A NASA Open-Source Science Initiative: TOPS: Transform to Open Science

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Science should be...

**Transparent**
Scientific process and results should be visible, accessible, and understandable.

**Inclusive**
Process and participants should welcome participation by and collaboration with diverse people and organizations.

**Accessible**
Data, tools, software, documentation, and publications should be accessible to all (FAIR).

**Reproducible**
Reproducible by members of the community.
What is Open Science?

A collaborative culture enabled by technology that empowers the open sharing of data, information, and knowledge within the scientific community and the wider public to accelerate scientific research and understanding.
Open-Source Science is NASA’s method to put Open Science into practice.
Open-Source Science Initiative

Unlocking the full potential of a more equitable, impactful, efficient, scientific future

Policy development, education, compliance tools

*Updating* NASA policies on scientific information to better enable the activation of open science

Core Services for Science Discovery

*Developing* core data and computing services to enable open science

ROSES Elements

*Supporting* open-source software, tools, frameworks, libraries, platforms, and training with over $5 million dollars in grants

Community Building & Partnerships - Transform to Open Science (TOPS)

*Accelerating* adoption of open science
Leading the Path to Open-Source Science

Transform to Open Science (TOPS) is a $40 million* 5-year NASA Science Mission Directorate mission.

Objectives:
- Increase understanding & adoption of open science.
- Accelerate major scientific discoveries.
- Broaden participation by historically underrepresented communities.

Goals for 2027:
- 20K earn Open Science Badge
- 5+ major discoveries
- Increase participation of underrepresented groups by 2x

*pending appropriations
2023 is NASA’s Year of Open Science

TOPS will be energizing and uplifting open science across the scientific community through:

- Visibility
- Capacity Sharing Resources
- Incentives
- Moving towards openness

Open Data
Open Software
Open Access
Community
TOPS in the News! We are Everywhere!

NIH issues a seismic mandate: share data publicly

Technology Network

Can open datasets help machine learning solve medical mysteries?

Global, Sustainable and Cooperative Open

TOPS and Year of Open Science Visibility

Agency comms
Articles
Announcements
Twitter Spaces
Community meetings

Conference Visibility

Annual 2023 Meeting: Open Science theme
Promote & Launch the TOPS Open Science Course
Booths, Events, Workshops, Plenary Talks, Comms
AGU, AMS, AAS, AAAS, and more....
Capacity Sharing: Resources

- Open Science Course in Open edX
  - High quality, interaction Open Online Course
  - Free, public, open - for in-person, virtual, and independent learners
  - Videos / quiz / interactive activities/workbooks
  - Fast-pass option for experienced open science practitioners
  - Open edX LMS tracks learners, completion of modules, data analytics

- Incentivize completion of course
  - Gamification: Certification / badges
  - Prizes, challenges, and bootcamps

- Make it easy & everywhere
  - Workshops at all big meetings
  - Workshops at science team meetings
  - Workshops through virtual cohorts
**Capacity Sharing - Resources: Open Science Curricula**

5 Modules Organized as a Scientific Workflow

- **ETHOS OF OPEN SCIENCE**
- **OPEN TOOLS & RESOURCES**
- **OPEN SOFTWARE**
- **OPEN DATA**
- **OPEN RESULTS**

**What is open science, why does it benefit me, and why does it benefit the greater scientific community?**

**How to share software**

**Best practices for sharing all results and analysis, as well as peer reviewing**

- **How to use popular open science tools**
- **How to effectively use and share open data**

**Earn Badges at Each Level**

Complete All 5 & earn TOPS Open Science Badge & Certification
Capacity Sharing within the Community

**TOPS Champions**
Scientists to help teach modules at events and act as Open Science champions

**Cohorts**
Engage with learners through a virtual cohort model to increase Open Science Badge achievement

**Summer Schools**
Institutions selected to run 8-12 weeks of teaching the 5 modules to selected science teams + open competitive student/early career researchers

**Curriculum Expansion**
Groups funded to migrate/create discipline specific modules and data science skills modules to Open edX TOPS platform

**Hackathons**
More hackathons that advance data science skills and open science
Incentives: Open Science Awards

• Societies create & manage TOPS Open Science Prizes & Awards programs
  ○ Award Purpose: To reward significant leadership and progress toward open science and showcase the benefits of open science

• Work with societies to evaluate and update their existing awards and recognitions to:
  ○ Include open science activities as review criteria
  ○ Where possible allow for team nominations
Moving towards openness: Year of Open Science and the Future

Our proposed plan is to use 2023 Year of Open Science to build momentum and support for moving towards more openness in science.

- Recognizing open science practices
- Holding open meetings
- Sharing hidden knowledge
- Inclusive collaborations

2023

- Update necessary systems to increase visibility

2024

- Require a little

2025

- Require a little more

2026

- Require a lot

2027
Open Science results speak for themselves.

“We’re deeply grateful to all the open source contributors who made our work possible.” —Dr. Katie Bouman

“Open source is very important for scientists; imagine if we had to do everything from scratch every single time.” —Dr. Chi-Kwan Chan

“We greatly improved our own work by adopting well-tested community packages that contain the collected wisdom of many other projects.” —Dr. Lindy Blackburn

“With the open source projects in NumFOCUS, we were able to iterate our algorithms so fast that they enabled us to finish our work in two years.”

Paola Masuzzo
@pcmazzuzzo

An aspect we should talk more about, open research practices as a driver to a real reform in the research endeavor. I try to depict it in this image:

@BelizeGEO @BzGEO @TheNASEM

Our friends @SERVIRGlobal have many examples of how algorithms + code from one region have been customized for use in another. An example is gold mining monitoring, where Amazonia + W. Africa have collaborated in an #OpenScience context, leveraging #IGFES

@simonastalger
@simonastalger

Reducing illegal gold mining in the tropical forests of Ghana and Peru. A forthcoming collaboration across the Atlantic: SERVIR/Africa, SERVIR/Amazon, and SERVIR/Peru. #igfes

Dr. Julia Stewart Lomas
@juliawald

Congrats Chloe! The welcoming, inclusive, collaborative and productive #OpenSciences community is something that changed my life and my work-life. Thank you! It's a joy to distill these few attempts:

Max Grover @skyscraper - Mar 11 2023 - Twitter Web App

Here’s a great case of @PyAIF, which is funded by @openfisca at @gbench. Over 200 citations so far, with many including awesome code like this paper which enables #OpenScience!

@MillindSharma
@MillindSharma - Mar 11 2023 - Twitter Web App

The power of open source software! The authors of @skyscraper and @openfisca also provide a clear code to encourage reproducibility in science. I could apply their technique to my dataset within a few hours. Neat! Yes to #OpenScience!
Questions?
Why Open-Source Science?

We are facing **big** challenges

**Open Science:**
- Accelerates the pace of science
- Increases the impact of science
- Expands applications of data and science
- Shares hidden knowledge & expands participation in science

Open science enables **more** people - more hands, more eyes, more brains - with diverse experiences to participate so that we ask the best questions and find the best solutions

Image credit: NOAA
We now have the tools to make open science a reality. Advances in technology have created accessible, reproducible, inclusive science at a scale not possible a few years ago.

There is national and global momentum for the move to open science.

Equal and open access benefits the public.
2023 is NASA’s Year of Open Science

TOPS will be energizing and uplifting open science across the scientific community through:

### Visibility
Publishing articles, appearing on podcasts, developing targeted communication that expands footprint
Integrating Open Science into themes at large-scale events and conferences

### Capacity Sharing
Producing online, free, Open Science curriculum on Open edX
Hosting workshops, events, cohorts, science team meetings, hackathons
Constructing multiple pathways to Open Science Badge

### Incentives
Developing Open Science Badge/Certification
Sponsoring high profile prizes and challenges
Establishing high profile awards in support of open science research

### Moving toward Openness
Recognizing open science practices
Holding open meetings
Sharing hidden knowledge
Inclusive collaborations