Open Science by Design: Realizing a Vision for 21st Century Research

Alexa T. McCray
Professor of Medicine
Harvard Medical School
alexa_mccray@hms.harvard.edu

Study Sponsor:
Laura and John Arnold Foundation

Consensus study overseen by:
Board on Research Data and Information
Policy and Global Affairs Division
National Academies of Sciences, Engineering, and Medicine

ARL Fall Association Meeting, September 26, 2018
Study Process

• Statement of Task
  – Identify and address the challenges of broadening access to the results of scientific research, recognizing the importance of accelerating progress toward open science.
  – Focus on how to move toward open science as the default for scientific research results, with specific recommendations to be implemented.

• Committee work began in July 2017

• Report was launched in July 2018
Consensus Study Committee

- Alexa T. McCray (Chair), Harvard Medical School
- Francine Berman, Rensselaer Polytechnic Institute
- Michael Carroll, American University College of Law
- Donna Ginther, University of Kansas
- Robert Miller, LYRASIS
- Peter Schiffer, Yale University
- Edward Seidel, University of Illinois at Urbana-Champaign
- Alex Szalay, The Johns Hopkins University
- Lisa Tauxe, University of California, San Diego
- Heng Xu, The Pennsylvania State University
An Inflection Point

- Potential of a new generation of information technology tools and services to change the practice of science
- U.S. federal agencies have developed and implemented policies based on memoranda from the Office of Science and Technology Policy
- Private research funders have also introduced mandates
- Some publishers are strengthening requirements to ensure that the data and methods underlying articles are available
Accelerating Progress

- Achieving open science will require persistent, coordinated actions on the part of research enterprise stakeholders.
- The committee developed findings, recommendations, and implementation actions based on its review and synthesis of the information gathered throughout the course of the study.
Open Science by Design

A set of principles and practices that fosters openness throughout the entire research life cycle.

1. Provocation: connect and discover
2. Ideation: plan and design
3. Knowledge generation: observe and experiment
4. Validation: analyze and interpret
5. Dissemination: report and share
6. Preservation: store and maintain
Open Science by Design

- **Provocation**: explore or mine open research resources and use open tools to network with colleagues.

- **Ideation**: develop and revise research plans and prepare to share research results and tools under FAIR (Findable, Accessible, Interoperable, Reusable) principles.

- **Knowledge generation**: collect data, conduct research using tools compatible with open sharing, and use automated workflow tools to ensure accessibility of research outputs.
Open Science by Design

• **Validation**: prepare data and tools for reproducibility and reuse and participate in replication studies.

• **Dissemination**: use appropriate licenses for sharing research outputs and report all results and supporting information, including data and code.

• **Preservation**: deposit research outputs in FAIR archives and ensure long-term access to research results.
Building a Supportive Culture

• **Finding:** Continued effort by stakeholders, working internationally and across disciplinary boundaries, is needed to change evaluation practices and introduce other incentives so that the cultural environment of research better supports and rewards open practices.

- **Recommendation One:** Research institutions should work to create a culture that actively supports Open Science by Design by better rewarding and supporting researchers engaged in open science practices. Research funders should provide explicit and consistent support for practices and approaches that facilitate this shift in culture and incentives.
Training for Open Science by Design

• **Finding:** There is little formal training and education in the principles and practices of open science. The emergence of data science as a recognized interdisciplinary field has highlighted the need for new educational content and approaches related to data.

  ➢ **Recommendation Two:** Research institutions and professional societies should train students and other researchers to implement open science practices effectively and should support the development of educational programs that foster Open Science by Design.
Ensuring Long-Term Preservation and Stewardship

• **Finding:** Developing and sustaining the infrastructure required for long-term stewardship of research products will present a continuing challenge.

  ➢ **Recommendation Three:** Research funders and research institutions should develop the policies and procedures to identify the data, code, specimens, and other research products that should be preserved for long-term public availability, and they should provide the resources necessary for the long-term preservation and stewardship of those research products.
Facilitating Data Discovery, Reuse, and Reproducibility

• **Finding:** As progress toward opens science by design continues, it is important that the community adhere to the ultimate goal of achieving the availability of research products under open principles.

  ➢ **Recommendation Four:** Funders that support the development of research archives should work to ensure that these are designed and implemented according to the FAIR data principles. Researchers should seek to ensure that their research products are made available according to the FAIR principles and state with specificity any exceptions based on legal and ethical considerations.
Developing New Approaches to Fostering Open Science by Design

- **Finding:** Public and private funders have made significant contributions to fostering open science to this point. They should continue to support initiatives that accelerate progress, and evaluate and revise their policies as needed.

- **Recommendation Five:** The research community should work together to realize Open Science by Design to advance science and help science better serve the needs of society.
Concluding Remarks

• Openness and sharing of information are fundamental to the progress of science and to the effective functioning of the research enterprise.

• The research enterprise has already made significant progress toward open science.

• **Open Science by Design** is a framework that empowers the researcher to conduct research openly and transparently throughout every phase of the research process.

• There is still more to be done to support the principles and practices of **Open Science by Design**.