## Open Science, Reproducible Research, and R

**An Overview** 

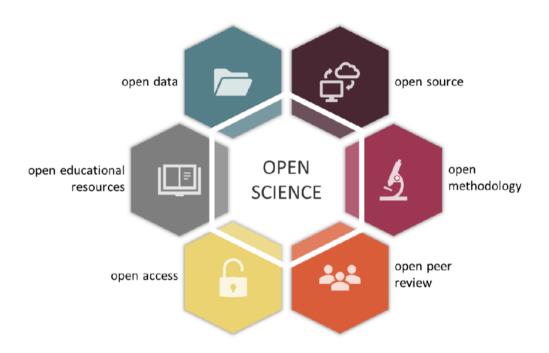
**Ernest Guevarra** 

2023-01-23

#### **Outline**

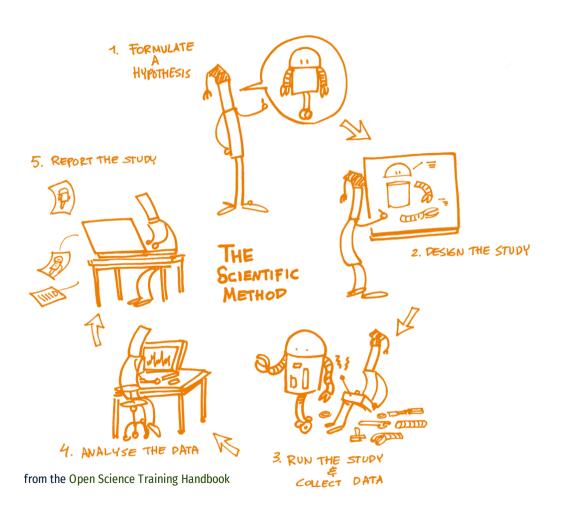
- 1. What is Open Science?
- 2. What is Reproducible Research?
- 3. Why Reproducible Research?
- 4. How to do Reproducible Research?
- 5. Why R?

#### What is Open Science?



- movement to make scientific research and dissemination accessible to anyone
- aims for greater transparency in research and removes barriers for sharing outputs, resources, methods or tools at any stage of the research process

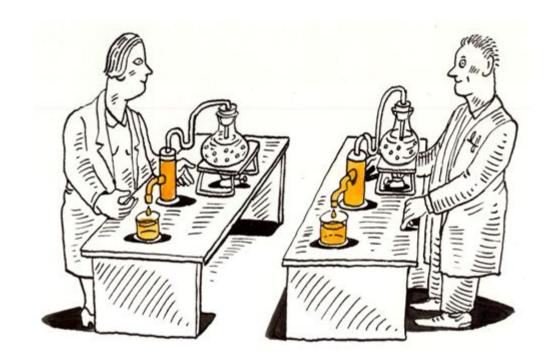
#### What is Reproducible Research?



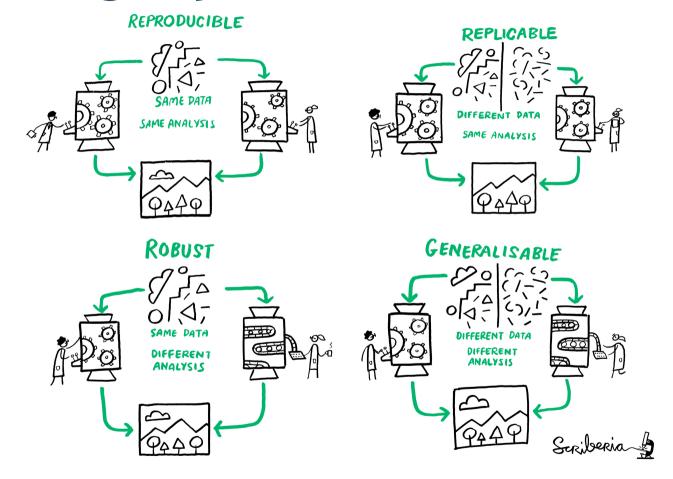
- The concept of reproducibility is directly linked to the scientific method
  - 1. Formulating a hypothesis
  - 2. Designing the study
  - 3. Running the study and collecting the data
  - 4. Analyzing the data
  - 5. Reporting the study
- Each of these steps should be clearly reported by providing clear and open documentation, and thus making the study transparent and reproducible.

#### What is Reproducible Research?

- Research papers with accompanying software tools that allow the reader to directly reproduce the results and employ the methods that are presented in the research paper (Gentleman and Lang, 2004)
- Research data and code are made available so that others are able to reach the same results as are claimed in scientific outputs (Open Science Training Handbook)
- The standard of reproducibility calls for the data and the computer code used to analyze the data be made available to others (Peng, 2012)

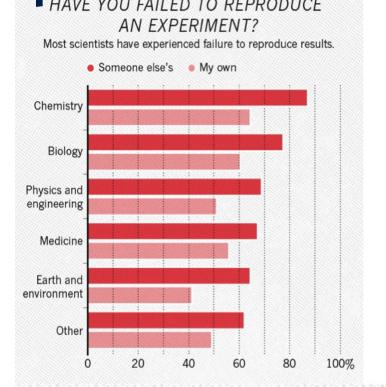


#### Differentiating Reproducible Research

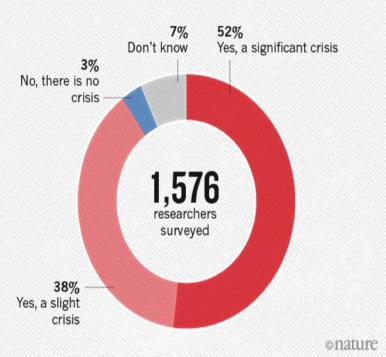


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Why Reproducible Research?



#### IS THERE A REPRODUCIBILITY CRISIS?



Number of respondents from each discipline: Biology 703, Chemistry 106, Earth and environmental 95, Medicine 203, Physics and engineering 236, Other 233

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### Factors in irreproducible research









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#### Factors in irreproducible research

- Not enough documentation on how experiment is conducted and data is generated
- Data used to generate original results unavailable
- Software used to generate original results unavailable
- Difficult to recreate software environment (libraries, versions) used to generate original results
- Difficult to rerun the computational steps

#### How to do Reproducible Research?

#### The reproducibility spectrum

Data Replication & Reproducibility

PERSPECTIVE

#### Reproducible Research in Computational Science

Roger D. Peng

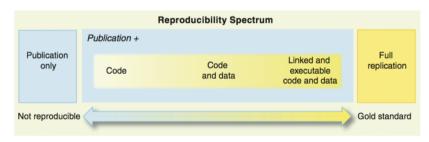


Fig. 1. The spectrum of reproducibility.

1226 2 DECEMBER 2011 VOL 334 SCIENCE www.sciencemag.org

#### Steps in reproducible research

- Record the project's provenance
- Data and metadata curation
- Establish a testing/analysis workflow
- Test, document, and publish your code
- Share

### Why R for Reproducible Research?

- freely available
- huge user and developer community
- has a robust set of user- and communitydeveloped packages that support reproducible research



# **Questions?**

### Thank you!

Slides can be viewed at https://oxford-ihtm.io/open-reproducible-science/session6.html

PDF version of slides can be downloaded at https://oxford-ihtm.io/open-reproducible-science/pdf/session6open-reproducible-science.pdf

R scripts for slides available here