CELEBRATING CITIZEN SCIENCE

PUBLIC PARTICIPATION IN SCIENCE AND TECHNOLOGY

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Wilson Center COMMONS LAB

Definitions

In the United States

- A collaboration where the public participates in scientific research to meet real world goals (Bowser & Shanley, 2013)
    - Typically designates large scale data collection driven by scientific researchers

In the UK (and Europe, and Africa…)

- A model of civic involvement where the public understanding of science informs and shapes scientific research (Irwin, 1995)
    - Typically designates public involvement in science to drive policy goals

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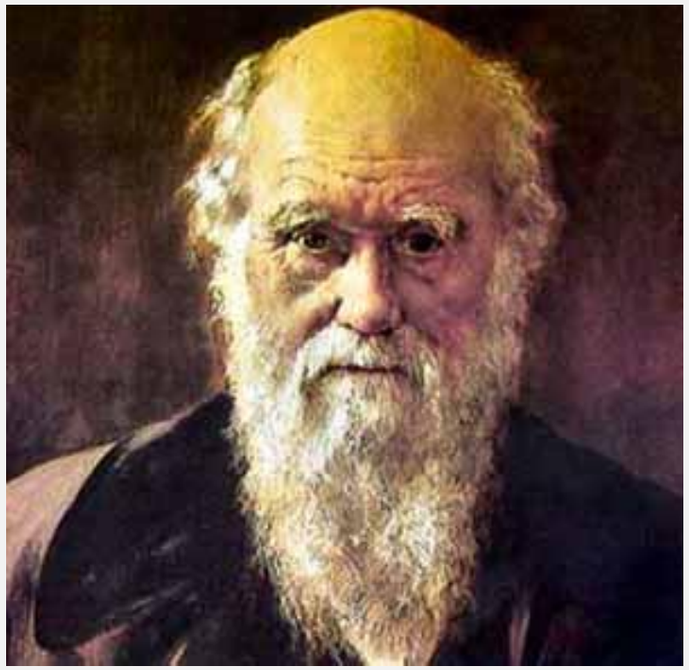
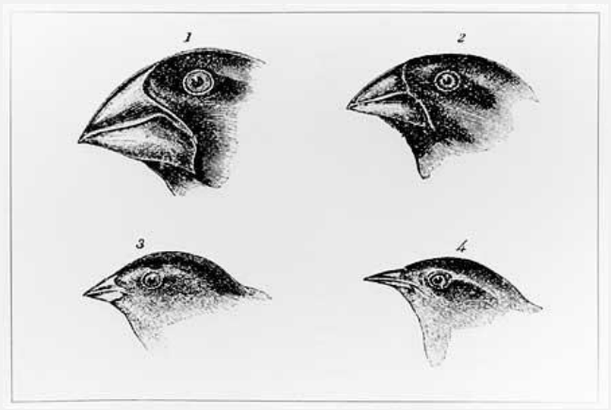
A time honored tradition





Darwin and other humans

*Citizen scientists **do science** outside a formal setting.*
Some have scientific training; others do not.

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A changing tradition

Level 4: Extreme Citizen Science

- Truly collaborative science

Level 3: Participatory Science

- Participation in problem definition and data collection

Level 2: Distributed Intelligence

- Citizens as interpreters

Level 1: Crowdsourcing

- Citizens as sensors; volunteer computing

New Technologies, new models

Citizen science is growing, facilitated by new technologies, and changing to include different types of models.

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Three Exemplar Projects

Galaxy Zoo: Virtual citizen science to classify galaxies (Oxford University)

Celebrate Urban Birds (CUBS): Birds in underserved communities (Cornell Lab of Ornithology)

Indigenous Observation Network Water Monitoring (Nonprofit: Yukon River Tribal Watershed Council)

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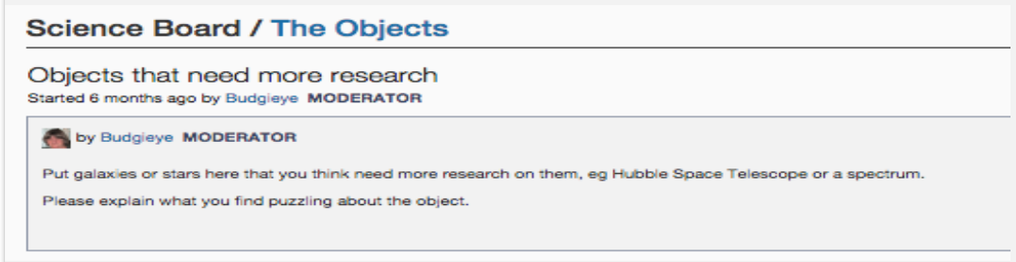
Galaxy Zoo



Platform is designed to support discovery and social interaction.

Mission/ Vision (1.0): Classify over 1 million galaxies photographed in the Sloan Digital Sky Survey.

Participation is simple: volunteers visit the website, look at pictures, answer questions.

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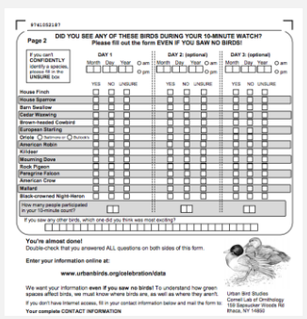
Celebrate Urban Birds

Mission/ Vision: "to reach diverse urban audiences who do not already participate in science or scientific investigation."

Engagement/ outreach through art and community.



Participation: Volunteers submit species presence/ absence data on 16 focal species (ideally 10 minutes, 3x a week).

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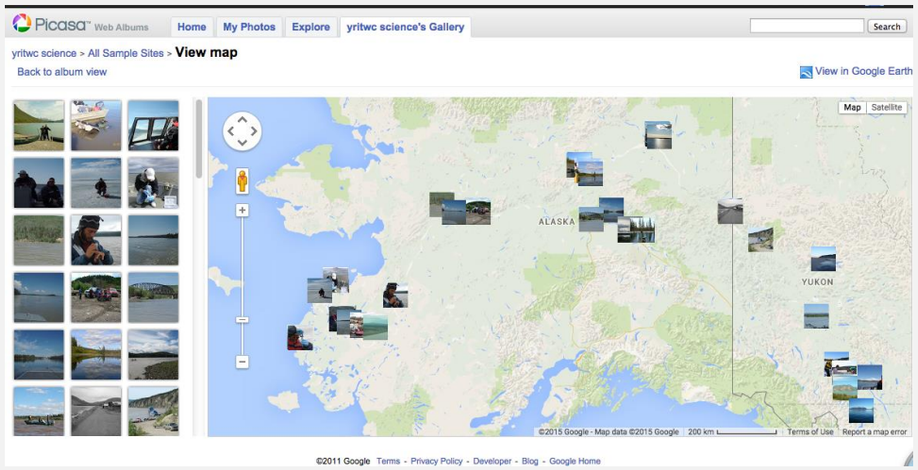
Indigenous Observation Network

Mission/ vision: “Our vision is, to put simply, to be able to drink water directly from the Yukon river.”

Participation: Volunteers collect water samples using USGS protocols..



Traditional and scientific knowledge is collected across time and place.

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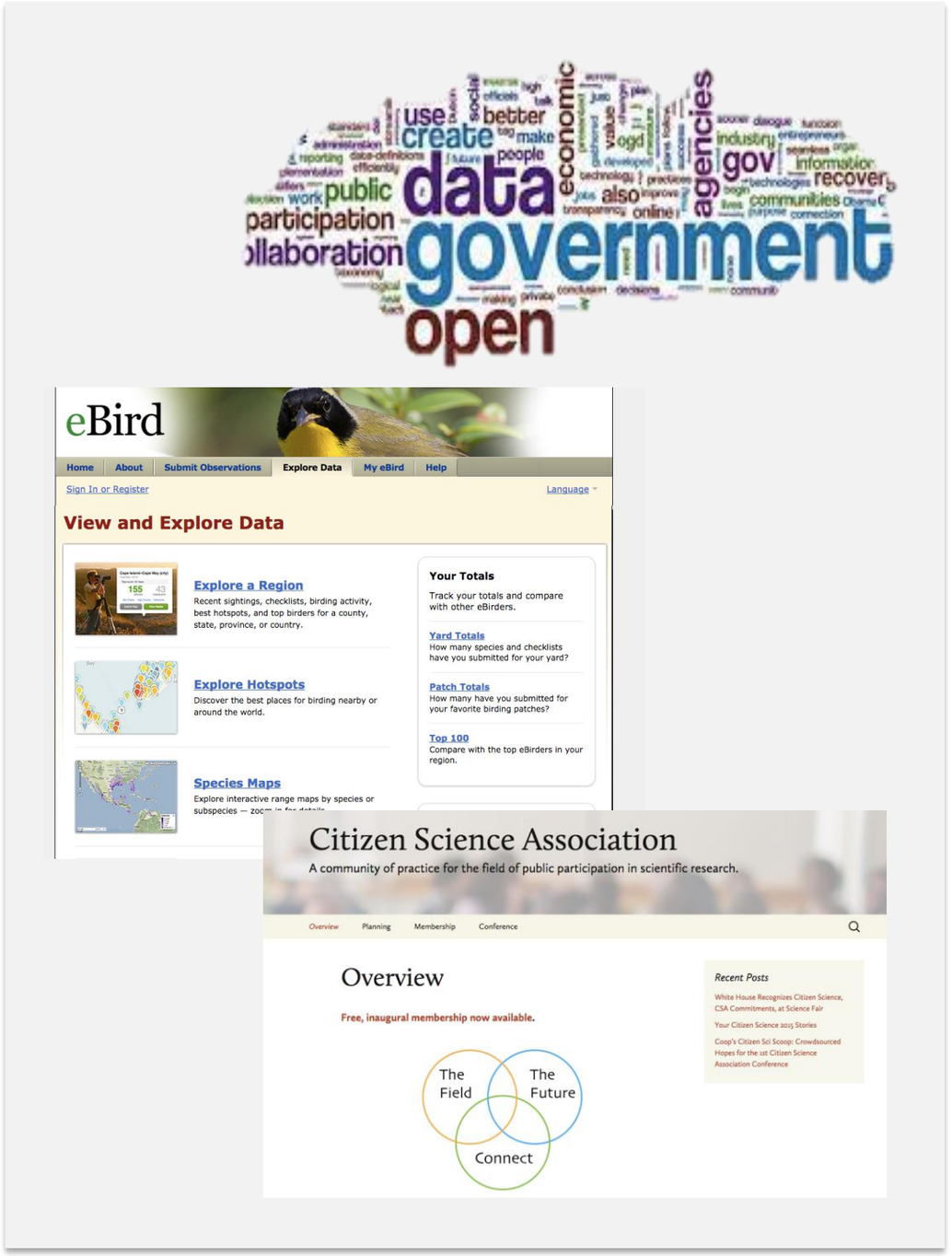
Accelerators



Can this be done? How?

New funding streams, success stories, and new tools demonstrated that citizen science is possible. Recent efforts support growth and convergence.

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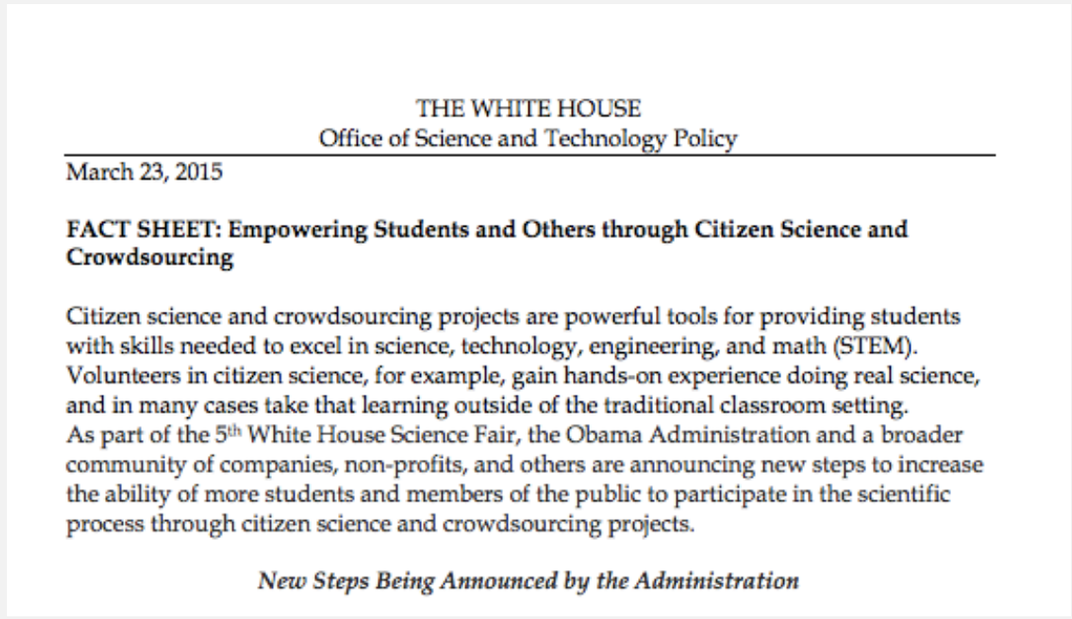
Government accelerators

THE OPEN GOVERNMENT PARTNERSHIP

SECOND OPEN GOVERNMENT NATIONAL ACTION PLAN FOR THE UNITED STATES OF AMERICA

December 5, 2013

"The administration will expand its use of crowdsourcing and citizen science to further engage the public in problem solving" (**2013**)



THE WHITE HOUSE
Office of Science and Technology Policy

March 23, 2015

FACT SHEET: Empowering Students and Others through Citizen Science and Crowdsourcing

Citizen science and crowdsourcing projects are powerful tools for providing students with skills needed to excel in science, technology, engineering, and math (STEM). Volunteers in citizen science, for example, gain hands-on experience doing real science, and in many cases take that learning outside of the traditional classroom setting.
As part of the 5th White House Science Fair, the Obama Administration and a broader community of companies, non-profits, and others are announcing new steps to increase the ability of more students and members of the public to participate in the scientific process through citizen science and crowdsourcing projects.

New Steps Being Announced by the Administration

- White house participation!
- New public-private partnerships
- Increased access to software and tools
- Support for STEM learning objectives **(2015)**

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Sticks-in-the-mud

Barriers for advancing the field

Research needed on data quality; limitations to funding and government support; duplication, communication; different models of participation.

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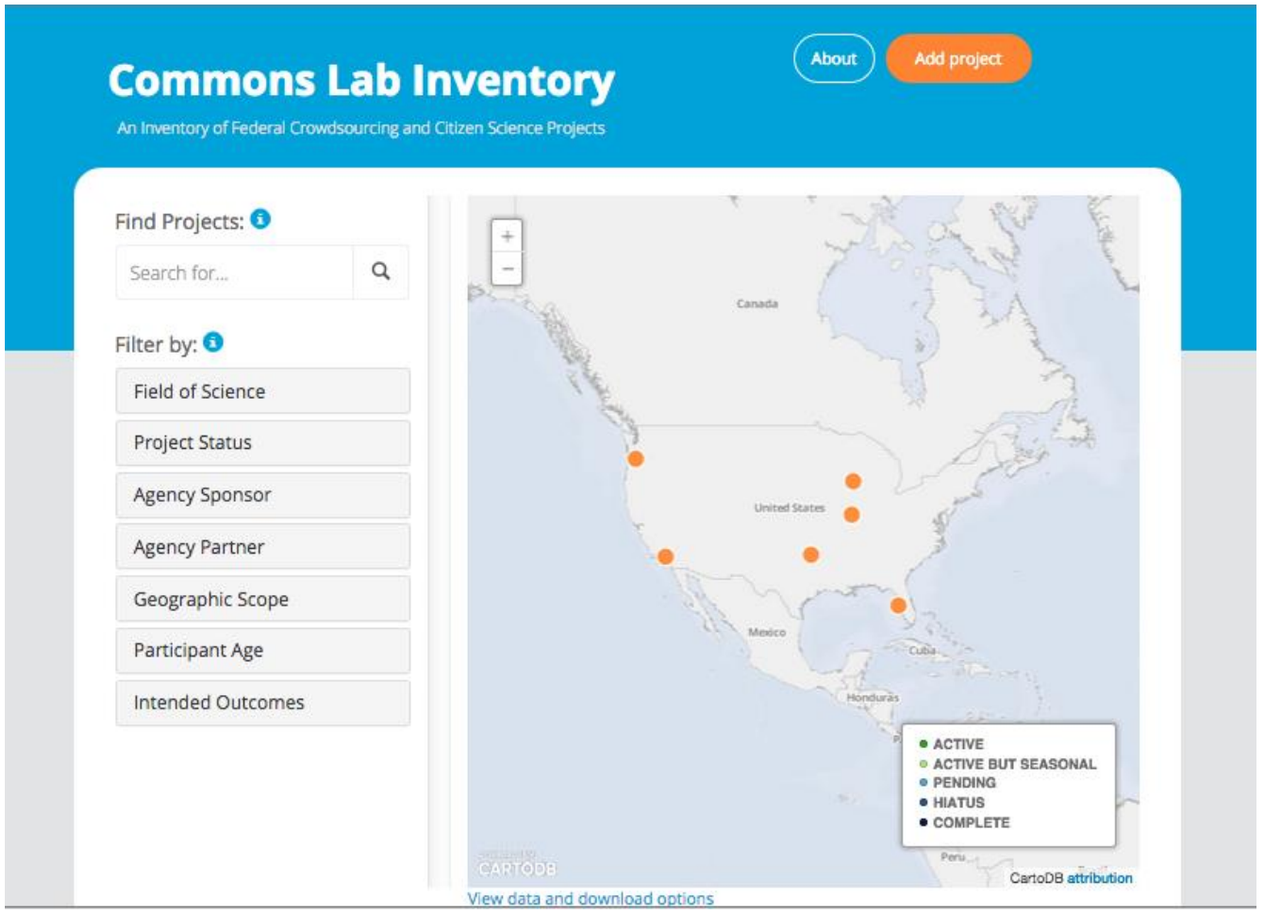
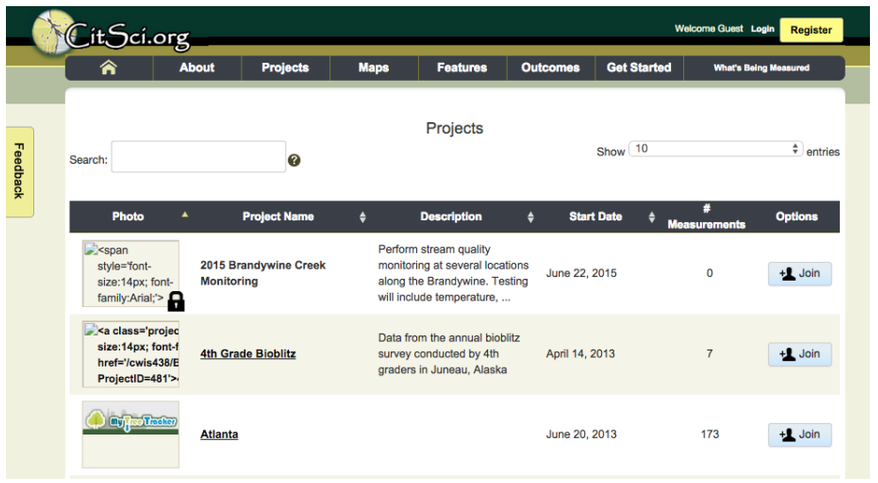
Citizen science inventories





Share resources, reduce duplication

- *Commons Lab:* Federal citizen science
- *Scistarter:* Supporting volunteers
- *Citizen Science Central (CSA):* practitioners
- *CitSci.org:* Ecological projects AND data!

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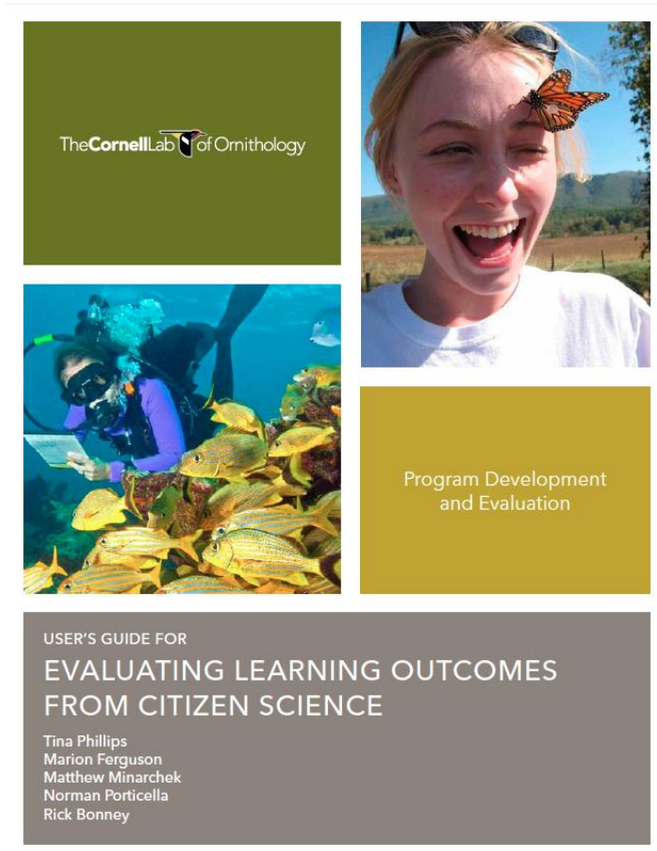
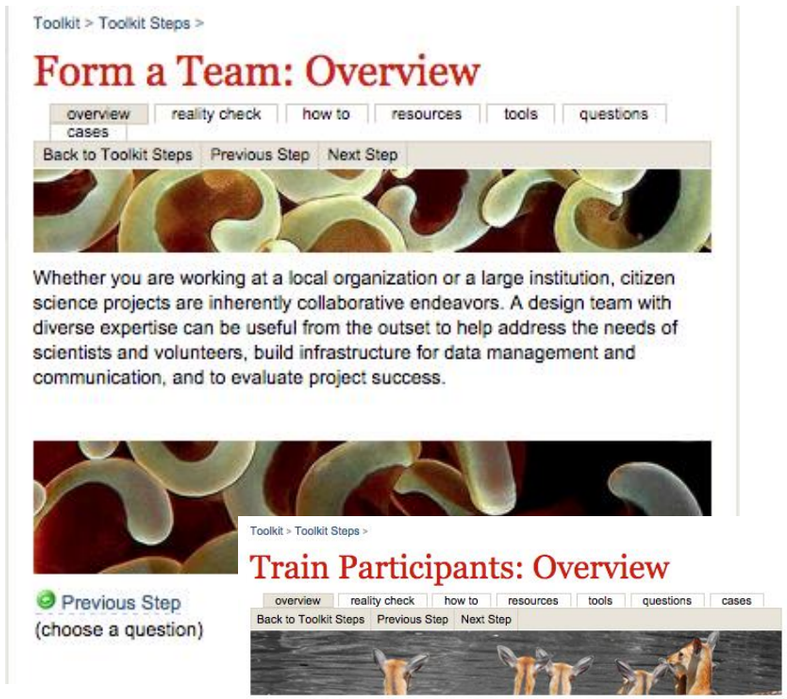
Sharing resources





Citizen Science Central

White papers on data management, data policy, etc; Evaluating learning outcomes; toolkit; bibliography.

http://www.birds.cornell.edu/citscitoolkit

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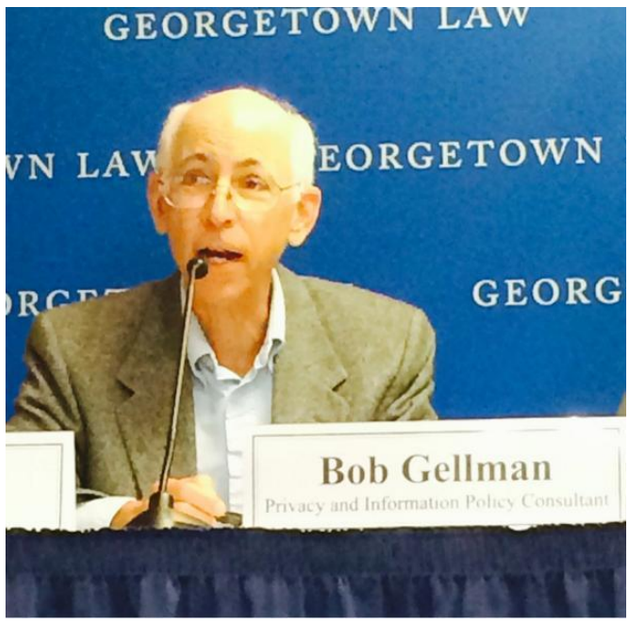
Working with(in) the Government

Commons Lab Publications

Case studies of citizen science and open innovation; citizen science and policy; typology of IP issues; legal barriers (including PRA)

http://www.wilsoncenter.org/publication-series/commons-lab



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Research and Best Practices

Overarching Position Papers

Silvertown, J. (2009). A new dawn for citizen science. *Trends in Ecology & Evolution, 24*, 9, 461-471.

Silvertown identifies three trends responsible for the recent surge of interest on citizen science. These include the recognition of volunteers as a key source of labor, the emergence of new technologies, and the inclusion of a “public outreach” component in grant calls from agencies like NSF.

Newman, G., Wiggins, A., Crall, A., Graham, E., Newman, S. and Crowston, K. (2012). The future of citizen science: Emerging technologies and shifting paradigms. *Frontiers in Ecological Environments,* 10, 6.

Building on Silvertown’s work (2009), researchers explore how emerging technologies will drive citizen science research and practice in the coming decade. They note that technology will support new models of participation in building teams, defining research questions, collecting data, and analyzing data

Mueller, M., Tippins, D., and Bryan, L. (2013). The future of citizen science. *Democracy & Education,* 20.1 (2013), 1-12.

This paper explores citizen science in the context of formal and informal education. The authors argue that citizen science does not go far enough in addressing community concerns, and suggest that a fully realized model of citizen science may place volunteer goals at odds formal authorities.

Bonney, R., Shirk, J., Phillips, T., Wiggins, A., Ballard, H. & Parrish, J. (2014). Next Steps for Citizen Science. *Science,* 343, 1436-1437.

This article outlines important considerations, such as advocating for the quality of data produced by volunteers, which must be met in order to advance the field. The authors also state the need for an emerging Citizen Science Association and a National Centers of Excellence.

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Research and Best Practices

Models of Participation

Bonney, R., Ballard, H., Jordan, R., McCallie, E., Phillips, T., Shirk, J., and Wilderman, C.C. (2009a). *Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education*. Technical Report. Center for Advancement of Informal Science Education.

> The authors define and study *contributory projects*, where volunteers largely contribute data to projects designed by scientists; *collaborative projects*, which also involve volunteers in data analysis or interpretation; and *co-created projects*, designed by scientists and volunteers working together.

Haklay, M. Citizen science and volunteered geographic information—overview and typology of participation. In Sui, D., Elwood, S. and Goodchild, M. (eds)., *Crowdsourcing Geographic Knowledge: Volunteered Geographic Information (VGI) in Theory and Practice.* Springer: Berlin, 2013.

> Haklay introduces four levels of citizen science, beginning with crowdsourcing and ending with extreme citizen science (see: Slide 4).

Wiggins, A. and Crowston, K. 2011. From conservation to crowdsourcing: A typology of citizen science. In *Proceedings of the 44th Hawai'i International Conference on System Science* (Koloa, HI, January 4-7, 2011). HICSS ’11. Computer Society Press.

> Bonney and his colleagues considered projects based on level of volunteer involvement in the research process. Wiggins and Crowston instead categorize projects based on stated goals and the role of the physical environment. They identify five types of projects including: Action, Conservation, Investigation, Virtual, and Education.

Research and Best Practices

Impacts & Opportunities

Brossard, D., Lewenstein, B. & Bonney, R. (2005). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education,* 27, 9, 1109-1121.

This paper evaluates the Birdhouse Network, a project hosted by the Cornell Lab of Ornithology. Researchers found an increase in topical knowledge through participation, but not an enhanced understanding of the scientific process or attitude changes. This demonstrated the need for more research on impacts.

Lintott, C., Schawinski, K., Slosar, A., Land, K., Bamford, S., Thomas, D., Raddick, M. J., Nichol, R., Szalay, A., Andreescu, D., Murray, P., and Vandenberg, J. 2008. Galaxy Zoo: Morphologies derived from visual inspection of galaxies from the Sloan Digital Sky Survey. *MNRAS,* 389 (September 2008), 1179-1189.

This paper reports on Galaxy Zoo, a citizen science project where over 100,000 digital volunteers classified 40,000,000 pictures taken by the Hubble Telescope to create the largest existing data set of morphological classifications. This paper demonstrates that citizen scientists can produce research quality data.

Volunteer Motivation

Raddick, J., Bracey, G., Gay, P., Lintott, C., Murray, P., Schawinski, K., Szalay, A. and Vandenberg, J. (2010). Galaxy Zoo: Exploring the motivations of citizen science volunteers. *Astronomy Education Review,* 9, 010103.

Raddick and colleagues identified 12 unique motivations for participating in Galaxy Zoo. These include established motivations such as learning and personal interest, and also unique motivations, such as vastness (i.e., “I am amazed by the vast scale of the universe”).

Rotman, D., Preece, J., Hammock, J., Procita, K., Hansen, D., Parr, C., Lewis, D. and Jacobs, D. (2012). Dynamic changes in motivation in collaborative citizen-science projects. In *Proc. of CSCW ’12.* New York, NY: ACM Press, 217-226.

Rotman and her colleague’s find that volunteer motivations are complex and change over time, with egoism playing a large role in the initial desire to participate and other motivations becoming salient later on.

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Research and Best Practices

Technology and games

Cooper, S., Khatib, F., Treuille, A., Barbero, J., Lee,J., Beenen, M., Leaver-Fay, A., Baker, D., Popovic, Z. & Foldit players (2010). Predicting protein structures with a multiplayer online game. *Nature, 466,* 5, 756-760.

Through Foldit, volunteers were able to design a protein-folding algorithm that helped explain the reproduction of PIV, a primate virus that is equivalent to HIV in humans. The developers of Foldit also demonstrate that volunteers playing the game perform as well as computers do on certain types of protein folding problems.

Prestopnik, N. & Crowston, K. (2012). Purposeful gaming and socio-computational systems; A citizen science design case. In *Proc. GROUP 2012.* New York, NY: ACM Press, 75-84.

Prestopnik and Crowston describe their experience of building multiple interfaces with various levels of gamification. “Hunt and Gather” is a natural species classification tool; “Citizen Sort” is described as a gamified platform for species classification. Forgotten Island is presented as a full immersion game.

Sullivan, B., Wood, C., Iliff, M., Bonney, R., Fink, D. and Kelling, K. (2009). eBird: A citizen-based bird observation network in the biological sciences. *Biological Conservation,* 142, 2282-2292.

In this paper, researchers explain how adding tools that add concrete value for volunteers (including digital species checklists, and visualizations of modeled eBird data) motivate continued participation.

Wiggins, A. (2012). Free as in puppies: Compensating for ICT constraints in citizen science. In *Proc. CSCW 2012.* New York: ACM Press, 251-260.

Wiggins cautions projects against adopting suboptimal ICT. She characterizes cheap and easy technological solutions as “free as in puppies,” with hidden costs in usability and data quality. This paper also includes case studies of technology used by three projects- eBird, The Great Sunflower Project, and Mountain Watch.

FOLLOW UP

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