, Science)—SubjectToClimate
- ◆ [Whirling Swirling Air Pollution](#) (Science)—Environmental Protection Agency (EPA)



WATER QUALITY

PreK–Grade 2

- ◆ [Water Pollution Demonstration activity](#) (Science)—National Agriculture in the Classroom
- ◆ Plastic art projects (Art, Science)*

Grades 3–5

- ◆ [Where does my drinking water come from?](#) (Science)—Idaho Department of Environmental Quality
- ◆ [What is Ground Water Contamination?](#) (Science)—Idaho Department of Environmental Quality
- ◆ [Where's Your Watershed?](#) (Social Studies, Science, Geography/Environmental History)—Idaho Department of Environmental Quality

Grades 6–8

- ◆ [From Contaminated to Clean: How Filtering Can Clean Water](#) (Science)—Science Buddies
- ◆ [Pollution and a Healthy Environment: Like Oil and Water](#) (ELA, Health, Geography/Social Studies, Science)—Idaho Department of Environmental Quality
- ◆ [Water Filtration Methods with Activated Charcoal](#) (Science)—Science Buddies
- ◆ [Washed Ashore Integrated Arts Marine Debris Curriculum](#) (Art, ELA, Social Studies, Science)—National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program

Grades 9–12

- ◆ [Predicting Future Water Quality with Machine Learning](#) (Environmental Science, Artificial Intelligence)—Science Buddies
- ◆ [The Science and Civics of the Flint Water Crisis](#) (STEAM)—TeachRock

* For younger students, you can tailor some of the activities for older students on marine plastic debris. One example is the [Washed Ashore Integrated Arts Marine Debris Curriculum](#) from the National Oceanic and Atmospheric Administration (NOAA). Search the web for ideas on plastic art projects. Create a lesson series on collecting plastic waste, and learning what plastic is and how long it lasts. Students could create art that represents sea life or other topics. Consider having students do the art projects in their homes for quicker cleanup.



HEAT

PreK–Grade 2

- ◆ [Do Different Colors Absorb Heat Better?](#) (STEAM)—ncwit.org | Teach Engineering
- ◆ [Observing Schoolyard Surfaces—Energy: Sunlight](#) (Physical Science, Engineering)—OpenSciEd

Grades 3–5

- ◆ [How Much Heat Will It Hold?](#) (STEM)—ncwit.org | Teach Engineering
- ◆ [Our Sun and Heat Transfer Basics: Heat It Up!](#) (STEM)—ncwit.org | Teach Engineering
- ◆ [It's Really Heating Up in Here!](#) (Science and Technology)—ncwit.org | Teach Engineering

Grades 6–8

- ◆ [Feeling the Heat—Urban Heat Island Effect](#) (Physical Science, Environmental Science)—University Corporation for Atmospheric Research (UCAR), Center for Science Education
- ◆ [Using Heat from the Sun](#) (Physical Science, Science and Technology)
- ◆ [Earth's Resources & Human Impact](#) (Earth Science, Social Studies)—OpenSciEd

Grades 9–12

- ◆ [Analyzing the Urban Heat Island Effect](#) (Science)—NYC Environmental Protection
- ◆ [Role-Play Exercise: Who Will Take the Heat?](#) (Social Studies)—(Public Broadcasting Services [PBS])

Phase 5: Communicate What You Find

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Share the findings from completed student projects with your community and the public. This is an important last step in using a school citizen science approach to school environmental health. Use the **PRACTICE GUIDE 4** to do the following:

- ◆ **Raise awareness about the school and community environmental issues that students have identified.** This will broaden the impact of your projects.
- ◆ **Gather local support to address these issues.** Local supporters could help develop school environmental health policies, get funding, and carry out school environmental health programs.

Summary

Students, teachers, and school staff need a healthy school environment to succeed. Citizen science and civics projects give the school community a chance to engage in real-world learning. These projects allow students to investigate important environmental topics that can improve the physical health of their school.

This guide presents several classroom and curriculum resources. Teachers and students can use these resources to explore environmental topics of interest

and engage in citizen science. Use the other practice guides in the series to learn about your school's environmental health issues and make a feasible plan to address them ([PRACTICE GUIDE 1](#)); get the funding you need for your program ([PRACTICE GUIDE 3](#)); and communicate with your school community to create and sustain feasible programs that can benefit students' educational experiences and academic outcomes ([PRACTICE GUIDE 4](#)).

Resources



Use the following resources for environmental learning and instruction. Examples of resources include the environmental health impact of school building materials, playground surfaces, pests, and soil. Some resources focus on creating suitable educational environments and supporting teachers.

These materials can be useful across content areas to supplement your curriculum development and instruction. They also can help teachers integrate environmental health subject matter into their instructional practices in the long term by going beyond a stand-alone topic or single semester project. Table 3 includes examples of community-school partnerships and implementation of environmental education at the city and state levels. Teachers also can use the screening and mapping tools and the data sources in the [PRACTICE GUIDE 1 RESOURCES TABLE](#).

Table 3. Curriculum Resources for Environmental Learning

CURRICULUM RESOURCE	DESCRIPTION
Toolbox for Teaching Climate & Energy NOAA	Resources from educational and science programs that support climate-focused learning.
CLEAN Collection	A collection of climate and energy lesson plans and educational resources.
SubjectToClimate Teaching Resource Library	A climate education resource library that can be searched by grade, subject, resource type, and more.
Citizen Science Toolkit California Academy of Sciences	A guide for teaching science through citizen science that includes lessons, worksheets, and reading materials.
ClimeTime Climate Science Learning	Instructional materials for classroom and professional climate science learning linked to the Next Generation Science Standards (NGSS).
OpenSciEd	NGSS-aligned science materials developed for classroom learning by science educators and researchers.

CURRICULUM RESOURCE	DESCRIPTION
<u>Science Buddies Hands-On Science Resources for Home and School</u>	A collection of science projects, project guides, and activities for students.
<u>FieldScope BSCS Science Learning</u>	An interactive learning platform that promotes engagement in citizen science for educators, community members, and organizations.
<u>Environmental Health Science Education</u>	A website with classroom curricula for educators, scientists, and students from the National Institute of Environmental Health Sciences (NIEHS).
<u>Project Citizen</u>	A program developed by the Center for Civic Education to build civic education and engagement among young people in the United States. Using high-quality instructional resources, students work together to investigate problems in their local community and identify policy solutions.
<u>Austin Independent School District (ASID) Outdoor Learning and Sustainability</u>	A partnership with the National Wildlife Federation that began in 2010 and increased students' interest and engagement in science and teachers' use of citizen science practices. This project has led to an ongoing commitment to outdoor learning after COVID 19 pandemic-related school closures. The project leverages community networking and collaboration and has established policies, outdoor learning spaces, and educator professional development resources, like EcoRise.
<u>California Regional Environmental Education Community (CREEC) Network</u>	California's State Board of Education launched the California Regional Environmental Education Community (CREEC) Network in 2003 to make environmental literacy a core part of the state's K–12 instructional standards. Since then, the state has launched several initiatives to promote environmental awareness in a comprehensive way.
<u>NYC Climate and Energy Education—Green Design Lab</u>	Many New York City schools have adopted solar energy projects, sustainability curricula, and environmental service-learning opportunities in partnership with the solar development firm Solar One. This partnership provides free professional learning programs for teachers of grades 3–12, access to curricula aligned with New York State standards, and free classroom materials to facilitate climate and energy education. It is a model for collaborative scientific learning between companies, communities, and schools.

Endnotes

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- ⁷ van Noordwijk, C. G. E., Bishop, I., Staunton-Lamb, S., Oldfield, A., Loiselle, S., Geoghegan, H., & Ceccaroni, L. (2021). Creating positive environmental impact through citizen science. In K. Vohland, A. Land-Zandstra, L. Ceccaroni, R. Lemmens, J. Perelló, M. Ponto, R. Samson, & K. Wagenknecht (Eds). *The Science of Citizen Science*. Springer, Cham. [Chapter 19: Creating Positive Environmental Impact Through Citizen Science](#)
- ⁸ van Noordwijk, C. G. E., Bishop, I., Staunton-Lamb, S., Oldfield, A., Loiselle, S., Geoghegan, H., & Ceccaroni, L. (2021). Creating positive environmental impact through citizen science. In K. Vohland, A. Land-Zandstra, L. Ceccaroni, R. Lemmens, J. Perelló, M. Ponto, R. Samson, & K. Wagenknecht (Eds). *The Science of Citizen Science*. Springer, Cham. [Chapter 19: Creating Positive Environmental Impact Through Citizen Science](#)
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1400 Crystal Drive, 10th Floor
Arlington, VA 22202-3289
+1.202.403.5000 | [AIR.ORG](#)

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