OPEN SCIENCE & ITS TOOLS

A student handbook

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INTRODUCTION

Open Science is being talked about, increasingly mandated, and what is most important – practiced by many people around the world (in different ways)!

The course Open Science and Its Tools provides some initial input into the more practical aspects of Open Science, at the same time discussing more conceptual and critical perspectives that we think are relevant already for Masters students.

Dr. Ljerka Ostojić,
Assistant Professor

This Handbook is a summary of what Roberta, Ksenia, Bruno, and Rafal took as the main take-home messages for themselves and what they want to share with other Masters students. They made it interactive, so you can follow the hyperlinks from all underlined words and pictures.

Student Team:

Roberta Bajčić

Bruno Lewis

Ksenia Sarycheva

Rafal Sperczynski

WHAT IS OPEN SCIENCE?

"Open science is a set of principles and practices that aim to make scientific research from all fields accessible to everyone for the benefits of scientists and society as a whole. Open science is about making sure not only that scientific knowledge is accessible but also that the production of that knowledge itself is inclusive, equitable and sustainable."

UNESCO, 2023

Outreach

- Open Educational Resources
- Citizens Science ...

Study Design & Tracking

- Preregistrations
- Open processes
- Replicability
- Analysis plans
- Statistical inference
- Open Materials & tools ...

Publication

- Open Access
- Open Peer Review
- Open Data & Code
- Preprints
- Alternative dissemination pathways
- CREDIT system for authorship ...

Data Collection

- Citizen Science
- Open Hardware & Software
- Open Data & Code
- Reproducibility
- Analysis plans & transparency
- Reporting guidelines
- Statistical inference ...

Adapted from Govnaris et al. (2022)

What about Open Science Tools?

"Open Science tools are any tools that enable and facilitate openness in research, and support responsible Open Science practices... Open Science tools are very often open source and/or free, but not necessarily."

Retrieved from OpenSciency

Open Science tools can be used for:

- **Discovery**: Tools for finding content to use in your research
- **Analysis**: Tools to process your research output, e.g. tools for data analysis and visualization
- **Writing**: Tools to produce content, such as Data management Plans, presentations, and pre-prints
- **Publications**: Tools to use for sharing and/or archiving research
- **Outreach**: Tools to promote your research

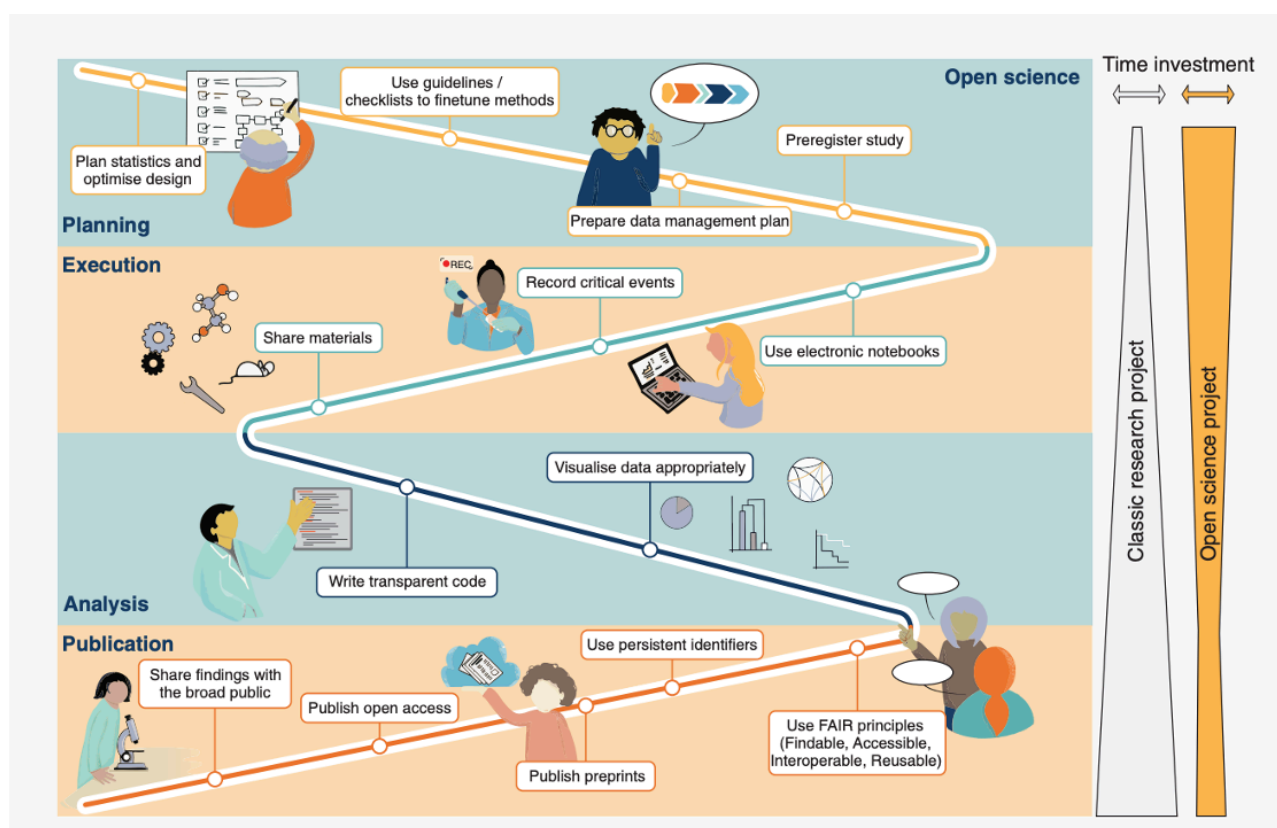Retrieved from The Royal Society

Figure 2. Examples of open science practices that can be implemented throughout the research lifecycle.
Implementing open science practices at various stages of a project (planning, execution, analysis and publication) helps maximise the impact of science. The different practices within each stage are not necessarily in strict chronological order. Typically, engaging in open science practices requires a greater time investment in the early stages of a research project (front-loaded) compared to classic research projects, which are often rear-loaded.

Bertram et al. (2023)

WHAT IS PREREGISTRATION?

"When you preregister your research, you're simply specifying your research plan in advance of your study and submitting it to a registry. Preregistration separates hypothesis-generating (exploratory) from hypothesis-testing (confirmatory) research. Both are important. But the same data cannot be used to generate and test a hypothesis, which can happen unintentionally and reduce the credibility of your results."

Centre on Open Science

What is specified in the preregistration?
- your hypotheses (before data collection)
- the analyses and statistical comparisons that you plan on using
- the sample size and data exclusion plans (if applicable)
- your methods in detail

Where can you Preregister your study?

There are many online services that support preregistration, some examples include:

- Open Science Framework (OSF)
- ClinicalTrials
- AEA Registry
- AsPredicted
- WHO Registry Network

Read more about it:
- Research Preregistration 101
- Preregistration: A Plan, Not a Prison
- Seven Selfish Reasons for Preregistration

When can you Preregister?

- Right before your next round of data collection
- After you are asked to collect more data in peer review
- Before you begin analysis of an existing data set

Centre on Open Science

Why Preregister?

- Makes your science better by increasing the credibility of your results
- Allows you to stake your claim to your ideas earlier
- It's an easy way to plan for better research

Centre on Open Science

Reported Benefits

- Transparency (37.89%)
- Trustworthiness of science (37.37%)
- Reduced uncertainty (5.26%)
- Helpful for study planning (41.58%)

Spitzer and Mueller (2023)

Reported Drawbacks

- Time costs (43.41%)
- Loss of flexibility (17.58%)
- Increased effort (15.38%)
- Perceived devaluation of exploratory research (7.15%)
- Perceived incompetence if deviations occur (6.59%)
- Not suitable for all projects (6.59%)
- Possibility of scooping (5.49%)

Spitzer and Mueller (2023)

What is a Registered Report then?

Simply said, it is a format of preregistration in journals.

"Registered Reports is a publishing format that emphasizes the importance of the research question and the quality of methodology by conducting peer review prior to data collection. High-quality protocols are then provisionally accepted for publication if the authors follow through with the registered methodology."

Center for Open Science

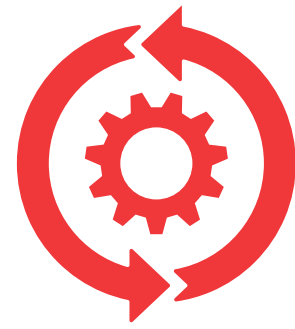

Center for Open Science

How often do journals use Registered Reports?

Currently, over 300 journals use the Registered Reports publishing format either as a regular submission option or as part of a single special issue. Other journals offer some features of the format.

FIND THE PARTICIPATING JOURNALS BY CLICKING HERE

WHAT IS OPEN WORKFLOW?

An open research workflow is when each of step of the research process is openly shared through documentation that makes all stages of the research project transparent and reproducible. Clear documentation includes using best practices around file naming conventions, project metadata, file formats, etc.

UBC

Workflow stages and tools

The 101 Innovations in Scholarly Communication Project surveyed tools used by researchers for different aspects of their work and has sorted academic workflows into six higher-level stages: discovery, analysis, writing, publication, outreach, and assessment. Their circle of tools showcases the wide variety of workflow tools available for each stage of this process.

UBC

You can go a long way to shaping an open workflow by ensuring that all aspects of your project are carefully documented, that the tools you use are accessible to your team and your community, and that your files are predominantly stored in open file formats (or can be exported to open file formats) so that your work won't be lost if a tool or format stops being available in future.

Source: 101innovations website
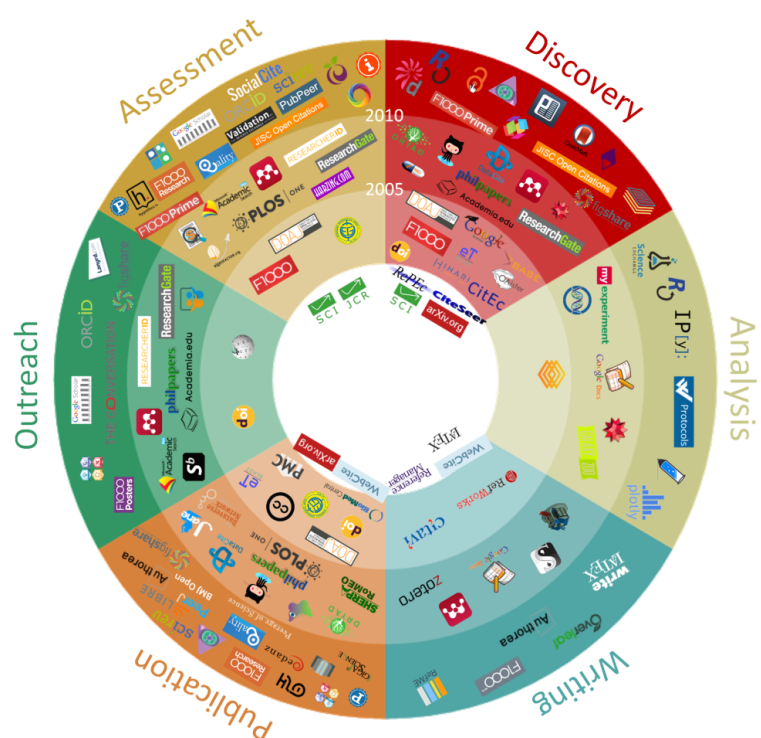
Why open workflows matter?
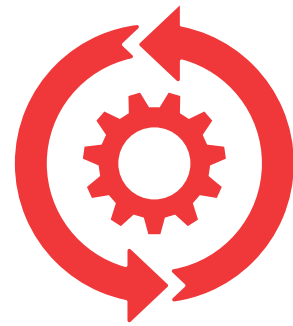
- Traditional non-open research workflows are constantly impacted by the introduction of new tools, approaches, and software.

- What stays the same, across disciplines, is a need to communicate ideas and conclusions so that they may be built on by future scholars.

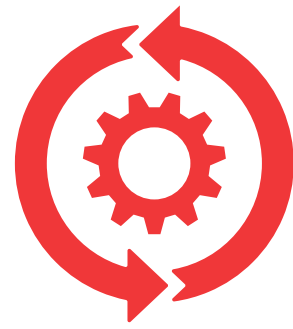- Sharing the complete context of your work helps future scholars understand why a conclusion was reached.

UBC

A no-go for a research workflow?

Here is a video from the NYU Health Sciences Library to illustrate what shouldn't happen when a researcher makes a data sharing request. A video is worth a thousand pictures!
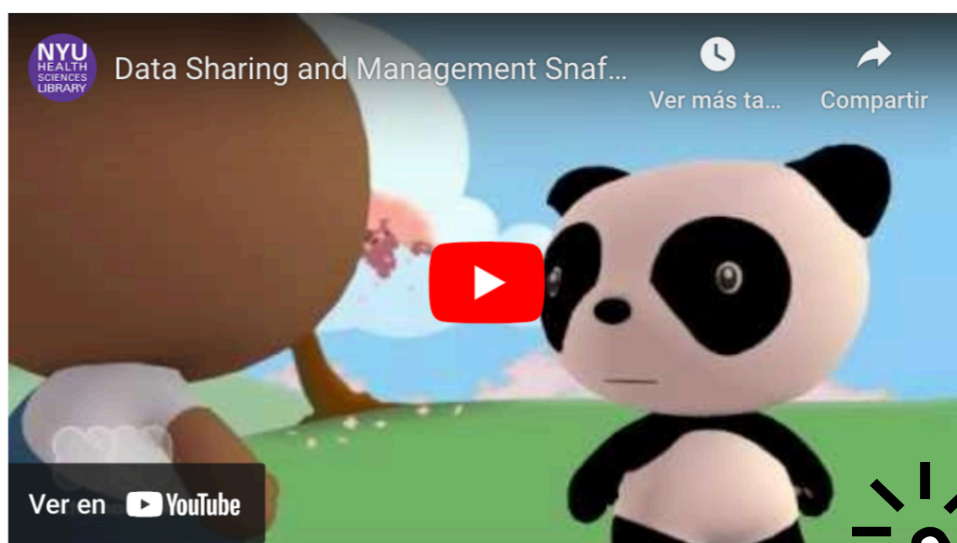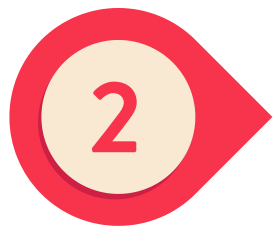
How do open workflows look like?

1 **Scripted & automated:**
Focused on minimizing human-dependent steps

2 **Well documented:**
Focused on minimizing human-dependent steps

3 **Centralized:**
Be kind to your future forgetful self

4 **Transparent:**
Be transparent to yourself, your colleagues, and others

To learn more about open workflows, read the following:

▶ A blog article from 2015 on the 101 Innovations in Scholarly Communications project;

▶ Arguments for open research workflows from "Why Open Research?"

▶ Explore the Open Science Training Handbook, CC-0

▶ A platform to promote Open Science: Foster

WHAT IS OPEN DATA?

"Open Data is a strategy for incorporating research data into the permanent scientific record by releasing it under an Open Access license. Open Data practices ensure that data remains accessible and discoverable. For verification, replication, reuse, and enhanced understanding of research."

PLOS

Why do researchers choose to make their data public?

- **Increased attention** - data shared in a depository is more discoverable, accessible, and reusable
- **Increased trust** - data transparency supports reproducibility and reanalysis
- **Preservation** - your data is kept safe and accessible
- **Academic credit** - Repository use makes it easier to claim academic credit for data collection and curation
- **Meeting requirements** - more funders, institutions and publishers encourage or require data sharing

PLOS

What data should you share?

You should share as much data as necessary. At minimum, include all the data others might need to reproduce your analysis. Make sure to provide raw, unprocessed data.

PLOS

What should you do with your data before sharing?

- Try to make them easy to read (include metadata, variable names, description of the study site, collection methods)
- Try to use some general standard (e.g. EML data)
- Find a repository to put the data (and metadata) in
- Choose your licence

What is FAIR data?

F • **Findable** - it should be easy to find, for both humans and computers (machine-readable metadata)

A • **Accessible** - the user needs to know how it can be accessed, can include authentication and authorisation

I • **Interoperable** - it should be possible to integrate it with other data and interoperate with applications or workflows for analysis, storage, and processing

R • **Reusable** - the final goal is to optimise reusing of data

GO FAIR

What should you keep in mind?

Don't compromise privacy, safety, or legality. Remove identifying information and consider copyright and patent restrictions. If your data cannot be shared, be prepared to explain why not.
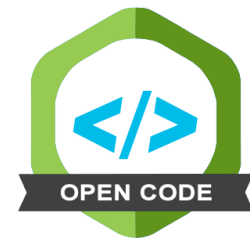
PLOS

What are data brokers?

Data brokers are knowledgeable, independent parties who act as data stewards for sensitive data. Some of them are: The YODA Project, ClinicalStudyDataRequest, and Supporting Open Access for Researchers (SOAR).

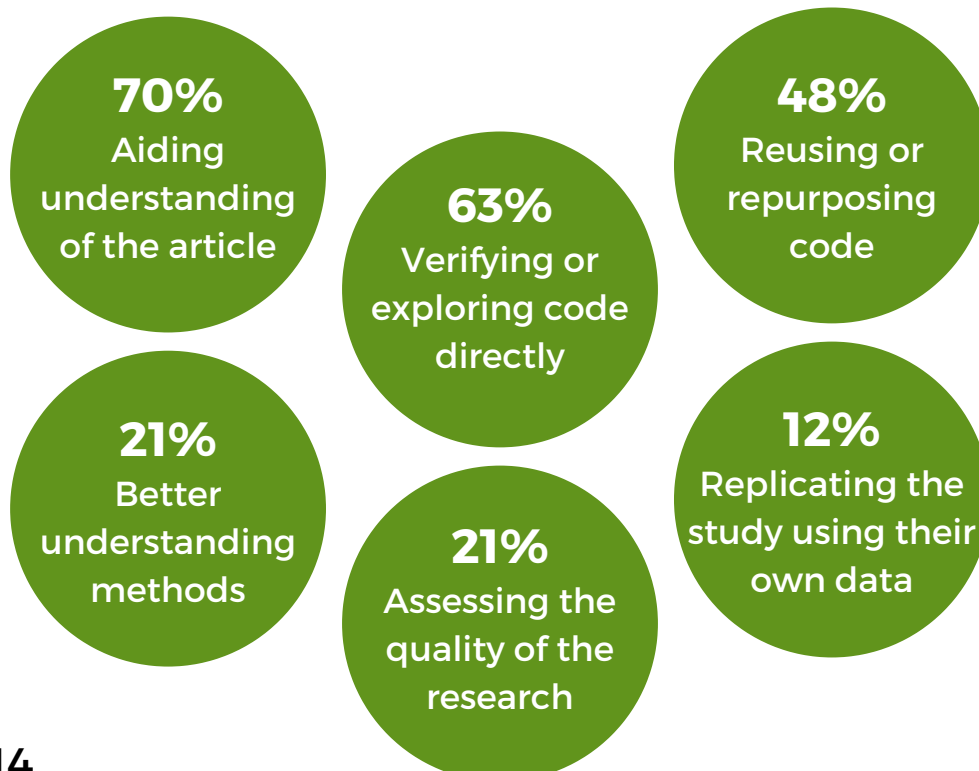The FOSTER Open Science Training Handbook

WHAT IS OPEN CODE?

"Open Code refers to custom, author-generated code used in a scientific research study — often during data collection, interpretation, or analysis — and subsequently made publicly available under an Open Access license. Open code gives context that helps readers understand the work, supports reproducibility, and improves the efficiency of subsequent related research."

PLOS

Do readers really want access to code?

Yes! In a survey by Cadwallader & Hrynaszkiewicz (2022), over 75% of respondents report consulting the code associated with published manuscripts when available. Their aims when consulting code included...

70%
Aiding understanding of the article

63%
Verifying or exploring code directly

48%
Reusing or repurposing code

21%
Better understanding methods

21%
Assessing the quality of the research

12%
Replicating the study using their own data

What does sharing the code help with?

- Understanding the analysis better
- Evaluating the conclusions
- Re-using the code
- Increasing trust in science (contributes to reproducibility & replicability)

What should you do with your code before sharing?

- Describe what your code does
- Use some inline comments to make it easier to read
- Write down the program version and the packages you used
- Write down the basic info on your computing environment
- Give it to someone to try to run it
- Find a repository to store the code (ideally with the data)

Are there any barriers to sharing the code?

- **Portability** - there are a lot of different computers and software, making it hard to run the same model everywhere.
- **Configurability** - after getting the code to run on a different system, setting it up for specific tasks is also difficult
- **Entrenchment** - models can have undocumented decisions from years of development, so they can be hard to understand for outsiders.
- **Model-data Blur** - models and data are deeply intertwined., processed data and models can affect each other's validity
- **Provenance** - reproducing results requires knowing all processing steps, which is challenging, especially with complex tools

Easterbrook, 2014

Where can I find and store Open Data and Open Code ?

Click on the logo and it will take you to the website!

What are Open File Formats?

Open File Formats are file formats that are published and freely available for anyone to use. They are often recommended for archiving because they typically do not require special software to open. For example:

- **Text**: TXT, ODT, PDF/A, XML
- **Tabular data:** CSV, TSV
- **Image:** TIFF, PNG, JPEG, SVG, GIF
- **WebP•Audio:** WAV, FLAC, OPUS
- **Video**: MPEG2, Theora, VP8, VP9, AV1, MJ2
- **Binary hierarchical data**: HDF5

The FOSTER Open Science Training Handbook

FIND THE LIST OF OPEN FILE FORMATS
BY CLICKING HERE
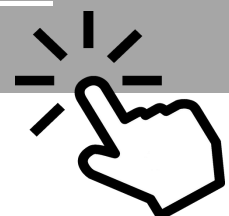
And what about licencing?

A licence in this context is a legal instrument for a rights holder to permit a second party to do things that would otherwise infringe on the rights held.

For years, Creative Commons has been involved in with projects and policy to enable and support the open sharing of scientific information. This is what some of them mean:

BY = Credit must be given to the creator

SA = Adaptations must be shared under the same terms

NC = Only noncommercial uses of the work are permitted

Find more information here: Open Definition and CC web
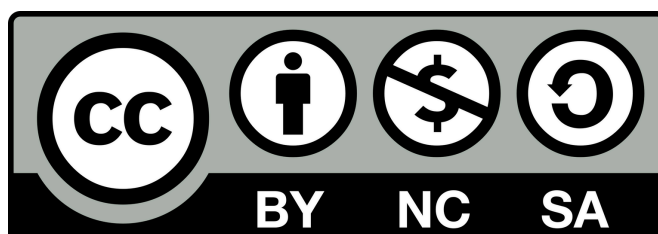
How to licence research data?

First, think about who owns the data and the authorship. Then, decide on a suitable licence and attach it to the data. If you would like to have more information on licencing, here is a really nice guide: How to License Research Data.

# What else I should consider?

- different countries have **different copyright laws**, which may limit the ability to choose any license
- because of the **interoperability of licenses** sometimes you won't be able to mix differently licensed content
- be aware of the **suitability of licenses** - for instance, CC licenses should not be used for software and there are specific licenses for databases

WHAT IS OPEN ACCESS PUBLISHING?

OPEN ACCESS

Open access publishing is a publishing model that allows unrestricted access to scholarly research papers over the internet, without charging readers or imposing restrictions associated with paid subscriptions. The main goal of this approach is to enhance the accessibility of scientific knowledge and its greater impact on society and science.

Gold Open Access

Green Open Access

Hybrid Open Access

Diamond Open Access
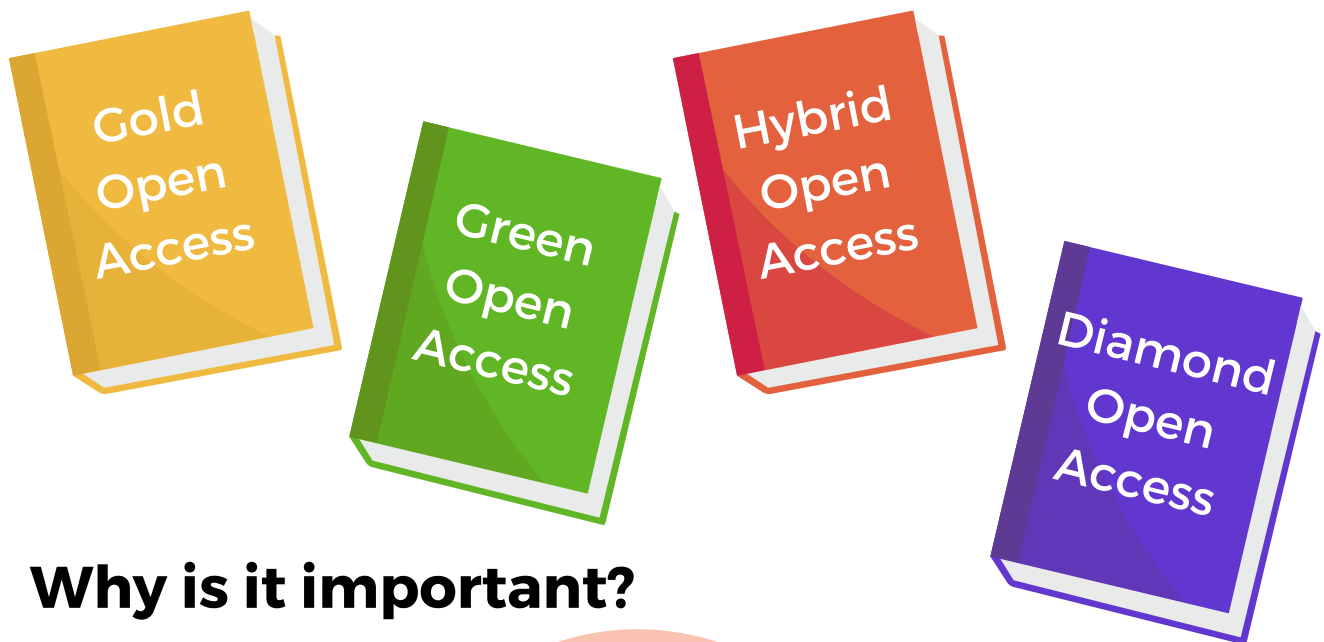
Why is it important?

- The Open Access (OA) model significantly increases the visibility and citation rates of scholarly works. This happens because publications that are freely available are more accessible to a wider audience, which includes not only researchers but also educators, students, and even individuals interested in knowledge outside the academic world. Research available in the OA model is often cited more frequently, which translates into greater recognition of scientists' work and an increase in their influence within their field.
- Open Access also has a significant impact on science and society. With easier access to the latest research results, knowledge can be exchanged more quickly and efficiently.
- Open publications also support education by providing teaching resources to teachers and students, which can be particularly valuable in regions with limited access to scientific libraries or educational resources. In this way, Open Access contributes to educational equity and promotes global social justice.

Gold Open Access:

Description:
Articles are immediately available to everyone on the publisher's website.

Costs:
Publication costs are typically covered by Article Processing Charges (APCs) paid by the authors or their institutions. These fees can be high, but some institutions or foundations may cover them.

Advantages:
Direct and immediate access to publications, increasing visibility and citation rates.

Examples:
Journals like PLOS ONE, BioMed Central.

How to publish gold?

1. Select a journal: Choose a Gold Open Access journal.
2. Prepare your manuscript: Follow the journal's submission guidelines.
3. Submit your article: Use the journal's submission system.
4. Peer review: Undergo the peer review process.
5. Pay APC: Upon acceptance, pay the Article Processing Charge.
6. Publication: Your article will be published and immediately accessible to everyone.
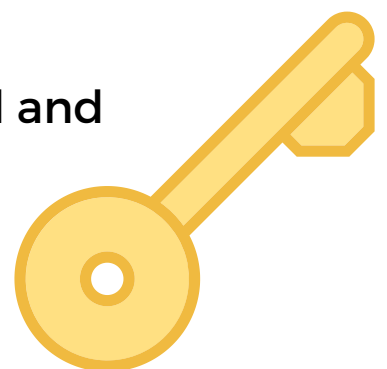
Green Open Access:

Description:

Authors can archive versions of their articles (such as pre-prints, post-prints but before final publisher format) in institutional or subject-specific repositories.

Costs:

No APCs for authors, but there may be embargo periods before the article becomes publicly accessible.

Advantages:

Authors can share their work without additional fees, which is beneficial for those without financial support.

Examples:

ArXiv for physics, economics, and computer science; PubMed Central for biomedical sciences.

How to publish green?

1. Select a journal: Choose any journal that allows Green Open Access.
2. Prepare your manuscript: Follow the journal's submission guidelines.
3. Submit your article: Use the journal's submission system.
4. Peer review: Undergo the peer review process.
5. Archive your article: After acceptance and publication, deposit the allowed version (pre-print or post-print) in an institutional or subject-specific repository.
6. Observe embargo: If applicable, adhere to any embargo period before making the article publicly accessible.

Hybrid Open Access:

Description:

Journals offer the option to publish articles in open access within traditional subscription-based journals. Authors can choose open access by paying an additional APC.

Costs:

APCs paid by authors for open access articles; the rest of the journal's content remains subscription-based.

Advantages:

Authors can choose open access for their articles even in journals that are not fully open access.

Examples:

Many publishers offer this option, e.g. Springer, Wiley.

How to publish hybrid?

1. Select a journal: Choose a hybrid journal that offers open access options.
2. Prepare your manuscript: Follow the journal's submission guidelines.
3. Submit your article: Use the journal's submission system.
4. Peer review: Undergo the peer review process.
5. Choose open access: Upon acceptance, decide if you want your article to be open access.
6. Pay APC: If choosing open access, pay the Article Processing Charge.
7. Publication: Your article will be published as an open access article.

Diamond Open Access:
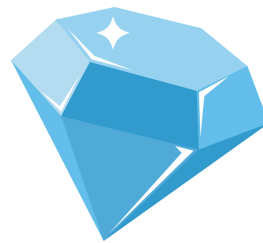
Description:

Articles are freely available to both authors and readers. Publication costs are covered by institutions, foundations, scholarly societies, or other sources.

Costs:

No APCs for authors; costs are covered by other sources.

Advantages:

Completely free access and publication, promoting wide dissemination of knowledge.

Examples:

Sciendo

How to publish diamond?

1. Select a journal: Choose a Diamond Open Access journal.
2. Prepare your manuscript: Follow the journal's submission guidelines.
3. Submit your article: Use the journal's submission system.
4. Peer review: Undergo the peer review process.
5. Publication: Your article will be published without any fees and be freely accessible to everyone.

How do I find Open Access journals?

- Directory of Open Access Journals
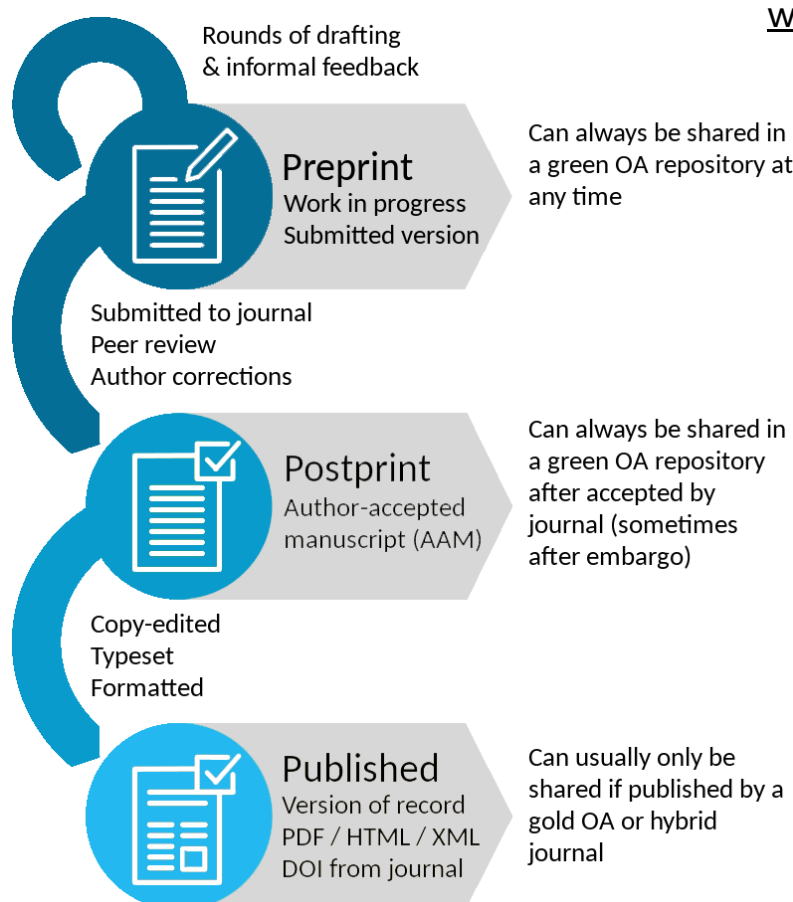- Sherpa Romeo
- Journal Checker Tool

WHAT IS PREPRINTING?

"Preprints are preliminary versions, or manuscript versions, of scholarly works – especially journal articles – that are made available to the public. As a rule, they are non-peer-reviewed versions whose public release primarily serves to expedite the sharing of research findings. Preprints are made freely available to the public on preprint servers."

<div align="right">

Open Access Network

</div>

What about postprinting?

"A postprint is a digital draft of a research journal article after it has been peer reviewed and accepted for publication, but before it has been typeset and formatted by the journal."

<div align="right">

Wikipedia definition

</div>

Rounds of drafting & informal feedback

Preprint
Work in progress
Submitted version

Can always be shared in a green OA repository at any time

Submitted to journal
Peer review
Author corrections

Postprint
Author-accepted manuscript (AAM)

Can always be shared in a green OA repository after accepted by journal (sometimes after embargo)

Copy-edited
Typeset
Formatted

Published
Version of record
PDF / HTML / XML
DOI from journal

Can usually only be shared if published by a gold OA or hybrid journal

Based on: Shafee, Thomas (2020). Typical publishing workflow for an academic journal article (preprint, postprint, and published) with open access sharing rights per SHERPA/RoMEO. Own work; adapted from diagram by Ginny Barbour Wikimedia Commons (CC BY 4.0 International)

Why are preprints good?

- Preprints increase Early Career Reasearchers visibility and facilitate networking
- Preprints can help ECRs accelerate training time and optimise research design and quality
- Preprints allow ECRs with limited funds to publish their findings open access
- Preprints in public health and medical research can boost ECR research
- Preprints can accelerate the peer-review process to make ECRs more efficient
- Preprint commenting can help ECRs develop their reviewer skills
- Preprints help ECRS perform corrections via revisions
- Publishing all research findings and conditions in preprints can benefit ECRs

Sarabipour et al. (2019)

Want to find the right preprint server for your discipline and research area?

ASAPbio

WHAT IS POSTPUBLICATION PEER REVIEW?

Concept and Purpose:

- **Continuous Evaluation:** Traditional peer review occurs before publication, but postpublication peer review continues the assessment afterwards, enabling a broader scientific dialogue and ongoing scrutiny.

- **Community Engagement:** It allows the entire scientific community, not just a few appointed reviewers, to contribute feedback and criticism, which can help identify errors missed during initial review processes.

- **Dynamic Corrections:** Facilitates quick corrections, retractions, or clarifications as more reviewers engage with the content over time, potentially improving the reliability and accuracy of published research.

Find out more HERE!

What are the mechanisms of Postpublication Peer Review?

- **Online Platforms and Journals:**

Platforms like PubPeer, ResearchGate, and specific journal-hosted forums where comments and discussions can be posted directly on published papers. Some journals have incorporated structured postpublication peer review alongside or as a replacement for traditional models.

ResearchGate

PUBPEER
The online journal club

- **Social Media and Blogs:**

Researchers increasingly use blogs and social media to discuss and critique published work. These discussions, while informal, can significantly influence public and academic perception of the research.

- **Integration with Pre-publication Review:**

Some hybrid models involve initial traditional peer review followed by an open postpublication process where the article can evolve through community feedback and updates.
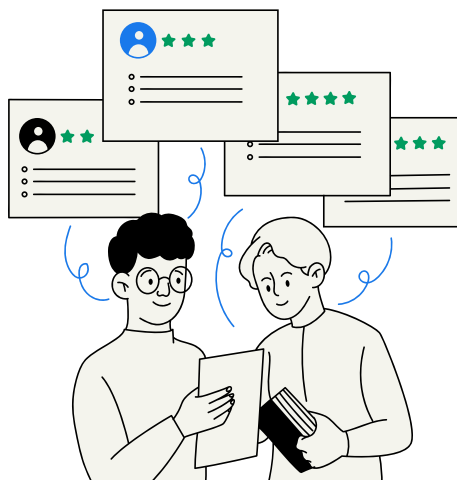
What are the advantages of Postpublication Peer Review?

- **Increased Transparency and Scrutiny:**

More eyes on a study can lead to a more thorough vetting process, reducing the prevalence of flawed or fraudulent research.

- **Enhanced Scientific Dialogue:**

Encourages ongoing debate and reconsideration of findings, which is crucial for scientific advancement.

- **Flexibility and Timeliness:**

Allows for real-time critique and feedback, which is particularly important in fast-moving fields like medicine and technology.

What are the challenges of Postpublication Peer Review?

- **Quality Control:**

Comments and reviews are often unstructured and vary in quality, making it difficult to gauge their legitimacy and scientific value.

- **Potential for Misuse:**

Anonymity and lack of formal oversight might lead to non-constructive criticism, personal attacks, or other unprofessional behaviors.

- **Impact on Researchers' Careers:**

Negative postpublication reviews can harm reputations and career prospects, particularly for less established researchers.

- **Overload of Information:**

The volume of feedback can be overwhelming for authors to manage and for other scientists to navigate effectively.
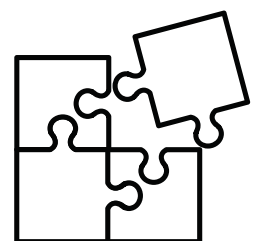
PUBPEER
The online journal club

PubPeer is an online platform that allows for the post-publication review of scientific works. It enables anonymous and open commenting on published research by the scientific community.

Click on the logo to visit their website!

Advantages:

- **Anonymity**: Protects reviewers from potential personal consequences, encouraging open and honest critique.
- **Transparency**: Facilitates access to critical opinions on research, enhancing the transparency of scientific discourse.
- **Quick Error Detection**: Allows for the rapid identification and correction of errors or irregularities in research.

Disadvantages:

- **Risk of Abuse**: Anonymity can lead to unjustified criticism and personal attacks.
- **Lack of Formal Verification**: Comments are not subject to formal review, which can affect their quality and credibility.
- **Potential Negative Consequences for Authors**: Anonymous criticism can adversely affect their reputation

F1000Research
Open for Science

F1000 (Faculty of 1000) is a unique open access publishing platform that supports the rapid publication of scientific research across various disciplines. It employs an open peer review process, where reviewers are named and their comments are made public alongside the articles.

Click on the logo to visit their website!

Advantages:

- **Open Peer Review**: Increases transparency by publishing reviewer comments and identities, promoting accountability and constructive feedback.
- **Speed of Publication**: Allows for quick dissemination of research findings, which is crucial in fast-evolving fields.
- **Visibility and Accessibility**: Being an open access platform, it ensures that published research is accessible to a wider audience without paywalls.

Disadvantages:

- **Perception of Quality**: The rapid publication model may raise concerns about the thoroughness of the review process.
- **Cost**: Authors typically bear the publication costs, which can be a barrier for researchers without sufficient funding or institutional support.
- **Potential Bias**: The visibility of reviewer identities could potentially influence their comments, either positively or negatively, due to personal or professional relationships.

eLife is an open-access scientific journal focused on life sciences and biomedical research. eLife aims to improve the publication process by promoting transparency, fairness, and high-quality science through innovative editorial and review practices.

Click on the logo to visit their website!

Advantages:

- **Open Access:** All articles published in eLife are freely accessible to anyone, enhancing the dissemination of scientific knowledge.
- **Transparent Peer Review Process:** The journal uses a consultative peer review process where reviewers work collaboratively, providing authors with a consolidated set of comments, reducing redundancy and confusion.
- **Editorial Decision-Making:** Decisions are made quickly and the process emphasizes scientific merit and potential impact rather than perceived prestige.
- **No Publication Fees:** Unlike many other open-access journals, eLife does not charge authors article processing fees, making it more accessible for researchers without substantial funding.

Disadvantages:

- **Selective Nature:** eLife is highly selective, which can make it challenging for all researchers to publish their work in this venue.
- **Perceived Impact:** While eLife is highly respected, it is relatively new compared to longer-standing journals, which may affect the perceived impact within certain academic circles.
- **Pressure on Peer Reviewers:** The collaborative review process, while beneficial in many ways, can place additional pressure on reviewers to agree on feedback and assessments, potentially lengthening the review process.
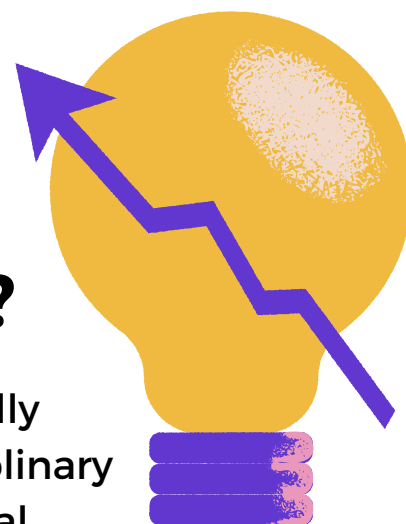
WHAT ARE COLLABORATIVE PLATFORMS?
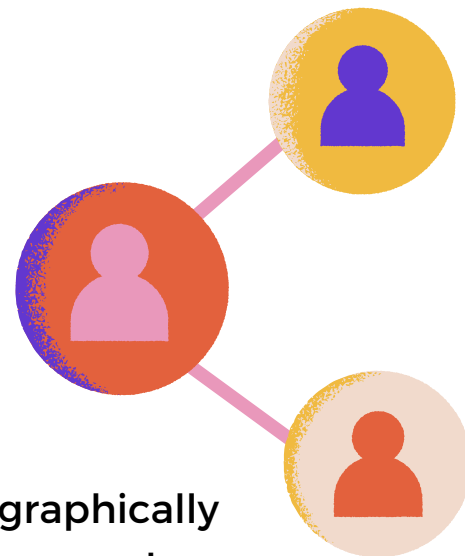
Online collaborative platforms connect geographically dispersed researchers and enable them to cooperate seamlessly on their research, sharing research objects, ideas and experiences. They provide a virtual environment where multiple people can connect concurrently and work on the same task. These can range from extensive virtual research environments (VREs) which encompass various tools to facilitate sharing and collaboration, to single specific tools that enable researchers to work together in real-time on specific aspects of research (such as writing or analysis).
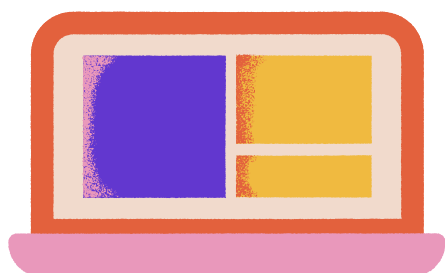
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Why is there a need for Collaborative Platforms?

"Research collaboration is growing exponentially and teams are becoming ever more interdisciplinary as researchers increasingly work in international and cross-disciplinary groups to enable a multitude of perspectives on specific research questions. Virtual Research Environments (VRE) and collaborative platforms enable collaboration across continents, time zones, and disciplines!

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What are some Collaborative writing platforms?

In the currently predominant "publish or perish" culture of research, writing is a core task in the life of researchers. Several online tools and platforms can help you with that:

- Overleaf
- Authorea
- Fidus Writer
- Google Docs

What about sites for reference management & discovery?

There are plenty of tools which enable groups to store and manage references. Examples include:
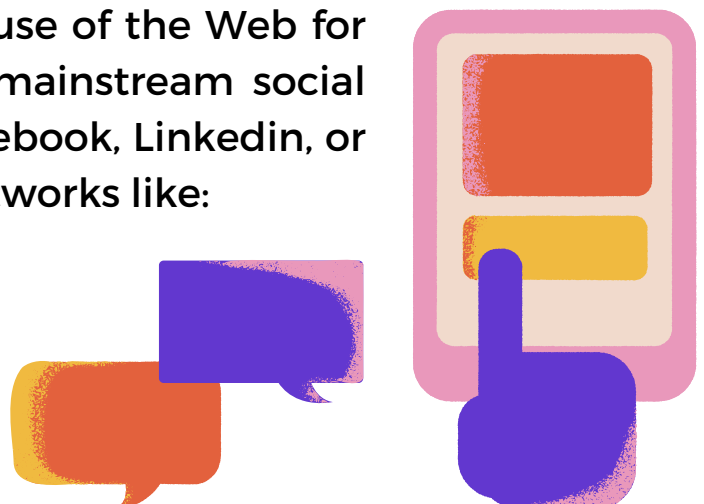
- Zotero
- Citavi
- Mendeley
- BibSonomy

Hmm, what about annotation?

- Hypothes.is
- PaperHive

Any academic social networks?

Researchers have long made use of the Web for social networking, either via mainstream social networks - Twitter/now X, Facebook, Linkedin, or dedicated academic social networks like:

- ResearchGate
- Academia.edu
- Mendeley

WHAT IS CITIZEN SCIENCE?

"Citizen science is any activity that involves the public in scientific research and thus has the potential to bring together science, policymakers, and society as a whole in an impactful way. Through citizen science, all people can participate in many stages of the scientific process, from the design of the research question, to data collection and volunteer mapping, data interpretation and analysis, and to publication and dissemination of results."

https://eu-citizen.science/

How is it connected to Open Science?

"Citizen science is both an aim and an enabler of Open Science. It can refer to citizens actively and openly participating in the research process itself, often through crowdsourcing activities. Alternatively, it can also mean greater public understanding of science facilitated through greater access to information about the research process, including the ability to use open research data and to have open access to journals."

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What are some examples?

- The first documented Citizen Science project took place at Christmas in 1900 in the USA, when the National Audubon Society carried out a Christmas Bird Count.
- One of the most successful Citizen Science project is "Galaxy Zoo" with over 150,000 participants who classified galaxies in one year.

Rafal's media corner!

Nielsen
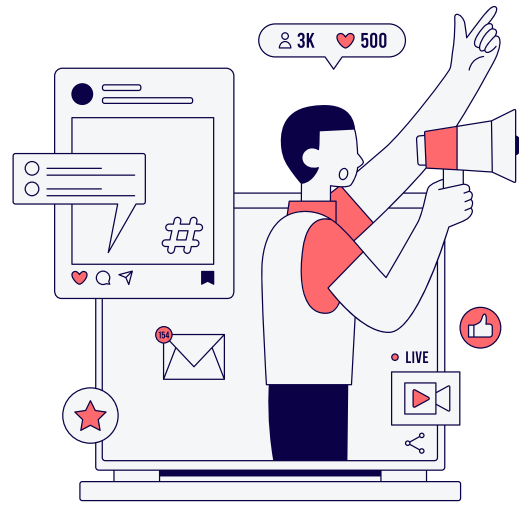
A data analytics platform that provides insights into audience preferences and behaviors, which can help researchers understand the impact and reach of their media content in scientific communications.

buffer

A social media management tool that helps schedule, publish, and monitor content across various platforms, crucial for promoting research and engaging communities.

Unsplash

A free database of high-quality photos provided by photographers worldwide, useful for enhancing the visual aspect of scientific publications and presentations.

mailchimp

An email marketing platform that allows designing, sending, and analyzing email campaigns, which can be utilized for communicating with research participants or disseminating scientific knowledge.

Click on the logos to visit their websites!