



U.S. NATIONAL SCIENCE FOUNDATION
2415 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22314

NSF 24-049

Dear Colleague Letter: Leveraging Innovations From Evolution (LIFE)

January 17, 2024

Dear Colleagues:

The Directorate for Biological Sciences (BIO) of the National Science Foundation (NSF) encourages submission of proposals focusing on Leveraging Innovations From Evolution (LIFE).

Over the history of life on Earth, organisms have repeatedly evolved innovative adaptive traits in response to diverse biotic and abiotic pressures. Convergent evolution refers to cases where analogous traits arise independently in separate lineages, often as a response to similar selective pressures. This comparative framework is valuable for robustly exploring the origins, mechanisms, and macro-evolution of life's innovations. Due to the explosive growth of a) high-quality reference genomes from diverse organisms, b) new methodological and computational advances (e.g., application of generative artificial intelligence to protein structural modeling and synthetic biology), c) the extended research utility of biological collections, and d) deep organismal and more complete phylogenetic knowledge of species across the entire tree of life, scientists are now poised to collaboratively discover the underpinnings of nature-based solutions to life's common problems. **NSF BIO seeks to speed discovery and understanding of biological innovations that hold significant potential for applications in the bioeconomy, including industrial processes, pharmaceuticals, agriculture, energy production, nature-based solutions to climate change, and planetary sustainability and resilience.**

The unprecedented and myriad environmental challenges that confront human society today require bold actions and new research paradigms. In Executive Order 14081 (Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy), the White House directed federal agencies to foster innovative solutions to climate change, food and agriculture security, human health, and sustainable technologies through the use of new data, predictive models, and products gleaned from discoveries originating from the study of diverse organisms across the tree of life. **With this**

DCL, the NSF seeks to catalyze research that leverages the full diversity and complexity of life to focus attention on the discovery of molecular and evolutionary mechanisms that have permitted organisms, over millions of years of evolution, to innovate and thrive, often in hostile and changing environments. By Leveraging Innovations From Evolution (LIFE), and bolstering computational tools and resources (e.g., biobanks, databases, and algorithms), NSF BIO seeks to speed discoveries of nature-based solutions that will benefit science and society.

THE BIOLOGY OF LIFE

Despite the remarkable proliferation of genomic resources, organismal and phylogenetic knowledge, and computational capabilities, most of life's functional solutions - uniquely evolved or independently replicated - remain poorly understood for the vast majority of species. Furthermore, studying convergent innovations from a hierarchical perspective at multiple biological levels (e.g., molecular, organismal, phylogenetic) will enable a more robust and integrative understanding of the various pathways that have converged on similar solutions despite unique developmental, environmental, and evolutionary contexts and constraints. The expanding application of comparative non-model organismal research reflects the inherent value of integrating evolutionary perspectives with mechanistic studies of gene and genome function across the tree of life. However, high global extinction rates and the consequent loss of biodiversity, threatens the opportunity to discover, understand, and capitalize on these evolutionary solutions to biological challenges. LIFE will necessarily require that scientists bridge cultural and intellectual gaps that currently divide some biological sub disciplines, such as those separating molecular and cell biology from systematics and evolutionary biology. In addition, there is a critical need to develop sustainable collaborations, training, and partnerships between biologists focused on fundamental research and those working to harness biological discovery for use-inspired and applied benefit, including scientists in other fields (e.g., engineers, computer scientists, climate and biodiversity policymakers, chemists, and experts in agriculture and industry).

For all the aforementioned reasons, this DCL encourages proposals that use comparative approaches to identify evolutionary convergent adaptations to life's challenges and the mechanisms that underlie them. Proposals should include relevance of the proposed work to inform applications towards a sustainable global bioeconomy.

PROCESS FOR SUBMITTING PROPOSALS RELEVANT TO LIFE

Proposals responsive to this DCL should be submitted to one of the following programs, and Principal Investigators (PIs) are strongly encouraged to reach out to a cognizant Program Officer (PO) to discuss the topic before submission.

- **Integrative Research in Biology (IntBIO) track, or directly to the core solicitation** in any of the following divisions:
 - [Division of Environmental Biology](#) (currently [NSF 23-549](#))
 - [Division of Molecular and Cellular Biosciences](#) (currently [NSF 23-548](#))
 - [Division of Integrative Organismal Systems](#) (currently [NSF 23-547](#))
- [Infrastructure Innovation for Biological Research program](#) (currently [NSF 23-578](#))

Proposals submitted in response to this DCL must include the acronym LIFE in the title immediately after any other solicitation specific title requirements (e.g., IntBIO:LIFE:). Proposals must adhere to guidelines for submission in the [NSF Proposal & Award Policies & Procedures Guide](#) (PAPPG) as well as specific criteria in the relevant solicitation to which the LIFE research is proposed. Proposals are particularly encouraged to include novel research collaborations and robust integrative training initiatives that cross intellectual silos and bridge the fields of molecular and cellular biology, biochemistry, organismal biology, systematics and/or evolutionary biology. While proposals in response to this DCL are not required to include translational aims, PIs are encouraged to articulate how the results of their proposed research could broadly impact aspects of the bioeconomy. PIs are also strongly encouraged to consult with a PO from the LIFE working group (life@nsf.gov) prior to developing a proposal in response to this DCL.

POINTS OF CONTACT

- Dr. Leslie Rissler, lrisssler@nsf.gov (Division of Environmental Biology, DEB)
- Dr. Steve DiFazio, sdifazio@nsf.gov (Division of Molecular and Cellular Biosciences, MCB)
- Dr. Jennifer Weller, jweller@nsf.gov (Division of Biological Infrastructure, DBI)
- Dr. Susan Renn, srenn@nsf.gov (Division of Integrative Organismal Systems, IOS)

Sincerely,

Dr. Susan Marqusee, Assistant Director
Directorate for Biological Sciences (BIO)