Open Science for the 21st century

A declaration of ALL European Academies

presented at a special session
with Mme Neelie Kroes, Vice-President of the European Commission,
and Commissioner in charge of the Digital Agenda

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The European Federation of National Academies of Sciences and Humanities

Towards open science in the 21st century

The digital revolution makes it possible to realize the right "to share in scientific advancement and its benefits" that is enshrined in Art.27 of the Universal Declaration of Human Rights, a principle which has become a binding norm as Art.15 of the International Covenant on Economic, Social and Cultural Rights of 1966. The Berlin declaration on Open Access of 2003 was a landmark in the establishment of a global movement striving for broader access to scientific materials. UNESCO, in its Charter for the Preservation of the Digital Heritage of 2003, stressed the vulnerability of all digital materials, including the records of science, and the need for international cooperation for long-term preservation.
These challenges were taken up by policies developed in international organizations like OECD, ESF, EuroHORCs, ScienceEurope, LERU and others. The European Commission pleads for Open Access in its Digital Agenda and included a number of Open Access pilots in the FP 7 programme. It proposes that under "Horizon 2020", the successor to FP7, all research results are to be made available and accessible for everyone.

The grand challenges of the 21st century transcend borders, and science will be increasingly global. A strong commitment to open science by the scientific community, as represented by ALLEA and its Member Academies, and by science funders, like the European Commission, will stimulate science inside and outside of Europe: the emerging Global Knowledge Partnership promises more efficient data-sharing, amplification of observations, replication of experiments, better testing of theories and accelerates innovation. It will enhance transparency and integrity to the scientific enterprise.

ALLEA has been striving to connect the knowledge and experiences of its Member Academies to these debates, emphasizing the universality of science, stressing the desirability of more equitable access across an economically and socially uneven world in Europe and beyond, supporting the development of pan-European and globally networked research infrastructures (which includes developing those infrastructures traditionally used by social sciences and humanities scholars, for example through Europeana as well as public and private archives, libraries and collections), pointing to the potential of harnessing legitimate business and civil society interests and insights in tackling the "Grand Challenges", and generally promoting an enlightened and evidence-based approach to building more subtle and also socially more innovative public-private partnerships. In particular the issues of securing permanent access to the record of science (and its equivalent in the area of social sciences and humanities, as well as securing use and re-use of data of public organisations), the promotion of benefit sharing by making better use of the opportunities offered under Open Access and open science approaches, the notion of "science as a public enterprise" (with implications for areas as diverse as science communication, patenting, and education and training), and the link between data and publications management, performance assessment and ethically sound and responsible conduct of research, have been at the heart of many of ALLEA's recent initiatives.

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Preamble: A Vision for Open Science in the 21st century

Data are the bedrock on which the scientific edifice is built. More efficient data-sharing and more open access to information and resources will make it easier for observations to be confirmed, experiments to be replicated, hypothesis to be supported, rejected or refined, and, ultimately, for answers to societal challengers to be given.

Powerful digital technologies for data acquisition, storage and manipulation create new opportunities, but also risk widening the "digital divide". Open Science envisages optimal sharing of research results and tools: publications, data, software, and educational resources. It will rely on advanced e-infrastructures that enable online research collaboration. The potential to link cognate, and to re-use initially unrelated datasets will reveal unexpected relationships and will trigger new dynamics of scientific discovery. The collective intelligence of scientific communities will be unleashed through new collaborations across institutional, disciplinary, sectoral and national boundaries. The open science environments will help restore transparency and integrity to the scientific enterprise, for all to see. New points of exchange with non-academic end-users of scientific knowledge will be created, and progress will be made towards the vision of scientifically literate societies: this may require releasing scientific data in forms that are accessible to citizens.

A number of requirements are to be fulfilled for this vision to be realised:

Open Scientific Content arising from publicly funded research
Publications should be made openly available online, as soon and as freely as possible, as should also ***educational resources*** and ***software*** resulting from publicly funded research.
Scientists and their organisations should apply open sharing principles to the ***data*** that underpins such publications, including "negative" results; measures should be put in place for quality assurance and preservation of such data for re-use.
Consequently, ***research proposals*** requesting public funds should include measures aimed at advancing open science and apply the above principles. Qualifications to open science principles should require specific explanations, as for example legal obligations or legitimate commercial interests, or security, privacy or ethical concerns.

Open e-Infrastructures for public and private research
High-performance and economically efficient ICT infrastructures are needed to manage the expected scale of future data flows. Adequate computational resources should be available to all researchers in order to fully leverage the online access to data and computational resources. Also beyond Europe open high-speed connectivity should help reduce existing knowledge divides. Infrastructures should therefore be built with a view to global interoperability, fostering collaborations between different scientific fields and different societal sectors, and capable of handling extremely large and complex datasets.

Towards an Open Science Culture
Academic assessment and reward systems should see merit in participation in the culture of sharing, in enabling online collaboration and reproducible e-science. Those producing or reusing scientific information should comply with codes of conduct and conform to the standards of scientific integrity in their discipline, subjecting publications and also datasets to peer review and quality assessments.
Commercial and security interests are to be considered, but the existence of scientific data that arises from privately funded research or that is security-sensitive should also be registered, when it is in the interest of the public good, with sector- and field-specific licences on limited or delayed release of such information subject to time-based expiry.
Open science should facilitate access to quality educational tools and should allow citizens to benefit from advanced technologies. It is hoped that the young will find inspiration for new discoveries and entrepreneurship, joining the ranks of scientists, engineers and innovators in far greater numbers than is currently the case.

Making it Happen

ALLEA and its Member Academies consider the open science approach an essential building block for the construction of the European Research Area and of Global Knowledge Partnerships.
The Academies commit themselves to debate and promote practical applications of open science principles within their national arenas of activity, and to jointly advocate their adoption also in the international domain.

They will interact with the research and higher education environments in their national jurisdictions, and, jointly and individually, in Europe and beyond, by:

(1) Urging funding bodies, including the European Commission, to **implement open science principles for publications, research data, software, educational resources and research infrastructures,** insisting that funding mechanisms are fashioned in such a way as to allow the long-term commitment to the curation of and, hence, to securing permanent access to research data;

(2) Encouraging scientific and research institutions in their countries and the supporting industries to **innovate and promote open science platforms**, making research results discoverable and re-usable, interacting also with publishers and libraries/repositories to explore new business models for sustainable open science data management and to develop new customer services (such as platforms for collaborative research; experimental open processes such as open peer review, new science-in-society relations etc.);

(3) Involving scientists, educators, students, in a sustained dialogue about the need to **embrace the culture of open science**, putting in place reward mechanisms that recognise stewardship and innovation in preserving and enabling the re-use of results from research, developing field-congruent rules on the best point and time of access to such data and on authority to award a quality seal and to dispose of data, and supporting the behavioural shifts, including an appreciation of the citizen scientist and the importance of moving, in teaching, towards open education and e-science literacy;

(4) Engaging with regional, national and European decision-makers in order to mobilise them to **establish and expand top-class e-infrastructures**, offering as much as possible free, secure and sustainable access to and re-use of documents and datasets, opening them up to computation and recombination, and enabling seamless collaboration in Europe and beyond, while ensuring that European researchers and industry can take full advantage of the benefits arising from global knowledge partnerships;

(5) Collaborating with their global networks and other science organisations in order to **develop world-wide, interoperable data centres**, that will be governed by equitable rules for access and use, and based on an appropriate level of standardisation and metadata (integrating also data and expertise from the social and human sciences), ensuring that such scientific data as will be stored is described unambiguously and vetted with great care (duly referring also to uncertainties), in order to strengthen and enhance wider science-in-society exchanges and policy-relevant interactions.

ALLEA Member Academies

Albania: Akademia E Shkencave E Shqipërisë; **Austria**: Österreichische Akademie der Wissenschaften; **Belarus**: Нацыянальная акадэмія навук Беларусі; **Belgium**: Académie Royale des Sciences des Lettres et des Beaux-Arts de Belgique; Koninklijke Vlaamse Academie van België voor Wetenschappen en Kunsten; **Bosnia and Herzegovina**: Akademija nauka i umjetnosti Bosne i Hercegovine; **Bulgaria**: Българска академия на науките; **Croatia**: Hrvatska Akademija Znanosti i Umjetnosti; **Czech Republic**: Akademie věd České republiky; **Denmark**: Kongelige Danske Videnskabernes Selskab; **Estonia**: Eesti Teaduste Akadeemia; **Finland**: Suomen Tiedeakatemiain Valtuuskuntal; **France**: Académie des Sciences - Institut de France; Académie des Inscriptions et Belles-Lettres; Académie des Sciences Morales et Politiques; European Academy of Arts, Sciences and Humanities (Associated Academy); **Georgia**: □□□□□□□□□□□□ □□□□□□□□□□□□□ □□□□□□□□ □□□□□□□□; **Germany**: Deutsche Akademie der Naturforscher Leopoldina; Union der deutschen Akademien der Wissenschaften (Akademie der Wissenschaften in Göttingen, Akademie der Wissenschaften und der Literatur Mainz, Bayerische Akademie der Wissenschaften, Berlin-Brandenburgische Akademie der Wissenschaften, Akademie der Wissenschaften zu Hamburg, Heidelberger Akademie der Wissenschaften, Nordrhein-Westfälische Akademie der Wissenschaften und der Künste, Sächsische Akademie der Wissenschaften zu Leipzig; Associated Academies); **Greece**: Ακαδημία Αθηνών; **Hungary**: Magyar Tudományos Akadémia; **Iceland**: Vísindafélag Islendinga; **Ireland**: The Royal Irish Academy - Acadamh Ríoga na hÉireann; **Israel**: האקדמיה הלאומית הישראלית למדעים; **Italy**: Accademia Nazionale dei Lincei; **Kosovo**: Akademia e Shkencave dhe e Arteve e Kosovës; **Latvia**: Latvijas Zinātņu akadēmija; **Lithuania**: Lietuvos mokslų akademijos; **Macedonia**: Македонска Академија на Науките и Уметностите; **Moldova**: Academia de Ştiinţe a Moldovei; **Montenegro**: Crnogorska akademija nauka i umjetnosti; **Netherlands**: Koninklijke Nederlandse Akademie van Wetenschappen; **Norway**: Det Norske Videnskaps-Akademi; **Poland**: Polska Akademia Umiejętności; Polska Akademia Nauk; **Portugal**: Academia das Ciências de Lisboa; **Romania**: Academia Română; **Russia**: Российская академия наук; **Serbia**: Srpska Akademija Nauka i Umetnosti; **Slovakia**: Slovenská Akadémia Vied; **Slovenia**: Slovenske akademije znanosti in umetnosti; **Spain**: Instituto de España; Real Academia de Ciencias Morales y Políticas; **Sweden**: Kungl. Skogs- och Lantbruksakademien, Kungl. Vetenskapsakademien; Kungl. Vitterhets Historie och Antikvitets Akademien; **Switzerland**: Akademien der Wissenschaften Schweiz; **Turkey**: Türkiye Bilimler Akademisi; **Ukraine**: Національна академія наук України; **United Kingdom**: The British Academy; The Royal Society of Edinburgh; The Royal Society of London;**Vatican**: Pontificia Academia Scientiarum

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