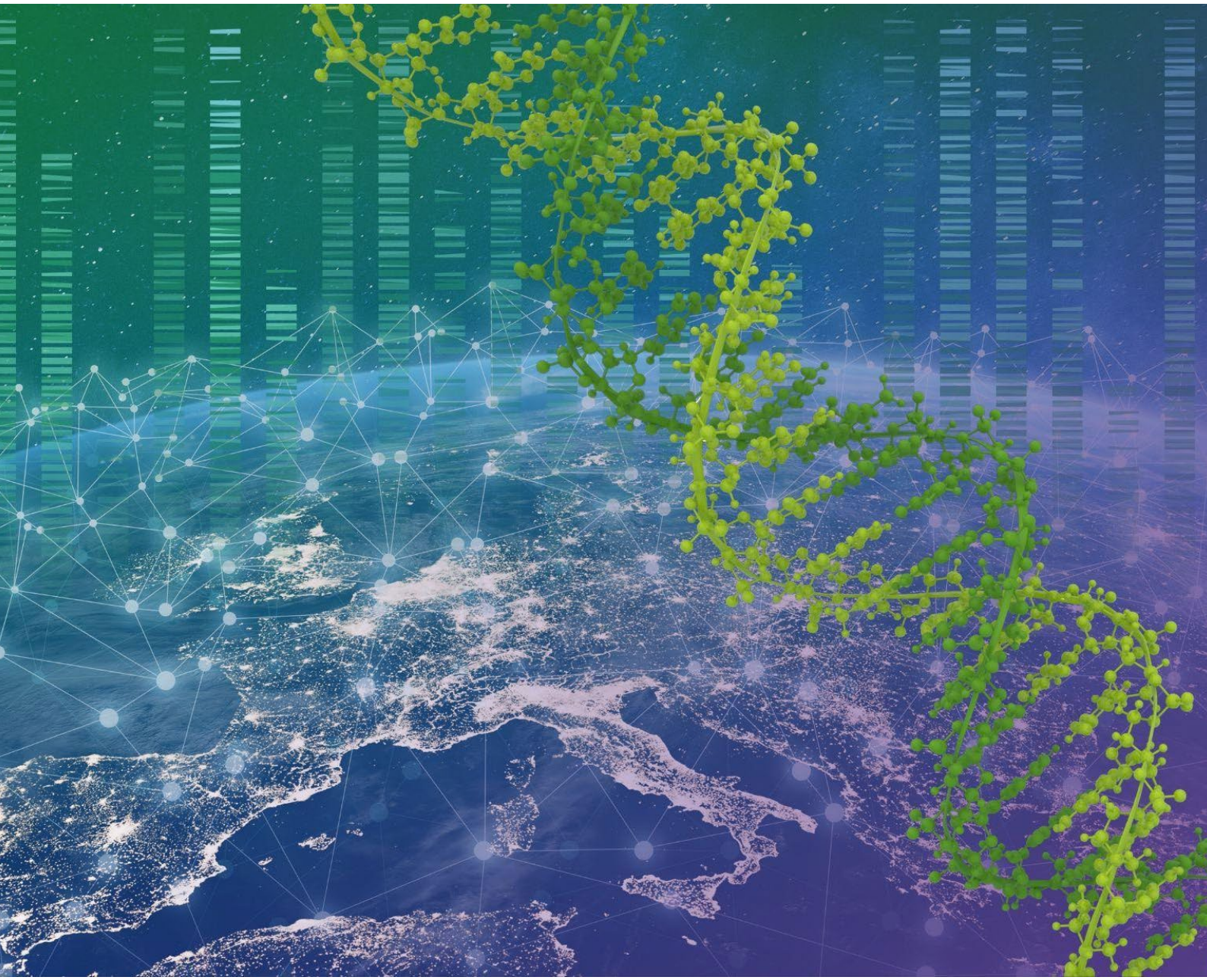
EMBL's Recommendations
Strategy for European Life Sciences

April 2025

European Commission | Call For Evidence



The **European Molecular Biology Laboratory** (EMBL) strongly supports the European Commission's initiative to develop a comprehensive life sciences strategy for Europe. As Europe's leading intergovernmental organisation for molecular biology, EMBL has dedicated the last 50 years to fostering scientific excellence, advancing emerging technologies, and supporting Europe's global leadership in the life sciences. In this consultation response, EMBL outlines key priorities it considers critical for Europe's continued competitiveness and resilience in this rapidly changing global environment.

1. Investing In Fundamental Science

At the heart of all transformative innovations lies fundamental science. EMBL strongly believes that **basic research is the essential foundation upon which truly ground breaking societal and technological advancements are built**. Throughout history, the most significant scientific achievements in the life sciences have emerged from the pursuit of curiosity-driven research, often in areas that initially seemed disconnected from immediate practical applications. From the discovery of the structure of DNA to the development of CRISPR gene editing[1], fundamental research has consistently been the driving force behind disruptive innovations that have reshaped our understanding of life and transformed industries. Without a strong commitment to exploring the unknown, investing in the long-term pursuit of knowledge, and understanding of the inner working of the human body from molecules to organs, these lifesaving innovations would not be possible.

One of the key priorities of the EU Life Sciences Strategy should be to sustain and expand funding for fundamental life science, as it remains the most powerful engine of scientific discovery and technological progress. Europe must continue to prioritise this critical area to secure its leadership in the global knowledge economy.

Proposed Areas for Action

1.1 Prioritise Interdisciplinarity and Improved Connectivity Between Environmental and Human Health (One Health)

Strengthening interdisciplinary research that links environmental sciences and human health through the One Health framework is essential. This approach will enhance surveillance and decision-making, as well as a more effective response to emerging health threats driven by environmental factors, such as pollutants, antimicrobial resistance, infectious diseases, and pandemics. Interdisciplinary approaches should be favoured, for example by integrating mechanistic genetic, molecular and cellular investigations with novel

[1] https://www.embl.org/news/science/nobel-prize-chemistry-2020/

experimental models emerging from tissue engineering, multicellular and large-scale omics, 3D mesoscopic and microscopic imaging, and computer modelling.

1.2 Accelerate Biodiversity Research for Population Variation and Adaptation

Investigating biodiversity, including intra- and inter-species variation, is crucial for understanding population dynamics and how species across the tree of life adapt to changing environments. It is also fundamental to bring these investigations to controlled laboratory settings, to study their responsiveness to environmental factors and their adaptive mechanisms. This approach will help support conservation strategies, agricultural practices, and contribute to climate change adaptation efforts.

1.3 Advance Mechanistic Understanding of Microbiomes and Their Role in Health and Disease

Understanding of the diverse microbiomes, their interaction mechanisms within their complex communities and with hosts is crucial, for example, for precision medicine. There is significant untapped potential in exploring novel microbial genes, which could provide new therapeutic insights for human health and biotechnology applications.

2. Capitalising On And Expanding Existing Research Infrastructures

European Research Infrastructures (RIs) are the essential foundation upon which Europe's scientific excellence and innovation ecosystems in the life sciences are built. Investments[2] in life science infrastructures in the last decade have led to the generation of vibrant ecosystems in Europe, where research, data, talent, technology development and translation co-exist forming a highly complementary cycle.

From pioneering cryogenic electron microscopy[3] (cryo-EM) and the sequencing of the human genome to supporting COVID-19 vaccine development[4], RIs such as EMBL, have consistently driven the creation of new technologies and methods that push the boundaries of scientific understanding. **Without continued and expanded investment in these infrastructures and without the cutting-edge tools and data systems that they provide access to, for both academia and industry, breakthroughs in life sciences and medicines**

[2] EMBL, as an intergovernmental organisation, is a member of three ESFRI landmarks: ELIXIR, INSTRUCT-ERIC and Euro-Bioimaging ERIC https://www.embl.org/international-relations/esfri/

[3] EMBL alumnus Jacques Dubochet has been named as a co-recipient of the 2017 Nobel Prize in Chemistry for developing cryo-electron microscopy https://www.embl.org/news/science/jacques-dubochet-awarded-nobel-prize-for-chemistry/

[4] BioNTech, the biotech company that together with Pfizer recently presented the first positive results for a COVID-19 vaccine, used one of EMBL Hamburg's facilities for their research on vaccine development .https://www.embl.org/news/science/biontech-uni-mainz-embl-hamburg/

development will become harder to achieve. Europe risks losing its competitive edge in the sector.

RIs play a critical role in **generating high-quality, reliable data** that is fundamental to the success of AI systems in life sciences, ensuring that AI models are trained on accurate, real-world information essential for making precise predictions.

Unlocking the full potential of the digital and AI-driven transformation for Europe's life science sector will also depend on access to high quality and highly annotated data at scale[5], linked to key associated metadata types. Yet, the long-term sustainability of many open biodata resources, hosted by European infrastructures that are **used daily**[6] by the private and public sectors, is **far from secure**. Many are reliant on short-term competitive funding sources, sometimes from a single or very limited number of funders[7].

If not addressed, **the lack of secure and sustainable support for open data resources could be a true roadblock for Europe's resilience as well as the uptake of world-class data and AI methods in the life sciences.**

Proposed Areas for Action

2.1 Support Technology Development in Life Science Research Infrastructures

Life Science RIs, such as EMBL, already serve as incubators for novel technologies (e.g. imaging across scales, from atomic-scale visualisation of antibiotic action in human pathogens to investigations in human organoids or tissue biopsies). They support early-stage technology development[8] that is critical for fundamental research and, in the long term, for applications in pharmaceutical industries (e.g., drug screening and drug discovery). However, **there is a significant gap in funding for innovative technology development under current European programmes**, which prevents Europe from fully capitalising on the existing life science research and infrastructures ecosystem.

To address this, a **financial support mechanism such as cascading grants** should be introduced, allowing RIs to fund innovation directly for specific technological needs, and towards automation and streamlining of the most promising innovative solutions within their areas of expertise.

[5] Such as the Protein Data Bank (PDB), which was used to train the AlphaFold model.

[6] In 2024, **5.4 billion requests from 6.1 million unique IP addresses** to EMBL-EBI data resources came from EU member states. For example, UniProt serves 3.5 million weekly users worldwide, supporting substantial research impacts across public and private sectors, conservatively estimated to be worth €565 million annually.

[7] See Global Biodata Coalition Working Group on Sustainability. (2023). Consultation Paper. Zenodo. https://doi.org/10.5281/zenodo.8384740

[8] For example, EMBL Imaging Centre in Heidelberg (Germany) drives implementation of industrial early-stage next generation technologies for biological applications based on the needs of the user community. https://www.embl.org/about/info/imaging-centre/research/

As a complementary action, establishing **pan-RIs technology development programmes and staff exchanges over a longer time span** (5-10 years) would allow technology developers across RIs to address high priority and common engineering challenges, such as nanorobotics, cryogenics X-ray, structure prediction, electron or laser optics[9]. These initiatives will help companies and academics access and benefit from the latest cutting-edge technologies while capitalising on existing infrastructure investments.

2.2. Strengthen Europe's Resilience and Global Leadership In Life Sciences Data Infrastructure

To mitigate the risks associated with the uncertainty of external funding sources and ensure the long-term resilience of essential research infrastructure, Europe should establish a dedicated **European Data Infrastructure Investment Programme for Life Sciences**.

This Investment Programme would provide stable, long-term financing for Europe-based public and open-access data ressources, such as **Europe PubMedCentral[10] (EPMC)** and other critical services, such as global taxonomy resources[11], which substantially support life sciences research in Europe.

By ensuring that these resources remain resilient, operational, and accessible to both private and public sectors, this investment programme would safeguard the future of translational data, enabling innovation in areas like AI-driven biomedical research.

A robust, sustainable infrastructure is essential for Europe to maintain global leadership in data-driven research, and address current dependencies on databases operated and governed outside Europe.

3. Harnessing Data and AI for Advancing Life Sciences

The convergence of life sciences and artificial intelligence is one of the most promising frontiers in research and innovation[12]. From genomics and drug discovery to imaging and

[9] For example, EIROForum members formed an "Instrumentation" working group for the joint development of new scientific instrumentation, including for the life sciences, and the hosting of a yearly Summer School: https://www.eiroforum.org/activities/instrumentation/

[10] Europe PMC provides comprehensive access to life sciences literature from trusted sources. It is available to anyone, anywhere for free. With Europe PMC, users can search and read 45.9 million publications, preprints and other documents enriched with links to supporting data, reviews, protocols, and other relevant resources. https://europepmc.org/

[11] See The National Center for Biotechnology Information (NCBI) as one example: https://www.ncbi.nlm.nih.gov/

[12] Google DeepMind partnered with EMBL-EBI to develop the AlphaFold database and make openly available the results of an AI system which makes state-of-the-art, accurate 3D protein structure predictions, which previously took years, in minutes. https://www.embl.org/news/science-technology/alphafold-wins-nobel-prize-chemistry-2024/

personalised medicine, biology is becoming increasingly data intensive, and the transformative potential of AI in biology is particularly large.
Along with the rapid rise of technology companies that turn to life science questions, many European academic institutions are investing in AI initiatives to fully leverage this promising technology to accelerate scientific discovery.

Four key components are required for the successful uptake of AI in life sciences:
(1) Good questions, which map to feasible AI deployments; **(2)** Access to large-scale computable data, with appropriate metadata, to answer these questions; **(3)** Access to large-scale computing resources to train models, and resources for retention of large data; **(4)** Talented AI researchers who ask the good questions, make use of suitably managed and curated data, and design AI models.
The multidimensional nature of biological data demands tailored AI solutions, as life sciences research often involves highly specialised data types, such as genomic sequences, proteomics, and clinical data, which require sophisticated models that can account for biological complexities and variability.

Unlike other fields, this makes it imperative for Europe's Life Sciences Strategy to focus on AI initiatives that specifically address these challenges, guaranteeing that AI investments are designed and optimised to work with the nuances of life science data.

Proposed Areas for Action

3.1 Develop a Dedicated AI Roadmap for Life Sciences

To maximise the potential of AI in life sciences and healthcare, the Strategy should establish a dedicated "AI in Life Sciences Roadmap". This Roadmap should focus on integrating AI tools for **critical areas such as genomics, macromolecular interaction networks and structures, and imaging**, while ensuring that Europe's life science data infrastructure is optimised for AI-ready datasets (see point 2.2. above). The Roadmap would prioritise the training of researchers (see point 4.1 below), and supporting AI-driven experimental workflows, including the integration of AI into the lab for automation and real-time, smart, data acquisition.

3.2 Make High-Performance Computing (HPC) Work For the Life Sciences

As Europe invests in next-generation computing infrastructure, including AI Factories and Gigafactories, it is essential to consider how these powerful platforms can be made more accessible and impactful across diverse scientific domains. The life sciences, in particular, present distinct requirements that **merit tailored support** (see section 4 below) and **investment in real world use cases** to further align advanced computing infrastructure with the needs of biomedical research. Making HPC work better for the life sciences also requires

embedding AI Factories in the wider data and research infrastructures ecosystem in Europe, and dedicated training so that researchers can make most use of such resources (see point 4.1 below).

3.3 Accelerate the Deployment of Federated Genomics Data Infrastructure

As Europe gears up towards the European Health Data Space (EHDS), it is crucial to leverage the vast expertise, networks, and initiatives already driven by research exemplars, such as European **Research Infrastructures (see point 2 above),** to advance **genomic medicine capabilities**. Those can play a critical role in this transformation by developing and demonstrating **best practices** and **innovative approaches** in genomic data integration. Expanding and integrating such infrastructures into the EHDS will enable more seamless collaboration across Europe, accelerate the sharing of genomic insights by providing a solid foundation for the analysis of large-scale datasets.

4. Fostering Talent, Skills, and Public Engagement in Life Sciences

The Strategy should support the full breadth and diversity of research careers that make Europe's cutting-edge life science possible, from early career researchers to established scientists, including research-enabling roles such as Research Infrastructure scientists[13].

AI uptake, more specifically, will require rapid investments in tailor-made interdisciplinary training programmes that support upskilling and mobility at all levels, while ensuring that academic research environments are future-proof and can retain talent.

A stronger emphasis and commitment should also be placed on closing the cycle of training and public engagement, so that all researchers are equipped with the necessary skills to effectively communicate their findings to policy-makers and a general audience, thereby fostering greater societal trust and understanding of the scientific method. Public engagement should be recognised as a two-way, mutually beneficial opportunity for questioning, curiosity and connection, where society is invited to be part of the conversation and of the scientific endeavour.

[13] For example, ARISE2 (2025-2029) is an MSCA-funded postdoctoral fellowship programme offering talented STEM (science, technology, engineering and mathematics) fellows from around the world the unique opportunity to work on the development and/or improvement of technologies for Life Science Research while developing the expertise needed for a career in research infrastructures making them sought after experts both in academia and industry. https://cordis.europa.eu/project/id/101178241

Proposed Areas for Action

4.1 Incentivise AI Training and Data Literacy for Life Scientists

As the life sciences become increasingly data-driven, it is essential to provide **training incentives for life scientists, particularly those without extensive computational skills.** Tailored programmes should be rapidly developed to upskill researchers in data science and AI tools to help them effectively navigate complex biological datasets. **Simplified, user-friendly interfaces** for supercomputers and AI Factories should also be developed to make these tools more accessible to the broader life science community, and allow for more researchers to leverage AI in their work.

4.2 Integrate Engineers' Career Paths into Evaluation and Research Assessment Models

In the evolving life sciences landscape, engineers play a crucial role in developing the technologies and systems that drive innovation. Europe should **embed engineers' career paths into research assessment policies**, so that their contributions, such as the development of AI algorithms, data tools, and IT infrastructures, are adequately recognised and rewarded. This would shift focus from traditional publication metrics and better reflect the multifaceted contributions of engineers to scientific progress.

Furthermore, given the critical importance of attracting engineers to academic institutes, qualification requirements under EU-funded research training programmes should be adjusted to better align with the skills and expertise of engineers (for example, PhD qualifications should not be mandatory eligibility requirement for fellowship programmes).

4.3 Recognise Public Engagement As A Valued Research Output

As societal trust becomes increasingly important in life sciences, public engagement should be recognised as a critical component of scientific research and career development across the sector. The Strategy should incentivise equitable public engagement, ensuring that it is formally recognised as priority within research institutions, and supported by dedicated roles.

This also means **integrating public engagement into appraisals, job interviews, and career progression as a valued research output**. The Strategy should focus on skills development for researchers and staff, building communities of practice to ensure personnel are equipped to engage with the public in meaningful ways. **Funding structures should be put in place** that prioritise public engagement from the outset, such as pre-application

grants[14] that facilitate public involvement in the grant preparation, and flexible timescales to allow for partnership development.

5. Driving The Translation Of Life Science Through Co-Innovation And Partnership Schemes

"Translation enablers", such as research organisations' technology transfer units or research infrastructures, that help research teams seamlessly integrate research and innovation **are crucial for keeping European life science research competitive**. They facilitate the process of identifying and protecting intellectual property, enable the establishment of spin-off and start-up companies, and help license technologies to third parties.

The Strategy should make **co-innovation models** that accelerate joint technology development and deployment, competence building and cross-sectoral mobility, **the new normal.** This also includes supporting the establishment of exploratory, **small-scale research partnerships** between academic institutions and industry to foster innovation at early stages. These collaborations, particularly in areas of pre-competitive research, will help bridge the gap between fundamental research and its practical applications.

The Strategy should continue to incentivise researchers to pursue innovative ideas beyond the initial research phase by offering **flexible support mechanisms, such as top-up funding for new company creation post-project, and ambitious proof-of-concept funds that embrace failure.**

Proposed Areas for Action

5.1 Normalise Co-Innovation Models Between Academia and Industry

Life scientists often seek innovative ways to answer biological questions, frequently developing new technologies and methods in close collaboration with industrial partners. This approach has proven particularly effective for imaging technology development[15], which is critical for future pharmaceutical applications (see point 2.1 above). For successful translation and technology deployment, industry needs reliable, sustainable and ambitious

[14] UK-based funders, such as UKRI, already offer pre-application grants for public engagement in research projects; similar mechanisms may be explored at EU level. See for example: https://www.ukri.org/opportunity/supporting-researchers-to-involve-public-at-pre-application-stage/

[15] For example, at the EMBL Imaging Centre, technology development is done side by side with users testing new technologies for applicability in their research. Partner companies can thus feed these experiences directly back into their R&D, to make sure new products deliver what users need to accomplish their research goals.

public-private partnerships. Beyond technology, co-innovation can also help bridge competences and foster mobility between the public and private sector, with companies directly co-funding staff positions within research organisations.

5.2 Strengthen Existing Schemes to Support Translational Innovation in Life Sciences

To accelerate the translation of life sciences research into real-world applications, the EU should strengthen the collaboration between the European Innovation Council (EIC) and the European Research Council (ERC), especially for beneficiaries of the ERC's Proof of Concept funds. The EIC should normalise rapid access to proof-of-concept funds, including for individual PIs, as well as top-up funding for projects initiated under EU Framework programmes, to allow for company creation.

5.3 Accelerate Public-Private Partnerships (PPPs) in Pre-Competitive Research

The Strategy should promote small scale PPPs to bridge the gap between basic research and commercial application, based on existing examples in the sector. For example, Open Targets[16], a 10-year collaboration between academia, pharma industry, and the public sector helps identify drug targets for complex diseases by integrating genomic and clinical data. Similar partnership models, including with big tech for AI needs, should be explored and set up to support early-stage partnerships in pre-competitive life science research.

An Integrated And Empowered European Life Science Ecosystem

Responding to mounting global challenges - from climate change to emerging pathogens and uptake of AI – will require an empowered and united European life science. To achieve this, **the Strategy needs to support initiatives that seek to enhance the connectivity of countries and regions, thus levelling the playing field in the European Research Area**. Life science research has greatly benefited from European Framework Programmes, also thanks to the Widening support which allowed for the creation of networks and exchange of knowledge and talent across the continent.

To continue building on these achievements, Europe should consider instruments that can contribute to **the sustainability of existing Widening projects,** helping them reach their full potential and amplifying their impact on national, regional and European level. Deepening the interconnectivity across European life science networks will enable stronger collaborations among academia, industry, and research infrastructures, contributing to a more competitive Europe.

[16] Open Targets: 10 years of partnership in target discovery. Nature Reviews Drug Discovery 24, 153-154 (2025). https://doi.org/10.1038/d41573-024-00204-2

Beyond the boundaries of Europe, strategic **international collaboration remains essential for European life science research**, as it enriches and amplifies its diversity, impact and influence. Additionally, having strong and strategic international links ensures that Europe has access to expertise and unique data unavailable on our continent yet critical for understanding human and planetary life in its full complexity. These are the conditions needed for the development of holistic solutions for the global challenges we face.

Europe should play a prominent role in shaping global science agendas, being a leader in setting standards and policy frameworks for responsible biological research, data collection, and data access and use. Active participation in strategic international dialogues and coalitions[17], aligned with Europe's life science priorities, will ensure Europe plays a key role in driving the sector forward.

Ultimately, the success of this strategy hinges on **building Europe's resilience in life sciences and allowing for new ideas and technologies to emerge in a supportive ecosystem.** Empowering fundamental discoveries, upskilling talent, capitalising on its research infrastructures, as well as harnessing the power of AI and investing in the long-term access of its data infrastructure will secure Europe's position as a global leader in scientific discovery and life science innovation.

About EMBL

The **European Molecular Biology Laboratory** (EMBL) is one of the world's leading research institutions, and Europe's flagship laboratory for the life sciences, founded in 1974. With 29 member states, the EMBL is an inter-governmental organisation with more than 110 independent research groups and service teams covering the spectrum of molecular biology across six sites in Germany, France, Spain, the United Kingdom and Italy. EMBL is driving visionary fundamental research, offers vital services to scientists globally, trains Europe's future scientific talent while actively engaging in technology transfer and industry relations, and nurturing policy dialogue in Europe and worldwide. www.embl.org

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[17] For example, the Global BioData Coalition: https://globalbiodata.org/