

CELEBRATING CITIZEN SCIENCE

PUBLIC PARTICIPATION IN SCIENCE AND TECHNOLOGY

Anne Bowser

Commons Lab of the Science and Technology Innovation Program

Woodrow Wilson International Center for Scholars

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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

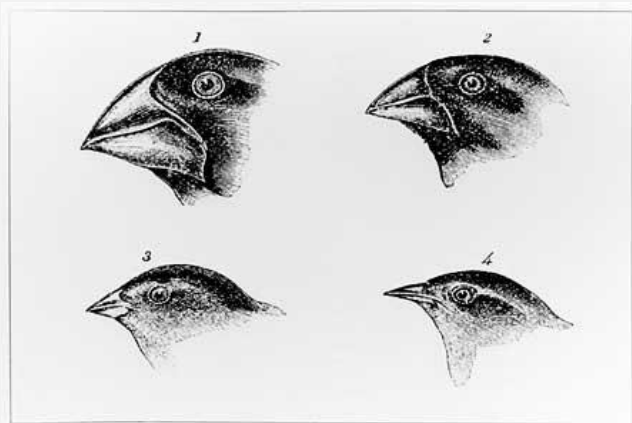
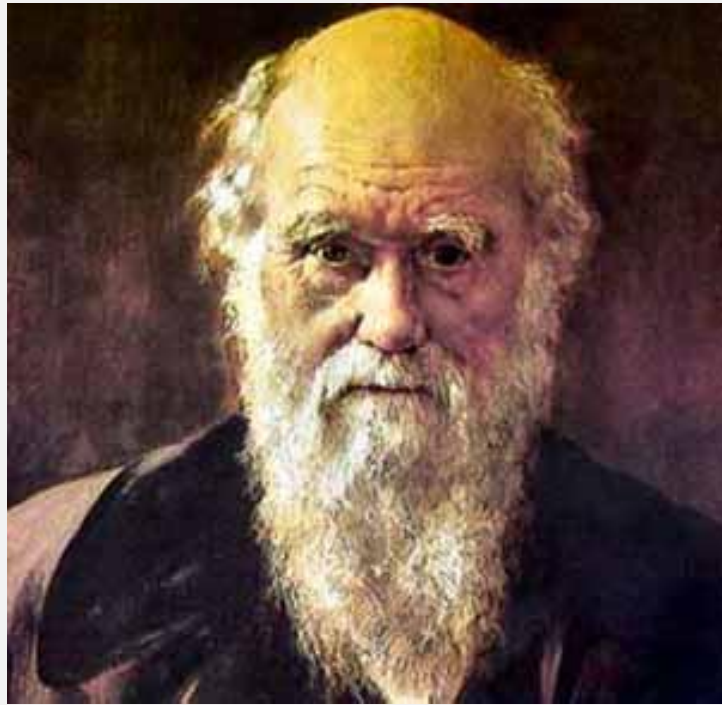


In the UK (and Europe, and Africa...)

- 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

A time honored tradition



Darwin and other humans

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

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.

Three Exemplar Projects



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

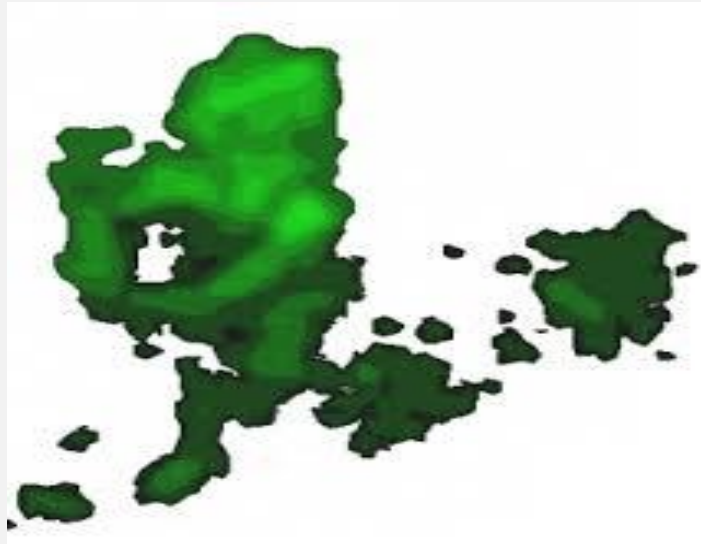


Celebrate Urban Birds (CUBS): Birds in underserved communities (Cornell Lab of Ornithology)



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

Galaxy Zoo



Science Board / The Objects

Objects that need more research
Started 6 months ago by Budgieye MODERATOR

by Budgieye MODERATOR

Put galaxies or stars here that you think need more research on them, eg Hubble Space Telescope or a spectrum.
Please explain what you find puzzling about the object.

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.

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.

A detailed data collection form titled 'Page 2 DID YOU SEE ANY OF THESE BIRDS DURING YOUR 10-MINUTE WATCH?' It includes a table for recording sightings of 16 bird species across three days (Day 1, Day 2, Day 3). The species listed are: House Finch, House Sparrow, Barn Swallow, Cedar Waxwing, American Goldfinch, European Starling, Chipping Sparrow, American Robin, Blue Jay, Mourning Dove, Rock Dove, Pouterbeak Pigeon, Rock Dove, and Pouterbeak Pigeon. The form also includes a section for 'How many people participated in your celebration?' and a 'You're almost done!' section with instructions on how to submit the data.

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

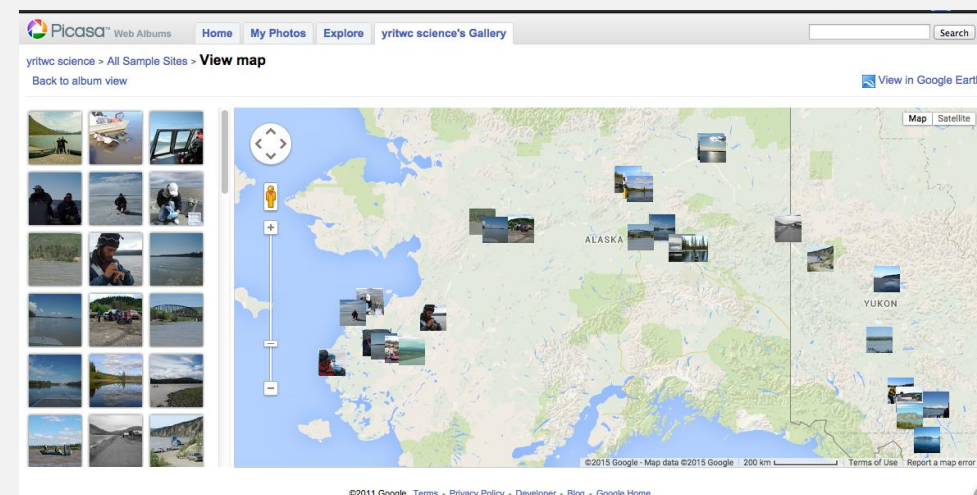
Indigenous Observation Network



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.

The collage consists of three distinct images. The top-left image is the logo of the National Science Foundation (NSF), featuring a blue globe with the letters 'NSF' in white, surrounded by a golden, stylized sunburst or molecular structure. The top-right image is the cover of the November 11, 2010 issue of the journal 'Nature', which features a colorful, abstract illustration of a protein structure and the headline 'Heading towards atoms'. The bottom image shows a disassembled Kinect v1 sensor, with various components like the camera module, motor, and sensors laid out on a white surface. A 'fixit' logo is visible in the bottom right corner of this section.

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



Government accelerators



“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)**

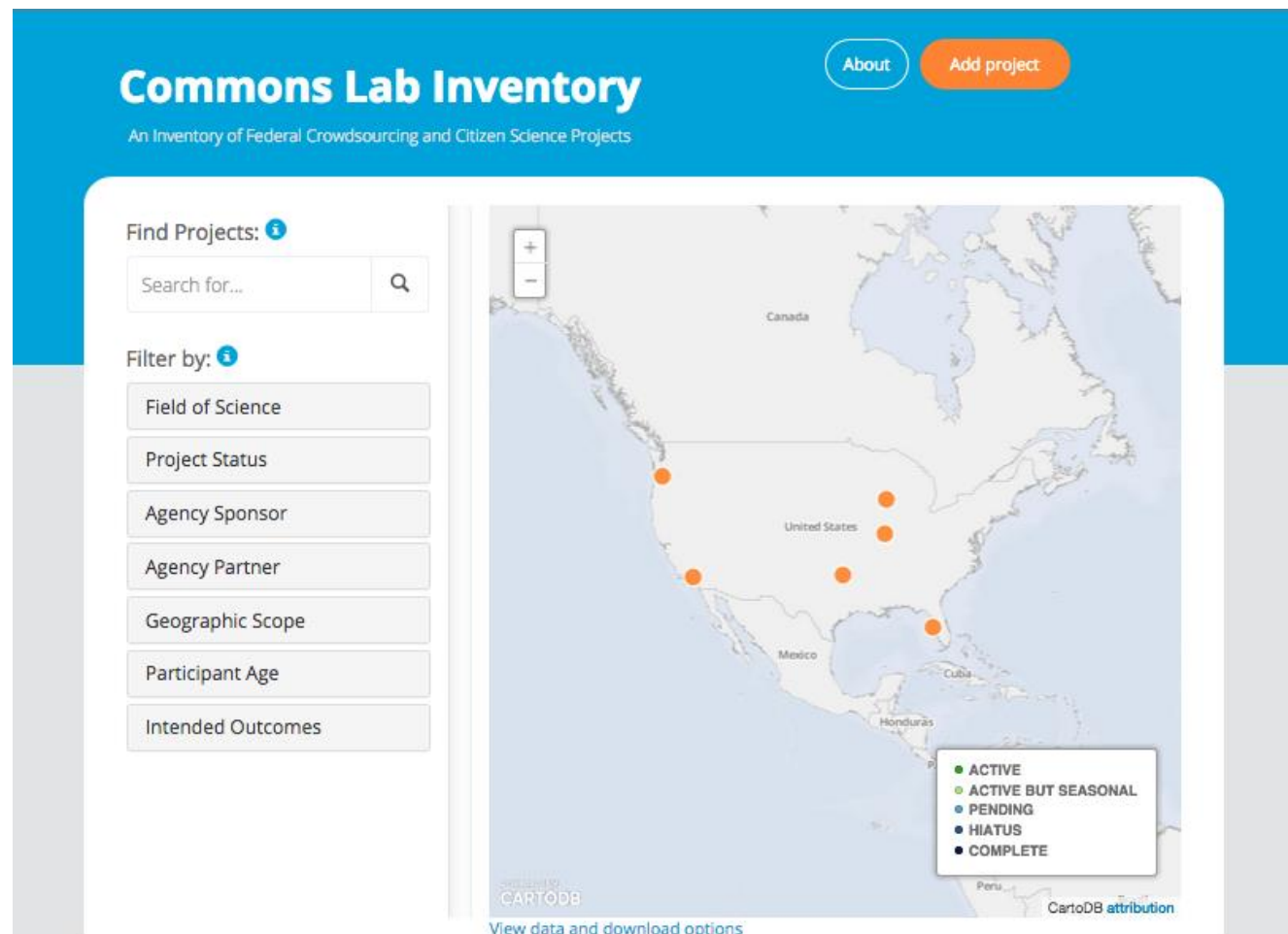
Sticks-in-the-mud



Barriers for advancing the field

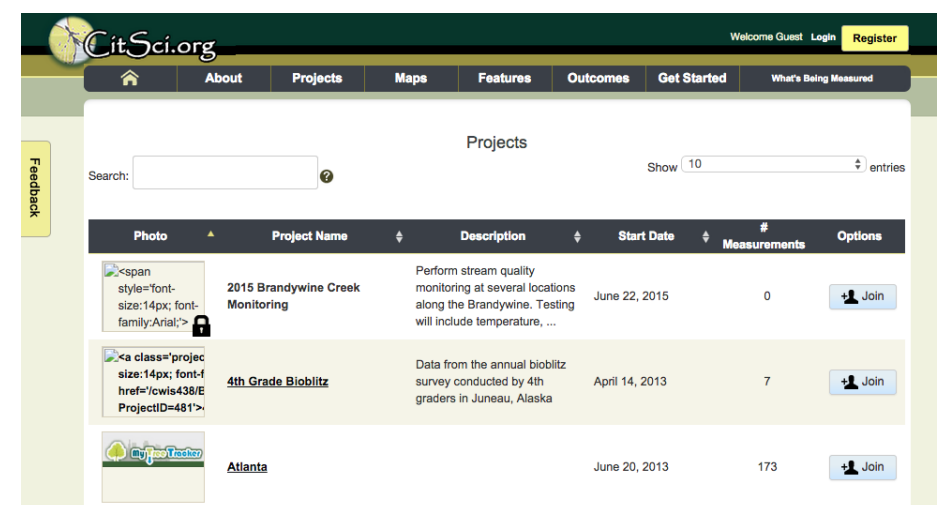
Research needed on data quality; limitations to funding and government support; duplication, communication; different models of participation.

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!



Sharing resources

Data Management Guide for Public Participation in Scientific Research

DataONE Public Participation in Scientific Research Working Group
February, 2013

Data Policies for Public Participation in Scientific Research: A Primer

DataONE Public Participation in Scientific Research Working Group
August, 2013

enney, Eric Graham, Sandra Henderson, Steve
chard Littauer, Kelly Lotts, William Michener,
ric Russell, Robert Stevenson, & Jake Weltzin

management life cycle. It includes examples from
to help project organizers optimize the quality
; result from following best practices to manage
d less time on data management and more time
practices. Better data management makes data
m, following good data management practices
king, policies, and research beyond the project's

Anne Bowser, Andrea Wiggins, and Robert D. Stevenson

Abstract

This guide introduces data policies in the context of Public Participation in Scientific Research, or citizen science. Four types of data policies are examined: user agreements, terms of use, legal policies, and privacy policies. Each is briefly explained with examples from existing citizen science projects and best practices for implementation. Practical instructions that describe how to craft data policies for citizen science projects and information on how data policies fit within the data management lifecycle are included. This guide was designed to inform project managers about data policies for their citizen science programs. Citizen science volunteers will also benefit from this guide by learning about the rights and responsibilities that their contributions entail.

The Cornell Lab of Ornithology



Program Development
and Evaluation

USER'S GUIDE FOR EVALUATING LEARNING OUTCOMES FROM CITIZEN SCIENCE

Tina Phillips
Marion Ferguson
Matthew Minarchek
Norman Porticella
Rick Bonney

Citizen Science Central

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

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

Toolkit > Toolkit Steps >

Form a Team: Overview

overview | reality check | how to | resources | tools | questions | cases

Back to Toolkit Steps | Previous Step | Next Step



Whether you are working at a local organization or a large institution, citizen science projects are inherently collaborative endeavors. A design team with diverse expertise can be useful from the outset to help address the needs of scientists and volunteers, build infrastructure for data management and communication, and to evaluate project success.



Toolkit > Toolkit Steps >

Train Participants: Overview

overview | reality check | how to | resources | tools | questions | cases

Previous Step
(choose a question)

Back to Toolkit Steps | Previous Step | Next Step



Whether you have recruited novice researchers or tapped into amateur expertise, your project will depend on volunteers' familiarity with and commitment to the data collection protocols. Striking the appropriate balance between precision in research and a rewarding experience with science may come down to how this step is handled. Look within for training resources and ideas.



Toolkit > Toolkit Steps >

Analyze Data: Overview

overview | reality check | how to | resources | tools | questions | cases

Back to Toolkit Steps | Previous Step | Next Step



Next Step
(accept data)

Having tens, hundreds, or even thousands of volunteers collecting data can increase the statistical power of research, but may also result in a large, messy data set. Dealing with such data can raise both technical and philosophical questions. Looking for sophisticated data reduction techniques? Seeking tools to make data analysis accessible to volunteers? Find tips and links to resources here.



Previous Step
(accept data)

Toolkit Steps

Next Step
(disseminate results)

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>

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.

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.

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

ANNE.BOWSER@WILSONCENTER.ORG

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