NSF PCL Test Bed: NSF 25-541

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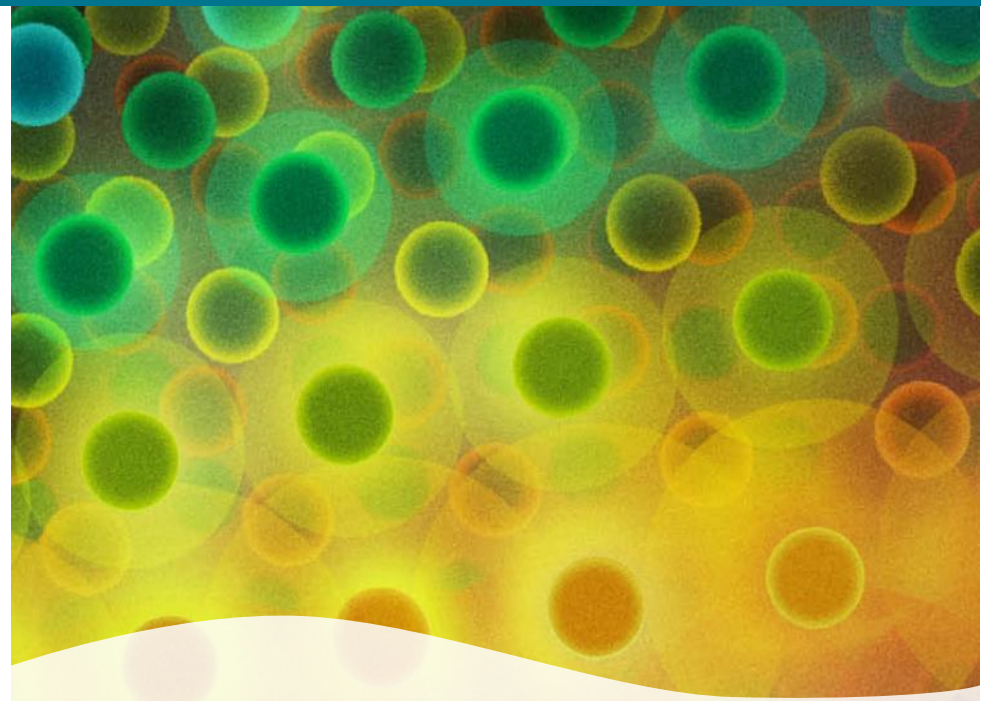
TIP Directorate

The U.S. National Science Foundation Test Bed: Toward A Network Of Programmable Cloud Laboratories (NSF PCL Test Bed)

- Accelerate discovery in laboratory science – automation, scaling
- Generate data from experiments to feed AI models
- Educate and train students and the workforce for a future where discovery is autonomous, intelligent, and deeply multi-disciplinary



Opportunity available to:

- Academia
- Business & Industry
- Nonprofits

NSF PCL Test Bed: Key Characteristics

- **AI in the loop** – accelerate laboratory science and discovery by shortening experiment cycles by orders of magnitude
- **Bespoke programmable laboratory workflows**
- **Enable remote access** to expensive laboratory instruments
- **Facilitate collaborations** among the laboratories including to establish standards – for experiment protocols, metadata, data, use of AI

Accelerating science through AI and data

NSF TIP Workshops

"Facilitate a more effective, more efficient, more inclusive way of doing science…dramatically accelerate the pace of scientific innovation while democratizing access to cutting-edge open and reproducible scientific experimental data, and computational research capabilities"

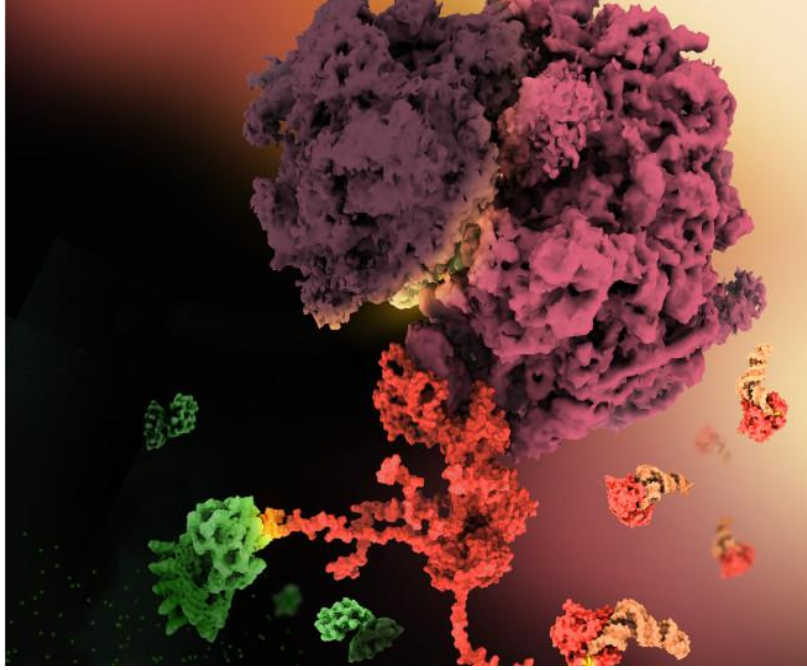
"Bring experimentation into the hands of a broad community of scientists by providing a level of automation, throughput, and ease of use."

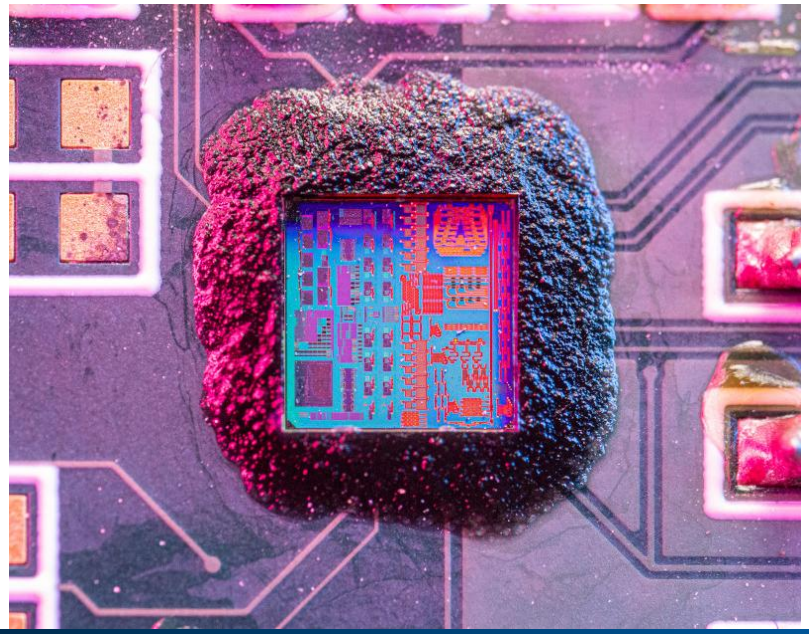
"Give researchers access to state-of-the-art automated instrumentation for biotechnology data collection and experimentation"

National Security Commission on Emerging Biotechnology Report, April 2025

Multi-disciplinary, use-inspired research

- Interplay between science and engineering drivers and data and AI infrastructure
- Example drivers:
  - **Biotechnology:** high-throughput characterization services for the bioeconomy supply chain
  - **Advanced materials:** materials science, materials synthesis and characterization
  - **Chemistry**
  - **Engineering**
  - …
- NSF supports research across all science and engineering disciplines
- TIP Directorate focuses on translational research





A network of programmable cloud laboratories

Individual PCL nodes are linked together via common experiment protocols, data standards, and AI tools

Common experimental design protocols, laboratory protocols, and metadata and data standards

Image credits: Argonne National Lab

Eligibility

- Only organizations with ***pre-existing instrument facilities*** are eligible to apply to the program to be a PCL node.
- Proposals must include at least one **co-principal investigator** with relevant expertise in **data management and AI** to support the activities described in the proposal.
- Each PCL Node will be funded up to $5 million/year for four years, for a total budget not to exceed $20 million per PCL node.

Multi-institutional proposals: For projects involving a collaboration among multiple institutions, the proposal must be submitted by a **single lead institution** with funding for all other participating institutions made through **subawards**.

Proposals submitted as separately submitted NSF "collaborative proposals" as described under PAPPG Chapter II.E.3.b will be returned without review.

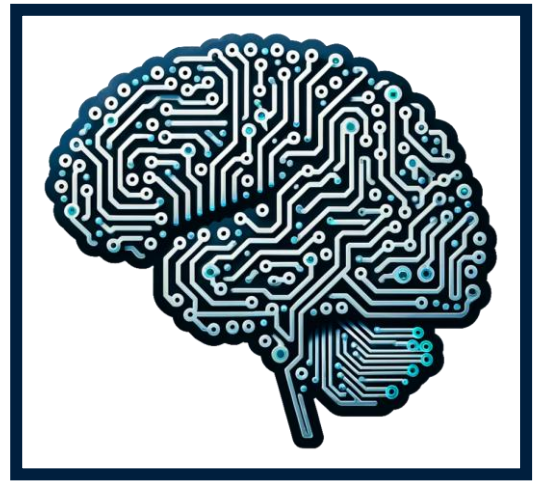
Types of organizations that can apply

- Institutions of higher education (IHEs) - two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the U.S., acting on behalf of their faculty members.

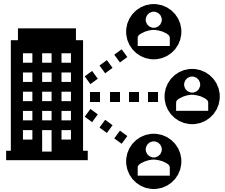
- For-profit organizations - U.S.-based commercial organizations, including small businesses, with strong capabilities in scientific or engineering research or education and a passion for innovation.

- Non-profit, non-academic organizations - Independent museums, observatories, research labs, professional societies, community organizations, and similar organizations located in the U.S. that are directly associated with educational or research activities or that bring relevant expertise/perspectives

Data and AI Capabilities



- Demonstrated expertise in data management, curation and state-of-the-art AI methods.
- Creation of AI models for efficient and effective use of the node and Test Bed.
- Use of AI for coordination across nodes.
- Integrating AI with lab experiments at every stage to enhance precision, insight and impact:
  - Pre-experiment stage: Use AI to assist in designing optimal experimental setups or determine if AI can simulate outcomes to predict the most promising approaches.
  - Experiment stage: Use AI to monitor real-time data through sensors or imaging tools, control experimental conditions autonomously and make real-time adjustments to maintain accuracy or respond to anomalies.
  - Post-experiment stage: Use AI to recommend follow-up experiments or accelerate data analysis and visualization.



Node and Test Bed usage models

1. Power users.
2. High-throughput users.
3. First-time automated lab users.
4. Prototyping users.
5. Industry users.
6. Educational.
7. Research.

NSF review criteria

All NSF proposals are evaluated using the following two criteria:

- **Intellectual merit**: The intellectual merit criterion encompasses the potential to advance knowledge.
- **Broader impacts**: The broader impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The NSF PCL Test Bed program has additional review criteria…

Additional Review Criteria Part 1

Science drivers

What are the science drivers that will help transform the science/engineering areas, while helping to drive the development and establishment of the PCL

Data and AI capabilities and expertise

What is the software, data and AI expertise available in the project to power user experiments and the operation of the PCL Node?

Node capabilities

What are the set of instruments that will be available? Please include an Ins*trument Inventory Table.*

What is the science and AI expertise available to the PCL node?

What are the partnerships, if any, that facilitate the creation and use of the PCL?

What access controls will be in place to control and monitor use of the PCL?

How is research security being addressed?

Details can be found in Section V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS of the PCL solicitation

Additional Review Criteria Part 2

Cross-node collaborations

Once established, cross-PCL Test Bed collaborations are expected to occur in a range of areas including, for example:

Experiment protocols, metadata and data standards, data sharing protocols, standardized interfaces (APIs), use of AI tools, and AI model development and use.

What are the plans in place to anticipate and enable these collaborations?

Training and education

What are the training and education-related plans in areas represented by the science drivers, data and AI, and relevant test bed technologies.

New users/user communities

What are the plans for bringing in new users/user communities to the PCL – in terms of outreach as well as "on-boarding".

Details can be found in Section V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS of the PCL solicitation

Additional Review Criteria Part 3

Metrics

What metrics will be used to evaluate the project, e.g., PCL node usage, user satisfaction surveys, and others?

Management plan

A strong management structure will be required to ensure success of all the aspects of the project. What is the management plan for the project?

Plan for post-award continued operation

What are the plans for operation after the period of the initial award from NSF? How will the test bed be established over the course of this effort in order to sustain itself.

Budget preparation. Ensure that your budget covers all necessary aspects of the effort, e.g.:

Node operations and resources, science driver support, data and AI support, on-boarding new users, acquisition of lab supplies/resources including any justified new instrument(s), support for the annual PI meeting.

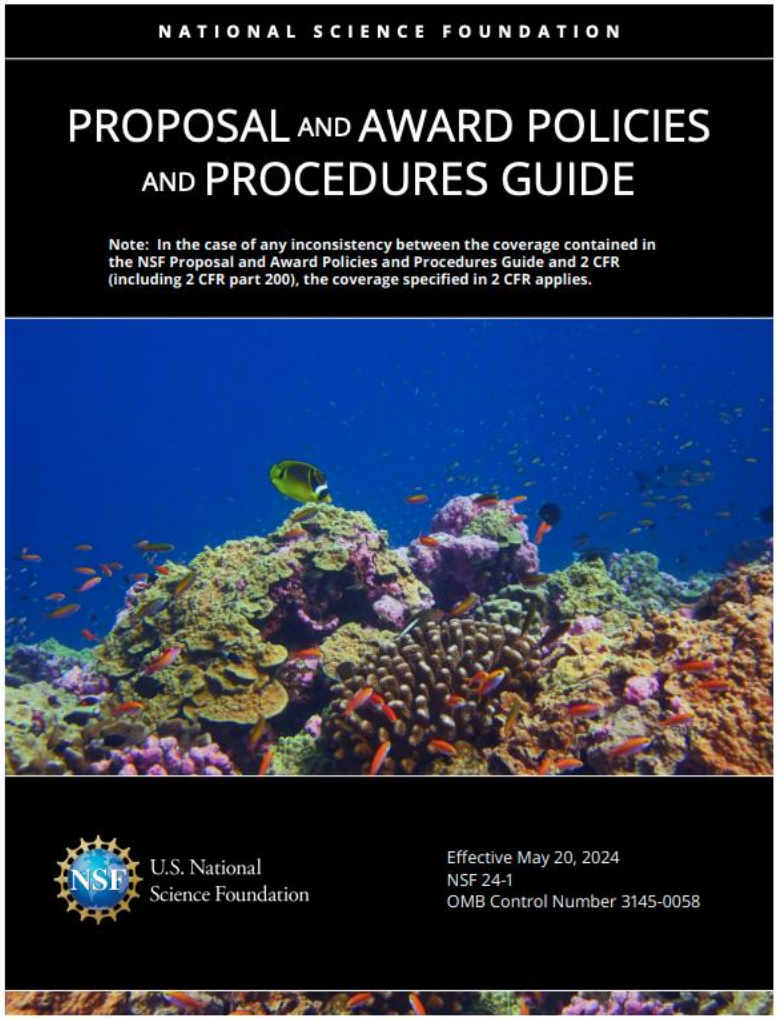
Details can be found in Section V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS of the PCL solicitation

Be sure to review the PAPPG…

https://www.nsf.gov/policies/pappg/24-1

and additional guidance on NSF's priorities and executive order implementation

https://www.nsf.gov/executive-orders#information-for-proposers-611



Seeking reviewers for the NSF PCL program!

Email: pcl-testbed@nsf.gov

- Name
- Organization
- Information on your areas of expertise

Related NSF Computational and Data Resources and Services

ACCESS | Advancing Innovation
ALLOCATIONS SUPPORT OPERATIONS METRICS

support.access-ci.org

CloudBank

www.cloudbank.org

PATh PARTNERSHIP to ADVANCE THROUGHPUT COMPUTING

Throughput Computing, Data, and Support
www.path-cc.io

SGX3

Science Gateways
sciencegateways.org

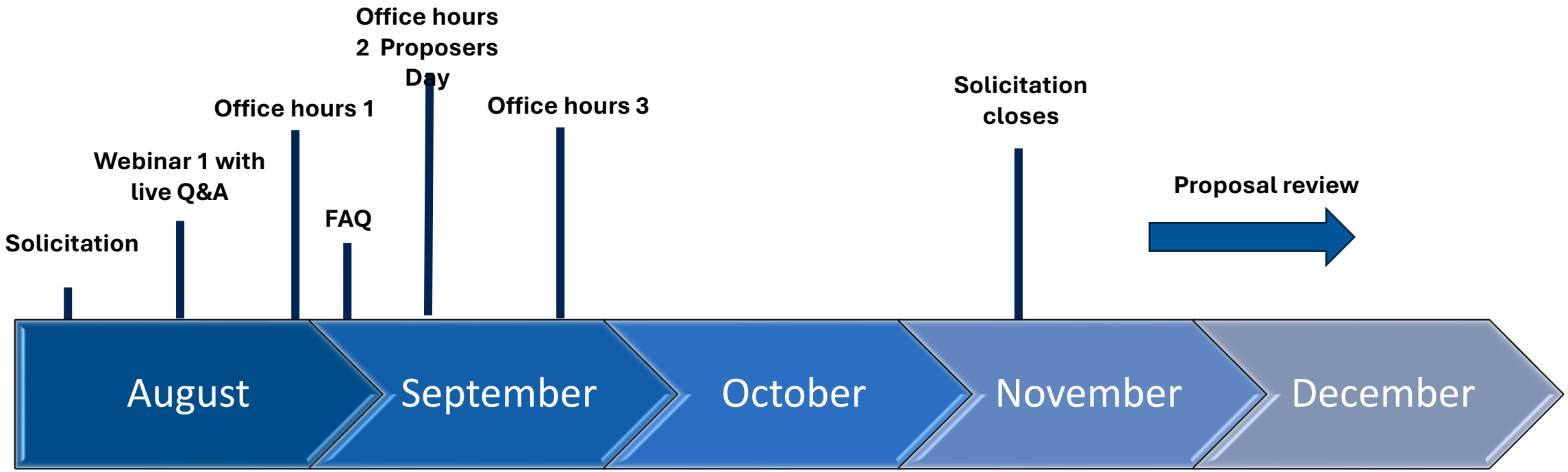
NRP NATIONAL RESEARCH PLATFORM

www.nrp.ai

NAIRR Pilot National Artificial Intelligence Research Resource Pilot

nairrpilot.org

Timeline


Office hours
2 Proposers
Day
Office hours 1
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Solicitation
closes
Webinar 1 with
live Q&A
FAQ
Proposal review
Solicitation
August
September
October
November
December

U.S. National Science Foundation
Directorate for Technology, Innovation and Partnerships

Questions?

Email: pcl-testbed@nsf.gov

Research.gov Help Desk e-mail: rgov@nsf.gov

Grants.gov Contact Center: e-mail: support@grants.gov

NSF PCL Test Bed

The Opportunity

A **game-changing transformation** in how science is conducted, how STEM professionals are trained, and how labs operate.

A **scientific frontier** powered by AI, automation, and data-driven discovery.

- **Self-Driving Labs**: Revolutionizing experimentation and analysis.
- **AI-Augmented Research**: Accelerating insights and reducing time-to-discovery.
- **Next-Gen STEM Workforce**: Training scientists for a future where digital fluency is as critical as lab skills.