EBRC Engineering Biology Research Consortium

Response to NIH's Request for Information on Measuring and Rewarding Scientific Impact

The Engineering Biology Research Consortium (EBRC) is a nonprofit, public-private partnership that brings together scientists, engineers, and industry leaders to advance the field of engineering biology to address national and global needs. EBRC's members include experts from over 100 universities and research institutes, alongside leaders from more than 30 companies, philanthropies, and other organizations. Working closely with partners across the engineering biology ecosystem, EBRC focuses on four key areas: Research Roadmapping, Policy & International Engagement, Education, and Security.

EBRC appreciates the opportunity to respond to the National Institutes of Health (NIH) Request for Information on Measuring and Rewarding Scientific Impact (NOT-OD-26-087). EBRC supports NIH's efforts to broaden how scientific contribution and impact are recognized across the biomedical and biological research enterprise. Engineering biology exemplifies the interdisciplinary, collaborative, iterative, and translational approaches NIH seeks to better recognize. Traditional publication- and citation-based measures may underrepresent important engineering biology contributions to biomedical research, including shared biological platforms, computational tools, standards, datasets, enabling technologies, research infrastructure, and intellectual property that enable subsequent research, discoveries, and breakthroughs across fields. As NIH considers updating its evaluation criteria, capturing these contributions requires a system designed for flexible, multifaceted research models. EBRC therefore encourages NIH to develop a flexible, multidimensional, principles-based approach that recognizes diverse forms of scientific contribution without replacing one rigid metrics-based system with another.

Cross-Cutting Principles for Measuring and Rewarding Scientific Impact

Across the seven areas identified in the RFI, EBRC recommends that NIH use indicators as complementary evidence for expert assessment, rather than as proxies for scientific value or as automatic scores or thresholds. Evaluation should account for differences in research context, career stage, discipline, institution type, and the time horizon over which impact may emerge. NIH should also avoid indicators that encourage metric gaming, prioritize short-term outcomes, or reward quantity over meaningful contribution.

1. Rigor and Reproducibility

Engineering biology contributes to biomedical discovery through the development and validation of new biological systems, technologies, and methods. Rigor and reproducibility are therefore important not only for individual hypothesis-driven findings but also for the tools and capabilities that enable subsequent research. Development of an engineered cell system,

organoid model, synthetic gene circuit, genome-editing component, or other biological technology may require extensive characterization and benchmarking across biological systems, laboratories, protocols, and measurement environments before reliably supporting other research.

NIH should therefore consider evidence such as:

- Independent replication, validation, or benchmarking of methods, platforms, biological systems, or findings, documented through publications, reports, datasets, or other appropriate research outputs
- Characterization and documentation of limitations, failure modes, and appropriate uses through methods publications, technical reports, protocols, or other research outputs
- Development and validation of standardized protocols, reference materials, or measurement approaches, including evidence of independent testing or adoption
- Reproducibility of computational models, software, and experimental workflows, supported by accessible code, data, documentation, or replication studies
- Evidence that methods, platforms, or biological systems perform consistently across laboratories, biological systems, protocols, measurement environments, or novel application contexts

Where possible, NIH should recognize these contributions through existing or emerging research outputs, such as validated protocols, benchmarking datasets, technical reports, methods publications, repository records, or independent validation studies, rather than requiring entirely new reporting mechanisms.

These indicators should support expert assessment rather than function as automatic scores or thresholds. NIH should also recognize well-documented negative results, limitations, unsuccessful approaches, and replication failures when they generate information that prevents duplication of ineffective approaches, clarifies the conditions under which findings hold, or improves subsequent research.

2. Data, Software, and Model Sharing

Engineering biology can contribute to biomedical discovery through shared datasets, computational tools, biological resources, experimental models, and research infrastructure that enable research beyond the projects that created them. A validated genetic-component library, engineered cell line, organoid system, biological dataset, or computational design tool may enable other researchers to pursue new questions, validate findings, or develop new applications. These contributions can advance biomedical discovery even when they are not fully reflected in publication or citation metrics.

NIH should not only assess whether resources are shared, but also their quality, usability, interoperability, and downstream scientific value. Relevant evidence could include:

- Quality and completeness of documentation and metadata
- Interoperability and adherence to relevant standards
- Independent validation or benchmarking
- Repository reuse metrics and attribution tracking (e.g., software downloads, dataset citations, biological repository requests) alongside narrative descriptions of downstream adoption
- Integration into other research workflows, models, platforms, or novel application contexts
- Contributions to reproducibility or new research questions

The absence of immediate reuse should not automatically indicate a lack of value, particularly for new resources whose applications may emerge over longer time horizons. NIH should also recognize the development of standards, reference materials, protocols, and other community infrastructure that enables research across institutions.

3. Training and Mentorship

NIH should recognize training and mentorship that build scientific capabilities across the biomedical research enterprise rather than simply counting trainees supervised or graduated. Engineering biology often requires expertise spanning molecular biology, engineering, computation, automation, and quantitative methods; developing this interdisciplinary capacity can enable new research approaches across an entire field.

NIH could consider evidence such as:

- Development of interdisciplinary training programs and curricula
- Creation of shared training resources and educational materials
- Development of new technical competencies
- Contributions to interdisciplinary research communities
- Evidence of trainees subsequently contributing to research, technology development, public-sector activities, industry, education, or other parts of the biomedical ecosystem

Measures should account for differences across career stages and research environments. NIH should recognize both direct mentorship and contributions to broader training infrastructure, including shared curricula, workshops, and community resources.

4. Collaboration

As biomedical research becomes increasingly interdisciplinary and convergent, NIH should develop approaches for assessing and recognizing substantive contributions to team-based science without equating contribution with authorship position or individual publication output.

Engineering biology is inherently collaborative, often bringing together biologists, engineers, computational scientists, clinicians, and technology developers. Contributions such as enabling technologies, biological platforms, verified datasets, computational methods, and experimental workflows may be essential to a team's scientific output without being fully reflected in authorship position or publication counts.

NIH should therefore consider:

- Structured contribution statements detailing specific technical, methodological, or platform contributions to team science beyond authorship position
- Development of enabling technologies and shared experimental capabilities
- Creation of computational methods, biological platforms, or experimental workflows
- Contributions to team-based infrastructure
- Leadership or coordination of interdisciplinary research efforts
- Evidence that a contribution enabled new research, novel applications, or capabilities

Evaluation should recognize meaningful scientific contribution within collaborative research rather than simply rewarding the number of collaborations or co-authorships. Structured contribution statements, building on existing NIH approaches to describing contributions to science, could provide useful evidence for reviewers.

5. Entrepreneurship and Translation

Engineering biology spans fundamental discovery, engineering, technology development, validation, scale-up, and application, with meaningful contributions occurring throughout this continuum. A novel genetic circuit, genome-editing technology, computational design tool, engineered cell system, or organoid model may demonstrate translational value through technical validation, characterization, standardization, and de-risking well before commercialization.

NIH should consider technology maturity, including where appropriate frameworks such as Technology Readiness Levels (TRLs). To assess translational progress without creating rigid commercialization targets, reviewers should consider contextual evidence such as:

- Documented progress from proof-of-concept toward testing in relevant application environments
- External characterization, multi-laboratory validation, or testing by industry, clinical, or public-sector partners
- Executed MTAs, licensing agreements, or other technology-transfer activities
- Contributions to consensus standards or regulatory readiness activities
- Adoption of design tools, genetic parts, or protocols into third-party research or DBTL workflows

- Application or implementation of emerging technologies in new domains or translational contexts

These indicators should serve as qualitative evidence for expert assessment rather than requirements for successful research. NIH should avoid creating pressure to commercialize research that is better suited to foundational or enabling work. Approaches to data and resource sharing should similarly balance openness with legitimate considerations related to intellectual property, privacy, biosecurity, and responsible access.

6. Foundational Scientific Exploration

Engineering biology also illustrates the importance of recognizing contributions whose significance may emerge only over time. The development of a new biological capability and the generation of large-scale datasets can precede recognition of the questions, phenomena, or applications they ultimately make possible, creating opportunities for discovery and innovation that are difficult to anticipate in advance.

NIH should therefore:

- Avoid systematically favoring short-term outcomes over exploratory or foundational research
- Recognize enabling technologies and platforms whose applications may be difficult to predict
- Account for well-documented negative results, limitations, and iterative development
- Allow impact to emerge over longer time horizons
- Ensure support for a broad portfolio of biomedical discovery pathways, including hypothesis-driven science as well as the creation of datasets, methodologies, technologies, platforms, and other enabling resources

The technologies underlying modern genome editing, such as CRISPR-based techniques, emerged from decades of foundational research whose eventual applications could not necessarily have been predicted. Similarly, large-scale datasets such as those generated through the Human Genome Project have continued to enable discoveries and applications decades after their initial development. More broadly, developing a biological platform or computational capability may itself be a significant scientific contribution because it allows researchers to investigate questions that were previously inaccessible.

7. Public Impact

Engineering biology can contribute to public impact through multiple pathways, including advances in health, scientific infrastructure, workforce development, biotechnology and biomanufacturing innovation, and public-sector capabilities. These contributions may be direct

or may occur through technologies and platforms that enable subsequent research and applications.

NIH should therefore consider evidence such as:

- Advances in health and biomedical research
- Improvements in clinical practice or patient outcomes
- Scientific and technological infrastructure
- Standards and reference systems
- Workforce development
- Public-sector research and technological capabilities
- Biotechnology and biomanufacturing innovation

Public impact should not be defined solely by immediate clinical outcomes, commercialization, or economic activity. Doing so could systematically disadvantage foundational and enabling research whose ultimate public benefits emerge through subsequent scientific and technological advances or use of technologies in novel settings or application areas. The appropriate pathway and timeframe for demonstrating public impact will vary across research areas, career stages, institution types, and stages of technology development.

Other Comments: Implementation, Administrative Burden, and Unintended Consequences

NIH should implement any new approach without creating substantial reporting burdens or replacing one rigid metrics system with another. Wherever possible, NIH should use information already available through grant applications, publications, repositories, and other existing systems. Proposed indicators should also be evaluated for unintended consequences, including metric gaming, pressure toward short-term clinical or commercial outcomes, and disadvantages for early-career researchers, interdisciplinary fields, or less-resourced institutions.

NIH should consider piloting approaches that give reviewers structured evidence of contribution and impact without creating fixed quantitative thresholds. For example, NIH could allow researchers to identify a limited number of significant contributions and provide evidence such as:

- Documented use of a dataset, software tool, biological resource, platform, protocol, or technology by researchers or organizations outside the originating group
- Independent replication, external benchmarking, or validation of a method, model, platform, or biological system
- Technology transfer, licensing, industry or public-sector adoption, standards development, or incorporation into clinical, research, or manufacturing workflows, where appropriate to the maturity of the work

- Structured contribution statements describing substantive scientific or technical contributions that may not be reflected by authorship position
- Letters or statements documenting contributions from relevant stakeholders beyond academic collaborators, including industry, clinical, public-sector, or other research partners, where those stakeholders can provide direct evidence of the contribution's significance, utility, or application

Evaluation frameworks should also remain adaptable as scientific practices, technologies, and forms of research output evolve.

Conclusion

EBRC supports NIH's effort both to broaden and to more accurately define how scientific contribution and impact are recognized and rewarded across the biomedical research enterprise. Engineering biology demonstrates both the need for this evolution and the challenges of developing measures that can fairly capture modern, interdisciplinary, technology-driven research.

A flexible, multidimensional, principles-based approach can better recognize diverse contributions by:

- Recognizing indicators of scientific impact and contributions beyond traditional publications, citations, journal impact factor, and authorship position
- Maintaining expert judgment in evaluation
- Accounting for differences across disciplines, career stages, and research models
- Recognizing foundational and long-term contributions
- Recognizing enabling technologies, platforms, data, software, standards, and infrastructure as critical to biomedical discovery
- Minimizing administrative burden and unintended incentives
- Allowing evaluation frameworks to evolve alongside science and technology

Such an approach can strengthen incentives for rigorous, collaborative, innovative, and translational research while preserving support for foundational science and the diverse pathways through which biomedical impact emerges.