Engineering Biological Systems Strategic Vision Team Update

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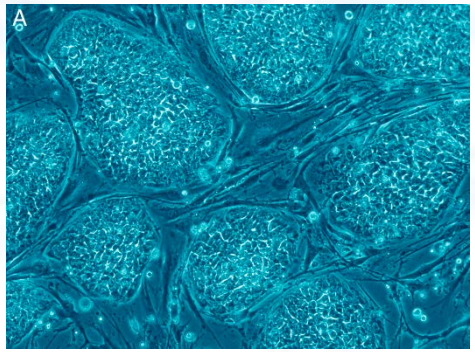
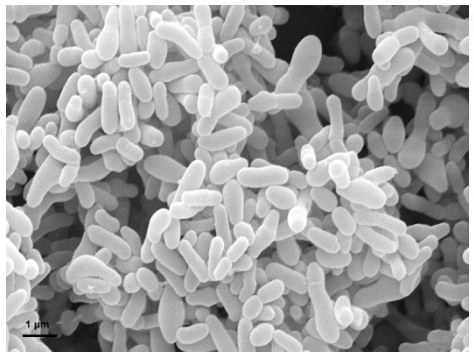
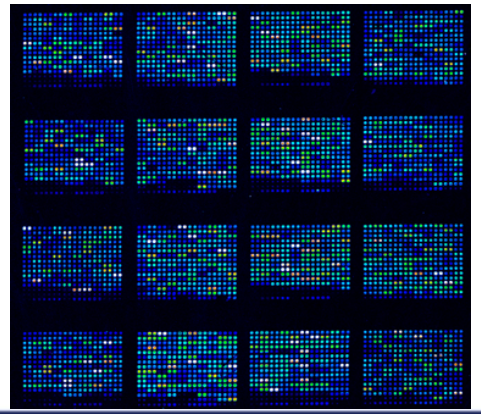
NIST Biological Sciences Strategic Priorities

Previously







❑ Complex Biotherapeutics

Develop measurement science, standards and tools to support the quantitative definition of complex biologic therapeutics and correlation of their structural differences with clinical outcomes.

❑ Microbial Metrology

Develop measurement infrastructure for microbial measurements in health and environmental applications.

❑ Engineering Biology

Develop the measurements and models for engineering biology to map the fundamental principles that drive the development of the next generation of bio-based products.

❑ Precision Medicine

Develop measurement science and standards to ensure confidence in clinical decision-making, and ultimately enable adoption of precision medicine.

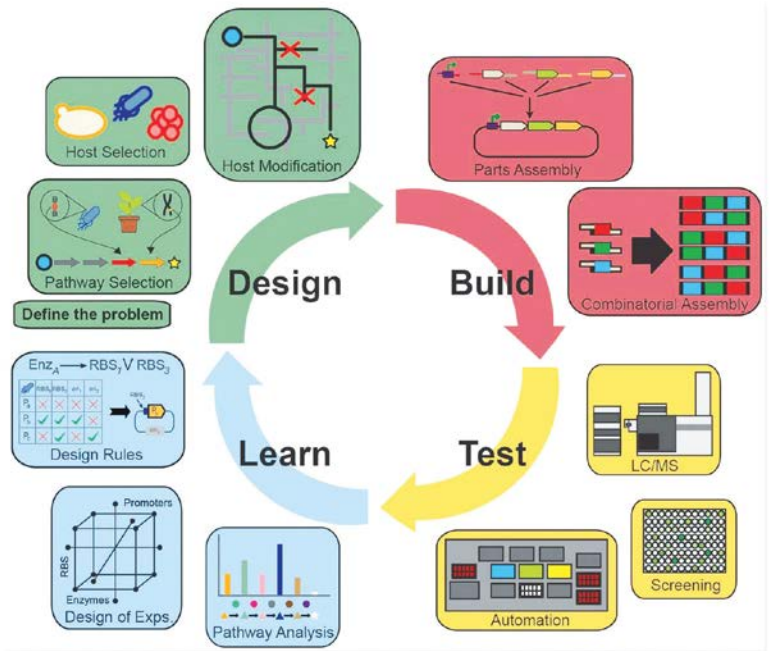
❑ Reproducibility of Biomedical Research

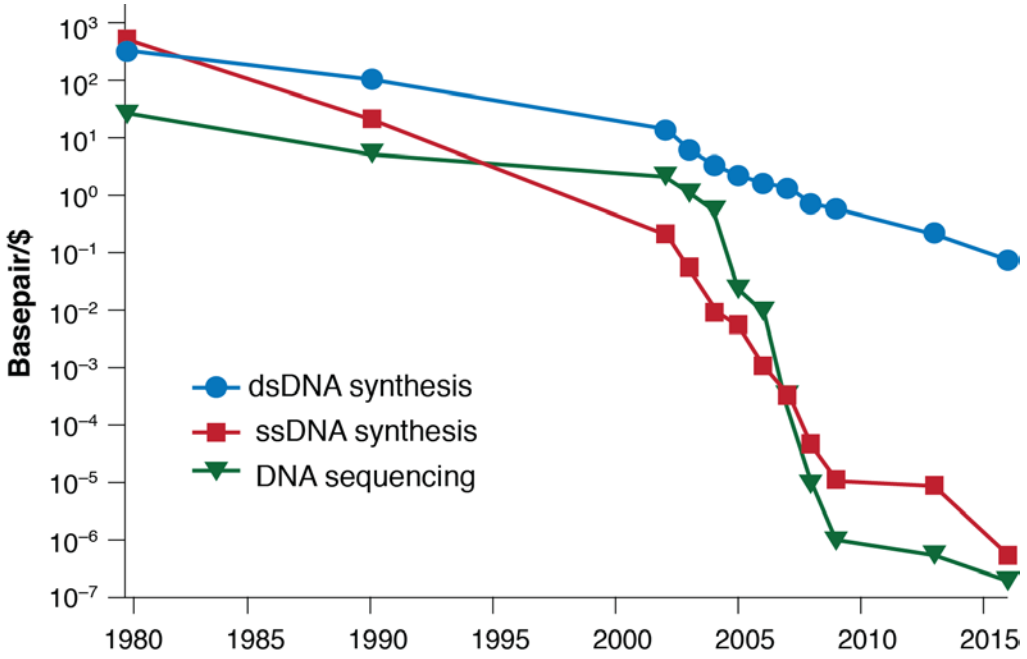
Establish NIST as the agency for measurement assurance to enable reproducibility of biomedical research results.

https://mmlstrategy.nist.gov/

Why Now?

- Industry can deliberately alter cell-based platforms to produce biologically synthesized products, from high-value biopharmaceuticals to commodity chemicals.
- Technology is increasingly accessible and advancing rapidly, including, next-generation DNA sequencing, ‘omics’ technology, and targeted gene-editing tools such as CRISPR/Cas.





Preparing for Future Products of Biotechnology, National Academies of Science, 2017

Why NIST?

- Existing capabilities include
  - genomic and biomolecular measurement assurance,
  - imaging technologies,
  - sensors and nanoscale devices,
  - data and AI technology
- Existing partnerships
  - industrial biomanufacturing
  - academic laboratories
  - stakeholder communities

NIST Provides a Foundation of Trust

NIMBL

JMB
The Joint Initiative for Metrology in Biology

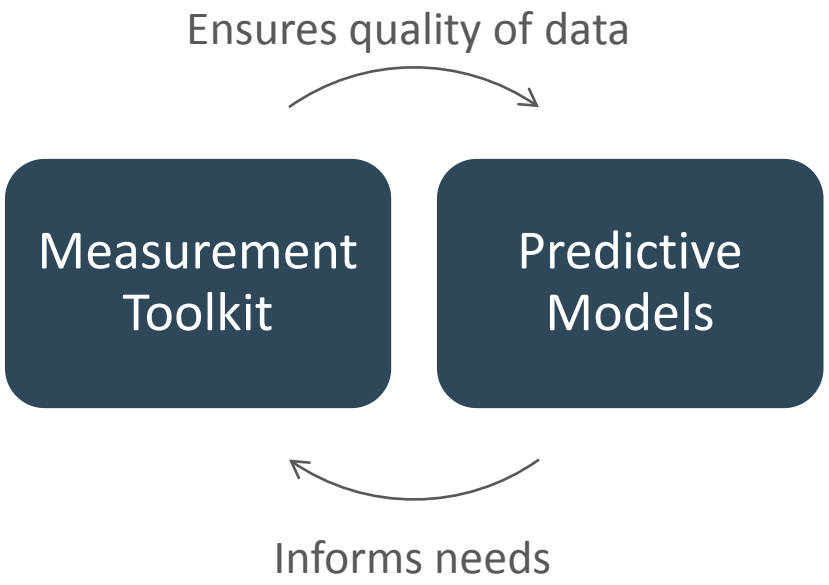
UNIVERSITY OF MARYLAND | NIST
INSTITUTE FOR BIOSCIENCE & BIOTECHNOLOGY RESEARCH

insight | innovation | application

Vision and Strategies

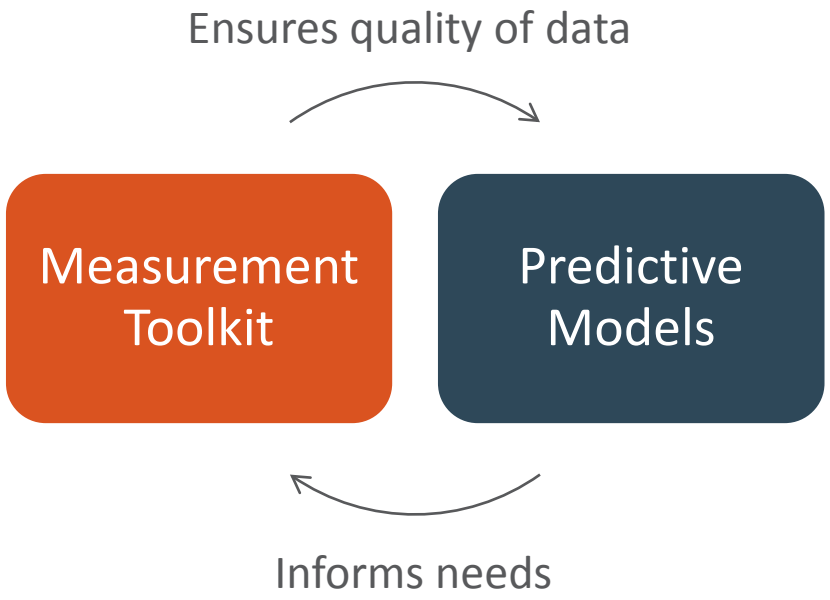
Biological systems can be intentionally and efficiently engineered to produce robust, safe, and trusted outcomes, enabling a growing bioeconomy.

- Develop a measurement toolkit to quantitatively define critical attributes and performance metrics for engineered biological systems and associated biomanufactured products.
- Support the development of foundational knowledge of enabling engineering principles that harness the controlling forces of biological systems.



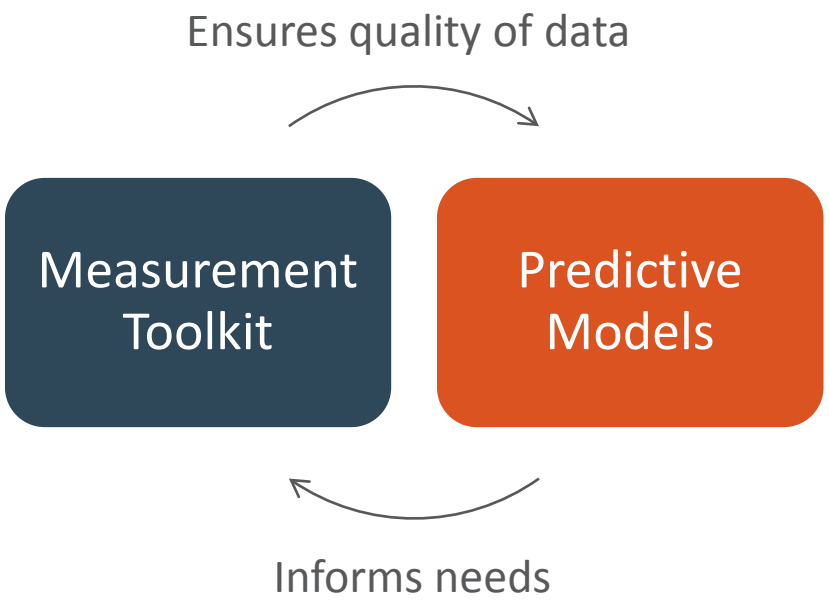
Measurement Toolkit

- Required measurements will be high-throughput, multimodal, non-destructive, and include and bridge molecular and cellular-system scales
- NIST must provide methods, products, and tools for measurement assurance
- NIST should leverage current strengths and build new capabilities through partnerships



Predictive Models

- Models linking genotype and other perturbations to intermediates and outcomes in different contexts will allow intentional design
- New AI and machine learning tools will leverage data variety and volume
- NIST should partner with stakeholders to curate and share high-quality data and models for integration, mining, and discovery
- NIST's measurement toolkit will enable partners to ensure the quality of data shared



What does success look like?

Measurement Toolkit

- NIST has broader capabilities in cutting-edge bioengineering tools and techniques
- NIST's unique sensor and imaging capabilities provide new tools for measuring cellular systems
- NIST-developed tools and protocols for improving assurance in engineering biology practices frequently used by academic and industrial stakeholders

Predictive Models

- Standards for data curation and sharing, including natural language ontologies
- Stakeholders are actively sharing data and models in open-source facility
- A suite of multiscale models and AI tools are available for predicting complex cellular response

Questions for Discussion

- Even with a focus on engineering biological systems, the problem space could still be all-encompassing. Are there particular problem areas that NIST should target above others?
- How does NIST ensure relevancy in a field with so many other large Government players?
- What new tools and approaches can NIST offer to provide measurement assurance in biology?