JLSC

ISSN 2162-3309 | JLSC is published by the Iowa State University Digital Press | http://jlsc-pub.org

Volume 12, 1 (2024)

Brief Reviews of Books and Products

NASA TOPS Open Science 101

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White, J. (2024). NASA TOPS Open Science 101 [Brief Reviews of Books and Products]. *Journal of Librarianship and Scholarly Communication*, 12(1), eP17753. https://doi.org/10.31274/jlsc.17753

ISSN 2162-3309 10.31274/jlsc.17753

NASA TOPS Open Science 101. (2023). NASA TOPS Open Science 101 version 1.0. Zenodo. https://doi.org/10.5281/zenodo.10161527. Free of charge.

Openscience101.org is a freely accessible website containing an educational curriculum developed and maintained by over 50 open-science subject-matter experts from across a range of disciplines. Learners should expect to take 3 to 12 hours to complete the curriculum, depending on their existing familiarity with the content. The US agency NASA's initiative "Transform to Open Science" (TOPS) leads the US federal government's efforts to "rapidly transform agencies, organizations, and communities to an inclusive culture of open science" (https://nasa.github.io/Transform-to-Open-Science/). Openscience101.org organizes and crystallizes open-science concepts and practices that have been building momentum over the few past decades, spurred on by technological advancement and improved coordination in digitizing research data and the scholarly record. The key aims of the open-science movement are to establish clear, straightforward guidelines to ensure that the methods and results of research activity are well-organized, clearly described, and publicly accessible, without paywalls as much as possible.

In a December 2023 webinar titled "US Federal Guidance and PIDs," a speaker compared the current moment in open-scholarly infrastructure to the golden spike moment in the history of the transcontinental railroad (https://www.youtube.com/watch?v=J6w9XGCKxn0). The tools needed to reap the benefits of a more open, inclusive system of research data generation, analysis, sharing, and reuse are firmly in place. Openscience101.org introduces learners from all backgrounds to skills and dispositions necessary to climb aboard the open-science train.

Because the curriculum has a permissive license and is also hosted in a Github repository, there are options for engaging with the material outside of the openscience101.org context for those who would prefer to take their own path. However, learners who complete all five modules and pass all five assessments on openscience101.org receive a NASA Open Science badge for social media and a NASA qualification for their Open Researcher and Contributor ID (ORCID) record. There is an option to take a "Fast Track" for each module, which a learner can qualify to go on instead of the regular module provided that they pass a timed examination.

Anyone involved with research and development who wants to understand how data management and sharing technologies transform scholarly communication and research assessment will find valuable content and links on openscience101.org. Beyond publications in

expensive, gated, peer-reviewed academic journals, the state of research on a topic or the value of a particular researcher's contributions to their field can now also be measured through other research outputs such as preregistrations, study protocols, and computer code used for data analysis.

Many of the vignettes and anecdotes included in the openscience101.org curriculum are geared toward scientists who might be engaged with the US federal government's funding ecosystem for scientific research. However, anyone involved in computational and data-intensive research in the humanities, economics, public health, or other social sciences would also stand to gain from going through the modules.

Openscience101.org contains five modules, each five lessons long, with a summary and an assessment at the end of the module. At the end of each lesson, students must pass a "Knowledge Check" to proceed with the course. The first module offers a broad overview of open science and contrasts open-science approaches with traditional methods. It also highlights pain points and shortcomings of traditional methods and how open science addresses these problems. Librarians seeking to introduce open science as part of library instruction should look closely at lessons 3 through 5, which emphasize the planning and decision-making that researchers should perform before they begin collecting data.

The second module surveys the tools and resources available today to practitioners of open science. This module explains how open-science practices are beneficial at different stages of a project, such as depositing preregistrations, protocols, and data-management plans in repositories that make the content easy to share and preserve.

Next is a module on open data, which addresses issues that come up with proprietary data formats; the benefits of using open data formats; best practices for describing, preserving, and sharing data; and the importance of data being both machine-readable and human-readable. The module includes a "conformity check" that researchers can use to check whether a repository is a good fit for their data.

The fourth module covers open-source software. For anyone who is already familiar with computer coding, this module might be valuable to see how open-science practices are modeled on open-source software development. For those who are not coders, the module is a helpful introduction to the culture and ethos of free and open-source (FOSS) software development.

The final module covers open results and contains, along with the first module, the most valuable material for librarians who field questions regarding publishing research findings. Lesson 2 discusses how to critically assess and cite others' work. However, this module

goes beyond the final peer-reviewed article to encourage depositing and openly licensing research objects from all stages of the research lifecycle. Beyond peer-reviewed articles, this module also includes blog posts, GitHub repositories, recorded lectures or short videos, or specially made websites as valid examples of open results.

Openscience101.org is a product of a large group of contributors, and, as such, there were a few errors and typos when I went through the modules after they first launched. However, because the project attempts to live by example, the Transform to Open Science group (TOPS) maintains a discussion board and encourages those who provide feedback regarding openscience101.org to create issues or pull requests on the project's GitHub page.

The questions in the assessments were fair and well-developed, and there were very few questions that were confusing or did not align with course content. Learners who do not have experience in software development or data analysis might find certain parts of the curriculum too advanced; however, each module provides links for supporting educational resources that learners can utilize to better familiarize themselves with the terminology and practices.

The openscience101.org curriculum attempts to address two of the most pressing issues for the scientific endeavor: the need to improve public trust through transparency and fewer paywalls, and the need to create a more inclusive and open culture of participation in research itself. The tools needed to accomplish these goals, such as ORCID, Github, Zenodo, and DMPTool, are mature, and barriers to entry for those with access to computing and internet are low. This website provides a quick introduction to these resources and compelling reasons why they merit adoption. Although geared primarily toward laboratory scientists, other participants in the research ecosystem, such as college students, librarians, research administrators, publishers, and policymakers, will also find useful material in this curriculum.