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An introduction to the
UNESCO Recommendation on

OPEN SCIENCE

What is open science and why do we need it?

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. For example, scientists and engineers can use open licenses to share their publications, data, software and hardware more widely—not only with each other but also with the rest of society. 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.

By promoting science that is more accessible, inclusive and transparent, open science furthers the right of everyone to share in scientific advancement and its benefits as stated in Article 27.1 of the Universal Declaration of Human Rights.

OPEN SCIENCE
Key Messages

Open science aims to increase the sharing of scientific knowledge widely and openly for the benefit of all people everywhere—and to open the process of contributing to and building that knowledge.

Our interconnected world needs open science to help solve complex social, environmental, and economic challenges and achieve the Sustainable Development Goals.

The Recommendation is built upon the values of quality, integrity, equity, fairness, diversity and inclusiveness. Its principles include transparency, scrutiny, reproducibility, equality of opportunity, collaboration, flexibility and sustainability.

The UNESCO Recommendation on Open Science provides an international framework for open science policy and practice aimed at reducing the technological and knowledge divide between and within countries. It outlines a common definition, shared values, principles and standards, and proposes actions to support fair and equitable open science for all at individual, institutional, national, regional and international levels.

You can promote open science by reading, talking, and writing about it, becoming an *Open Science Ambassador*, publishing on open platforms, creating a community of practice, investing in open science and adopting open science principles in your organization's policies and codes of conduct.

The practice of open science aims to:

Open the processes and products of knowledge creation to people outside of the traditional research community

Make knowledge from all scientific disciplines and aspects of scholarly practices—including basic and applied sciences, natural and social sciences and humanities—available and accessible to everyone in multiple languages

OPEN SCIENCE

Encourage collaboration and information-sharing to benefit science and society

To understand open science, it may help to consider some examples of "closed" science, such as: research published in paywalled journals that not everyone can access; data that supports scientific results being unavailable or only accessible to those who can afford it; software, source code, workflows and protocols being unknown or inaccessible; favoring knowledge produced in developed countries, and science that is inaccessible to communities that would benefit from it.

In contrast to closed science systems, open science sets new standards that ensure that, through increased availability of data, tools and processes, scientific practices are reproducible, transparent, inclusive and collaborative.

In addition, open science calls for engagement of stakeholders beyond the scientific community. Openness to varied sources of knowledge, such as Indigenous and local knowledge systems and citizen science, broadens and diversifies information for everyone. It engages the broader public by reaching contributors and end-users alike through collaborative research, crowdsourcing, volunteering and transdisciplinary methods.

AS OPEN AS POSSIBLE

Access to scientific knowledge should be as open as possible, but sometimes access may need to be restricted, for example to protect human rights, confidentiality, intellectual property rights, personal information, threatened or endangered species, and sacred and secret indigenous knowledge. Open science encourages scientists to develop tools and methods for managing data so that as much data as possible can be shared, as appropriate.

The world needs open science *now*. Why?

Open science can accelerate our ability to help solve the complex challenges of our interconnected world. We need it because:

Global challenges such as poverty, armed conflict, the climate crisis, environmental degradation and health and humanitarian crises are urgent—and science, technology and innovation can better respond to them if they collect and apply ideas from diverse contributors and knowledge systems.

Open science has the potential to accelerate the achievement of the Sustainable Development Goals by reducing or ending inequalities in access to science, technology, innovation and their applications.

Research practices that are more transparent, collaborative and inclusive are subject to more effective peer review, increased scrutiny and critique which in turn increases the verifiability and reproducibility of the science produced. This ultimately leads to better science, more trust in science and more relevant and positive impacts of science on society.

What is the UNESCO Recommendation on Open Science? How will it be used?

The Recommendation provides an international framework for open science policy and practice that aims to reduce the technological and knowledge divides between and within countries.

The Recommendation outlines a common definition and shared values, principles and standards for open science at the international level, and it proposes actions to support fair and equitable open science for all, at individual, institutional, national, regional and international levels. It asks Member States to:

- **Promote a shared understanding of open science** and set out diverse paths to achieving it
- Develop an **enabling policy environment** for open science
- **Invest in infrastructure and activities** that contribute to open science
- Invest in **training, education, digital literacy and capacity-building** to support open science
- **Foster a culture** of open science and align incentives to support it
- **Promote innovative approaches** for open science at all stages of the scientific process
- **Encourage international and multi-stakeholder cooperation** in the context of open science to reduce gaps in technology and knowledge

The Recommendation is meant to be used by all research institutes and organizations that practice, regulate and promote science, as well as by researchers and anyone concerned with the rules, policies and ethics of science.

NON-BINDING, YET POWERFUL

UNESCO Recommendations are non-binding, which means Member States are free to consider the recommended principles and take whatever legislative or other steps they deem appropriate to their individual constitutions. Despite being non-binding, the recommendations carry considerable political and moral authority.

Who is the Recommendation for?

Because the Recommendation has openness at its heart, it is for everyone and anyone, anywhere in the world, who stands to benefit from wider access to the process and products of science and innovation. In other words, while scientists, knowledge keepers and the scientifically curious will certainly benefit in their work from greater access to data and information, the world at large will benefit from the scientific, social and economic progress that results.

Until the Recommendation was adopted in 2021, there was no universal definition of open science. Some standards existed only at the regional, national or institutional levels. In adopting the Recommendation, 193 countries have agreed to abide by common standards for open science.

What are its values and principles?

1

QUALITY AND INTEGRITY
ensuring that science is high-quality and scrutinized by bringing together different sources of knowledge and making evaluation of scientific methods and outputs more transparent and accurate.

2

COLLECTIVE BENEFIT
recognizing that science is a global public good that belongs to all of humanity.

3

EQUITY AND FAIRNESS
ensuring equitable, fair and reciprocal access to science for all producers and consumers of knowledge regardless of their location, nationality, race, age, gender, income, socio-economic circumstance, career stage, discipline, language, religion, disability, ethnicity, migratory status or any other grounds.

4

DIVERSITY AND INCLUSIVENESS
embracing diversity of knowledge, practices, workflows, languages and research topics and outputs.

Six guiding principles

An agreed set of principles helps Member States uphold these values and make open science a reality.

1. Transparency, scrutiny, critique and reproducibility—to reinforce the rigor of scientific results, enhance the positive impact of science on society and increase society's ability to solve complex interconnected problems.

2. Equality of opportunities—to ensure that all scientists and those with an interest in science have equal opportunity to access, contribute to and benefit from science, regardless of origin or circumstance.

3. Responsibility, respect and accountability—to be responsible for and aware of public accountability, potential conflicts of interest, intellectual integrity and the possible social or ecological consequences of research activities.

4. Collaboration, participation and inclusion—to ensure that scientific collaborations transcend the boundaries of geography, language and resources, and include knowledge from marginalized communities to solve problems of great social importance.

5. Flexibility—to acknowledge that there is no one-size-fits-all way to practice open science and to encourage different pathways to practicing it while upholding the core values.

6. Sustainability—to be as efficient and impactful as possible by building on long-term practices, services, infrastructures and funding models to ensure participation of scientists from less-privileged countries or institutions.

Join UNESCO in promoting Open Science

How you can best support open science depends on your interests, career and life stage—and the opportunities that come with these. For example, you could:

Learn about open science

- Educate yourself about open science, starting at https://on.unesco.org/openscience.
- Read the full text of the UNESCO Recommendation on Open Science.
- Explore the existing literature, news and events about open science relevant to your community.

Share what you learn

- Look for opportunities to explain open science at research symposia, include it in your curricula or find like-minded colleagues and other open science ambassadors in your community to champion its values and principles.
- Organize roundtables, panels or conferences to discuss the role of open science in improving the quality and accessibility of scientific information and in addressing global challenges and achieving the Sustainable Development Goals.
- Engage science journalists, writers and opinion leaders to discuss and write about open science.

Practice open science

- Ensure that your scientific work and outputs are conducted and disseminated in line with the principles of open science.
- Include references to open science values and principles in your organization's policy and documents—such as research policies, strategies or codes of conduct.
- Invest in open science and develop innovative approaches for its implementation.
- Build a community of practice to enhance the potential reach and impact of the UNESCO Recommendation.

Collaborate

- Reach out to your colleagues and peers and in your country and beyond.
- Engage with stakeholders beyond your community.
- Explore and join UNESCO's **Global Open Science Partnership**, which brings together relevant and interested open science stakeholders from across the world.
- Contribute to science through crowdfunding, crowdsourcing, open dialogue, citizen science and scientific volunteering.

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