

## DEVELOPING POLICIES FOR OPEN SCIENCE

This document is part of the UNESCO Open Science Toolkit, designed to support implementation of the UNESCO Recommendation on Open Science. Developed through the discussions and inputs from the members of the Working Group on Open Science Policies and Policy Instruments, this guide sets out the key factors to consider when developing policies for open science.

### What is an open science policy?

Open science policies can be defined as a set of guidelines, rules, regulations, laws, principles or directions to put open science values and principles into practice. Open science policies are crucial to foster a culture of open science and to develop science, technology and innovation systems which contribute to making research more efficient, trusted, impactful, inclusive and responsive to societal needs.

Open science policies can range from community to institutional, national, and regional to international policies. While this document focuses on national policies, the key factors identified to guide the development of open science policies are broadly applicable. It is important to note that institutional policies also have to address the specific needs, challenges and objectives of the related institutions, such as universities or other research-performing organizations, which can differ from the general scope of national policies and may need more targeted actions.

Open science policies can be used to:

- mandate or incentivize open science practices;
- manage the conduct of open science;
- address misconduct in open science;
- secure or enhance funding for open science;
- build capacity for open science;
- support the cultural changes needed to enhance open science practices;
- guide organizational changes needed to foster open science practices; and
- monitor open science and its impacts.

They can be designed to standardize open science processes to ensure consistent behaviour among institutions or

researchers (e.g. open access and open data mandates and standards, including attribution standards) and/or to incentivize open science practices to support a culture of open science (e.g. bottom-up funding of open science practices, support of open communities, strategic development of an open science support services and infrastructure ecosystem, revision of research assessment and career evaluation aligned with open science principles).

### Why have an open science policy?

As open science gains momentum across different scientific and non-scientific communities, the groundswell of action can benefit from the support and structure provided by relevant policy developments.

An open science policy can provide:

- longer-term stability, including of funding, which:
  - » facilitates a genuine change in practice and culture;
  - » facilitates infrastructure development and delivery; and
  - » increases the likelihood that scientists will have access to the necessary training and support personnel to implement open science;
- clarity of funding and resourcing in line with a holistic view of open science, which increases the likelihood of funding projects that may not have access to or be competitive in other grant systems;
- demonstration of commitment to operationalize open science values and principles;
- opportunities for education and engagement of the scientific community in the transition to open science; and
- deconstruction of the legal impediments and structural boundaries that hinder open science practices.



Those designing an open science policy need to be able to define the main purposes of having such a policy and to establish the goals or changes they are pursuing. Moreover, they must be able to identify key performance indicators to measure if the policy has achieved its goals, and they must be able to review and update the policy if the goals are not achieved.



### Who needs to be involved in the development of an open science policy?



Open science policies can be developed by any open science actor, including but not limited to governments, research-performing institutions, research funders or scientific publishers.

An ideal open science policy increases societal engagement with science in an open and transparent manner and is created and implemented with participation of all relevant open science actors<sup>1</sup>.



Open science actors can be brought together to develop national policies, action plans, and implementation, evaluation and monitoring plans. In practice, national multi-stakeholder committees or working groups for open science can be structured and used to bolster inclusivity.



The different open science actors need to be included in all phases of the policy cycle, including policy formulation, implementation, evaluation and impact assessment to ensure, *inter alia*, that those who could be negatively affected by the implementation of the policy are adequately supported.



While it is important to include the relevant actors beyond researchers, a focus should be placed on working with academics and researchers while developing a specific policy to ensure the resulting policy is truly accepted and included in the research practice taking into account regional and disciplinary specificities.

### Key factors to consider in developing an open science policy

#### Mainstreaming

Open science should be an integral part of a transformed system for science, technology and innovation (STI), as well as research and development (R&D), including basic and applied sciences, natural and social sciences and the humanities.

Consequently, a policy dealing with open science should not be perceived as an additional step, separate from 'other' kinds of science. It should be mainstreamed in the framework of the existing national and institutional STI policies, strategies and action plans, as well into any policy addressing the management and/or governance of scientific knowledge, actors and processes.

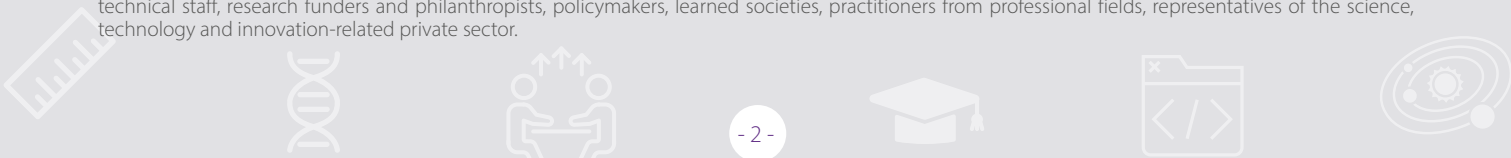
It is important to develop open science policies with adequate resourcing and attention to associated cultural changes which are needed to implement the open science values, principles and practices within the existing STI systems.

#### Alignment with existing policies

To avoid any overlap or contradiction and to enhance synergies and desired impact on society, any policy that enables open science practices needs to align with national policies across a range of sectors producing knowledge or shaping the next generation of researchers, such as education, technology and innovation. For open science to become a reality, the principles of open science need to be woven into policies that determine research agendas, funding, career evaluation and rewarding systems.

Alignment of policies at the institutional level is also important, as they may take a comprehensive approach to open science or focus on specific components, such as copyright, intellectual property, open access, open research data, citizen science or engagement with society or indigenous peoples. When a series of policies, national or institutional, addresses these different aspects of open

<sup>1</sup> As defined in the Recommendation, open science actors include, among others: researchers, scientists and scholars, leaders at research institutions, educators, academia, members of professional societies, students and young researcher organizations, information specialists, librarians, users and the public at large, including communities, indigenous knowledge holders and civil society organizations, computer scientists, software developers, coders, creatives, innovators, engineers, citizen scientists, legal scholars, legislators, magistrates and civil servants, publishers, editors and members of professional societies, technical staff, research funders and philanthropists, policymakers, learned societies, practitioners from professional fields, representatives of the science, technology and innovation-related private sector.





science individually, it is critical to ensure interconnectivity and coordination of the overall governance of open science across a given national STI system or institution.

Since much of the open sharing of scientific knowledge and infrastructures takes place online, a focus on building relevant digital skills and digital literacy is required more generally, including among marginalized populations and those at risk of digital inequality. This baseline level of digital literacy is an important foundation for wider involvement in the creation and implementation processes for open science. For this reason, infrastructure, technology and innovation policies should be considered in a policy approach to open science.



### Clarity

Effective communication about the policy requirements and associated procedures and expectations is central to success. A lack of clear understanding of terms or practices related to open science (as well as what open science does not encompass) can hinder policy creation and implementation, particularly when working with actors across different sectors, disciplines, institutions and/or countries.



To avoid misunderstandings about its requirements and course of implementation, an efficient open science policy:

- uses concise language and sets out specific requirements, but with enough flexibility to treat special cases in line with the policy objectives;
- sets out roles and responsibilities, identifying leadership;
- is clear on what is expected from all the interested actors of the open science community, such that it is understood by and has strong engagement of the research community;
- shows how researchers and institutions can comply with the requirements of the policy; and
- makes a clear distinction between what is mandatory and what is encouraged.



### Comprehensiveness

An effective open science policy is comprehensive, both in terms of federating existing open science initiatives as well as addressing all the elements of open science as defined in the UNESCO Recommendation on Open Science, in line with the policy's objectives and with consideration of the discipline. Such a holistic approach to open science enhances cohesive strategic research and action across all stages of the research cycle.



An effective open science policy provides a clear signal about the importance of all pillars of open science. At present, the pillars of 'Open engagement with societal actors' and 'Open dialogue with other knowledge systems' are under-discussed, under-recognized and underfunded areas. Significant effort and resources will need to be focused on those areas concerned with societal engagement, which are currently less advanced. An effective open science policy will need to enable bringing those pillars up to the level of mainstream open science.<sup>2</sup>



### Commitment to resourcing

Adequate funding and support measures are essential to foster compliance with a policy's objectives<sup>3</sup>. An efficient open science policy needs to be accompanied by proportionate financial and human resources to realize the necessary investments and long-term services, such as capacity support<sup>4</sup>, open access to scientific knowledge, open infrastructures<sup>5</sup>, platforms and mechanisms for engagement with society,<sup>2</sup> among others.



Adequate resources will also be needed for a proper public engagement process that allows actors beyond the scientific and policy making communities to be included in policy creation, implementation and evaluation. As open science policies require a holistic view of the research system, resources need to be available at all stages of the research cycle, including in the early stages of design of research questions and preregistration of research studies.



<sup>2</sup> See also: UNESCO Open Science Toolkit · Guidance: Engaging Society in Open Science

<sup>3</sup> See also: UNESCO Open Science Toolkit · Guidance: Funding Open Science

<sup>4</sup> See also: UNESCO Open Science Toolkit · Guidance: Building Capacity for Open Science

<sup>5</sup> See also: UNESCO Open Science Toolkit · Guidance: Bolstering Open Science Infrastructures for All





A strong open science policy addresses:

- costs for implementation of and compliance with the policy;
- equitable provision of support;
- costs resulting from (new) open science responsibilities that need to be supported with new/additional funds;
- costs resulting from open science practices that need to be integrated as 'good practice' within the existing funding framework;
- skill development for the necessary expertise within the organization(s) in order to implement the policy recommendations and monitoring systems;
- clear pathways to long-term sustainability of investments in open science, recognizing that resourcing for open science is not only about additional investments but also about spending the existing resources more efficiently, such as for shared infrastructures or collaborative practices; and
- incentives and rewards to perform open science.

**Equity and inclusion**

Any open science policy and the process of its formulation, implementation and evaluation should be inclusive, addressing all relevant stakeholders, as well as under-represented groups, who will be affected by the policy.

Open science policies should be underpinned by the concepts of equity and inclusiveness:

- respecting ethical considerations of producing and using open resources;
- opening access while respecting intellectual property and other applicable legislations;
- building inclusive governance of open science infrastructures; and
- creating two-way engagement with those affected by the policy.

As digital inequalities between and within countries determine who can contribute to open science efforts and who can benefit from resulting changes and transformations, special attention should be given to the engagement of young people in open science policy

creation and to addressing global inequality in Internet access, particularly for women and marginalized groups.

**Longevity**

A policy approach to open science contributes to creating a sustainable cultural change and supporting a community of practice around open science. A strong open research culture makes it easier to enforce and perpetuate open science policy recommendations. Effective longevity of a policy promoting open science is enhanced by encouraging collaboration, the development of common/open research agendas and community-wide thinking, rather than individual compliance with 'open science rules'.

In addition, an open science policy can support sustainability of open science practices, by spearheading long-term maintenance and governance of open science infrastructures and of digital public goods and systems, including financial sustainability. One such option may be the creation of dedicated offices for open science, or its subsets, such as public engagement and citizen science, within scientific institutions.

**Alignment of incentives**

Part of incentivizing open science is removing incentives for 'closed science' or removing disincentives for open science. Starting by simply taking away obstructions is an efficient, accessible approach. Identifying incentives for open science and providing rewards/recognition for compliance, which may involve the addition of new resources, is a separate step.

Barriers and incentives may involve financial resources as well as other incentives, such as recognition or a sense of moral justice. Recognition is a particularly valuable incentive within existing academic and research communities and institutional structures. There is an urgent need globally to incentivize change towards open science and participation in this change with the potential for recognition and institutional awards for the practice of open science, including all its components.

It is therefore particularly important that an open science policy promotes the recognition of different open science elements in academic career assessment, hiring and promotion practices, at the level of the researcher, and in assessing research itself in the context of projects and research-performing institutions.



### Learning and adaptation

Although ideally the possible cost, risks and adverse impacts of an open science policy are considered during the development of the policy, not all factors may be foreseen. Adaptation therefore needs to be integrated in the policy process. A policy equipped with an adaptive management process can respond more readily to emerging challenges.

Improving from lessons learned also needs to be a central part of the policy, and policy knowledge and expertise should be harnessed to create a realistic and pragmatic policy that:

- recognizes the skills and capacities needed to implement the required actions, and promotes and encourages the uptake of open science skills through the establishment of teaching and training opportunities (for example, mandatory open data policies may fail if researchers lack training and resources to support them in making their data open);
- promotes understanding of the principles, practices, value systems and attitudes of open science, especially among early career researchers and students; and
- includes the integration of open science within the training of early-career researchers.

### Flexibility

It is important that open science policies match local needs, which are country-specific in the case of national policies, but can draw on the evidence of best practices from a wide range of countries and organizations.

Open science policies should be:

- flexible, offering choices to all actors and accounting for geographical differences and differences among scientific disciplines;
- scalable and adaptable;
- designed to promote openness as a process, leading to more and better collaboration within and outside of the research system, with the principle of 'as open as possible, as closed as necessary', in addition to promoting openness as a 'formal' property through the application of specific licenses or technical standards;

- up-to-date and incorporating the current best practices, leaving the concrete 'how to' specification for accompanying guidelines or action plans that can be changed more easily than the policy and adjusted to the real needs and demands; and
- sustainable for the long-term future.

### Enforcement, monitoring and evaluation

The non-mandatory character of a grand majority of existing policies that address open science can represent a weakness in achieving their implementation.

Adequate support measures at the national and institutional levels should be provided to ensure that all the actors involved in the implementation of the policy or affected by it have the skills, infrastructure and support services to comply with the policy's objectives and requirements.

Compliance requires adequate measures for monitoring, with consequences for non-compliance. Many policies still lack a monitoring system to track their implementation and to clearly describe how and when compliance will be monitored, as well as to establish potential rewards and/or consequences for non-compliance.

The monitoring system should be assessed and re-evaluated on a regular basis, with sufficient attention to unintended consequences. The monitoring system should be explicit about its scope and should be implemented within a positive environment for researchers.

To support implementation, each open science policy, be it national or institutional, should adopt a monitoring system that considers the specific operational, legal and cultural context that the policy aims to regulate.

An effective open science policy:

- provides coherent monitoring framework(s) for measurement of progress in meeting open science objectives and for assessing its impacts;
- outlines effective monitoring of compliance, including communication about the monitoring that will be performed; and
- uses effective tools for monitoring compliance and enforcement of policy-recommended practices.



### Implementing an open science policy

Policies are strengthened when accompanied by a plan for implementation that identifies the resources and infrastructure needed. Policies are hard to design and very hard to implement. While designing a policy, the actors involved should plan for its progressive implementation for the short, medium and long terms, incorporating flexibility and adaptability.

Results gathered in the European University Associations' *Open Science Survey report*, published in June 2021, showed that although open science is seen as an important strategic priority for over 50% of the institutions surveyed, implementation of institutional open science policies still lags behind. The participating institutions noted that the gap between strategic importance and implementation was smaller in the established area of open access to research publications but much wider in data-related areas (such as research data management, FAIR data and data sharing), which were nevertheless given relatively high importance. When asked about their perception of how far open science is embedded in institutional priorities and practices, most respondents answered that open science is sporadic or gaining traction, and less than 10% considered open science to be fully embedded.

An implementation plan might show how researchers and others can fulfill the requirements of the different open science policies to which they are subject, using the services and tools that the country or institution can provide or identified and accessible alternatives. For instance, an institution might not provide an infrastructure for depositing and publishing research data, but it can point out external solutions that fulfill policy requirements. It is also useful to compare those solutions with other external options with undesired features.

Implementation of open science policies and policy instruments (such as open access mandates, FAIR data standards and so on) is often de facto 'owned' by service providers, such as a grants officer, library or information technology staff. A fundamental challenge of creating and implementing better open science policies is to engage researchers as partners, who own their implementation and, as a result, change their research practices.

#### Useful links:

- Funder Policy Development Tools, Open Research Funders Group: <https://www.orfg.org/policy-development-guide>
- Toolkit for policy makers on Open Science and Open Access: Model Policy on Open Science for Research Performing Organisations (RPOs), OpenAIRE: <https://www.openaire.eu/model-policy-on-open-science-for-research-performing-organisations>
- Model Policy for Research Data Management (RDM) at Research Institutions/Institutes, Leaders Activating Research Networks (LEARN): [learn-rdm.eu](https://learn-rdm.eu)
- Chapter 9: Open Science Policies, Open Science Training Handbook, FOSTER: [https://open-science-training-handbook.github.io/Open-Science-Training-Handbook\\_EN/02OpenScienceBasics/09OpenSciencePolicies.html](https://open-science-training-handbook.github.io/Open-Science-Training-Handbook_EN/02OpenScienceBasics/09OpenSciencePolicies.html)
- Example re. clarity of obligation: NASA Open Science policy (SPD-41: [Scientific Information policy for the Science Mission Directorate](#)), Section II-F.



### Key elements of an open science policy

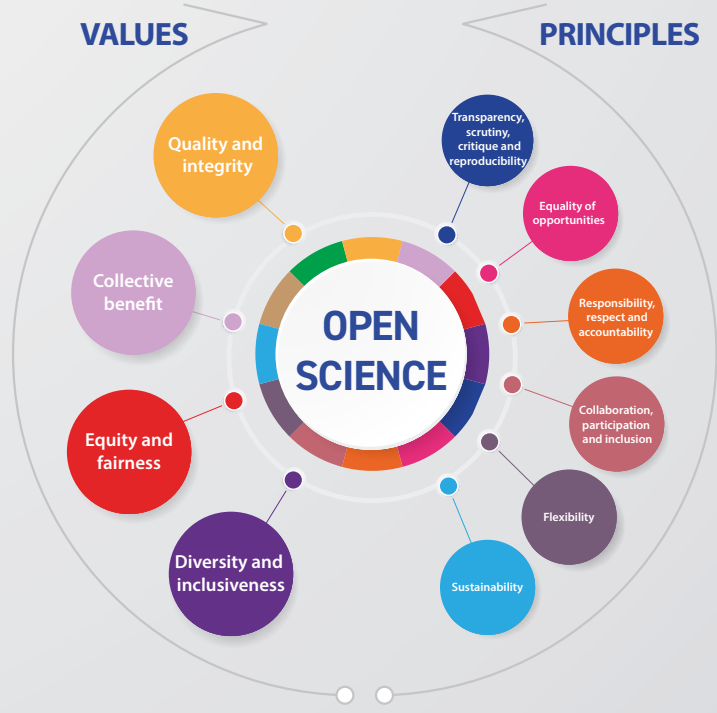
- ✓ provide a rationale and a forward-looking vision for open science practices in line with the key values and principles of open science as per the UNESCO [Recommendation on Open Science](#);
- ✓ clearly state the jurisdiction and effect of the policy;
- ✓ specify the roles, rights, responsibilities and duties of all those involved in developing and implementing the policy;
- ✓ provide guidance for ensuring open access to scientific knowledge (and all kind of outputs, at any stage of the research life cycle, including educational resources), developing and using open science infrastructures, enhancing open engagement with societal actors and open dialogue with other knowledge systems, in other words addressing all the pillars of open science as set out in the UNESCO Recommendation on Open Science:
- ✓ define specific provisions and terms of providing open access to scientific knowledge, including scientific articles, open research data, code and software and the use and creation of open educational resources (e.g. mandatory deposit, locus of deposit, time of deposit, provision of open access, licenses and copyright provisions for archiving, sharing, long-term preservation, terms of re-use, etc.);
- ✓ encourage and incentivize uptake of open science practices of and beyond open access to publications and data, including the extended collaboration between scientists and societal actors beyond the scientific community, opening up practices and tools that are part of the research cycle and making the scientific process more inclusive and accessible to the broader inquiring society based on new forms of collaboration and work such as citizen science, crowdfunding, crowdsourcing and scientific volunteering;
- ✓ enhance training, including in-house training, to raise awareness and build capacity for open science;
- ✓ enhance and incentivize the development and/or use of repositories that meet quality standards and adopt best practices;
- ✓ set out research assessment and evaluation in line with open sciences values and principles including incentives for open science practices and reward mechanisms for researchers practicing open science;
- ✓ support open science metrics, along with ways of rewarding the full diversity of scientific outputs and of recording the broader social impact of research;
- ✓ recognize disciplinary and regional differences in open science perspectives;
- ✓ take into account academic freedom, equity, gender-transformative approaches and the specific challenges of scientists and other open science actors in different countries and in particular in developing countries;
- ✓ provide funding for policy compliance, including the allocation of funds for awareness-raising activities and training in cooperation with research-performing organizations and other stakeholders;
- ✓ outline a mechanism for monitoring policy compliance, including possible sanctions, where appropriate, for no compliance;
- ✓ contain a specific time plan for its review and possible update; and
- ✓ be assigned unique and persistent identifiers (PIDs) and be machine-readable (i.e., accessible via an application programming interface).

These elements were created with input from the UNESCO Working Group as well as example policies, checklists and toolkits provided by OpenAIRE and the Open Research Funders Group.

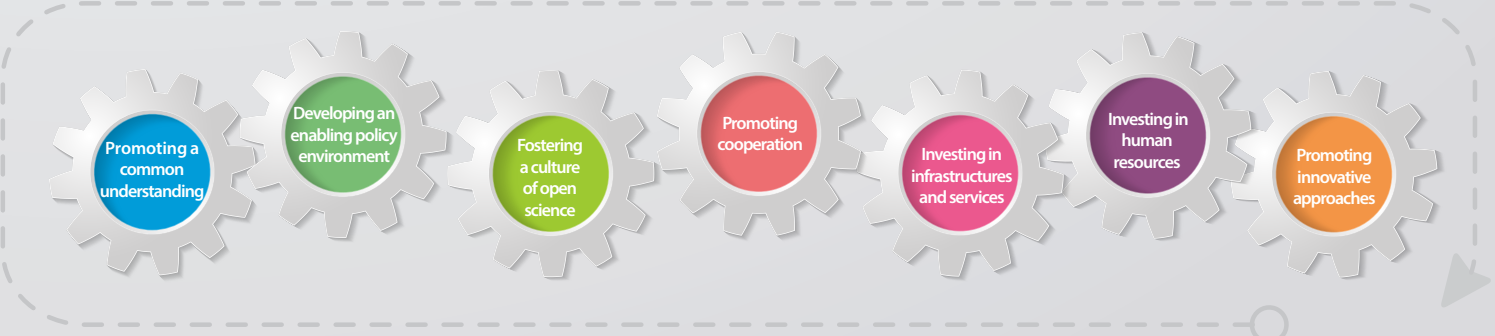


### UNESCO Recommendation on Open Science at a Glance

The **Recommendation on Open Science**, the first international standard setting instrument on open science, was adopted by 193 countries in November 2021 at the 41<sup>st</sup> 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

