

Open Science and Reproducibility for Greater Impact



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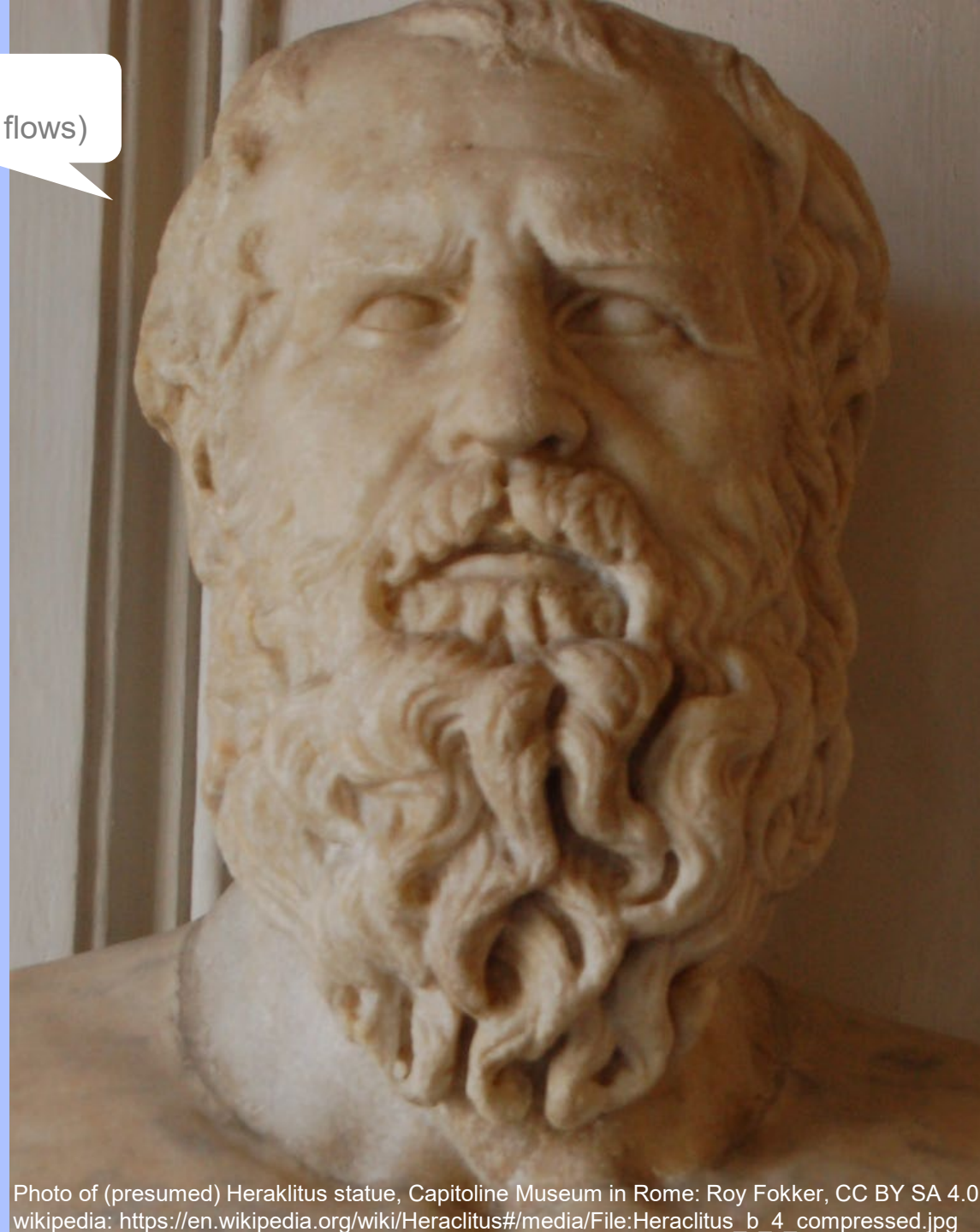


Funded by
the European Union

Panta rhei
(everything flows)

Why open?

- **Effective** gathering (and **honest** sharing) of information is essential for any human effort in the constantly transforming world, including
- Science – **collective** endeavor
- **Communication** is a key to real-world **impact** of any knowledge
- **Openness increases efficiency of communication in science.**



General principles of Openness



Knowledge (or tools...) are considered **open**, if they enable users to freely:

- **Access** the full content (reading, downloading...),
- **Use** it,
- **Modify** it (translation, enhancement, adapting to local needs or for a group with special needs...),
- **Share**, disseminate.

... legally enabled by open licenses, e.g. Creative Commons



What opportunities does openness offer us?

1. **Seeing** into matters:

Transparency, credibility, reproducibility, accountability (author indicates that he has a clean record and used proper methods),
Openness can help us see things about ourselves (our data) that we wouldn't have noticed on our own
An opportunity to correct mistakes or discover unexpected benefits.



2. The chance to **influence** things / processes, a free environment:

We can learn from and make use of others' open data without unnecessary barriers.



3. **Readiness** to respond to external signals / changes of environment:

The ability to respond more quickly to changes and adapt strategies to current developments.



4. **Sharing** with others, building relationships and collaborations, **creating new values**:

Allow others to access your results, make use of it in new ways (the more people re-use your data, the more worthwhile it is for a funder to invest in your research – the gain doesn't necessarily mean money, but could be, for example, visibility and public image of your of institution, or public benefit), strengthen collaboration, and encourage others to share – change of research culture.

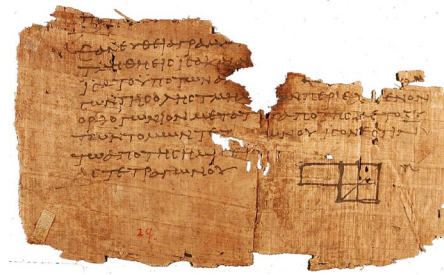


Tangled today

- Current state of scholarly communication: hard to navigate
- **Barriers** (to access – subscription journals, legal barriers – copyright transfers, barriers to publish – high fees that reflect more of an intended aura of prestige than the actual production costs...)
- **Power imbalance**, sense of injustice: scientists write and review articles for free, but their institutions pay subscription and / or publishing fees
- Causes are **rooted in history**

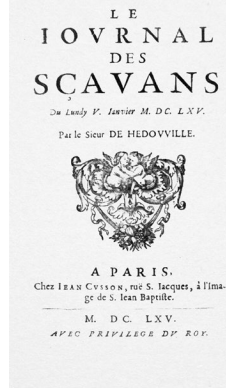


Long story short



Scholarly communication history:

1. **Speech** – crucial, but reaches only immediate listeners
2. **Scrolls, codices** – greater outreach in terms of time and space, but manually transcribing makes it expensive and rare.
3. **Printed books** – cheaper, wider outreach, but still expensive for author / publisher
4. **Republic of letters** (17.th century) – community, catalyst of the scientific revolution
5. First **scholarly journals** – wider efficiency and outreach compared to writing letters, faster than publishing books, no expenses for the author (publishers: mostly learned societies, low or no profit).



Why does science need journals?

Main functions:

- **registration** (e.g. X. was first to discover...)
- **certification** (quality control, peer-review)
- **distribution** (publishing)
- **archiving** (long-term storage) and **curation of scholarly record** (not only choosing what to publish, but also corrections, expressions of concern, retractions of articles...)

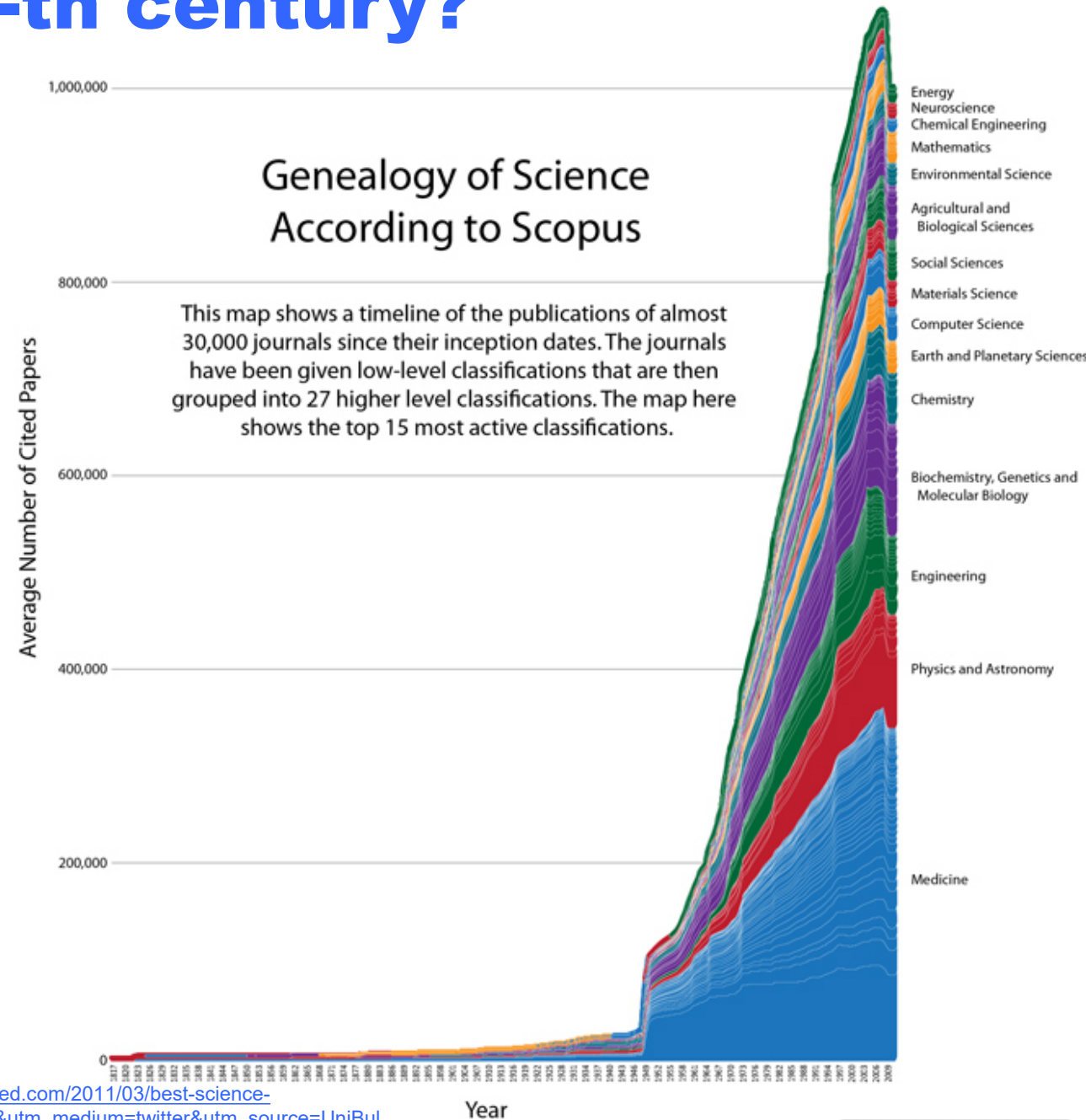
Academy-owned publishing:

Reciprocal free exchange of journals between scientific institutions was normal. Subscriptions were affordable, researchers often **personally subscribed to 1 or several journals** most important in their field.



What happened in the 20-th century?

- **Informatio explosion in academic publishing**
- the states have realised that investment in science and education wins wars
- libraries / research institutions have money
- a whole segment of science is growing, new disciplines are emerging
- **professionalisation** and **commercialisation** of the scholarly publishing sphere (academics still do scientific part of the work, but commercial publishers take care of the business)
- **Academy loses control over many scholarly journals, but researchers still depend on publishing in them because of research evaluation system**

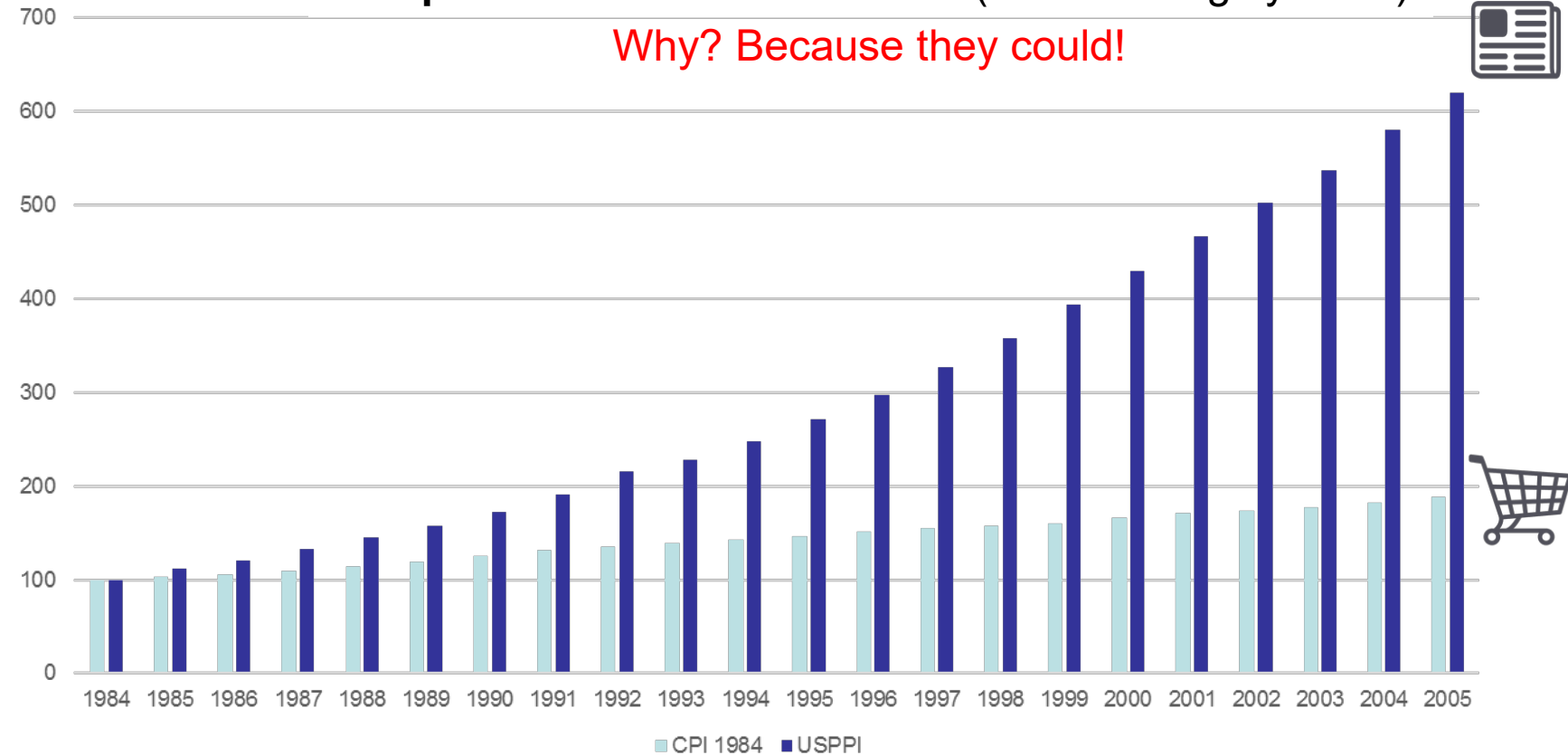


The most disadvantageous out-sourcing in history

Disproportionate pricing

- a distorted market in scientific publishing
- **Access crisis**
- **cancellation of individual subscriptions**
- „**Big Deal**“ (bundle) measure by publishers against cancellation of subscriptions by libraries
- big publishers – higher profits than oil companies (2010: Exxon Mobil 28,1 %, Elsevier 35,7 %)
- these profits are **not returned to science**

Growth of scholarly journal subscription prices compared to consumer basket (source: Dingley 2005)

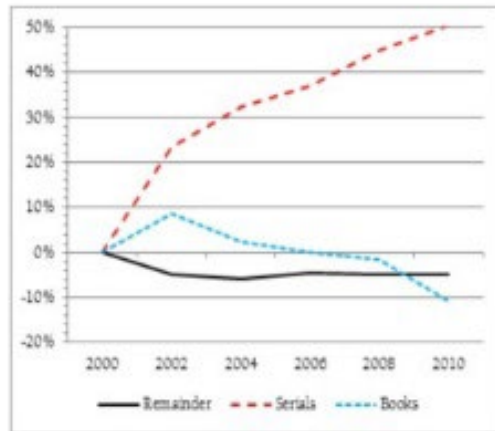


- the content of each journal is unique, it **cannot be replaced by another, cheaper one**;
- Unequal **bargaining positions**: a small number of large publishers versus a large number of libraries and universities **dependent** on access to prestigious journals.

Wider consequences of the serial crisis

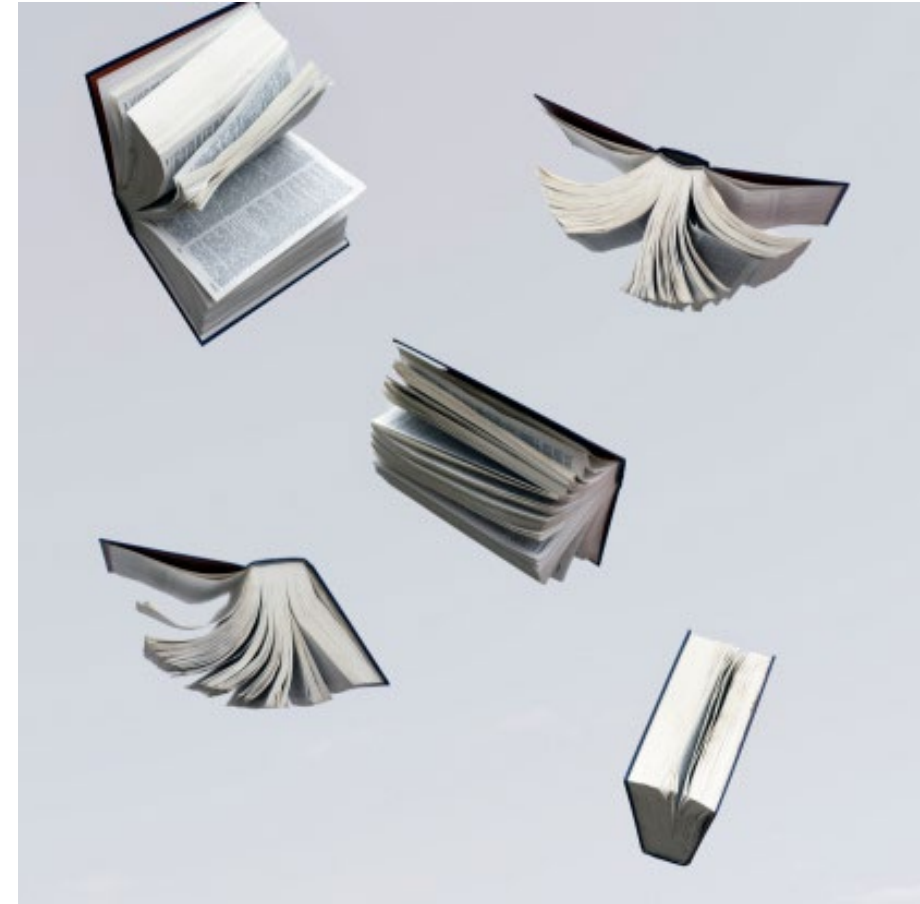
The Big Deal and The Damage Done

Walt Crawford



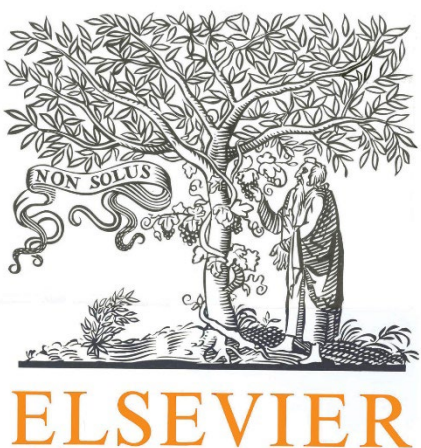
A Cites & Insights Book

- shifting funding from books to journals
- consequence: **monograph crisis**
- problems with **archiving**
- **opacity** of the situation, **fatigue** (variable policies in different publishers, librarians forced to negotiate constantly)
- In short, instead of the declared symbiosis, it seems more like the exploitation of academic resources by large commercial publishers.



Big publishers oligopoly

- Big publishers still gaining new journals, small ones are losing out.
- Big Deal policies make it easier for libraries to cancel subscriptions to a small publisher than to a large one
- Graph: percentage of articles in the natural and medical sciences (left) and social sciences and humanities (right) published by the five largest publishers, 1973–2013 (red line – „the rest“, small publishers).



ELSEVIER

sage

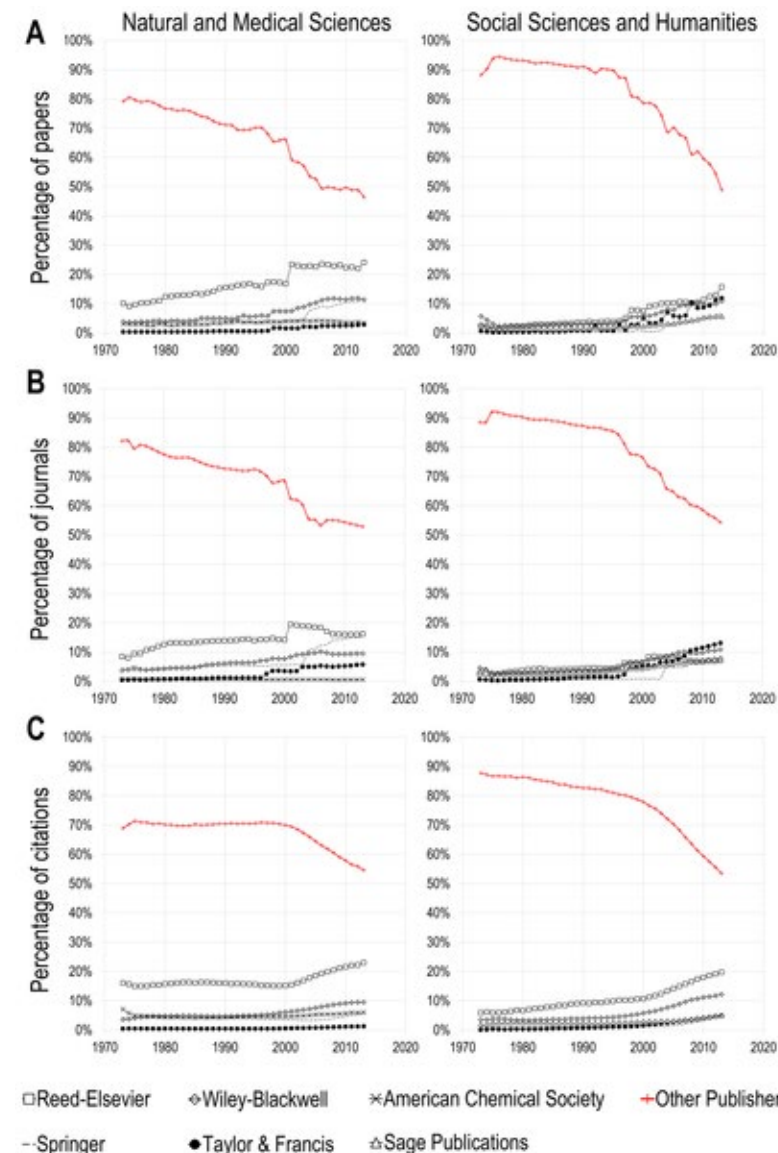


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Is a big publisher always a big win for a journal? (visibility/prestige vs individual approach)

Oligopoly of the big publishers, Larivière et al., 2015:
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0127502>

Asking for access

P. Suber (2013): „...we donate time, labor, and public money to create new knowledge and then **hand control over the results to businesses** that believe, correctly or incorrectly, that their revenue and survival depend on limiting access to that knowledge.“

Elsevier's business practices bordering on extortion did not go unchallenged:

- Stevan Harnad 1994: **Subversive proposal** (for researchers to archive their articles in repositories)
- 1997 **CogPrints**, GNU **E-Prints** – open source software for repositories
- Harold Varmus, Patrick O. Brown and Michael Eisen appealed to commercial publishers for access to literature (2000): PLoS – **Public Library of Science**
- 2001: [Budapest Open Access Initiative](#) (BOAI)
- 2003: [Bethesda Statement](#)
- 2003: [Berlin Declaration](#)
- 2018: cOAlitionS, [Plan S](#)



Open Access - solving the crisis of access to scientific information

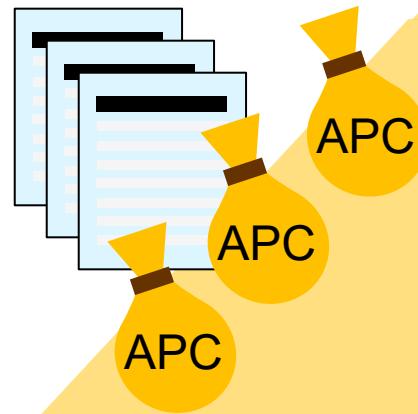


Platinum/diamond route:

- journal has its own funding
- libre OA without author fees /APCs

Gold route

- **journals**
- immediate open access
- CC-BY licences
- author fees (Article Processing Charges)
- disadvantage: additional costs for the author, trend of price increases (unequal access to publishing),

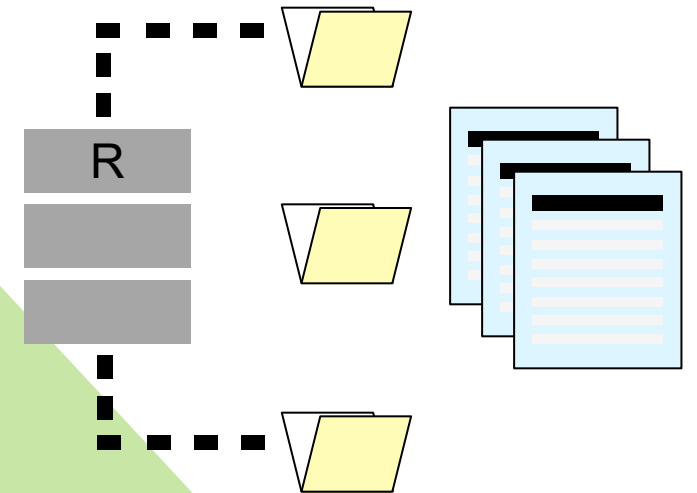


Open Access

- always online
- always free for the reader (**gratis OA**)
- seeks to remove legal barriers (CC-BY licences → **libre OA**)

Green route

- **autoarchiving (of author's own articles) in repositories, e.g. Zenodo, arXiv, bioRxiv...**
- no author fees
- compatible with publishing in subscription-based journals
- disadvantage: depends on journal policy (does it allow pre-print, post-print archiving?; does it apply an embargo?)
- advantage: space for the data and information too voluminous to be presented in journals



Hybrid open access:

- publishing in „traditional“ subscription-based journal
- author pays additional fee to publish his article open access („double dipping“)
- not supported by some funders

Bronze open access:

- publishing free for the reader, but without open licences (unclear conditions of use)



Promoting transparency and openness according to the Open Science Framework (OSF)

- Promoting principles of transparency and openness in journal policies and editorial processes
- They focus on specific practices that contribute to the reproducibility of research:
- Citation – not only of the articles the author drew upon, but also of **data, code, materials**, etc.) – **consistent citation of various forms of contributions by other researchers increases their motivation for openness**,
- Transparency regarding **data**,
- Transparency regarding **analytical methods** (code),
- Transparency regarding **materials**,
- Transparency regarding **design and analyses**,
- **Pre-registration of studies**,
- **Pre-registration of analyses**,
- **Replication** of research.

The document itself contains several versions of the proposed wording at different levels (**Level 1, 2, 3**), depending on the depth to which the journal wishes or needs to address the topic in its policies.

Level 1: State whether the data/materials will be open access (or at least under what conditions they will be made available to other researchers),

Level 2: The journal publishes only articles in which the data/code/materials are documented and will be made available to other researchers for the purpose of replicating the experiment,

Level 3: The journal publishes articles in which the data/code/materials are made available to the journal (reviewers) prior to publication to verify reproducibility.

„A journal article is a central element of the scientific communication process. Guidelines for authors **define which aspects of the research process should be made available** to the community **for evaluation, criticism, reuse, and further development**. Scientists recognize the value of transparency, openness, and reproducibility. Improving journal policies can help make these values more evident in everyday practice and, ultimately, **enhance public trust in science itself**.“

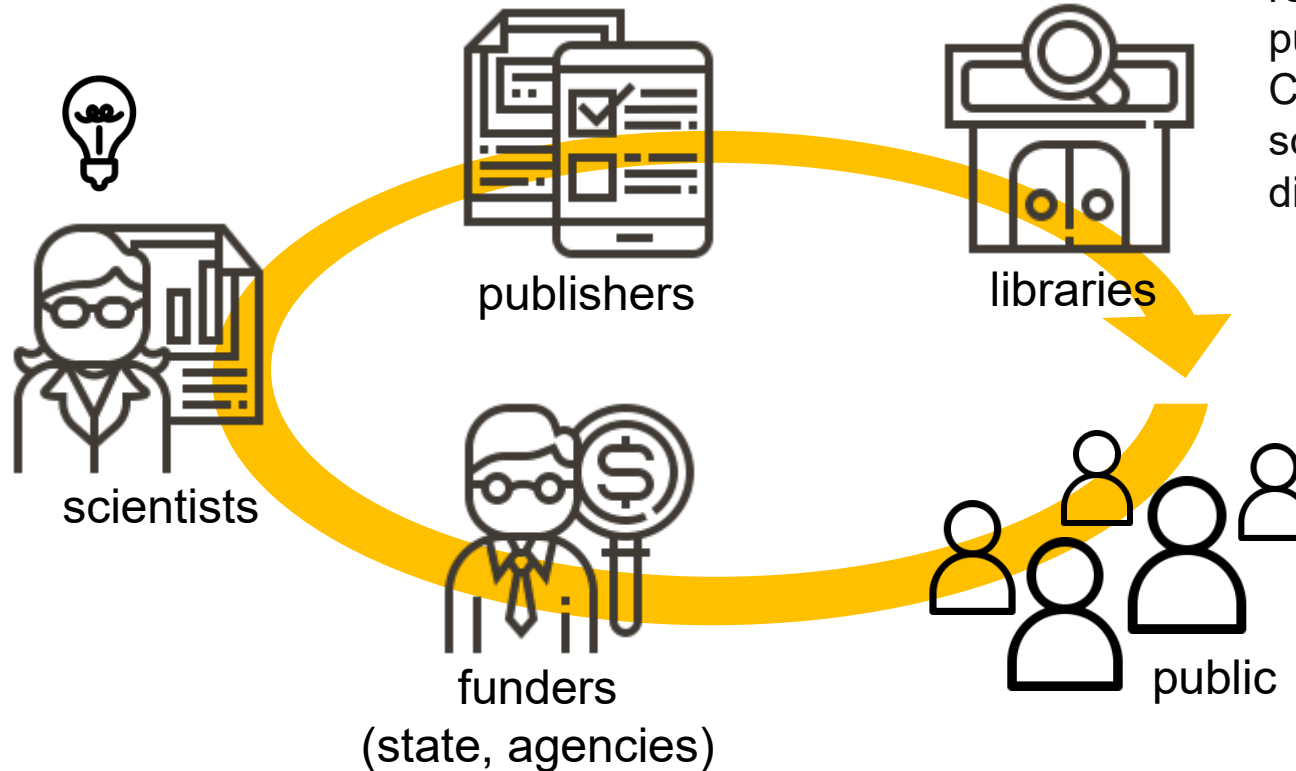


Stakeholders of scholarly communication and their roles

facilitation of independent peer review, editorial process, visibility, gatekeeping of publishing integrity. Challenge: striking a balance between intrinsic merit and financial requirements (fair gold)

management of information resources, mediation between publishers and readers, perspective. Challenge: renew contact with scientists, continuous learning, dissemination of good practice

They produce content, contribute to the world with their "gift culture", but easily give up rights. Challenge: change habits, keep authors' rights, take responsibility – their publishing choices shape the scholarly communication environment.



scientists

publishers

libraries

funders

(state, agencies)

public

Allocate resources, control implementation. Challenge: fairness, consistency, appropriate incentives

identification of dominant themes (social demand), feedback. Challenge: to call for a knowledge society and evidence-based decision-making

„Money is like gasoline during a road trip. You don't want to run out of gas on your trip, but you're not doing a tour of gas stations.“

Tim O'Reilly

Creative Commons Licences: the legal framework for open access

- Open access publishers do not ask authors to transfer copyrighted works but publish with **Creative Commons licenses** (not the only public licenses, but the most frequent in science).
- In 2001, the non-profit Creative Commons was founded by lawyer and activist Lawrence Lessing with the support of the Centre for Public Domain.
- **CC created a legal framework for publicly sharing content that is accessible to anyone without infringing copyright.**
- The use of these licenses is **free of charge**, without the need for registration and administrative tasks, it is enough to mark your work with the selected license including a link to the full text of the license, e.g.



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More information:

- **Creative Commons Certificate (EN):** <https://certificates.creativecommons.org/>
- **Guide to Creative Commons for Humanities and Social Science Monograph Authors (EN):**
https://openaccess.city.ac.uk/id/eprint/11863/1/CC_Guide_for_HSS_Monograph_Authors_CC_BY.pdf

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✓	✓	✗	✗	✓



You can redistribute (copy, publish, display, communicate, etc.)



You have to attribute the original work



You can use the work commercially



You can modify and adapt the original work



You can choose license type for your adaptations of the work.

Tools for access

- [Unpaywall](#) – database of open access articles, browser extension helping reader to find open (e.g. repository, green OA) versions of paywalled articles,
- [EndNoteClick](#) (formerly Kopernio) – browser plugin,
- [DOAJ](#) – Directory of Open Access Journals,
- [DOAB](#) – Directory of Open Access Books,
- [Unsub](#) – tool for librarians to analyze Big Deals / optimize costs,
- [Open Alex](#) – fully open catalogue of scholarly works (named after the Library of Alexandria) with bibliometric tools. Dataset is enriched with connections to authors, institutions, funders, and citations, and is downloadable, queryable via API, and available under CC0 license.



Regaining for control

Editors in some journals rebel against high prices and low availability of scientific content – the return of editorial boards from commercial publishers under control of the academic community

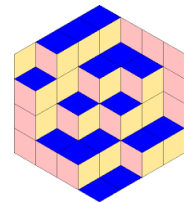


Journals switching to open access:

- 2015: linguistics journal *Lingua* (Elsevier) → *Glossa* (Ubiquity Press)

Johan Rooryck persuaded the entire editorial board to leave Elsevier and create their own Open Access journal

- 2018: *Journal of Algebraic Combinatorics* (Springer) → *Algebraic Combinatorics* (Centre Mersenne) (part of the Free Journal Network, network of 28 mostly mathematics OA journals)



ALGEBRAIC COMBINATORICS

Founding **overlay journals** (building on repository infrastructure and preprints, they lead selected preprints through the review process and corrections, forming another "layer" that overlays the original preprint)

- mathematics journal *Discrete Analysis* (2016, Timothy Gowers) – **overlay journal**, whose content is hosted in the **arXiv** repository.



Journals with low operating costs (published on **Open Journal System** platforms based on open source software) that publish content in open access and do not charge author fees.

Regaining for control

Academics-owned diamonds

- 2026 UK/US: [Open Journals Collective](#) (international collective of libraries, scholarly societies, and small non-profit publishers) – **diamond route to OA**, owned by academics (similar to [Open Book Collective](#))
- cuts: many academic libraries in the UK give up Big Deals
- systematic flipping of journals from commercial publishers
- investment to professionalization of diamond journals
- long-term sustainable, addressing inequalities in the system.

Caroline Edwards - Executive Director, Open Library of Humanities and Co-Director, Open Journals Collective:
<https://vimeo.com/1090554632>



01. We work with university-based publishers to make your favourite academic journals free to read and free to publish in.



02. We raise investment from libraries, funders, and consortia to ensure that cutting-edge research is available to everyone without any paywalls.



03. We protect against the commercialisation of academic journals by strengthening collaboration between university-based publishers.



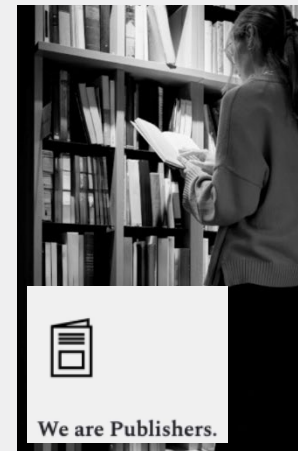
01. We offer a viable alternative to commercial Transformative Agreements, giving back control to academic communities and their libraries.



02. We flip high-quality journals into our collections, ensuring an equitable and scalable transition to diamond open access.



03. We leverage our academic networks to move journals away from commercial publishing models and deliver savings for library budgets.



01. We raise investment from libraries, funders, and consortia to sustain and grow open access journal publishing.



02. We empower journals to flip from subscription and hybrid models to diamond open access, securing a sustainable future for equitable publishing.



03. We create a powerful collective voice for university-based publishers, defending academic integrity and standing up to for-profit global publishers.

Transformation to open

- Some countries and institutions are **canceling or re-negotiating Big Deals** and investing saved money to open infrastructure (repositories, tools),
- Rise of **transformative agreements** (read and publish)
- Transition to open is proceeding, but not as fast as was hoped for
- Hurdles on the road (dishonest actors, **questionable / predatory publishers** – business model based on the abuse of gold OA and publish or perish pressures in academia. **The main culprit is not OA itself, but publish or perish culture** powered by research evaluation relying on journal metrics.
- **Need of complex approach**
- 2021: United Nations Educational, Scientific and Cultural Organization / UNESCO [Recommendation on Open Science](#)



Resource: Teaching module for academics on **how to avoid questionable publishers** – English and Czech versions (team of Terera Šímová, AVČR) <https://www.stoppredatorypractice.com/teaching-module>



What is Open Science?

Collaborative, transparent approach to research

„**Inclusive construct** that combines various movements and practices aiming to make multilingual **scientific knowledge openly available, accessible and reusable for everyone**, to increase scientific collaborations and sharing of information for the benefits of science and society, and to **open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community**. It comprises all scientific disciplines and aspects of scholarly practices, including basic and applied sciences, natural and social sciences and the humanities, and it builds on the following key pillars: **open scientific knowledge, open science infrastructures, science communication, open engagement** of societal actors and **open dialogue** with other knowledge systems.“

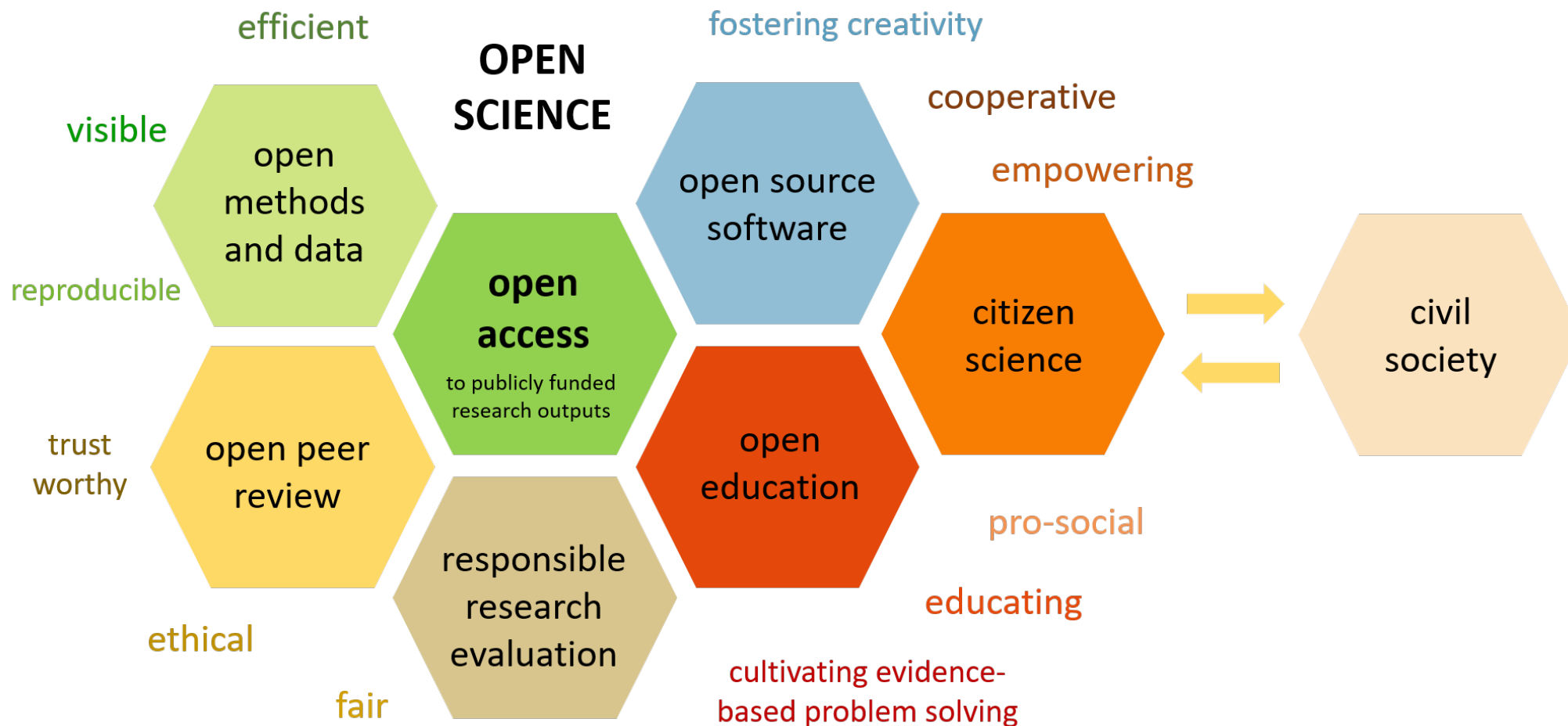
UNESCO Recommendation on Open Science

Transparency benefits every aspect of science.

Common denominator: The public's right of access to results produced using public funds.

„Lack of transparency is the best imaginable protection for bad governance.“

F. Dehousse (scientist, lawyer, judge)



Responsible Research Assessment

The **inappropriate use of journal metrics** (such as the journal impact factor) to compare researchers and research institutions has led to a distortion of the scientific landscape (e.g., by exacerbating the phenomenon of predatory publishing and paper mills). The scientific community has begun to distance itself from this and seek alternative ways to **reward researchers not only for writing articles, but also for other activities that the academic community and society need from them** (teaching, mentoring, popularizing science, the societal impact of research...).

- The **San Francisco Declaration ([DORA](#))** – in addition to the declaration, which is still open for signature, the DORA website features documents containing information and tools for implementing research assessment reform (e.g., Tools to Advance Research Assessment – TARA).
- [The Leiden Manifesto on Research Metrics](#),
- [The Hong Kong Principles of Research Assessment](#) (emphasis on integrity).

Reformscape (<https://sfdora.org/reformscape/>): a database of responsible research assessment policies.



[CoARA](#) (Coalition for Advancing Research Assessment)

27. 4. 2026, 15.00 – Introduction of Idea Catalogue Platform – a tool for searching for and sharing experiences in the field of research evaluation. It is a resource for those who develop or implement evaluation processes at various levels. <https://events.teams.microsoft.com/event/94077d60-f278-4a8b-b5b3-14f9f950bbec@69628d54-883a-4d88-863a-ca77ac2e1d4a>

Research data

- **Open data is a necessity for broad international collaboration:** from research on *Caenorhabditis elegans* to the **Human Genome Project** (1990–2003) –sequences were **published online within 24 hours of sequencing**. **The economic benefit of the project was estimated at \$1 trillion** (10^{12}). **Every dollar invested by the U.S. generated an additional \$65 for the economy.**
- After 2000: **OECD** (Organization for Economic Cooperation and Development), definition of open data; 2007: **Principles and guidelines for access to publicly funded research data:**

"Access to research data **increases the return on public investment** in this field; it strengthens open scientific inquiry; it **promotes diversity** in research and perspectives; it **fosters new areas of work**; and it enables the exploration of topics that the original researchers did not anticipate."



Where to find repository for your data?

- **Registry of Research DATA REPOSITORIES: re3data**, (<https://www.re3data.org/>)
- **Registry of Open Access Repositories, ROAR**, (<http://roar.eprints.org/>)
- **Open Directory of Open Access Repositories, OpenDOAR** (<https://v2.sherpa.ac.uk/opendoar/>)

Data as a valuable asset

In the commercial sphere – data as a commodity:
“**Data is the new oil.**” (Mathematician Clive Humby, 2006 – in 1995, he helped launch the first Clubcard loyalty program for Tesco).

Data is valuable, but it can only be truly used in processed form.

However, unlike oil, data can be reused.

FAIR data:

- **Findable** – rich metadata, persistent identifiers (as DOI), indexing in repositories
- **Accessible** – standard, open protocols,
- **Interoperable** – vocabularies, linked metadata,
- **Reusable** – licences, provenance, community standards.

Helpful tools:

Fairware – your first step towards FAIR dataset <https://fairaware.dans.knaw.nl/>

Amnesia – open data can maintain privacy: anonymise effortlessly <https://amnesia.openaire.eu/>



Open data can be a valuable resource for the private sector as well as for the public sector (for example, open data on transportation has led to the development of successful apps like **Citymapper**).

Innovators may not build their profits by selling data, but offering services based on open data.

Principle: As open as possible, as closed as necessary.

Research data management

Setting up processes leading to:

- securing data **against damage/loss**
- **greater efficiency** in research

Well-managed data leads to greater:

- willingness to **share** data
- willingness of others to **use your data**
- **increased credibility** of conclusions based on data.

Data management plan - **process and a tool** that can help researchers **plan and manage** their research and research data **during the whole data lifecycle**, clarify and agree with collaborators in advance (to prevent conflicts about data use), document important steps, make strategic decisions in the right time.

Mandatory **Data Management Plans** – some funders (Horizon Europe) or research institutions.

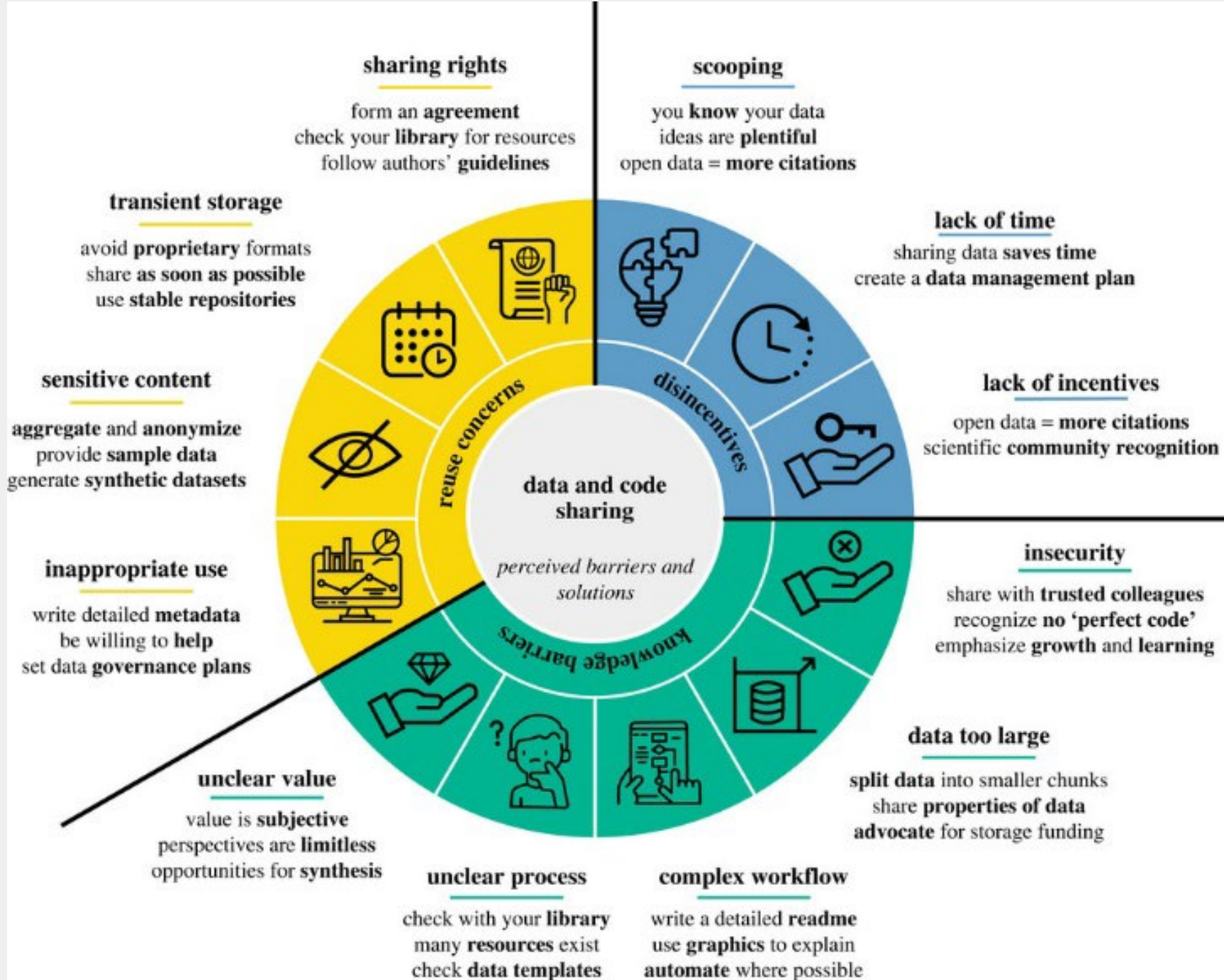
Tools for data management:

RDM kit – information on every step in research data lifecycle: https://rdmkit.elixir-europe.org/data_life_cycle

Argos - <https://argos.openaire.eu/portal/>

DMP tool - <https://dmptool.org/>





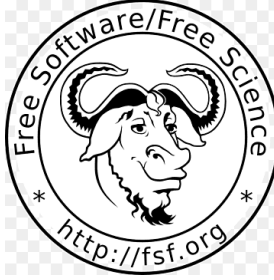
The price of reluctance to share



Data Not Available

- **Open data comes at a cost—but the hidden cost of a lack of data in the public sphere can be much higher.**
- **Health** (rapid information sharing, sequence sharing, and the ability to verify data saved lives during the **COVID-19 pandemic**. The lack of data leads to uncertainty and questionable decisions. Only the availability of data allows for cross-linking across different fields and the discovery of correlations, e.g., [pesticide sales in rural Brazil](#) correlate with more frequent fetal deaths and congenital anomalies in children),
 - **Public decision-making – climate data** (orders by the Trump administration to shut down websites or [restrict access to climate data](#) in the U.S., efforts by communities and universities to back up and make this data available),
 - **Data literacy** – if data is not available, people have all the less reason to learn how to work with it and understand it;
 - **The absence of accurate and verifiable scientific data creates an opening for manipulators and those who spread misinformation.**

Open Source Software



- 1950s–1960s: **The first software was supplied with hardware at no extra charge**, and the **source code** (the human-readable form of the software) **was open**—the academic sector contributed to fixing bugs and adding improvements (**hacking culture**).
- With the development of large operating systems, less organizations allowed changes to the operating software and eventually **closed** it off to modifications (though utilities and added features were still shared)
- **Richard Stallman** developed the **GNU operating system** (1983), which was **fully open-source**. He founded the **Free Software Foundation**. The GNU **General Public License** (copyleft principle) sparked a wave of open-source software, which gave rise to the **open-source movement**.
- 1980s–1990s – Large companies made proprietary software the standard.
- 1989 **Tim Berners-Lee** – **World Wide Web** (HTML, URL, HTTP...) – In 1991, he **invited the public to collaborate on the WWW project**. He made his idea available to the world without patents or fees so it could develop quickly.
- 1991 – **Linus Torvalds** developed the **Linux** operating system (using several elements of Stallman’s GNU) and released it in 1992 under the GPL license. Linux gained popularity thanks to its **adaptability**. Later (at the turn of the millennium), it was also adopted by large institutions and companies (NASA, Dell, IBM). It has the **fastest software development rate** – the community adds up to 10,000 lines of code to it every day.



Open Source Software

- Other examples: **MySQL** (databases), the **Perl** language, the **Apache** web server... Ordinary users may not have noticed the rise of these technologies at the turn of the millennium.
- After 2000, the commercial sector gradually realized the **benefits of open source** – businesses can develop new products quickly and with minimal effort (for example, by combining open-source components). The open-source approach has proven to be more advantageous in practice. It also helps **prevent vendor lock-in**, which is particularly important for organizations managing public funds (in the spirit of the **Public Money, Public Code** initiative <https://publiccode.eu/en/>).
- Open Source creates important infrastructures in Open Science movement.
- 1998 – **Public Knowledge Project** (John Willinsky, University of British Columbia, Vancouver, Canada). **Open Journal System, Open Monograph Press, Open Preprint Systems.**
- Both software and science thrive best through collaboration between the academic and commercial sectors but it must be fair.
- If the efforts of some companies to appropriate the fruits of joint endeavors and restrict access to them prevail and unduly limit the academic sector's room to maneuver, this hinders the development of the entire system.

Open Source and Software: guide with basic information for PhD students and young researchers:
<https://www.ouvrirlascience.fr/source-code-and-software/>

PKP



Citizen Science / participatory research methods

- **Active public engagement in scientific projects** (beyond the role of a research subject).
- It often makes use of modern technologies (smartphones, apps, sensors...), though not necessarily (some projects rely solely on mail).
- Increased availability of mobile technologies and the internet facilitates public engagement.
- A wide range of disciplines, forms, and approaches (advantage: a diverse array of possibilities; disadvantage: citizen science is difficult to delineate and define – and what is difficult to recognize is difficult to acknowledge).
- Definition: 10 principles of citizen science (European Citizen Science Association):

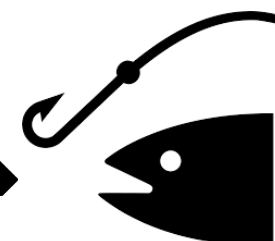
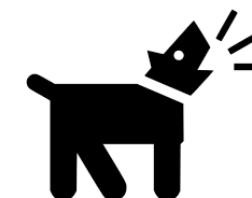
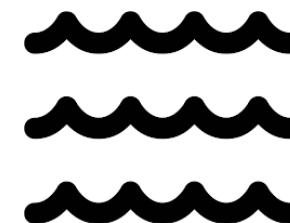
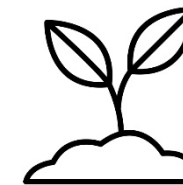
<https://ecsa.citizen-science.net/>





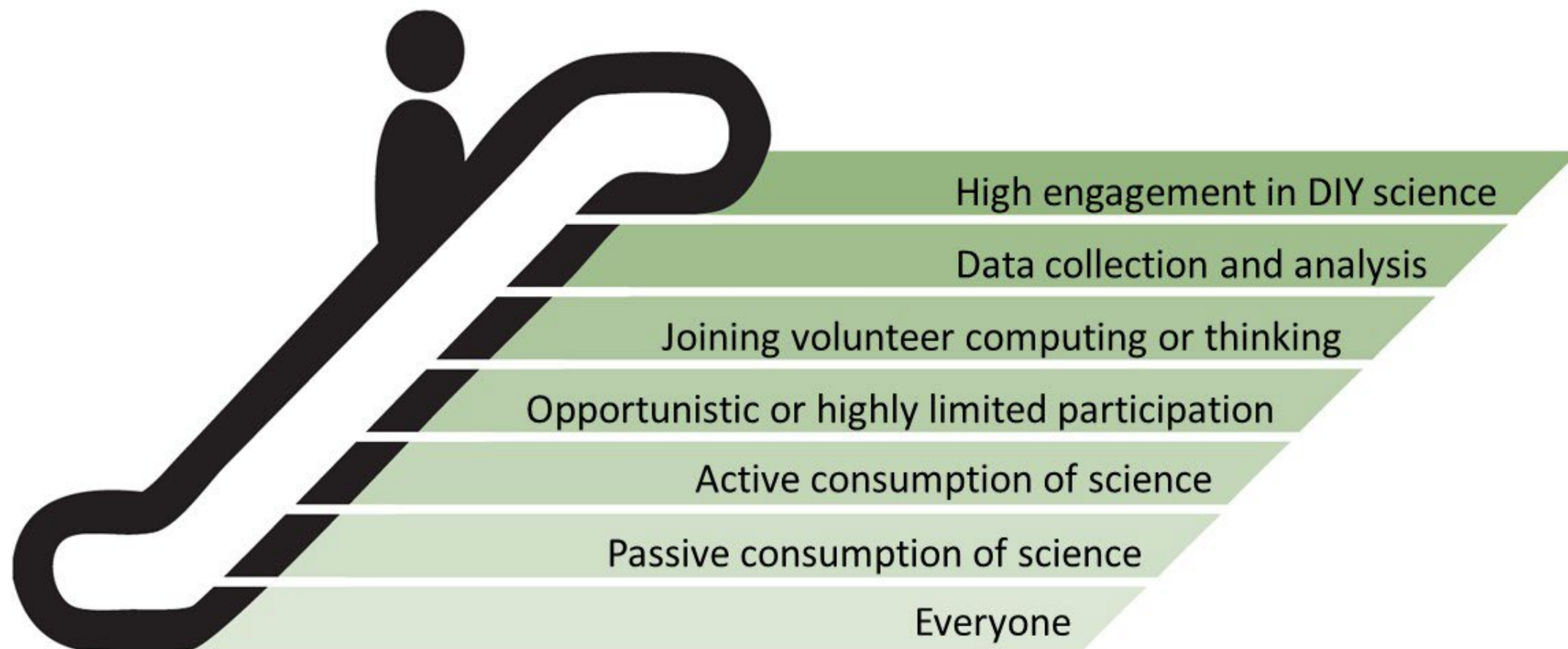
Citizen Science / participatory research methods

- Diverse – all **fields** and **topics**, ranging from the natural sciences (biology, the environment, as well as chemistry, seismology, astronomy...) to medicine and pharmacy (monitoring and recording symptoms of diseases, availability of medications...) to social sciences and humanities (housing availability, historical events through the lens of family history, linguistic diversity and dialects, perception of music...) or interdisciplinary;
- Various **forms** (from “educational computer games” that process data from telescopes or microscopic specimens, to physical interventions in the environment, e.g., planting wildflowers for pollinators in cities)
- Projects of all **sizes** (from local and short-term projects that result in a single publication to long-term projects lasting decades);
- Various **types of public engagement** – in project design, data collection, data processing, communication.
- A special (and significant) category: citizen science in **schools**.



Not every research question can be addressed using citizen science methods, but in every field there is a question or sub-problem through which scientists can engage the public.

7 Levels of Engagement



Citizen Science – examples

- [Old Weather](#). [M. F. Maury](#) (1807-1873) – from ship's logs entries he created maps of winds, ocean currents and whale migration – safer and faster sailing through the oceans. His old data are important again in the world of changing climate.
- [Isala](#) – pioneering citizen-science project at the University of Antwerp to better understand the female microbiome with advanced DNA technology. The project increased awareness and sparked a public conversation about women's intimate health in Belgium.
- [Foldit](#) – online puzzle video game about protein folding. It is part of an experimental research project developed by the University of Washington. 2011, Foldit players helped decipher the crystal structure of a retroviral protease from Mason-Pfizer monkey virus (M-PMV), a monkey virus which causes HIV/AIDS-like symptoms, a scientific problem that had been unsolved for 15 years. While the puzzle was available for three weeks, players produced a 3D model of the enzyme in only ten days that is accurate enough for molecular replacement.
- [Right to Repair](#) – sustainability activism (leading to [EU Right to Repair Directive](#)) and public Repair cafés. Repair should be accessible, affordable and mainstream. Repairing a product shouldn't cost more than buying a new one. Legal barriers shouldn't prevent individuals, independent repairers and community repair groups from repairing broken products.
- [Minagris](#) – micro and nanoplastics in soil (Soil plastic app). Exploring the Impact of Microplastics on Agricultural Soil Health.



Open Science – Take Home Message

- **Communication – essential** for the advancement of science and its societal impact.
- The forms and processes of scholarly communication have **changed** throughout history to meet the needs of the academic community;
- But: change doesn't come by itself, it is implemented by **motivated stakeholders**;
- Open access: **online, free for the reader** (gratis), **reduces legal barriers** (libre);
- **Green** (repositories), **gold** (APC) and **diamond** route (OA journals and platforms without APC);
- **Open Science**: approach to the research ecosystem, a systemic change towards transparency and efficiency, openness in multiple aspects of research and processes/steps of the research cycle (although not necessarily all of them – according to the motto *As open as possible, as closed as necessary*).
- Openness fosters innovation – sometimes the main driver is not the prospect of intellectual property rewards, but the number of minds involved.
- The costs of transformation to openness is high, but the reluctance to change may cost us even more.

**Thank you for
your attention**

**OPEN SCIENCE:
JUST
SCIENCE
DONE RIGHT**

Jon Tennant



photo: Z. Stožická, unsplash: <https://unsplash.com/photos/BFQOKBnpKGs>