USING MAPS TO INCREASE PUBLIC INTEREST AND REPRESENTATION IN PLANETARY SCIENCE. S. R. Bogle, S. R. Black, and H. C. Buban, U.S. Geological Survey Astrogeology Science Center, 2255 N. Gemini Drive, Flagstaff, Arizona 86001 (sbogle@usgs.gov)

Introduction: Public perception and interest in science have remained steady for roughly the last twenty years, with most Americans having a fair-to-favorable amount of confidence in science and its institutions [1]. Despite this, following the Coronavirus pandemic, public opinions of science have faltered, with 57% of Americans believing science has a positive impact on society, down from 73% pre-pandemic [1]. As trust in scientists has fallen, distrust has grown: More than a quarter of Americans (27%) now say they have "not too much or no confidence in scientists to act in the public's best interests," up from 12% in April 2020 [1]. Additional reports have highlighted problems with diversity and representation in the sciences [e.g., 2, 3]. The National Science Foundation's (NSF) 2022 Science and Engineering (S&E) report noted a continuation of underrepresentation for bachelors-educated Blacks, Hispanics, Native Americans, and women in STEM fields, a 20% decrease in college students' enrollment in S&E fields from 2020 to 2022, and K-12 students performing barely above worldwide standards on science examinations, and below average in mathematics [3]. These are trends that have been perpetuating for many years as educational disparities continue to persist. The questions these statistics beg us to ask are not just *why* this downward spiral of public opinion and interest in science continues, but also *how* can these issues be positively addressed and influenced?

Trust in Science Communication: While scientists wax poetic about the value of science to humankind, this perspective often comes from a place of passion, intensive training, and dedication to inquiry. Science communication efforts often rely on an assumption that the public understands what goes on "behind the curtain" of scientific research, which is often not the case. Thus, the bridge of communication between scientists and the public is built on an unreliable foundation. A combination of jargon-heavy language and an increase in scientific and technical specialization requires scientific information to be not only explained and supported with reason-based facts, but also translated into plain language and engaging visual images for effective communication and public engagement [4].

Barriers: One of the largest barriers in science communication is choosing effective and succinct language that explains a topic clearly without overwhelming the reader. Science communication must strive to be accessible to all, particularly with such large gaps in science literacy in the United States [5]. Knowing this, efforts have been made to emphasize the importance of language choice in science media, such as a push for plain-language or lay-person summaries in journal articles [6].

Despite these efforts, nearly half (46%) of surveyed adult Americans believe the sciences are "too hard" to pursue as a career of interest [7], and the increase in complex multidisciplinary analyses that has followed alongside the advancement of the sciences leaves many people feeling lost in the dark [8].

Maps as Communication Tools: People tend to prefer visual over numerical data when being presented new information, even those who have low graphical literacy skills [9]. Geologic maps can be complex yet aesthetically pleasing products full of visual information, making them stand out as an outreach material compared to other scientific products. Maps capitalize on the positives of using graphical data as opposed to numerical in the best of ways- they sparingly use words to communicate results [10].

If technical language and numerical emphasis stand out as a common barrier when trying to become engaged in the sciences, geologic maps alleviate this issue by being a visually minded product. Instead of complex text, symbols, colors, and lines tell a geologic map's story. Though interpretive map texts augment a geologic map to enable a full understanding of context and history, looking at the symbology and legend of a map is often enough to understand the basic story, much like looking at a painting [11]. This is contrary to other scientific products, in which the visual media component is supplementary to the intensely technical numerical and text-based report.

Maps as Art: The links between art and science are much closer than many think, considering how many parallels exist between the two disciplines. As any geologic mapper can attest, symbols, colors, and fonts are not chosen at random [12], much like the way artists deliberate on color, texture, composition, and shading of a piece [13]. Outside of their scientific value, maps have been used to create incredible pieces of art themselves, and historically, the line between art and cartography was often blurred [14]. By engaging the artistic mindset of maps, they can be used to find common ground with people who would perhaps otherwise turn away from the sciences [15]. In fact, many artists have found cartography to be a rich resource for imagery and artistic inspiration [16]. Synthesizing art with science has tremendous positive impact on learning outcomes in schools [e.g., 15, 17] and in the success of scientific engagement initiatives independent of scholastic endeavors [e.g., 18, 19]. Engaging students in the arts is a crucial way to boost morale and interest in school [20]. The use of maps as artistic expression allows students that might not excel in the traditional subjects such as language or mathematics, and students who might be facing difficult circumstances inside or outside of school a haven to let art and science be their creative outlet [21, 22]. Not only does this provide healthy coping mechanisms and instill an appreciation for STEAM in the growing generations, but if paired with visually stimulating STEAM products, such as geologic maps, it also allows for a low-barrier entry of interest in the sciences.

Figure 1: USGS staff teaching a university level workshop on planetary GIS and geologic mapping. (2022)

Planetary Maps and Outreach: The USGS Astrogeology Science Center provides public access to paper and web-based interactive planetary geologic maps. These products can be used for various outreach programs and initiatives, with a collection of over 10,000 geologic maps available. Our resources have been used in Geographic Information Systems (GIS) and geologic mapping workshops and courses (Fig. 1), conferences (Fig. 2), local festivals, K-12 school clubs, and in art projects. Most notably at the intersection of science and art, the Museum of the Moon, a 23-ft diameter Moon sculpture was created using NASA imagery. During the sculpture's time at the Desert Botanical Gardens in Phoenix, Arizona, the USGS handed out geologic maps of the Moon to promote lunar science, which was highly successful. Other efforts have included using maps as coloring activities, scout groups exploring topographic maps of the Moon, supplying geologic maps for university students' 2D and 3D art portfolios, and using maps to teach planetary geomorphologic concepts.

The USGS provides free paper copies of maps to anyone in the United States – including students, educators, artists, space enthusiasts, researchers, and club leaders. To request a paper map for your own outreach project or to find an interactive map of interest, email sbogle@usgs.gov or visit the USGS-NASA Planetary Geologic Mapping website.

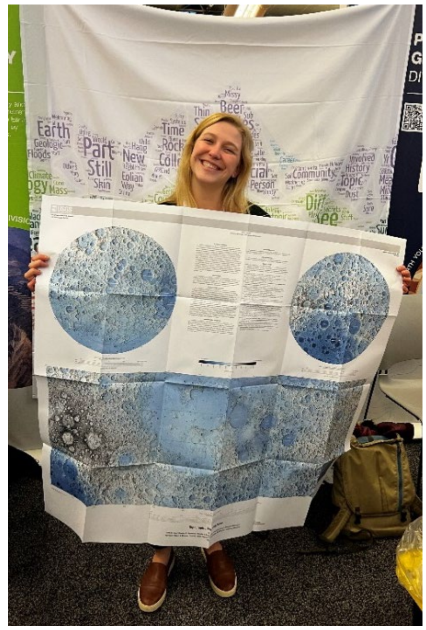

Figure 2: USGS staff showing off *USGS SIM3316* at the Planetary Geology Division booth of the Geological Society of America's Annual Conference. (2023)

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