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## **American Geophysical Union input on Improving Federal Scientific Integrity Policies**

### **Introduction**

The American Geophysical Union (AGU) is pleased to submit this RFI response to 2021-13640 on improving federal scientific integrity policies. AGU is the largest global organization covering the Earth sciences with a mission “to support and inspire a global community of individuals and organizations interested in advancing discovery in Earth and space sciences and its benefit for humanity and the environment.” Fostering integrity is a key part of our new strategic plan and past activities and we are engaged in supporting integrity broadly, including with federal agencies. Although not a focus of these recommendations, AGU has often spoken up through position statements and letters related to scientific integrity. Several examples are listed in the references.

With this perspective, we urge OSTP to consider two points that we elaborate below:

- Fostering integrity--and in turn public trust in science and science policy--requires a broad, holistic view of practices that extend beyond the typical focus on transparency and ethics to include ensuring deeper public engagement, addressing diversity and inclusivity in science and supporting the backbone infrastructure that enables all of these.
- The way science is supported, practiced and conducted is changing significantly, as is its dissemination and communication, and these changes have important implications for fostering integrity in the 21st century. Specifically, parts of the culture and reward system of science need improvement to align with these changes, and OSTP and federal policy can be a strong proactive force in enabling this change. This is particularly the case if these policies and practices provide leading examples and extend to federal grants. Many other organizations would then align.

Science is embedded in and critical for nearly every major societal challenge in the 21st century, such as the current COVID-19 pandemic - which is illustrating challenges to integrity and public trust in science, all aspects of planetary sustainability, climate change, resource management, food, energy and water availability for a global population, health outcomes and more. These challenges are all transdisciplinary and require trust in science and engagement among a broad coalition of diverse communities and stakeholders. The practice of science is changing to support these needs (although not as fast as is needed given the urgency of these issues). Research is increasingly done by diverse, international teams crossing traditional disciplines. Data interoperability from new distributed instruments and sensors and processed through machine learning is growing rapidly. Information is being utilized by diverse communities who are also contributing to and co-producing science. Even the way science is communicated is changing; with fewer science journalists and more public information officers, direct and deeper public engagement is increasingly important and necessary.

Success in addressing our societal challenges requires thinking about integrity in science in broader and different ways than have traditionally been considered to build for the future. Specifically, while individual responsibility and ethical practices are important, new institutional leadership is most needed. In addition to promoting transparency, access, replicability and the ability for scientists to communicate openly, fostering integrity in science in the 21st century also requires:

1. An infrastructure to support integrity, especially around quality, machine readable and auditable FAIR data and software (The FAIR Guiding Principles for scientific data management and stewardship <https://www.nature.com/articles/sdata201618> and <https://www.go-fair.org/fair-principles/>);
2. Inclusivity and diversity, to expand perspectives and enrich science and build broad trust in its value and communication;
3. Engagement that builds trust with diverse communities globally and creates opportunities for all communities to participate in, guide, apply and benefit from science, which also enhances resilience, sustainability, improved health and equity; and
4. A culture and reward system that supports these goals.

OSTP and federal science agencies have an opportunity to lead and shape this broader perspective of science integrity for the future. AGU and other societies can be key partners.

Below we provide specific areas where federal practices can lead and incentivize important aspects of integrity and how partnerships with societies are important. Several of these emphasize recommendations in the recent National Academies Report *Fostering Integrity in Research* <https://www.nap.edu/catalog/21896/fostering-integrity-in-research>) and in a recent book, *Scientific Integrity and Ethics in the Geosciences* (<https://agupubs.onlinelibrary.wiley.com/doi/book/10.1002/9781119067825>), but several go beyond these.

## 1. FAIR Data and Software

FAIR data and software across science provides integrity for published research and promotes new science, while building trust with local and global communities who increasingly use it for decision making. Although there is wide recognition of the need for FAIR data and software, specific incentives, practices and particularly investment are required to accelerate more widespread implementation. Specifically, to implement well-curated FAIR data and software, the following needs to happen:

First, federal policies and practices that require federally funded researchers to practice good data and software management that result in FAIR data are needed. Publishers are beginning to direct associated data and software to repositories that enable FAIR practices and require researchers to share and eliminate data supplements. For example, AGU has helped lead an initiative, the Enabling Fair Data Project (<http://www.copdess.org/enabling-fair-data-project/>) and developed a set of commitment tenets that many Earth, space and environmental

publishers have signed onto <http://www.copdess.org/enabling-fair-data-project/commitment-to-enabling-fair-data-in-the-earth-space-and-environmental-sciences/>. Beyond the Earth, space and environmental sciences, publishers have committed to improving data and software availability and citations through efforts from FORCE11, TOP Guidelines and other initiatives.

Even with the good intentions of requiring data to be preserved in a repository that is FAIR-aligned, however, many publishers across all disciplines are making slow progress on their commitment. In addition to specific federal mandates for good data and software management, it would also be valuable for federal agencies to provide incentives for researchers to select journals that align with these expectations as well as participate in roles serving as reviewers, co-authors, editors and in their societies, promoting that data and software be shared and cited.

Second, financial and organizational support is needed for leading domain repositories and efforts enabling real data interoperability. Domain repositories have staff skilled in curation and working with researchers on data management practices that simplify data discovery and reuse and support FAIR data and software. Quality curation and robust metadata in turn enable interoperability. Domain repositories also help set best practices around what parts of large or processed data and model output can and should be preserved. Many repositories support data deposition throughout the research cycle, creating a community of practice around data stewardship where publication is just one outcome. Most domain repositories are federally supported but not at a sustained level and would benefit from expanded support and improved coordination across the repository landscape.

Substantial directed funding and collaboration are also needed to encourage alliances between institutional repositories, whose curation services vary, and domain repositories. Such alliances could be mutually supportive; institutions could provide support to leading domain repositories who could then support their FAIR data needs more efficiently. One example is the Woods Hole Oceanographic Institution's support of the Biological Chemical Oceanographic Data Management Office (BCO-DMO). Support will also be important for related organizations—such as Research Data Alliance, FORCE11 and Earth Science Information Partners, among others—that ensure best practices and develop interoperability between research data and software services. In addition, because not all types of data have a repository home, new repositories will need to be started.

Third, researchers and their institutions need stronger incentives to practice FAIR data management and the federal grant process is a key lever. Many grant programs now require data management plans (DMP's), but such requirements should be expanded to mandate best practices and indicate that appropriate repositories have been consulted. To be specific, where “intellectual merit” is emphasized over reproducible outcomes (see guidelines, including for reviewers at NIH and NSF), we recommend extending or changing the “intellectual

merit” statement to include or become a broader “outcome” statement. An example would be: “Please indicate how this proposed research will advance science, provide tangible outcomes such as data, software, methods, and/or samples that will be shared using best practices, and provide societal impact. Reference your data management plan and broader impact statements directly.” This type of statement in conjunction with review and funding requirements would elevate data curation as a necessary practice, and emphasize the value of tangible outcomes for researchers, their institutions and reviewer. These reforms would incentivize recommendations in the recent National Academy reports *Open Science by Design* (<https://www.nap.edu/catalog/25116/open-science-by-design-realizing-a-vision-for-21st-century>) and *Reproducibility and Replicability in Science* (<https://www.nap.edu/catalog/25303/reproducibility-and-replicability-in-science>).

Finally, guidelines—including for repositories— need to be aligned with the reality that science teams and data increasingly span institutions, agencies and countries—again a reason for diverse institutions and agencies to support domain repositories.

## **2. Diversity, Equity and Inclusivity**

The U.S. science workforce, including at the federal agencies, is not diverse. Expanding diversity and inclusivity in the science workforce at all levels is critical both to produce better science and to enhance integrity and public trust in science. A diverse and inclusive workforce improves both communication with the public and co-creation and engagement of communities in science; both engender trust in science. In turn, this trust and expanded awareness of science will attract interest in science from a broader pool of people, leading to greater diversity in science. Promoting and increasing diversity and inclusivity should thus be key parts of federal practices promoting integrity. It is our premise that excellence and integrity in science are not achievable without attention to inclusion.

Visible federal science leadership in diversity and inclusivity, tied to integrity, would send a strong signal to other stakeholders, such as universities and private research groups, to establish new norms. Federal guidance can also be extended and provided through grant programs. For example, AGU’s new LANDInG program, funded by the National Science Foundation, is aimed at empowering key leaders with the skills and resources needed to enact diversity practices at institutions, including agencies (<https://www.agu.org/AGU-LANDInG>). AGU and other societies have also helped form a consortium aimed at addressing harassment and bias in science (<https://societiesconsortium.com/>). These groups would be thrilled to partner further with federal agencies to expand these efforts.

## **3. Community Science and Engagement**

The need to apply science to global challenges is critical. However, the use and benefits of science are not distributed widely or equitably across communities in the U.S. or globally. As such, there is an urgent need to

expand community-led initiatives that use science to address regional and local problems. Federal agencies are in a position to lead on these goals and build scientific integrity and trust in science by incentivizing community engagement and community science.

Several specific recommendations and opportunities are included in recent reports by societies, including from AGU (<https://www.essoar.org/doi/abs/10.1002/essoar.10507256.2>), to the National Science Foundation on supporting climate change solutions (<https://fromtheprow.agu.org/agu-community-provides-recommendations-and-ideas-for-implementing-climate-change-solutions-to-nsf/>). For example, among the recommendations are for federal agencies to develop grant programs to incentivize co-creation of science and deeper engagement with communities and for the creation of and/or support for a climate science corps and regional climate change solution centers. The federal workforce could be engaged in all these steps, which would serve to enhance inclusivity and diversity in science and help address inequities in access and resources, improving overall resilience.

AGU has developed a program around community science, the Thriving Earth Exchange (<https://thrivingearthexchange.org/>), that, in partnership with other societies and organizations, helps match science expertise with communities to address their unique needs. Working with community leaders, the Thriving Earth Exchange board found that expanding the concept of scientific integrity to include equitable and ethical engagement with community partners has been instrumental in achieving successful outcomes in these communities. This approach is captured in the “principles for integrity in community science” (<https://thrivingearthexchange.org/wp-content/uploads/2018/02/TEX-Statement-on-Integrity-in-Community-Science-05022018.pdf>) that the board has developed, adopted and shared. The National Park Service is already working with the Thriving Earth Exchange to train and mentor Park Service employees as they lead community science projects in their region.

The Thriving Earth Exchange, as well as a related AGU effort, Voices for Science (<https://www.agu.org/Share-and-Advocate/Share/Sharing-science-network/Voices-for-science>), are providing enormous benefits to communities and helping increase awareness of and engagement with science. Voices for Science offers mentorship and training to scientists looking to engage more deeply with their policymakers and their communities. These are examples of programs and practices that increase trust in science and foster integrity that could be scaled and expanded for greater impact. AGU and other societies will soon launch *Community Science*, a platform for sharing data from community science projects aimed at amplifying these efforts, developing a community of practice to empower the co-development of science with communities and providing connections for meaningful public science policy.

#### **4. Reward and Incentives and a Culture for Integrity**



Incentivizing integrity broadly in these ways requires a culture and career paths that reward these behaviors. Providing direction through federal grants, agency practices and programs are important ways for leading this reform. Aligning federal science hiring and promotion guidance toward these goals, as well as to promote team-oriented and convergent science, would also send a strong signal about the importance this Administration and the federal government places on scientific integrity.

## **Collaboration with Scientific Societies**

AGU and other scientific societies are integral partners for the federal government in fostering culture change that supports open science, integrity and trust. Society groups have long benefited from supporting integrity in science and have a vested interest in supporting programs in these broader aspects around integrity, including in promoting diversity, workforce development, and community engagement and communication.

Societies encourage open science in various ways, including opening meeting content, hosting preprint servers, leading in expanding diversity and inclusion in science, addressing harassment, fostering community engagement and supporting FAIR data standards.

Many societies are also leading publishers with a mission of advancing their science and fostering quality and transparency. AGU and other societies are supportive of expanding open-access publishing—in the standard open-access publishing model, integrity is tested directly because there is a direct payment for publication. Societies have a vested mission in quality and open governance and oversight that can help assure accountability and broad and equitable participation globally in this model of open access (see *The New Landscape of Ethics and Integrity in Scholarly Publishing* <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/9781119067825.ch8>). Many are engaged in promoting quality science communication.

AGU and other societies are also key in disseminating leading practices around integrity to the scientific community, in part through meetings and conferences that offer opportunities for networking, learning and sharing. The federal workforce is part of this community, as many federal researchers are members of multiple societies. Further, many early career scientists, who participate actively in science societies, will likely work at or with federal agencies, through meetings, workshops and direct training.

In sum, ensuring and promoting integrity and trust for science in the 21<sup>st</sup> Century requires a broader approach to the issue than has been previously recognized. It requires a renewed commitment to ethics and professionalism for scientists and agencies, but it also requires a recognition for how science is already changing and needs to progress further. Only this type of broad view can get at the larger issues of societal trust in science and to help science live up to its promise of addressing some of our most pressing societal challenges. AGU is eager to be a

partner in these efforts, and we look forward to continuing to work with OSTP and the agencies on this important initiative.

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### **Additional Resources**

- AGU Strategic Plan [https://news.agu.org/files/2020/05/Final\\_AGU\\_Strategic\\_Plan\\_2020\\_Final.pdf](https://news.agu.org/files/2020/05/Final_AGU_Strategic_Plan_2020_Final.pdf)
- AGU Position Statement on Data [https://www.agu.org/Share-and-Advocate/Share/Polymakers/Position-Statements/Position\\_Data](https://www.agu.org/Share-and-Advocate/Share/Polymakers/Position-Statements/Position_Data)
- AGU Position statement on Free Communication of Research <https://www.agu.org/Share-and-Advocate/Share/Polymakers/Position-Statements/Free-and-open-science>
- AGU Position Statement on Rights and Responsibilities of scientists <https://www.agu.org/Share-and-Advocate/Share/Polymakers/Position-Statements/Rights-and-responsibilities-of-scientists>
- Other recent letters and policy statements related to integrity and trust:
  - Coalition Letter on Whistleblower protection <https://whistleblower.org/wp-content/uploads/2021/04/GAP-264-Organizations-Whistleblower-Support-Letter-1.pdf>
  - Letters on EPA's Science Transparency Rule
    - <https://whistleblower.org/wp-content/uploads/2021/04/GAP-264-Organizations-Whistleblower-Support-Letter-1.pdf>
    - <https://www.agu.org/-/media/Files/Share-and-Advocate-for-Science/Letters/2020-Letters/AGUJointLetterMichaelJFoxEPAHouseScience111319.pdf>
    - <https://www.agu.org/-/media/Files/Share-and-Advocate-for-Science/Letters/AGU-Letter-EPA-Secret-Science-23Apr2018.pdf>
  - HONEST ACT – Letter of Concern <https://www.agu.org/-/media/Files/Share-and-Advocate-for-Science/Letters/AGU-Letter-HONEST-Act-8Mar2017.pdf>