

Open Science: Enabling science and research data to be more interoperable and reusable

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AGU's position statement on data affirms that

“Earth and space science data are a world heritage, and an essential part of the science ecosystem. All players in the science ecosystem—researchers, repositories, publishers, funders, institutions, etc.—should work to ensure that relevant scientific evidence is processed, shared, and used ethically, and is available, preserved, documented, and fairly credited.”

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150 years of *Nature*

A century and a half of research and discovery.

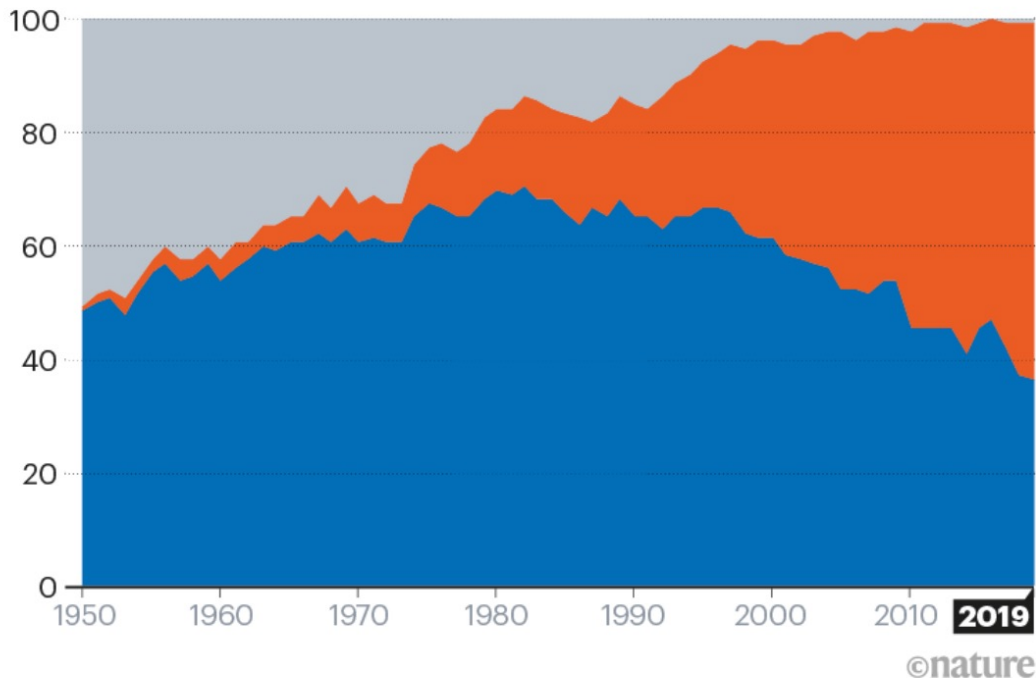


INTERNATIONAL COLLABORATIONS

Author lists on research publications show a shift towards multinational teams; fewer teams are composed entirely of researchers from one country.

Proportion of papers

■ Multinational ■ Domestic ■ Single author



Monastersky, R., & Van Noorden, R. (2019). 150 years of Nature: a data graphic charts our evolution. *Nature*, 575(7781), 22–23.
<https://doi.org/10.1038/d41586-019-03305-w>

The Future of Research...

- Research Teams (not individuals)
- International Collaborations
- Robust **tools to discover** relevant research worldwide
- Good **documentation** to understand that research, data, and/or software
- Data that is **interoperable**, no matter which research team created it
- Software that is **accessible** and developed in current tools (e.g., Jupyter Notebooks)
- Licenses that support **reuse**.

FAIR Guiding Principles

FAIR is...

Findable

Accessible

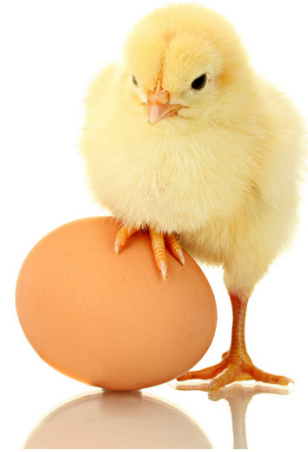
Interoperable

Reusable

Article in Nature journal *Scientific Data*:
Wilkinson, M. D. *et al.* The FAIR Guiding Principles
for scientific data management and stewardship.
Sci. Data 3:160018 doi: 10.1038/sdata.2016.18
(2016).

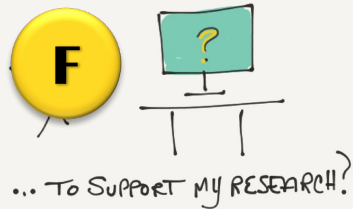


Why do we Care about FAIR?

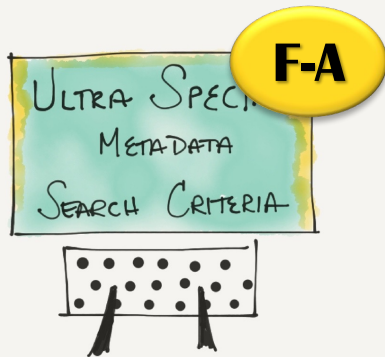


RESEARCHERS ♥ DATA MANAGEMENT!

HMM... WHAT DATA IS OUT THERE ...



F-A-I-R



Wow! SUPER RELEVANT USEFUL DATA!



AMAZING RESEARCH HAPPENS.

Now... TO SUBMIT MY unique & valuable RESEARCH DATA.



Why DOES THE DATA MANAGER INSIST ON SO MUCH METADATA?



DATA MANAGER
Sigh... I THOUGHT FOR SURE THIS ONE HAD MADE THE CONNECTION.

KEEP CALM & CURATE ON

DATA MANAGERS ... MAKING DATA MORE USEFUL ... AND PAVING THE WAY FOR FUTURE RESEARCHERS TO FIND VALUE IN YOUR DATA!

Shelley

The Future of Research...

Is...

FAIR

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F-A

F-A-R

F-A-I-R

R

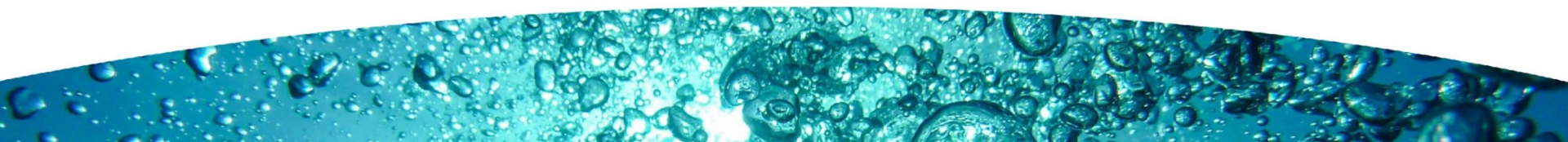
Open Science – Transparency and Trust

“Increased openness leads to increased transparency and trust in scientific information...”

Source: UNESCO
Recommendation on Open
Science; adopted
November 2021



<https://en.unesco.org/science-sustainable-future/open-science>



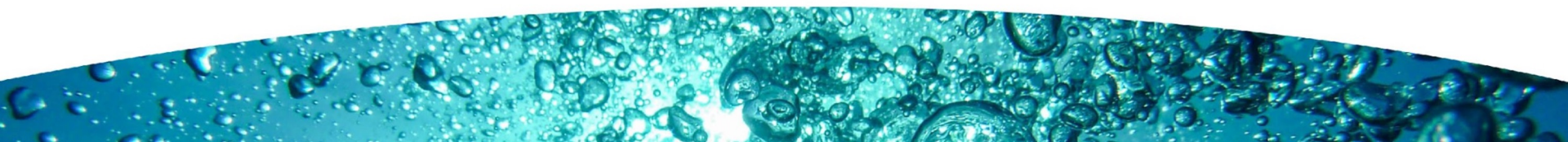
Open Science – The Key Pillars

- Open scientific knowledge
 - **Scientific publications**
 - **Open research data**
 - **Open source software and source code**
 - **Open hardware**
- Open science infrastructures
- Science communication
- Open engagement of societal actors
- Open dialogue with other knowledge systems.

Source: UNESCO
Recommendation on Open
Science; adopted
November 2021



<https://en.unesco.org/science-sustainable-future/open-science>



From the very beginning of the research process,

the researcher **both contributes** to open science and

takes advantage of the open science practices of other members of the research community.





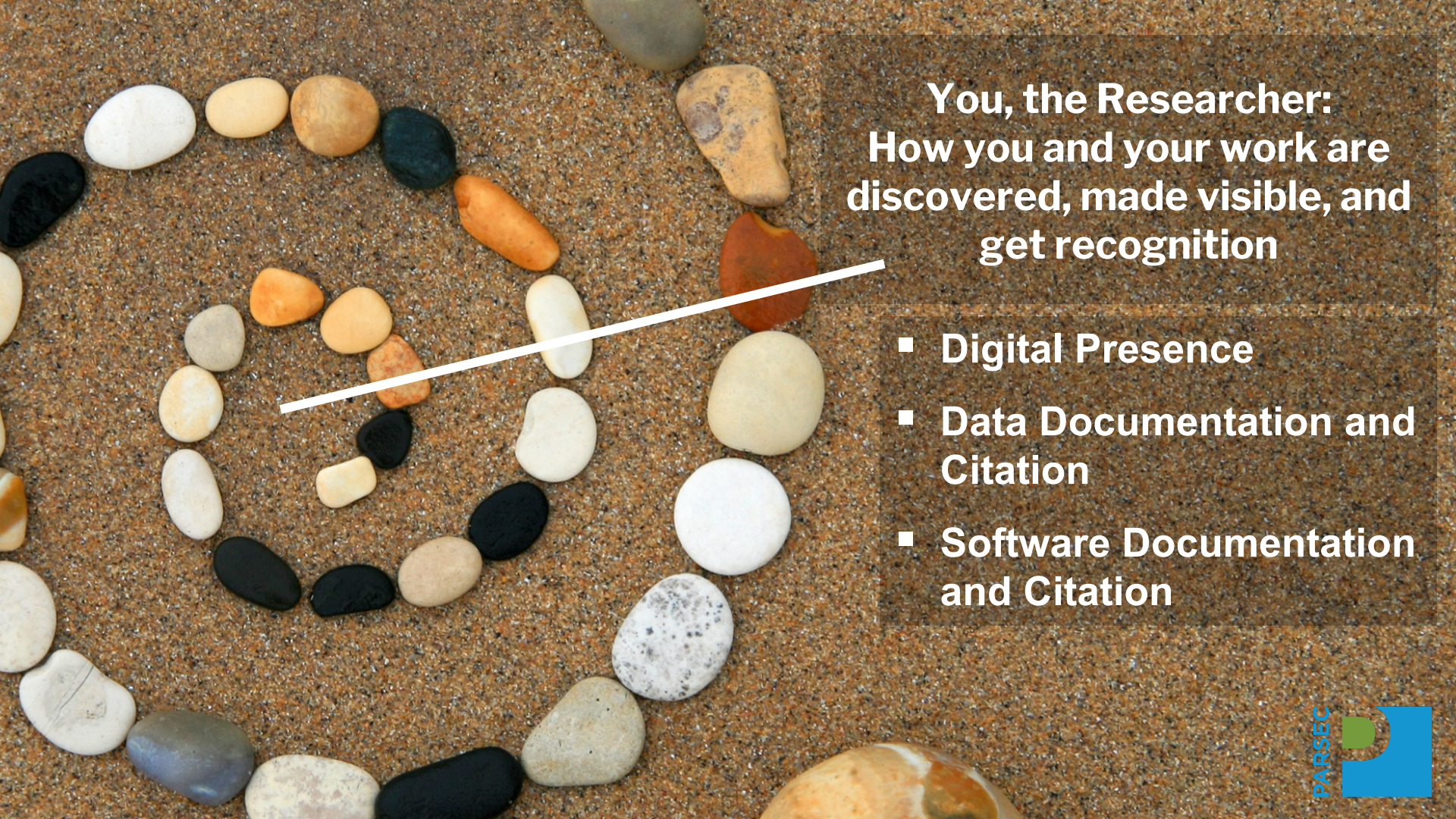
Wai...wai...wait.

This is all new to me!

What do you mean
this matters to my
research?!?

Building Your Open Science Skills

- **You, the Researcher:** How you and your work are discovered, made visible, and get recognition
- **Your Research Team/Lab:** Working Openly
- **Your Community:** Improving interoperability, sharing, and reuse beyond your team
- **Beyond Your Community:** Preparing for Cross-domain challenges



**You, the Researcher:
How you and your work are
discovered, made visible, and
get recognition**

- **Digital Presence**
- **Data Documentation and Citation**
- **Software Documentation and Citation**




Your Research Team/Lab: Working Openly

- Research Team Open Science Practices
- Resources and Lab Guidelines
- Project Archiving



Your Community: Improving interoperability, sharing, and reuse beyond your team

- **Transparency and Understanding**
- **Usability**
- **Trust and Persistence**



Beyond Your Community: Preparing for Cross- domain challenges

- Computational Notebooks
- Executable Environments
- Working with International Teams

Let's Start the Journey to Open Science...

- Digital Presence
- Data Documentation and Citation
- Software Documentation and Citation



DIGITAL PRESENCE CHECKLIST



Connect your research to your data, software, institution, and more. Use this checklist to optimize your digital presence, increase discovery of your work to potential collaborators and partners, and receive credit when others use your work.

You. YOUR ORCID.

- Have your own ORCID.** It provides a persistent digital identifier that distinguishes you from other researchers and supports automated linkages between you and your research activities. Go here to register: <https://orcid.org>, and select “For Researchers”.
- Include your ORCID on all scholarly work.** This includes your publications, datasets, software, presentations, posters, signature block of your emails. Everything. This helps with linking to your ORCID profile.
- Keep your ORCID profile current.**
 - Enable automatic updates from Crossref and DataCite. AGU [Digital Presence blog post](#) has the detailed steps.
 - Set a reminder every three months to ensure all your work is connected and current in your ORCID profile. Make sure your current affiliation and email are included and public for viewing. Add a second email (which can be private) to ensure account access should one become locked.

This work is part of the **Building New Tools for Data Sharing and Re-use through a Transnational Investigation of the Socioeconomic Impacts of Protected Areas (PARSEC)** project with funding provided by the Belmont Forum through the National Science Foundation, Grant 1929464 as well as the **Accelerating Open and FAIR Data Practices Across the Earth, Space, and Environmental Sciences: A Pilot with the NSF to Support Public Access to Research Data** project funded by the National Science Foundation, Grant 2025364.



Checklist

- <http://doi.org/10.5281/zenodo.4706118> (English)

Tutorial – 15 min

- <https://doi.org/10.5281/zenodo.4706146> (slides, link to recording)

Resources



Manage your Digital Objects – Research
Team Member Checklist



Software Citation - 5 Tips



Digital Presence - Connect your research
for better discovery



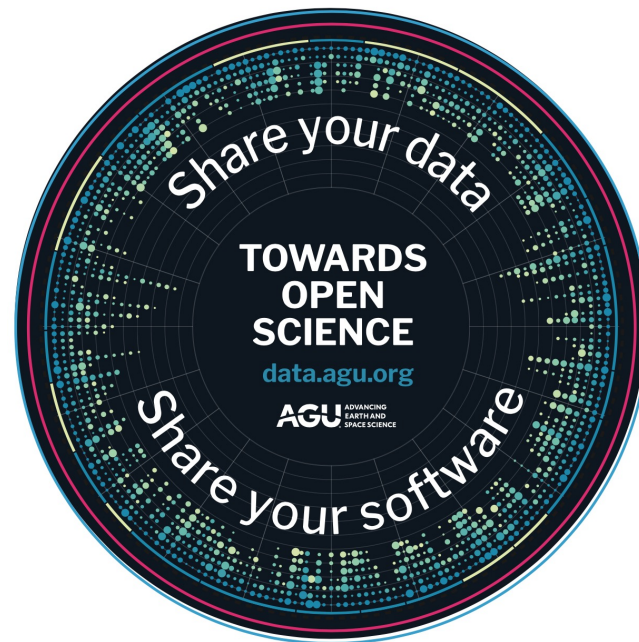
Guidance for AGU Authors - Jupyter
Notebooks



Data and Software Sharing Guidance for
Authors Submitting to AGU journals

Thank you

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