



# U.S. EPA Citizen Science



## Citizen Science Initiatives at EPA

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# U.S. EPA National Risk Management Research Laboratory (NRMRL)



EPA's Office of Research and Development (ORD) NRMRL Lab is in Cincinnati, Ohio. Our mission is to advance scientific and engineering solutions to manage current and future environmental risks. NRMRL conducts research supporting efforts to improve air quality, manage chemical risks, clean up hazardous waste sites, and protect America's water.

NRMRL has 4 divisions:

- Air and Energy Management Division (AEMD)
- Groundwater, Watersheds, and Ecosystems Restoration Division (GWERD)
- Land and Materials Management Division (LMMD)
- Water Systems Division (WSD)





## National Advisory Council for Environmental Policy and Technology (NACEPT)

U.S. EPA established NACEPT in 1988 to provide independent advice to the EPA Administrator on environmental policy, technology and management issues including citizen science.

- EPA published a 2016 NACEPT Report: “Environmental Protection Belongs to the Public, A Vision for Citizen Science at EPA”  
[https://www.epa.gov/sites/production/files/2016-12/documents/nacept\\_cs\\_report\\_final\\_508\\_0.pdf](https://www.epa.gov/sites/production/files/2016-12/documents/nacept_cs_report_final_508_0.pdf)
- The Report contains 13 robust recommendations regarding actions that EPA should take in response to technological and sociological developments in the area of citizen science.
- The Report urges EPA to embrace citizen science and capacity building initiatives that further advance the agency's mission of protecting the environment and human health and helps frame the issues - technical, policy , and social - that need attention.





## National Advisory Council for Environmental Policy and Technology (NACEPT)

The Council's 28 members—representatives of academia, business and industry, nongovernmental organizations, as well as state, local and tribal governments. NACEPT recommends that EPA:

- Embrace citizen science as a core tenet of environmental protection.
- Invest in citizen science for communities, partners and the Agency.
- Enable the use of citizen science data at the Agency.
- Integrate citizen science into the full range of work of EPA.

For instance, the NACEPT Information to Action Workgroup is collecting information on how to work and produce citizen science projects with informal communities.

I was interviewed about my perceptions about citizen science and the future of citizen science as a tool for US EPA in 2017.





## ORD Citizen Science Initiative in EPA Regions and States



EPA is already implementing some of the NACEPT Report recommendations. The Office of Research and Development has a new initiative for regional projects that use innovative approaches, including citizen science, for regional and state science priorities.

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## Ten Principles of Citizen Science

Citizen science programs and projects:

- 1) Actively involve citizens in scientific endeavor that generates new knowledge or understanding.
- 2) Have a genuine science outcome.
- 3) Provide benefits to professional scientists and citizen scientists.
- 4) Allow citizen scientists to participate in multiple stages of the scientific process.
- 5) Allow citizen scientists to receive feedback from the project.
- 6) Involve a research approach like any other, with limitations and biases that should be considered and controlled for.
- 7) Produce data and meta-data that are made publicly available and where possible, results are published in an open access format.
- 8) Allow citizen scientists to be acknowledged in project results and publications.
- 9) Are evaluated for their scientific output, data quality, participant experience and wider societal or policy impact.
- 10) Take into consideration legal and ethical issues surrounding copyright, intellectual property, data sharing agreements, confidentiality, attribution, and the environmental impact of any activities.



# NRMRL Citizen Science Initiative 2017

Advancing NRMRL Research through Public Engagement

In May of 2017, EPA's Innovation Team announced the selection of three projects for seed funding in the NRMRL Citizen Science Initiative

- 1) **Using Citizen Science to Improve Drinking Water Epidemiology Studies**  
Craig Patterson, Shannon Griffin, Jorge Santo Domingo, and Mark Bagley
- 2) **Engaging Citizens to Mitigate HABs**  
Nicholas Anastas, Hale Thurston, and Hilary Snook
- 3) **K-12 Crowdsourcing to Monitor Private Wells and Assess Contaminant Sources**  
Fran Kremer, Andrew Murray, Mark Rodgers, and Jim Weaver





# Citizen Science Project I

## Using Citizen Science to Improve Drinking Water Epidemiology Studies



Craig Patterson, Shannon Griffin, and  
Jorge Santo Domingo,  
USEPA, ORD, Cincinnati, Ohio  
Cristina Maldonado,  
USEPA Region 2, San Juan, Puerto Rico  
Raghu Venkatapathy,  
Pegasus Technical Services, Inc., Cincinnati, OH  
Graciela Ramirez, Melitza Crespo,  
Interamerican University, Puerto Rico



Citizen Science Community Meetings in Puerto Rico





# Community Drinking Water Projects Patillas, Puerto Rico (Since 2013)



Conventional Treatment and UV System Studies, Upper Source, Apeadero, Puerto Rico



Biosand Filters, Lower Source, Apeadero, Sand Filter/UV System Studies, La Sofia, Puerto Rico





# Community Volunteer Assistance and Citizen Science







# Community Volunteer Training and Citizen Science







# Community Volunteer Training for Analysis of Bacteria in Drinking Water



An IDEXX Quanti-Tray System provided by EPA Region 2 for Citizen Science Studies



Analyst	Sample ID	Readings 2Aug17			Readings from 3Aug17					
		UV		E. coli	Light		UV		Total Coliforms	E. Coli
		Large Cells	Small Cells	/100 mL	Large Cells	Small Cells	Large Cells	Small Cells	/100 mL	/100 mL
EPA	Blank	0	0	<1	0	0	0	0	<1	<1
EPA	Lower Source	30	2	47.1	49	13	42	3	152.3	90.5
CS	Lower Source	37	2	67	49	4	44	2	158.5	99.1
EPA	Biosand Filter	11	0	12.2	49	9	14	1	195.6	17.3
CS	Biosand Filter	9	0	9.8	48	16	14	0	228.2	16.1
EPA	After Lower Source	20	2	27.5	48	10	22	2	178.9	30.9
CS	After Lower Source	19	3	27.2	49	21	28	4	365.4	45.7
EPA	Tap Location	22	3	32.3	49	16	31	4	275.5	52.9
CS	Tap Location	18	0	21.8	48	5	22	0	148.3	28.2
EPA	Upper Source	21	0	26.5	8	0	4	0	8.6	4.1
CS	Upper Source	33	2	54.8	41	9	42	0	101.4	82.6
EPA	Water Boy	16	1	20.1	24	1	17	1	31.7	21.6
CS	Water Boy	7	0	7.5	13	0	9	0	14.8	9.8
EPA	Upper Storage	0	0	<1	0	0	0	0	<1	<1
CS	Upper Storage	0	0	<1	0	0	0	0	<1	<1
EPA	Tap Location	0	0	<1	0	0	0	0	<1	<1
CS	Tap Location	0	0	32.3	0	0	0	0	0	0



# Water System Damage After Hurricane Maria



Before Maria



After Maria





# Using Citizen Science to Improve Drinking Water Epidemiology Studies

This citizen science project

- Investigates the incidence and type of gastrointestinal illness using fecal and saliva tests in rural communities in Puerto Rico without municipal drinking water treatment plants,
- Inspires 4th to 6th grade school children (non-experts) to actively participate in targeted studies to improve their health and understanding of water treatment,
- Relies on input from grade school science teachers, and
- Requires the development of communication materials.



*Source: StudyCountry.Com*



*Source: Cienciapr.Org* | 4



# Using Citizen Science to Improve Drinking Water Epidemiology Studies

The citizen science project will be based in Puerto Rico with EPA analytical support in Cincinnati, Ohio

- Studies of waterborne disease usually rely on self reported symptoms (diarrhea, vomiting, cramping, etc.)
- Parents and 4th to 6th grade school children will report gastrointestinal illness to the school office and/or science teachers to trigger follow-up fecal and saliva tests in impacted school districts.
- The incidence of illness will then be linked to specific EPA Region 2 community water systems using SDWA sample results and violations.



Andrew W. Breidenbach Environmental Research Center Facility  
Cincinnati, Ohio



Center for Environmental Education, Conservation and Research  
San German, Puerto Rico



## Fecal Studies to Track Pathogens in 4<sup>th</sup> to 6<sup>th</sup> Grade Science Students

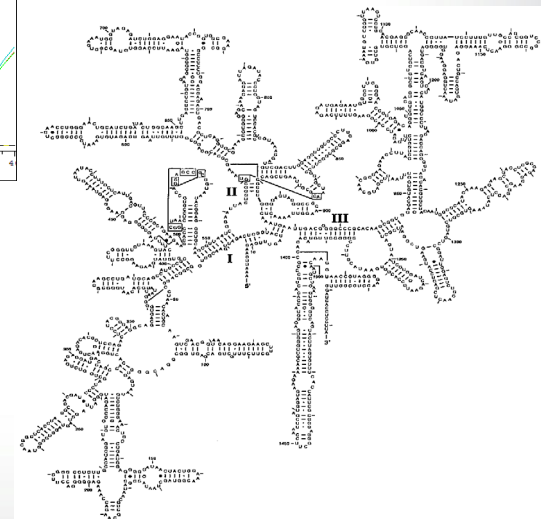
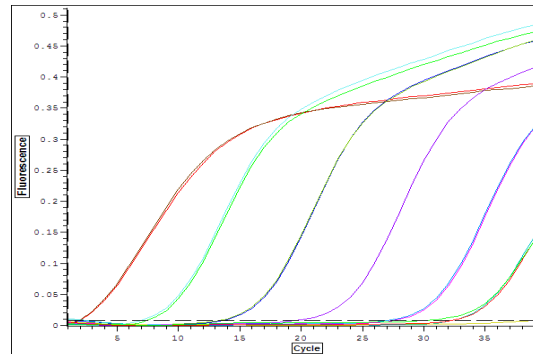
EPA NRMRL scientists will use DNA to determine the presence and relative abundance of different bacterial groups

### ➤ Next Gen Sequencing

- 16S rRNA gene
- Metagenomics

### ➤ PCR and qPCR assays

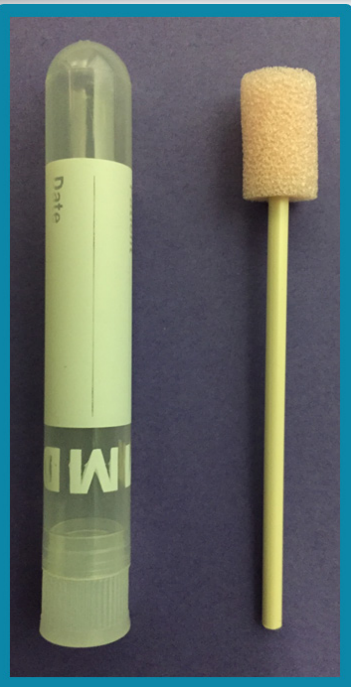
- Pathogen specific gene assays
- 16S rRNA gene group and genus specific assays



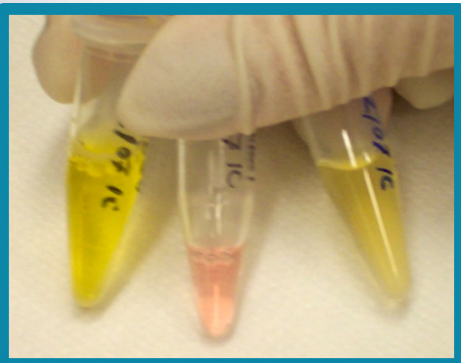




## Saliva Studies to Track Pathogens in 4<sup>th</sup> to 6<sup>th</sup> Grade Science Students



- Saliva samples will be analyzed for antibodies as non-invasive indicators of infection with various waterborne pathogens using an innovative Luminex microbead assay developed by EPA NERL scientists.
- Saliva is an inexpensive and safe alternative that is easy to collect (especially with children who are more susceptible to waterborne disease than adults).
- Students will serve as citizen scientists to self-collect saliva samples and fill out health diaries.
- EPA scientists will estimate incidence of infection to evaluate associations between community health and drinking water treatment.





# Using Citizen Science to Improve Drinking Water Epidemiology Studies

The anticipated outcomes of this project are to provide

- A direct link between community health and drinking water treatment using citizen science in underserved communities in rural Puerto Rico and
- A model for similar citizen-supported epidemiology studies throughout the U.S with the impetus for installation of adequate filtration and disinfection treatment processes for SDWA compliance.



*Source: New York Times*



*Source: NewsIsMyBusiness*

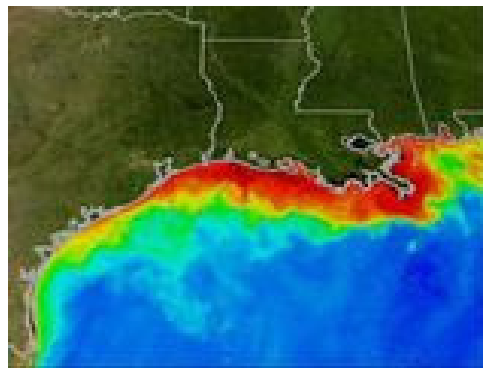




# Citizen Science Project 2

## Engaging Citizens to Mitigate HABs A USEPA and US Coast Guard Auxiliary (USCGA) Partnership

Nicholas Anastas, Hale Thurston, and Hilary Snook



### Expected Outcomes

- Engage a national group of mariners dedicated to protecting marine and freshwater resources
- Begin with 3-5 flotillas identified through discussions among EPA expert staff
- Sample and collect data to augment EPA efforts to monitor and manage Harmful Algal Blooms
- Provide training that generates increased knowledge and participation among USCGA members
- Develop a critical identification tool (“Dirty Dozen” taxonomic ID tool)



# Citizen Science Project 3

## **K-12 Crowdsourcing to Monitor Private Wells and Assess Contaminant Sources**

Fran Kremer, Andrew Murray, Mark Rodgers, and Jim Weaver

This project is working with high school STEM classes to assist students and families in assessing water quality in homes with private drinking water wells.

- EPA is providing education modules on the importance of water quality to their health, on low-cost sampling equipment, and on collecting water quality information from their homes.
- The data collected is being used to assist homeowners in protecting their water supply and is also providing useful temporal and spatial data on localized and watershed-level impacts to this drinking water source to improve public health.
- The project can be used as a model for other schools or communities to further replicate, building on an existing watershed or a new watershed.

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# Questions?

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