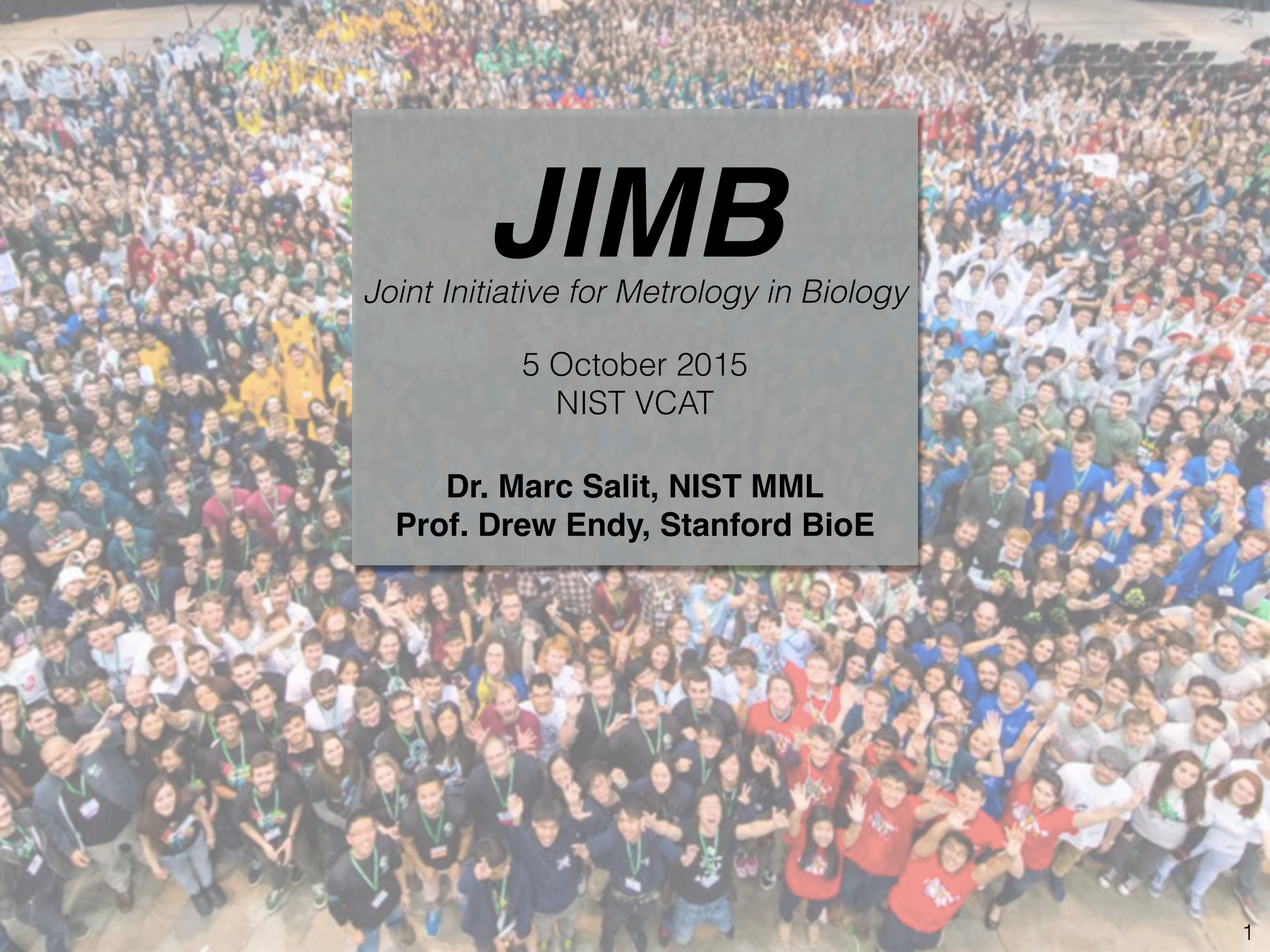


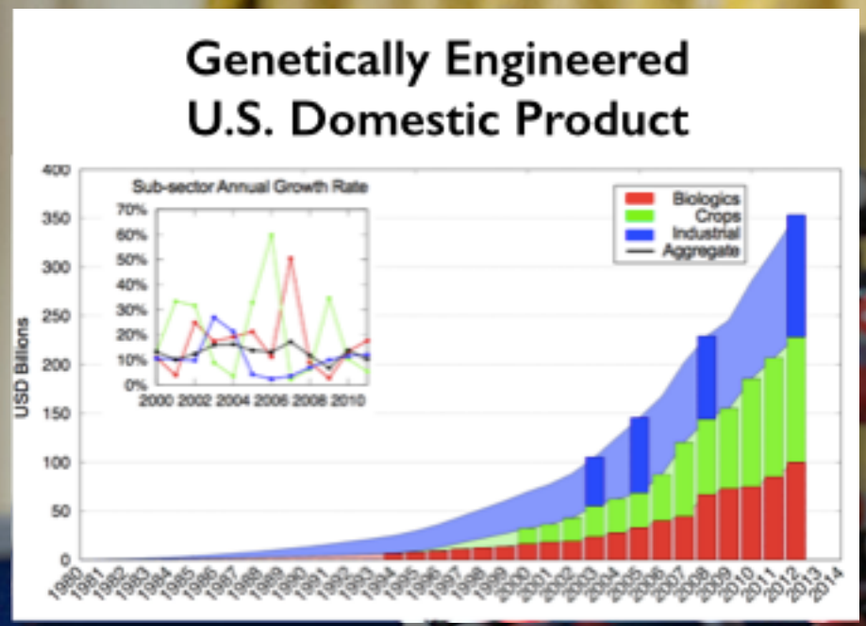
JIMB

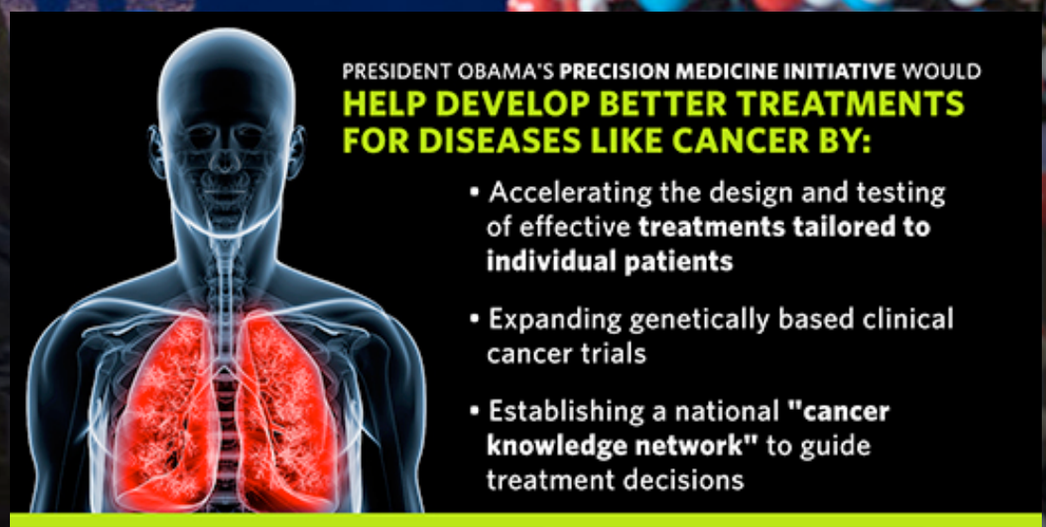
Joint Initiative for Metrology in Biology

5 October 2015
NIST VCAT

Dr. Marc Salit, NIST MML
Prof. Drew Endy, Stanford BioE

Science & engineering of biology are helping to define 21st century economy





US industry responding in earnest

Upgrade ad hoc practices with reliable reproducibility. Enable scaling via metrology.

PERSPECTIVE

The Economics of Reproducibility in Preclinical Research

Leonard P. Freedman[1]*, Iain M. Cockbu

1 Global Biological Standards Institute, Washin
School of Management, Boston, Massachusetts
Washington, D.C., United States of America

* lfreedman@gbsi.org

Abstract

Low reproducibility rates within life scie
production and contribute to both delay
analysis of past studies indicates that th
preclinical research exceeds 50%, resu
$28B)/year spent on preclinical researc
alone. We outline a framework for soluti
producibility rates that will help to accel
and cures.

On the reproducibility of science: unique identification of research resources in the biomedical literature

Nicole A. Vasilevsky[1], Matthew H. Brush[1], Holly Paddock[2], Laura Ponting[3], Shreejoy J. Tripathy[4], Gregory M. LaRocca[4] and Melissa A. Haendel[1]

[1] Ontology Development Group, Library, Oregon Health & Science University, Portland, OR, USA
[2] Zebrafish Information Fram
[3] FlyBase, Department of Ger
[4] Department of Biological Sc
Carnegie Mellon University,

ABSTRACT

Scientific reproducil
exist numerous initi
is simply a lack of sp
ducibility. In particu
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the magnitude of thi
tifiability" of researc
journal articles in th
Cell and Molecular
diversity of impact f
reporting guidelines
rat, zebrafish, worm

Must try harder

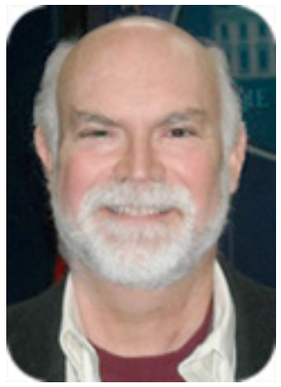
Nature **483**, 509 (29 March 2012) | doi:10.1038/483509a
Published online 28 March 2012

Too many sloppy mistakes are creeping into scientific papers. Lab heads must look more rigorously at the data — and at themselves.

Subject terms: Authorship · Publishing

Science: Branch of knowledge or study dealing with a body of facts or truths systematically arranged. So says the dictionary. But, as most scientists appreciate, the fruits of what is called science are occasionally anything but. Most of the time, when attention focuses on divergence from this gold (and linguistic) standard of science, it is fraud and fabrication — the facts and truth — that are in the spotlight. These remain important problems, but this week *Nature* highlights

NIST VCAT & friends foresaw importance of further advancing biometrology



Michael Amos

Ann Arvin

Thomas Baer

We applaud the efforts of the Director of the Chemical Sciences and Technology Laboratory (CSTL) for his leadership and implementation of a Bioscience plan that provides the foundation for a Bioscience strategic plan. In collaboration with the VCAT Bioscience subcommittee, the CSTL Director organized a process to identify customer and industry segment "critical measurement needs" for bioscience applications. This effort was launched by the recent bioscience international conference that was jointly hosted with UMBI titled, "Accelerating Innovation in 21st Century Biosciences: Identifying the Measurement, Standards, and Technological Challenges." The proceedings from this joint conference will provide an excellent foundation for developing a more comprehensive strategic plan. An initial draft of a document "Measurement Challenges to Innovation in the Biosciences: Critical Roles for NIST" has already been produced. The organization plans to use this to continue its interaction with technology and industry experts to further refine their determination of the most critical needs in Bioscience. We support this approach for NIST program prioritization, given the complexity and breadth of possible bioscience applications and emerging technologies.

- ✓ **Recommendation:** We urge the organization to continue its work on Bioscience strategic planning and to use this excellent work as a model for expanded work throughout the NIST laboratories.

Specific goals and recommendations for CY 2008

- We recommend that the OU directors and NIST senior management develop a comprehensive Bioscience/Healthcare Strategic Plan during 2008.
- We recommend that the management team explore establishing additional strategic alliance partnerships in order to gain application expertise for implementation of its strategic plan.

2007 & 2008 NIST VCAT Annual Reports

Joint Initiative for Metrology in Biology (JIMB)

"Biology" as both a science and as a type of material.

Combine innovative academics with metrology professionals and commercial partners; biometrology enabling everyone.

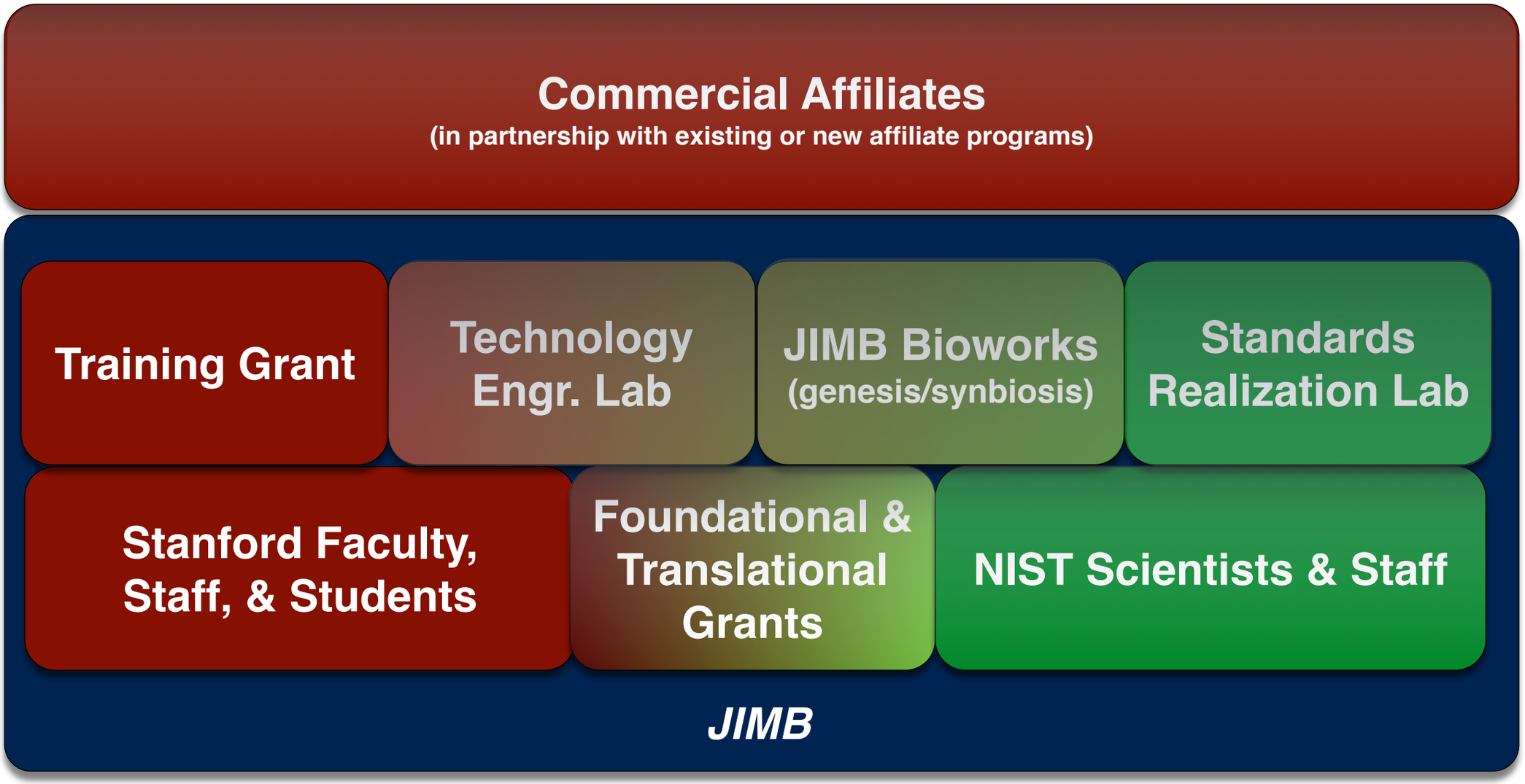
Advance science, engineering, & medicine:
- enabling science via better measurement methods
- advance engineering via reliable reuse of measures and materials as needed to support coordination of labor.
- not merely more; smarter science and engineering.

Advance in commerce:
- accelerate rollouts and reuse of products and offerings.
- develop metrology foundations underpinning regulatory science.
- position and maintain U.S. as the global leader in coordinating bioscience & biotechnology

Developing JIMB as a win-win for NIST & Stanford

NIST	Stanford
Instant access to innovative academics	Instant strengthening of metrology expertise
Immediate proximity to commercial customers	Sustained & celebrated focus on foundational science & technology
Prototype & promulgate biometrology curricula supporting workforce	Scaling “influence in behalf of humanity”
Co-development of novel facilities	Co-development of novel facilities

What's inside JIMB v1.0?

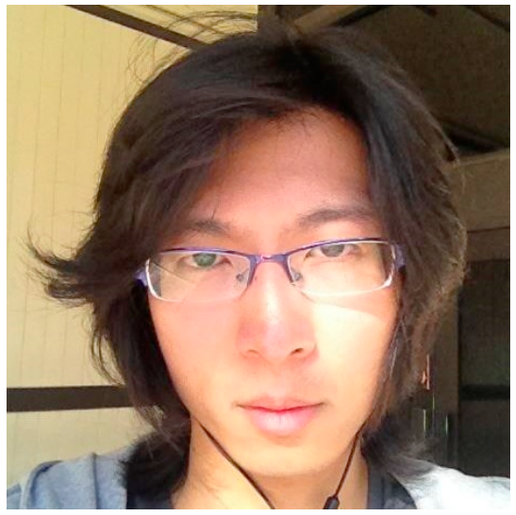


Overlay shading indicates status

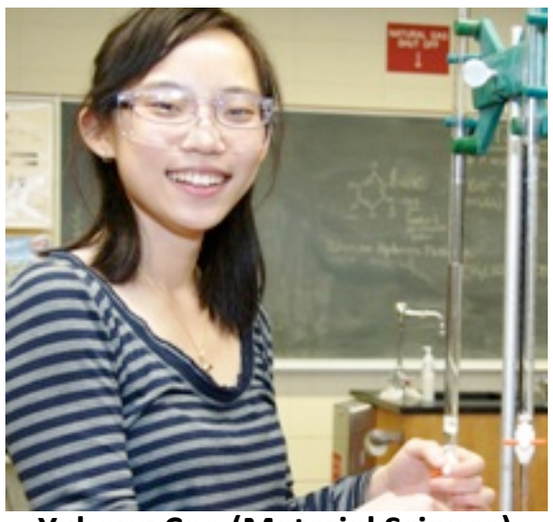
Engaging critical mass of Stanford faculty

JIMB Foundational & Training grant faculty

Enabling future biometrology leaders



Yuling Liu (Chemistry)

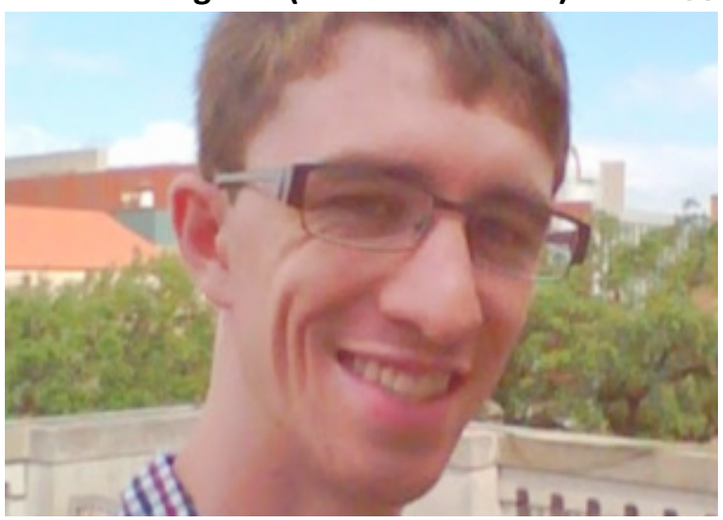


Yuhong Cao (Material Science)

Josh Mason (Bioengineering)

Fengjiao Lyu (Mechanical Engr.)

Michael Sikora (Genetics)



Calvin Schmidt (Bioengineering)

Erin Mitsunaga (Genetics)

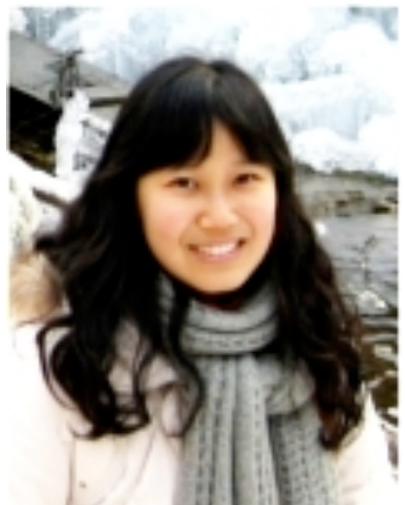
Aaron Mitchell (Bioengineering)

Dr. Luke Bawazer (Endy)

Dr. Noah Spies (Sidow)

Dr. Jeff Glasgow (Cochran)

Dr. Peter McLean (Smolke)



Dr. Crystal Han (Santiago)

JIMB Training Grant Graduate Trainees & Embedded NRC Fellows

Connecting commercial partners

	Name	Location	Classification
2	10X Genomics	Pleasanton, CA	Genomics Platform
3	23andMe	Mountain View, CA	DNA Testing
4	Affymetrix	Emeryville, CA	Gene Expression, Microarrays, Sequencing
5	Agilent	Santa Clara, CA	Measurement Tools
6	Amgen	South SF, CA	
7	Annai Systems	Burlingame, CA	
8	Applied Biosystems (Thermo Fisher)	Foster City, CA	
9	Ariosa Diagnostics	San Jose, CA	
10	Bina Technologies	Redwood City, CA	
11	Bio-rad	Pleasanton, CA	
12	Boehringer Ingelheim	Fremont, CA	
13	Boreal Genomics	Los Altos, CA	
14	Bristol-Myers Squibb	Redwood City, CA	
15	Calico Labs (Google)	Mountain View, CA	
16	Caliper Life Sciences (Perkin Elmer)	Mountain View, CA	
17	CareDx	Brisbane, CA	
18	Caribou Biosciences	Berkeley, CA	
19	Celera (Quest Diagnostics)	Alameda, CA	
20	Centrillion Biosciences	Palo Alto, CA	
21	Clontech (Takara Bio)	Mountain View, CA	
22	CollabRx	Palo Alto, CA	
23	Color Genomics	Milbrae, CA	
24	Complete Genomics	Mountain View, CA	
25	Counsyl	South SF, CA	
26	DNA2.0	Menlo Park, CA	
27	DNAnexus	Mountain View, CA	
28	Elim Biopharm	Hayward, CA	
29	Eureka Genomics	Hercules, CA	
30	Fluidigm	South SF, CA	
31	Genapsys	Redwood City, CA	
32	Genentech (Roche)	South SF, CA	
33	Genomic Health	Redwood City, CA	
34	GigaGen	San Francisco, CA	
35	GlaxoSmithKline	Palo Alto, CA	
36	Guardant Health	Redwood City, CA	
37	Human Longevity Inc	Mountain View, CA	
38	Illumina	Hayward, CA	
39	Ingenuity (Qiagen)	Redwood City, CA	
40	Invitae	San Francisco, CA	
41	MedGenome	San Francisco, CA	
42	Natera	San Carlos, CA	
702	Trivascular	Santa Rosa, CA	Devices for Endovascular Aortic Rep
703	True North Therapeutics	San Francisco, CA	Complement targeting antibodies
704	TTI Medical	San Ramon, CA	Surgical imaging
705	Tunitas Therapeutics	San Francisco, CA	Protein therapeutics
706	twoXAR	Palo Alto, CA	Drug Discovery Software
707	Ultragenyx	Novato, CA	Small Molecules, Biologics
708	Unchained Labs	Pleasanton, CA	Tools for biologics research & devel
709	United Immunoassay	San Bruno, CA	Antibodies and conjugates
710	Valitor	Berkeley, CA	Protein therapeutics
711	Vanton Research Laboratory	Concord, CA	Contract Research
712	Varian Medical Systems	Palo Alto, CA	Medical Devices & Software
713	Vascular Dynamics	Mountain View, CA	Hypertension Device
714	Vaxart	San Francisco, CA	Oral Vaccines
715	Vector Labs	Burlingame, CA	Blotting Products, Antibodies
716	Vedic Life Sciences	Redwood Shores, CA	Research/Consulting
717	Veeva Systems	Pleasanton, CA	Life Science Software
718	Velocity Pharmaceutical Development	South SF, CA	Assisting companies to advance dru
719	Venta Medical	Milpitas, CA	Contract Medical Devices
720	Veristat	San Bruno, CA	Contract Clinical Research
721	Verrica Pharmaceuticals	Palo Alto, CA	Topical therapies
722	Versartis	Mountain View, CA	Therapeutic Proteins
723	ViewRay	Mountain View, CA	MRI/Radiation combination therapy
724	Virobay	Menlo Park, CA	Protease inhibitors as drugs
725	VisionCare	Saratoga, CA	Ophthalmic devices
726	VistaGen	South SF, CA	Stem Cell Technology
727	Viveve	Sunnyvale, CA	Vaginal laxity correction
728	Vivus	Mountain View, CA	Small Molecules
729	Volcano (Philips)	Rancho Cordova, CA	Medical Devices
730	Xalud Therapeutics	San Francisco, CA	Neuropathic pain therapies
731	Xcell Biosciences	San Francisco, CA	Cell culturing system
732	Xcell Science	Novato, CA	Stem cell lines, cellular research mo
733	XenoPort	Santa Clara, CA	Small Molecules
734	Xlumena (Boston Scientific)	Mountain View, CA	Endoscopic technology
735	Xoft (iCad Inc)	San Jose, CA	Electronic Brachytherapy (eBx) syst
736	Xoma	Berkeley, CA	Biologics
737	YenZym Antibodies	South SF, CA	Custom antibodies
738	Zipline Medical	Campbell, CA	non-invasive skin closure solutions
739	Zogenix	Emeryville, CA	Small Molecules, Medical Devices
740	Zonare (Mindray)	Mountain View, CA	Ultrasound imaging
741	Zosano Pharma	Fremont, CA	Drug Delivery
742	ZS Pharma	Redwood City, CA	Small Molecule

Example JIMB work products

The Washington Post

Innovations

Three recent developments in synthetic biology you need to know

By Dominic Basulto May 7 Follow @dominicbasulto

Synthetic biology has the reputation for being a bit of freewheeling industry where anything goes and results are hard to replicate, so it's no surprise that the push is growing for standards so that companies and researchers can compare apples with apples and oranges with oranges. On March 31, the U.S. National Institute of Standards and Technology (NIST) convened a working group at Stanford University to launch the Synthetic Biology Standards Consortium. Working in groups, participants at Stanford discussed the types of standards would make it easier for researchers to share methods, materials and information within the field of synthetic biology.

The New York Times

HEALTH

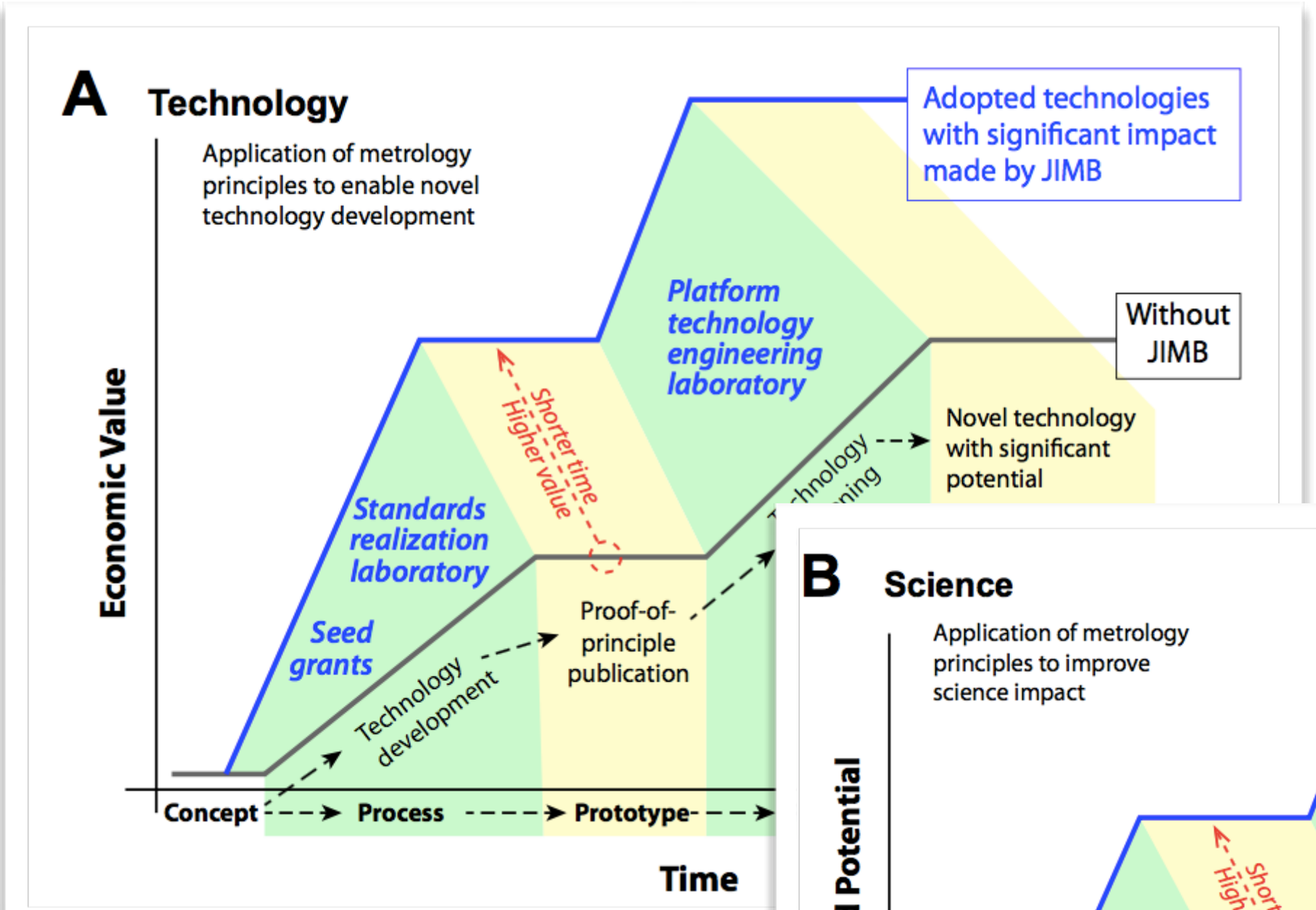
U.S. Introduces New DNA Standard for Ensuring Accuracy of Genetic Tests

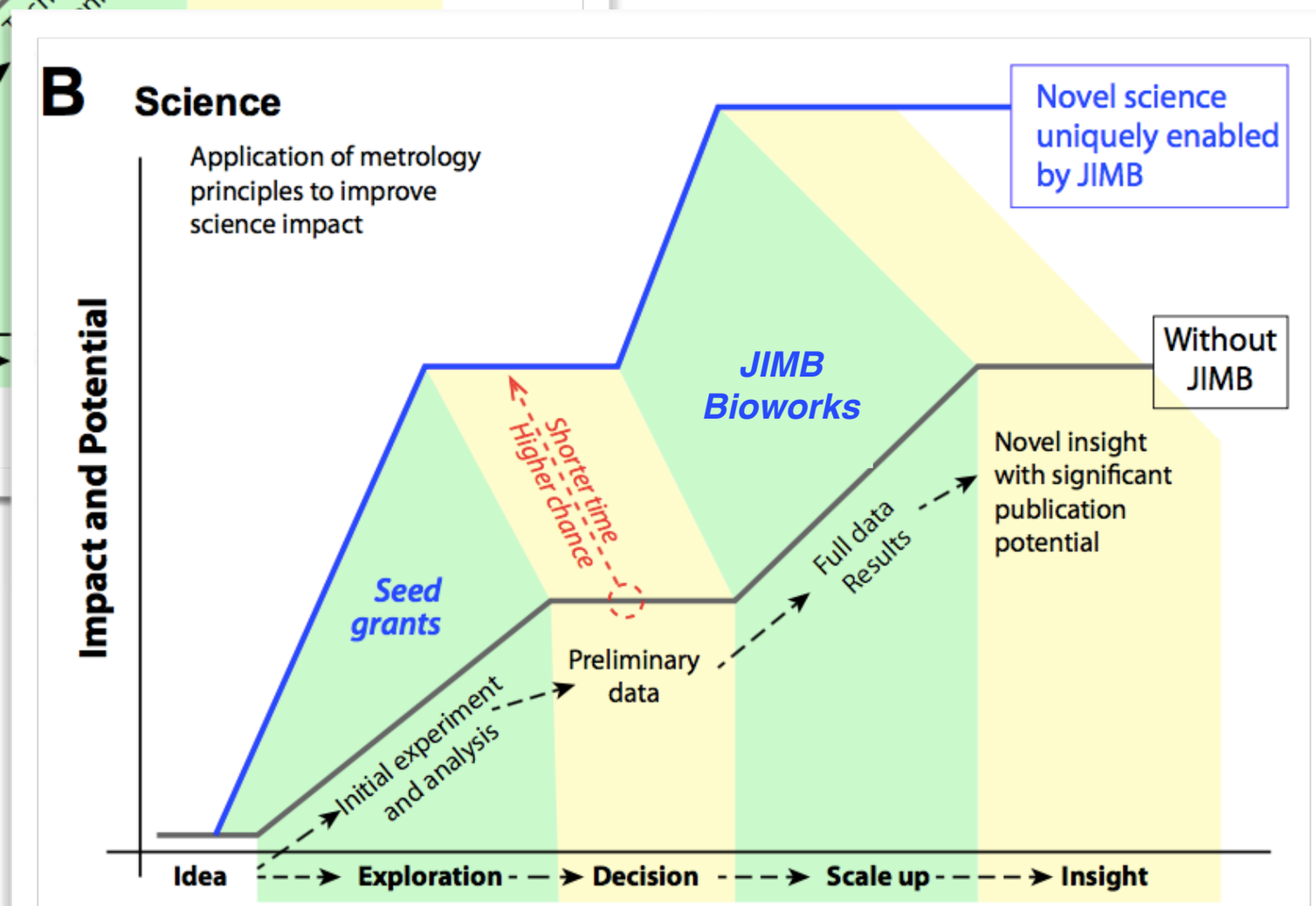
By ROBERT PEAR MAY 14, 2015

The National Institute of Standards and Technology said Thursday that it had developed "reference materials" that could be used by laboratories to determine whether their machines and software were properly analyzing a person's genetic blueprint, or genome.

"If you send a sample of blood or a tumor biopsy to different genetic testing laboratories, you can get different results," said Marc L. Salit, the leader of a genome measurement group at the institute. "While largely in agreement, they may have significant differences. Now, for the first time, we have a standard to check the reliability and quality of gene sequencing."

JIMB impacts & benefits





Initial JIMB partnering challenges

1. Space (where?), space (whose?), & space (how?).

2. Administrative “double jeopardy.”

3. Scaling NIST staffing (people) & engagement (resources) to match faculty enthusiasm.

4. Many minor details.

JIMB needs & next steps

1. Develop long-term staffing and space plan.

2. Create a simple administrative framework for JIMB.

3. Prototype JIMB platforms and standards realization labs.

4. Recruit three additional NIST Scientists (18 months); growing to ten Scientists (60 months).

5. Earn full support of Stanford, NIST, and industry.

Biometrology enabling science, engineering, & medicine.

21st century government; better partners, process, & products.