

Public Participation in Mars Exploration via Citizen Science

Addendum to the Citizen Science presentation and discussion at [MEPAG meeting 33](#) on February 22, 2017.

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With the power of the Internet, researchers can connect and enlist hundreds and even thousands of members of the public to participate and contribute to research tasks. "Citizen science" activities, in which the public contributes to the scientific process, can advance science investigations through activities that include formulating research questions, conducting scientific experiments, collecting and analyzing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems. One aspect of citizen science utilizes crowdsourcing, the combined assessment from multiple non-experts. This technique has been previously applied through all areas of astronomical research (see for Marshall et al 2015 <https://ui.adsabs.harvard.edu/#abs/2015ARA&A..53..247M/abstract> for review) and often outperforms the work of a single expert or automated routines. In the case of Mars exploration, some researcher teams have been involving the public in identifying features and mapping them in mission data.

A brief overview of four active Mars citizen science projects

- **Mars Mapper** (https://cosmoquest.org/x/?application=mars_simple_craters) - launched in June 2015 - Mapping locations and sizes of sub-km impact craters in candidate landing sites for the Mars 2020 rover and in the area around Elysium Mons and smaller associated volcanoes.
- **Planet Four** (<http://www.planetfour.org>) - launched in January 2013 - Focuses on mapping in subframes of HiRISE images the shapes, directions, and sizes of dark seasonal fans produced by carbon dioxide jets on the seasonal ice sheet on the Martian South polar region. To date over 136,000 people have participated in the project.
- **Planet Four: Terrains** (<http://terrains.planetfour.org>) - launched in June 2015 - invites members of the public to identify seasonally carved features in CTX subimages of the Martian South polar region. The main objective is to identify new locales with araneiforms, signatures of past or present carbon dioxide jet activity in addition to identifying locations with Swiss cheese terrain, and craters. Nearly 11,000 volunteers have contributed to the project, with over 1 million assessments of CTX subimages generated. The project has identified over 20 new regions of carbon dioxide jet activity followed up in the 2016-2017 HiRISE seasonal monitoring campaign.
- **Planet Four: Ridges** (<http://ridges.planetfour.org>) - launched in January 2017 - the public is enlisted to help identify whether rectilinear or polygonal ridges are present in subimages of CTX observations at Arabia Terra. Nearly 5,000 people have participated in the project generating over 1 million assessments to date.

Avenues for Pursuing Citizen Science with Mars Mission data

There are two platforms currently hosting and launching planetary science and Mars-focused online citizen science projects: the Zooniverse (<http://www.zooniverse.org>), which hosts the three Planet Four projects, and CosmoQuest (<https://cosmoquest.org>), which hosts Mars Mapper.

The **Zooniverse** is the largest online citizen science platform currently hosting 56 projects with over 100 peer-reviewed science publications derived from volunteer-generated classifications on the platform. The Zooniverse launched their project builder platform in 2015, which enables researchers to use a set of web tools to immediately build at no cost their own website and classification interface for the public to assess a set of uploaded images. Planet Four: Terrains and more recently Planet Four: Ridges were built using the Zooniverse Project Builder. More information can be found at <https://www.zooniverse.org/lab> or email contact@zooniverse.org

CosmoQuest is a Virtual Research Facility that currently hosts crater mapping citizen science projects focused on the surfaces of the Moon, Mars, Mercury, and Vesta. The platform now has a yearly call for proposals for the development of ~3 proposed planetary and astronomy citizen science projects per year. More details can be found at: <https://cosmoquest.org/x/blog/2016/08/announcing-cycle-1-request-for-research-grant-proposals/> or email cosmoquestx@gmail.com

Support for citizen science within NASA and the U.S. Government

Do you have a research project that might benefit from citizen science approaches? [NASA's Research Opportunities in the Space and Earth Sciences \(ROSES\)](#) expressly invites proposers to any ROSES program element to incorporate citizen science and crowdsourcing methodologies into their submissions where such methodologies will advance the objectives of the proposed investigation. The National Science Foundation also supports citizen science projects through a variety of grant programs.

Do you manage a citizen science project that you would like to promote to build your participant base? NASA Solve (www.nasa.gov/solve) is NASA's portal for all opportunities for the public to participate in the agency's research and development programs. If you have a project that receives NASA support or uses NASA data, contact NASA Solve manager Amy Kaminski (amy.p.kaminski@nasa.gov) to discuss getting your project posted to NASA Solve.

Want to learn more about how to set up a citizen science project of your own? Visit www.citizenscience.gov for a [toolkit](#) of tips for designing, carrying out, and sustaining citizen science projects and to read about the experiences of others who have set up projects of their own.