



CHECKLIST FOR UNIVERSITIES ON IMPLEMENTING THE UNESCO RECOMMENDATION ON OPEN SCIENCE

This document is part of the UNESCO Open Science Toolkit, designed to support implementation of the UNESCO Recommendation on Open Science. It has been prepared in partnership with Library Support for Embedded NREN Services and E-infrastructure (LIBSENSE). The aim is to provide practical assistance to the university community to better understand the Recommendation on Open Science, in particular by highlighting the areas that apply to university leaders who wish to support its implementation.



As a university practicing open science, how are you...

Nurturing open methods

Are the scientific practices at your university open by default? Are the innovators in your university encouraged and incentivized to make their practices and products open? Are newcomers to your institution introduced to open science early on?

It is possible to nurture open science from the bottom-up through capacity building and from the top-down through policy changes. Combinations of these approaches, such as mandates for training in open science, may be suitable in your context.

A clear understanding of the possibilities and risks of open science practices enable students, educators and researchers to make smarter decisions in a scientific system that is as open as possible, as closed as necessary.

Mainstreaming open practices

Rather than creating separate open science policies, it may be more efficient and effective to build openness into core policies for science, data management, educational resources and more.

Open science practices can also be mainstreamed into partnerships involving the university and external actors, including international partners.

Using and creating scientific infrastructures

Are the tools used by scientists and students at your institution openly available on open platforms? Infrastructures can be both physical and virtual. The UNESCO Recommendation on Open Science provides guidance for ensuring that access to the tools required for open science is itself open and equitable.

Thinking beyond scientific articles

Scientific practice spans far more than the production of data or articles. The Recommendation provides guidance for opening up all stages of the scientific process, from conceptualization and co-design of research projects through to post-publication communication.

Those scientific outputs related to publications¹ that are openly licensed or dedicated to the public domain should be deposited in a suitable open repository, following appropriate technical standards properly linking to the publications.

Supporting inclusive engagement and dialogue

Open science includes all scientific disciplines and aspects of scholarly practices and builds on four key pillars: open access to scientific knowledge, open science infrastructures, open engagement of societal actors and open dialogue with other knowledge systems.

There are multiple actors and stakeholders in research and innovation systems and each of them plays a role in the operationalization of open science. Similarly, universities serve many audiences in addition to academics and scientific researchers.

In practice, inclusive engagement ranges from addressing practical aspects of accessibility through to meaningful engagement with marginalized and underrepresented groups. Engagement and dialogue can inform not only education and the practices of open science but also the co-design, creation, use and production of scientific outputs in multiple formats.

¹ Such as original scientific research results, research data, software, source code, source materials, workflows and protocols, digital representations of pictorial and graphical materials and scholarly multimedia material



Open dialogue with other knowledge systems

Open dialogue with other knowledge systems is the dialogue between different knowledge holders. It is in line with the 2001 UNESCO Universal Declaration on Cultural Diversity and recognizes the richness of diverse knowledge systems and theories and the diversity of knowledge producers.

Open dialogue aims to promote:

- the inclusion of knowledge from traditionally marginalized scholars;
- inter-relationships and complementarities between diverse knowledge systems;
- adherence to international human rights norms and standards;
- respect for knowledge sovereignty and governance;
- the recognition of the rights of knowledge holders to receive a fair and equitable share of benefits that may arise from the utilization of their knowledge.

Open engagement with societal actors

Open engagement is the extended collaboration between scientists and societal actors beyond the scientific community. Open science provides the basis for citizen and community involvement in the generation of knowledge and for enhanced dialogue between scientists, policymakers and practitioners, entrepreneurs and community members, giving all stakeholders a voice in developing research that is compatible with their concerns, needs and aspirations. This is achieved by:

- opening up practices and tools that are part of the research cycle and by making the scientific process more inclusive and accessible to the broader inquiring society;
- encouraging new forms of collaboration and work such as crowdfunding, crowdsourcing and scientific volunteering.

Are your institutional values aligned with the core values of the UNESCO Recommendation on Open Science?

The core values of open science stem from:

- the rights-based, ethical, epistemological, economic, legal, political, social, multi-stakeholder and technological implications of opening science to society;
- the broadening of the principles of openness to the whole cycle of scientific research.

The four core values are:

1. Quality and integrity

Open science should respect the fundamental freedom of scientific inquiry and human rights. It should support high-quality research by:

- bringing together multiple sources of knowledge;
- making research methods and outputs widely available for rigorous review and scrutiny;
- facilitating transparent evaluation processes.

2. Collective benefit

As a global public good, open science should belong to humanity in common and benefit society.

To this end, scientific knowledge should be openly available and its benefits universally shared.

The practice of science should be inclusive, sustainable and equitable, as should opportunities for scientific education and capacity development.

3. Equity and fairness

Open science should play a significant role in ensuring equity among researchers from developed and developing countries.

Open science should enable fair and reciprocal sharing of scientific inputs and outputs and equal access to scientific knowledge for both producers and consumers of knowledge².

² Regardless of location, nationality, race, age, gender identity, income, socio-economic circumstances, career stage, discipline, language, religion, disability, ethnicity or migratory status, or any other grounds



4. Diversity and inclusiveness

Open science should embrace a diversity of knowledge, practices, workflows, languages, research outputs and research topics that support the needs of the scientific community as a whole.

Open science should embrace:

- diverse research communities and scholars;
- the wider public;
- knowledge holders beyond the traditional scientific community, including as appropriate:
 - » indigenous peoples and local communities;
 - » societal actors from different countries and regions.

Guiding principles aligned with the core values

The guiding principles for open science provide a framework to help the values be upheld and ensure that the ideals of open science are made a reality.

The six guiding principles are:

1. Transparency, scrutiny, critique and reproducibility

Increased openness should be promoted in all stages of scientific endeavour, with the view to:

- reinforcing the strength and rigour of scientific results;
- enhancing the societal impact of science;
- increasing the capacity of society as a whole to solve complex interconnected problems.

Increased openness leads to increased transparency of scientific information. It reinforces the fundamental feature of science as a distinct form of knowledge based on logic and the scrutiny of scientific peers.

2. Equality of opportunities

All scientists and other open science actors and stakeholders have an equal opportunity to access, contribute to and benefit from open science.

3. Responsibility, respect and accountability

With greater openness comes greater responsibility for all open science actors and this should be the basis for the good governance of open science.

The basis for good governance is also formed through:

- respect for ethical principles and implications pertaining to research;
- public accountability;
- sensitivity to conflicts of interest;
- vigilance as to possible social and ecological consequences of research activities;
- intellectual integrity.

4. Collaboration, participation and inclusion

Beyond the boundaries of geography, language, generations and resources, collaborations at all levels of the scientific process should become the norm.

To solve problems of social importance, collaboration between disciplines should be promoted together with the full and effective participation of societal actors and the inclusion of knowledge from marginalized communities.

5. Flexibility due to diversity

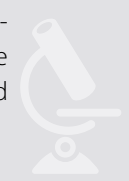
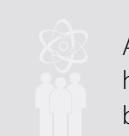
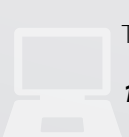
There is no one-size-fits-all way of practising open science. This is because of the diversity of knowledge systems, actors and capacities across the world, as well as the evolving nature of supporting information and communication technologies.

Different pathways for the transition to open science and for the practice of open science need to be encouraged. The pathways should uphold the core values above and maximize adherence to the guiding principles.

6. Sustainability

To be as efficient and impactful as possible, open science should build on long-term practices, services, infrastructures and funding models that ensure the equal participation of scientific producers from less privileged institutions and countries.

Open science infrastructures should be organized and financed upon an essentially not-for-profit and long-term vision. As far as possible, the vision should enhance open science practices and guarantee permanent and unrestricted access to all.





Do you incorporate the following areas of action into your university activities?

If not, have you planned a timetabled route to incorporate this area of action in the future?

The following text is from the UNESCO [Recommendation on Open Science](#), through the lens of universities.

Promoting a common understanding of open science, associated benefits and challenges, as well as diverse paths to open science

Promote and support the common understanding of open science as defined in this Recommendation, within the scientific community and among the different open science actors, and strategically plan and support open science awareness raising at the institutional, national and regional levels while respecting diversity of open science approaches and practices.

Ensure that publicly funded research is undertaken based on the principles of open science in line with the provisions of this Recommendation, and that the scientific knowledge from the publicly funded research, including scientific publications, open research data, open software, source code and open hardware, is openly licensed or dedicated to the public domain.

Encourage bibliodiversity through the diversity of formats and means of publications and diversity of business models, by supporting not-for-profit, academic and scientific community-driven publishing models as a common good.

Encourage multilingualism in the practice of science, in scientific publications and in academic communications.

Ensure that the needs and rights of communities, including the rights of indigenous peoples over their traditional knowledge, should not be infringed on in open science practices.

Enhance open science communication to support the dissemination of scientific knowledge to scholars in diverse research fields, decision makers and the public at large.

Engage the private sector in the discussion about the ways in which the scope of open science principles and priorities can be enlarged and mutually shared.

Enable open multi-stakeholder discussions on open science benefits and its real and apparent challenges as regards, for example, competition, extraction and exploitation of data by more advanced technologies, links to intellectual property rights, privacy, security and inequalities between publicly and privately funded research, in order to address these challenges constructively and implement open science practices in line with the values and principles outlined in this Recommendation.

Developing an enabling policy environment for open science

Develop or encourage policy environments, including those at the institutional, national, regional and international levels that support operationalization of open science and effective implementation of open science practices, including policies to incentivize open science practices among researchers. Through a transparent participatory, multi-stakeholder process that includes dialogue with the scientific community, especially early-career researchers, and other open science actors.

Develop effective institutional and national open science policies and legal frameworks that are consistent with existing international and regional law and are in line with the definition, values and principles as well as actions outlined in this Recommendation.

Align open science policies, strategies and actions from individual institutions to local and international levels, while respecting the diversity of open science approaches.

Mainstream gender equality aspects into open sciences policies, strategies and practices.

Implement policies and strategies for open science.

Enhance the inclusion of citizen and participatory science as integral parts of open science policies and practices at the national, institutional and funder levels.

Design models that allow co-production of knowledge with multiple actors and establish guidelines to ensure the recognition of nonscientific collaborations.

Encourage responsible research and researcher evaluation and assessment practices, which incentivize quality science, recognizing the diversity of research outputs, activities and missions.





Foster equitable public-private partnerships for open science and engage the private sector in open science, provided that there is appropriate certification and regulation to prevent vendor lock-in, predatory behaviour and unfair and/or inequitable extraction of profit from publicly funded scientific activities. Given the public interest in open science and the role of public funding, Member States should ensure that the market for services, relating to science and open science, functions in the global and public interest and without market dominance on the part of any commercial entity.

Design, implement and monitor funding and investment policies and strategies for science based on the core values and principles of open science. The costs associated with operationalization of open science relate to the support of open science research, publishing, data and coding practices, the development and adoption of open science infrastructures and services, capacity building of all actors and innovative, highly collaborative and participatory approaches to the scientific enterprise.

Investing in open science infrastructures and services

Promote non-commercial open science infrastructures and ensure adequate investment in the following:

- Science, technology and innovation.**
- Reliable Internet connectivity and bandwidth** for use by scientists and science users across the world.
- National research and education networks (NRENs)** and their functionality, encouraging regional and international collaboration to ensure maximum interoperability and alignment between NREN Services.
- Non-commercial infrastructures**, including computing facilities and digital public infrastructure and services supporting the open science approach. These should facilitate ensuring the long-term preservation, stewardship and community control of research products, including scientific information, data, source code and hardware specifications, co-operation among researchers and the sharing and reuse of research products. Any research-supporting infrastructure or service should have a strong community-led base and ensure interoperability and inclusivity. Digital infrastructures for open science should be based, as far as possible, on open source software stacks. These open infrastructures could be supported by direct funding and through an earmarked percentage of each funded grant.

Federated information technology infrastructure for open science, including high-performance computing, cloud computing and data storage where needed, and robust, open and community managed infrastructures, protocols and standards to support bibliodiversity and engagement with society. While avoiding fragmentation by enhancing the federation of existing open science infrastructures and services, at the national, regional and international levels, attention should be given to ensuring that this infrastructure is accessible for all, internationally interconnected and as interoperable as possible, and that it follows certain core specifications, notably the FAIR (Findable, Accessible, Interoperable, and Reusable) and CARE (Collective Benefit, Authority to Control, Responsibility and Ethics) principles for data stewardship.

North-South, North-South-South and South-South collaborations to optimize infrastructure use and joint strategies for shared, multinational, regional and national open science platforms, including through the promotion of research collaborations, sharing of open science infrastructures, technical assistance, transfer and coproduction of technology related to open science and exchange of good practices under mutually agreed terms.

A new generation of open information technology tools that automate the process of searching and analysing linked publications and data, making the process of generating and testing hypotheses faster and more efficient.

Innovative approaches at different stages of the scientific process and the international scientific collaboration.

Funding for the necessary costs associated with transformation towards and maintaining open science practices, as well as the promotion of open licensing schemes.

Platforms for exchanges and co-creation of knowledge between scientists and society, including through predictable and sustainable funding for volunteer organizations conducting citizen science and participatory research at the local level.

Community-based monitoring and information systems to complement national, regional and global data and information systems.



Investing in human resources, training, education, digital literacy and capacity building for open science

✓ Provide systematic and continuous capacity building on open science concepts and practices, including broad comprehension of the open science guiding principles and core values as well as technical skills and capacities in digital literacy, digital collaboration practices, data science and stewardship, curation, long-term preservation and archiving, information and data literacy, web safety, content ownership and sharing, as well as software engineering and computer science.

✓ Agree on a framework of open science competencies aligned with specific disciplines for researchers at different career stages, as well as for actors active in the private and public sectors or in civil society, who need specific competences to include the use of open science products in their professional careers; and develop recognized skills and training programmes in support of the attainment of these competencies. A core set of data science and data stewardship skills, skills related to intellectual property law, as well as skills needed to ensure open access and engagement with society, as appropriate, should be regarded as part of the foundational expertise of all researchers and incorporated into higher education research skills curricula.

✓ Invest in and promote advanced education and the professionalization of roles in data science and data stewardship. Enabling open science also requires data governors capable, in cooperation with the scientific community, of setting strategic directions for data management and openness at the national or local levels and advanced and professional data stewards who manage and curate data according to agreed principles, notably FAIR and CARE principles, within trusted institutions or services. In order to take advantage of the opportunities offered by open science, research projects, research institutions and civil society initiatives need to call on advanced data science skills including analysis, statistics, machine learning, artificial intelligence, visualization and the ability to write code and use algorithms with scientific and ethical responsibility.

✓ Promote the use of open educational resources (OER), as an instrument for open science capacity building. OER should therefore be used to increase access to open science educational and research resources, improve learning outcomes, maximize the impact of public funding and empower educators and learners to become co-creators of knowledge.

✓ Support science communication accompanying open science practices with a view to the dissemination of scientific knowledge to scholars in other research fields, decision-makers and the public at large. Dissemination of scientific information through scientific journalism and media, popularization of science, open lectures and various social media communications builds public trust in science while increasing the engagement of societal actors beyond the scientific community. To avoid misinterpretation and dissemination of misinformation, the quality and appropriate citation of original sources of information are of paramount importance to science communication as regards open science.

Fostering a culture of open science and aligning incentives for open science

✓ Engage actively in removing the barriers for open science, particularly those relating to research and career evaluation and awards systems. Assessment of scientific contribution and career progression rewarding good open science practices is needed for operationalization of open science. Attention should also be given to preventing and mitigating the unintended negative consequences of open science practices, such as predatory behaviours, data migration, exploitation and privatization of research data, increased costs for scientists and high article processing charges associated with certain business models in scientific publishing that may be causes of inequality for the scientific communities around the world and, in some cases, the loss of intellectual property and knowledge.

✓ Combine efforts of many different stakeholders, including research funders, universities, research institutions, publishers and editors, and scientific societies across disciplines and countries, to change the current research culture and to recognize researchers for sharing, collaborating and engaging with other researchers and society, and to support, in particular, early-career researchers to drive this cultural change.

✓ Review research assessment and career evaluation systems in order to align them with the principles of open science. Considering that a commitment to open science requires time, resources and efforts that cannot be automatically converted into traditional academic output, such as publications, but which can have a significant impact on science and society, evaluation systems should take into account the wide breadth of missions within the knowledge creation environment. These missions come with different forms of knowledge creation and communication, not limited to publishing in peer reviewed international journals.





✓ Promote the development and implementation of evaluation and assessment systems that:

- ✓ Build on the existing efforts to improve the ways in which the scientific outputs are evaluated, such as the 2012 San Francisco Declaration on Research Assessment, with an increased focus on the quality of research outputs rather than quantity, and by fit-for-purpose use of diversified indicators and processes that forego the use of journal based metrics such as the journal impact factor;
- ✓ Give value to all relevant research activities and scientific outputs including high-quality FAIR data and metadata, well-documented and reusable software, protocols and workflows, machine-readable summaries of findings, and teaching, outreach and engagement of societal actors;
- ✓ Take into account evidence of research impact and knowledge exchange, such as widening participation in the research process, influence on policy and practice and engaging in open innovation with partners beyond academia;
- ✓ Take into account the fact that diversity of disciplines requires different approaches in open science;
- ✓ Take into account the fact that assessment of researchers against open science criteria should be fit for different stages of careers, with particular attention to researchers at the beginning of their careers.

✓ Ensure that the practice of open science is well known and is taken into account as a scientific and academic recruitment and promotion criterion.

- ✓ **Adopt policies that require and reward open access** to scientific knowledge, including scientific publications, open research data, open software, source code and open hardware, in line with the provisions of this Recommendation.
- ✓ **Ensure diversity in scholarly communications** with adherence to the principles of open, transparent and equitable access and supporting non-commercial publishing models and collaborative publishing models with no article processing charges or book processing charges.
- ✓ **Enforce effective governance measures and proper legislation in order to address inequality and prevent related predatory behaviours** as well as to protect the intellectual creation of open science methods, products and data.

✓ Promote materials that are in the public domain and existing open licensing schemes, copyright and other intellectual property exceptions for research and educational uses that allow distribution and re-use of a copyright work, or work subject to other intellectual property protection, including partial or derivative use, on the condition that the creator is appropriately credited, in accordance with international law.

✓ Promote high-quality and responsible research and explore the potential of open science practices to reduce scientific misconduct, including the fabrication and falsification of results, violation of scientific ethical norms, and plagiarism.

Promoting innovative approaches for open science at different stages of the scientific process

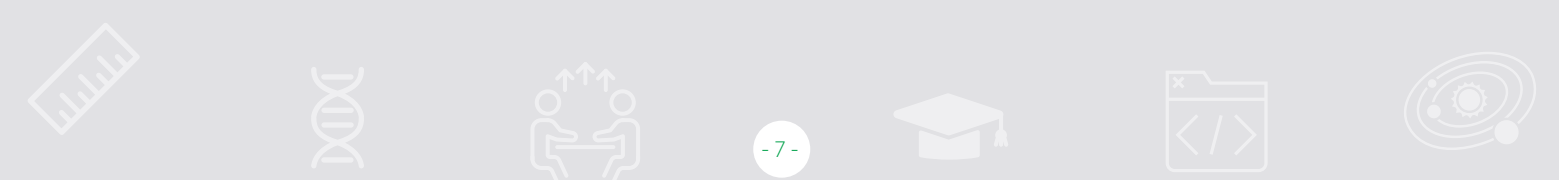
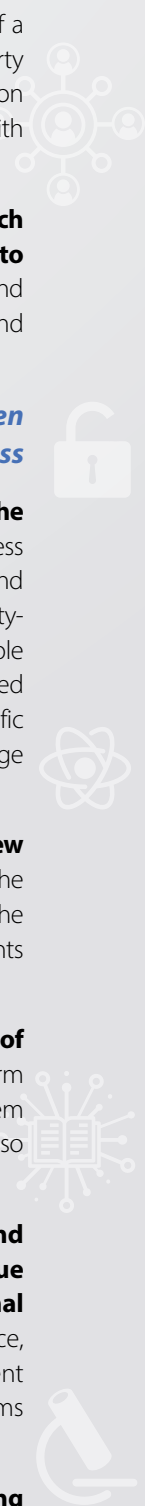
✓ Promote open science from the outset of the research process and extend the principles of openness in all stages of the scientific process to improve quality and reproducibility, including the encouragement of community-driven collaboration and other innovative models, for example preprints clearly distinguished from final peer-reviewed publications, and respecting the diversity of scientific practices, in order to accelerate dissemination and encourage rapid growth in scientific knowledge.

✓ Promote, as appropriate, open peer review evaluation practices including possible disclosure of the identity of the reviewers, publicly available reviews and the possibility for a broader community to provide comments and participate in the assessment process.

✓ Encourage and value publication and sharing of negative scientific results and those that do not conform to the results expected by the researchers who carried them out, and data associated with them, as these results also contribute to the advancement of scientific knowledge.

✓ Develop new participatory methods and validation techniques to incorporate and value inputs from social actors beyond the traditional scientific community, including through citizen science, crowdsource based scientific projects, citizen involvement in community-owned archival institutions, and other forms of participatory science.

✓ Develop participatory strategies for identifying the needs of marginalized communities and highlighting socially relevant issues to be incorporated into the science, technology and innovation (STI) research agendas.





✓ **Develop strategies that facilitate the deposit of data in archives** in order to promote their curation and preservation and make them usable and reusable for the appropriate time period.

✓ **Promote the development of shared infrastructures** for the collection, preservation and user-friendly access to open source software and source code.

✓ **Support scientists and other societal actors in accumulating and using open data** resources in a transdisciplinary mode to maximize scientific, social, economic and cultural benefits, and stimulate the creation of hybrid disciplinary collaborative spaces where scientists from different disciplines interact with software developers, coders, creatives, innovators, engineers and artists, among others.

✓ **Encourage sharing, promote interoperability, and enhance open access of large-scale research infrastructures**, such as international infrastructures in physics, astronomy and space science, as well as collaborative infrastructures in other fields, such as health and environmental and social sciences, among others.

✓ **Promote open innovation practices that connect the practices of open science to more rapid translation and development of its discoveries.** Like open science, open innovation and other open science partnerships assume broad and effective engagement and participation in the innovation process as well as the discovery and development of a business model for effective commercialization of new knowledge.

Promoting international and multi-stakeholder cooperation in the context of open science and with a view to reducing digital, technological and knowledge gaps

✓ **Promote and reinforce international cooperation among all open science actors**, whether on a bilateral or multilateral basis.

✓ **Encourage international scientific collaborations**, as one of the integral practices of open science and the most important driving factor for an intensive exchange of scientific knowledge and experience, as well as the paramount for the openness of science.

✓ **Promote and stimulate cross-border multi-stakeholder collaboration on open science**, including by leveraging existing transnational, regional and global collaboration mechanisms and organizations. This should include joining efforts towards universal access to the outputs of science, regardless of discipline, geography, gender, ethnicity, language or socioeconomic circumstances or any other grounds; it should also include development and use of shared open science infrastructures, as well as technical assistance and transfer of technology, capacity building, repositories, communities of practice and solidarity between all countries regardless of their state of open science development.

✓ **Establish regional and international funding mechanisms for promoting and strengthening open science and identify those mechanisms**, including partnerships, which can support international, regional and national efforts.

✓ **Support the creation and maintenance of effective collaborative networks to exchange best open science practices and lessons learned** from the design, development and implementation of open science policies, initiatives and practices.

✓ **Promote cooperation among countries in capacity building for open science**, including infrastructure development, software sustainability and data management and stewardship and to prevent the exploitation and misuse of open data across borders.

✓ **Promote international collaboration on metrics for open science.**

Monitoring

✓ **Monitor policies and mechanisms related to open science** using a combination of quantitative and qualitative approaches, as appropriate.

✓ **Deploy appropriate monitoring and evaluation mechanisms to measure the effectiveness and efficiency of open science policies and incentives** against defined objectives, including the identification of unintended consequences and potential negative effects, especially on early-career researchers.

✓ **Collect and disseminate progress, good practice, innovation and research reports on open science and its implications**, with the support of UNESCO and with a multi-stakeholder approach.





Consider the development of a monitoring framework with qualitative and quantitative indicators, within national strategic plans and shared at the international level, with objectives and actions in the short, medium and long term. **The monitoring of open science should be explicitly kept under public oversight**, including the scientific community, **and whenever possible supported by open non-proprietary and transparent infrastructures**. This monitoring aspect could include but should not be delegated to the private sector.

Develop strategies to monitor the effectiveness and long-term efficiency of open science, which include a multi-stakeholder participatory approach. Such strategies could focus on strengthening the nexus between science, policy and society, increased transparency and accountability for inclusive and equitable quality research which effectively responds to global challenges.





UNESCO Recommendation on Open Science at a Glance

The **Recommendation on Open Science**, the first international standard setting instrument on open science, was adopted by 193 countries in November 2021 at the 41st session of the UNESCO General Conference. The Recommendation provides an internationally agreed definition and a set of shared values and guiding principles for open science. It also identifies a set of actions conducive to a fair and equitable operationalization of open science for all at the individual, institutional, national, regional and international levels.



OPEN SCIENCE



AREAS OF ACTION

