University Consortium for GEOGRAPHIC INFORMATION SCIENCE

NSF Funding Opportunities for Geographic information Science

Daniel Sui

The Ohio State University

Madison, Wisconsin

May 24, 2018

MOVING FORWARD

10 Big Ideas for Future NSF Investments

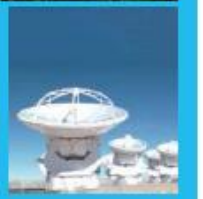
RESEARCH IDEAS

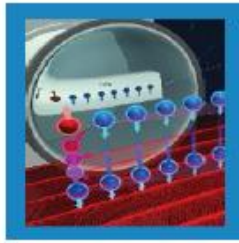
Harnessing Data for 21st Century Science and Engineering

The Future of Work at the Human-Technology Frontier

Navigating the New Arctic

Windows on the Universe: The Era of Multi-messenger





The Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life: Predicting Phenotype

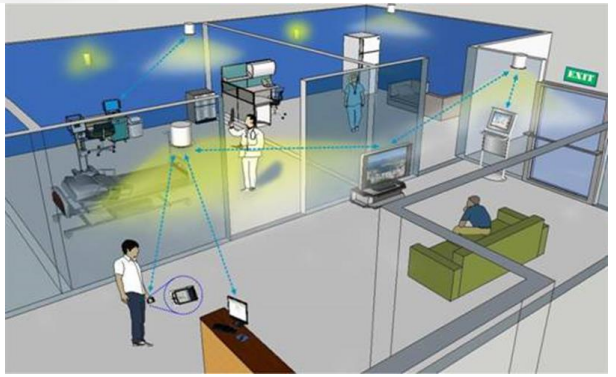
PROCESS IDEAS

Mid-scale Research Infrastructure

NSF 2026

Growing Convergent Research at NSF

NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

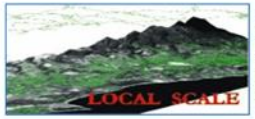


Global

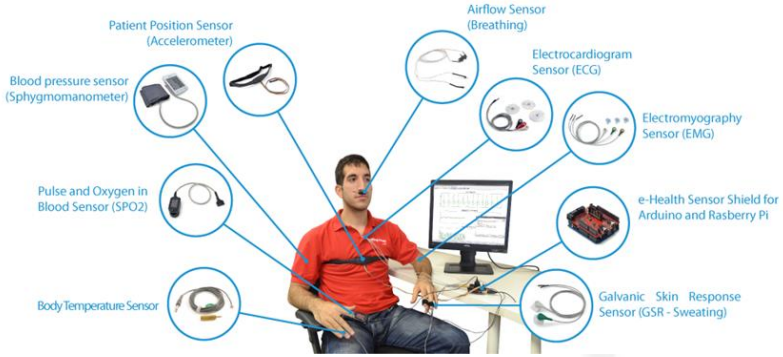
e.g.
Land Use
Demographics
Global Climate
Sea Surface Temperature
Digital Elevation

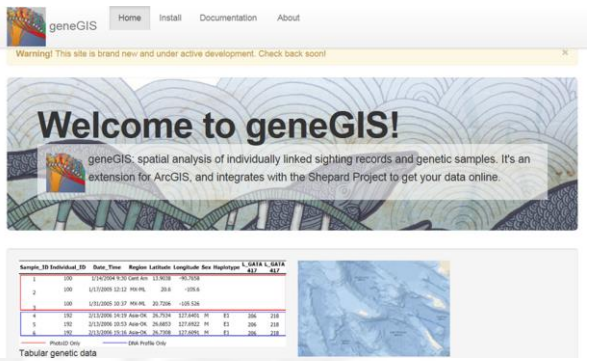
e.g.
Food and Fiber
Disaster Preparedness
Biodiversity
Coastal Sensitivity

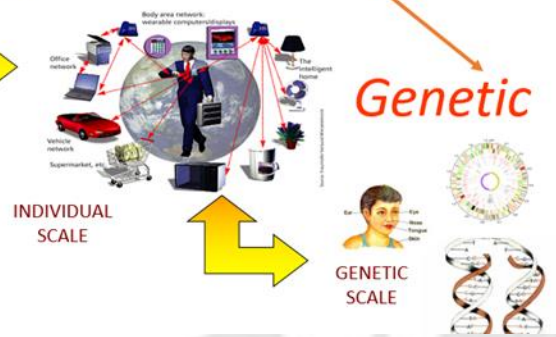
e.g.
Land Use/Land Cover
Precision Agriculture
Hydrologic Modeling
Transportation Planning



e.g.
Smart Growth
Public Health
Disaster Response
Weather





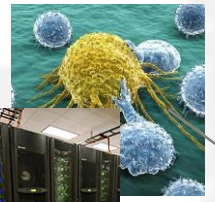


INDIVIDUAL SCALE

Genetic

GENETIC SCALE

BIO



CISE

EHR

ENG

GEO

MPS

SBE

OIA

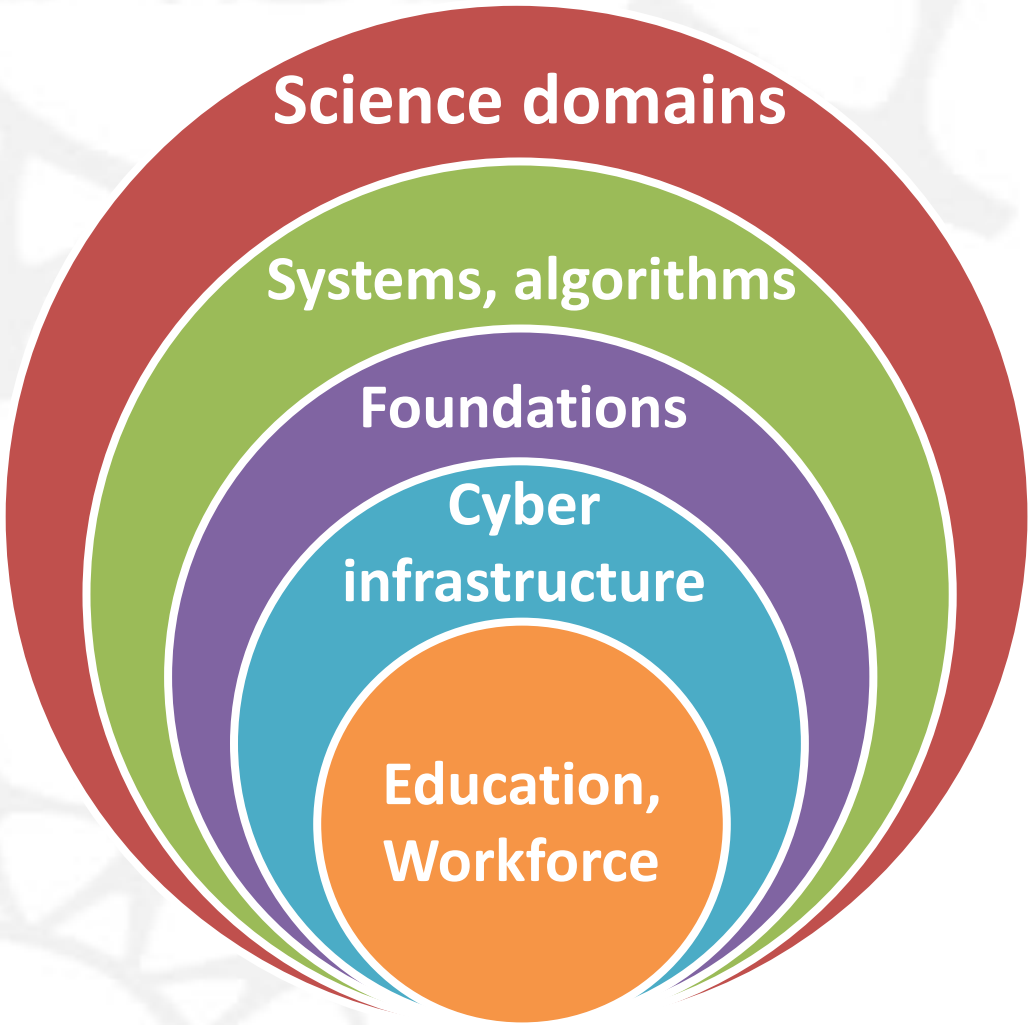
OISE

*"Engage NSF's research community in the pursuit of **fundamental research in data science and engineering**, the development of a cohesive, federated, national-scale approach to **research data infrastructure**, and the development of **a 21st-century data-capable workforce**."*

Directorates, Offices

Big Ideas

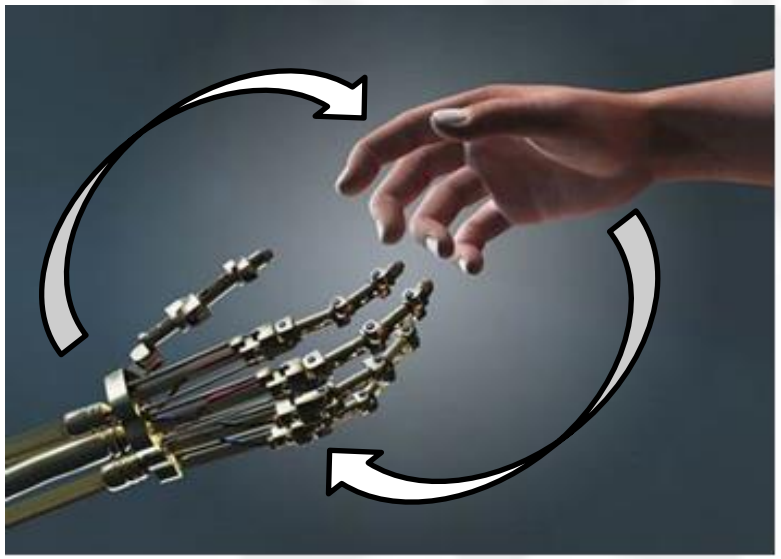
Harnessing the Data Revolution: Five Themes

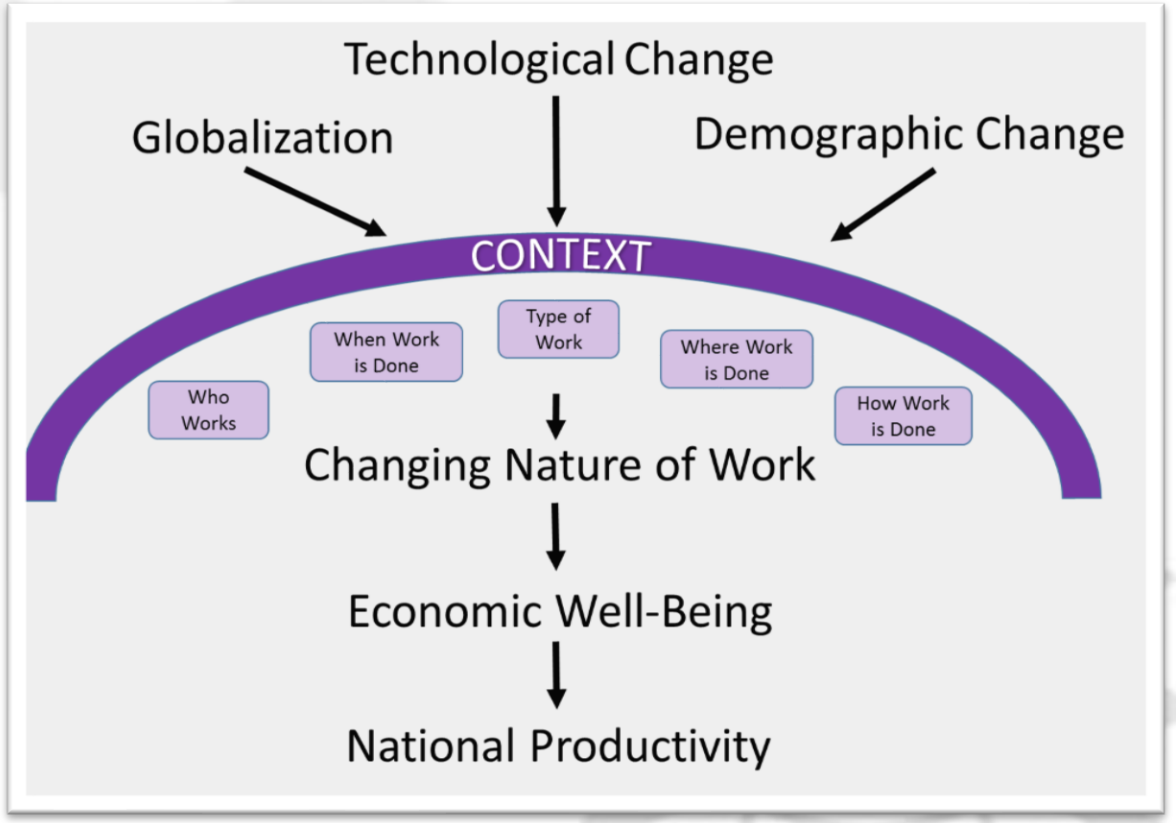


Harnessing the Data Revolution: Activities

- **New Solicitations:**
  - **Foundations:**
    - **Partnerships between Science and Engineering Fields and the NSF TRIPODS Institutes (TRIPODS + X; NSF 18-542)**
    - **Deadline May 29,2018**
  - *Systems & Algorithms/Cyber Infrastructure:*
    - *Open Knowledge Network: Platforms; Content*
    - *Model commons: Ideas Labs; Pilots; Platforms*
  - *Data-Intensive Research in Science and Engineering*
    - *HDR Center 1: Heterogeneous data integration - DCNs*
    - *HDR Center 2: Sensing/Analysis/Decision Making (streaming and real time data) - RCNs*
  - *Education/Workforce*
    - *Data Science Corps*
    - *HDR Academy*
- **New Website:**
  - https://www.nsf.gov/news/news_summ.jsp?cntn_id=244678&WT.mc_ev=click

Emergence of Work at the Human-Technology Frontier

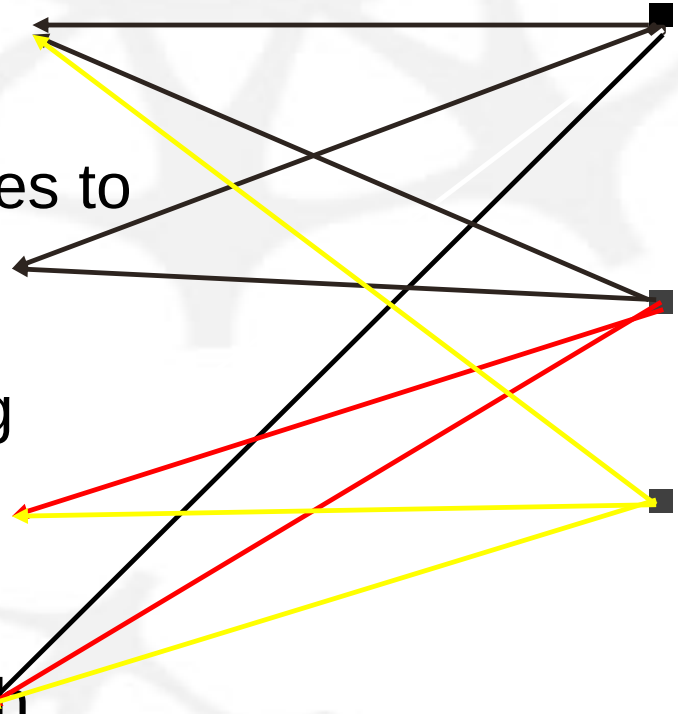




The Future of Work at the Human-Technology Frontier

Research Themes

- Understand and build the human-technology partnership
- Design new technologies to augment human performance
- Illuminate the emerging socio-technological landscape
- Foster lifelong and pervasive learning with technology



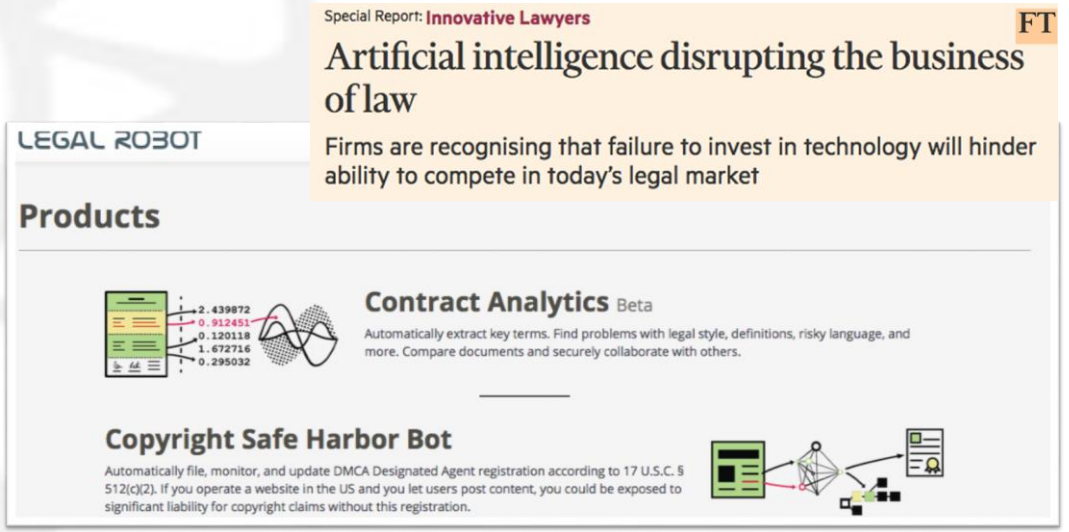
Focused Activities

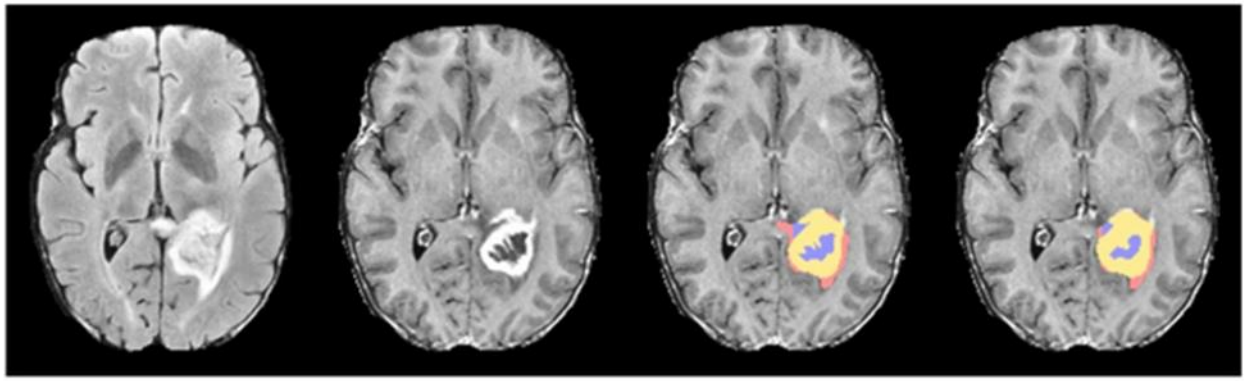
- FW-HTF: Advancing Cognitive and Physical Capabilities
- Convergent workshops and RCNs
- Cyberlearning for Work at the Human-Technology Frontier

NEW

FW-HTF: Advancing Cognitive and Physical Capabilities

- $27 million in funding: SBE, CISE, EHR, ENG.
- Two themes: Foundations for Augmenting Human Cognition and Embodied Intelligent Cognitive Assistants.
- Letters of Intent received mid-April.
- Proposals due June 4.





Understanding the rules of life

Predicting phenotype

Phenotype = the set of observable characteristics of an individual resulting from the interaction of its genotype with the environment.

"Rules" that explain and predict living systems.

- Cross spatial, temporal, organizational scales
- Interaction of biological components and environment

Potential Goals:

- Synthesize a cell or organism
- Understand multicellular structures, physiology
- Understand role of epigenetics in shaping phenotype
- Understand relationships among processes at various levels of organization

Rules of Life funding opportunities

NSF 18-031 Dear Colleague Letter: Rules of Life (RoL): Forecasting and Emergence in Living Systems (FELS) **EAGERs, RAISEs, and conference proposals – FY2018 processing and $$**

- Prospectuses have been reviewed and full proposals invited from a small fraction
- 1 RAISE prospectus with SBE interest invited for full proposal

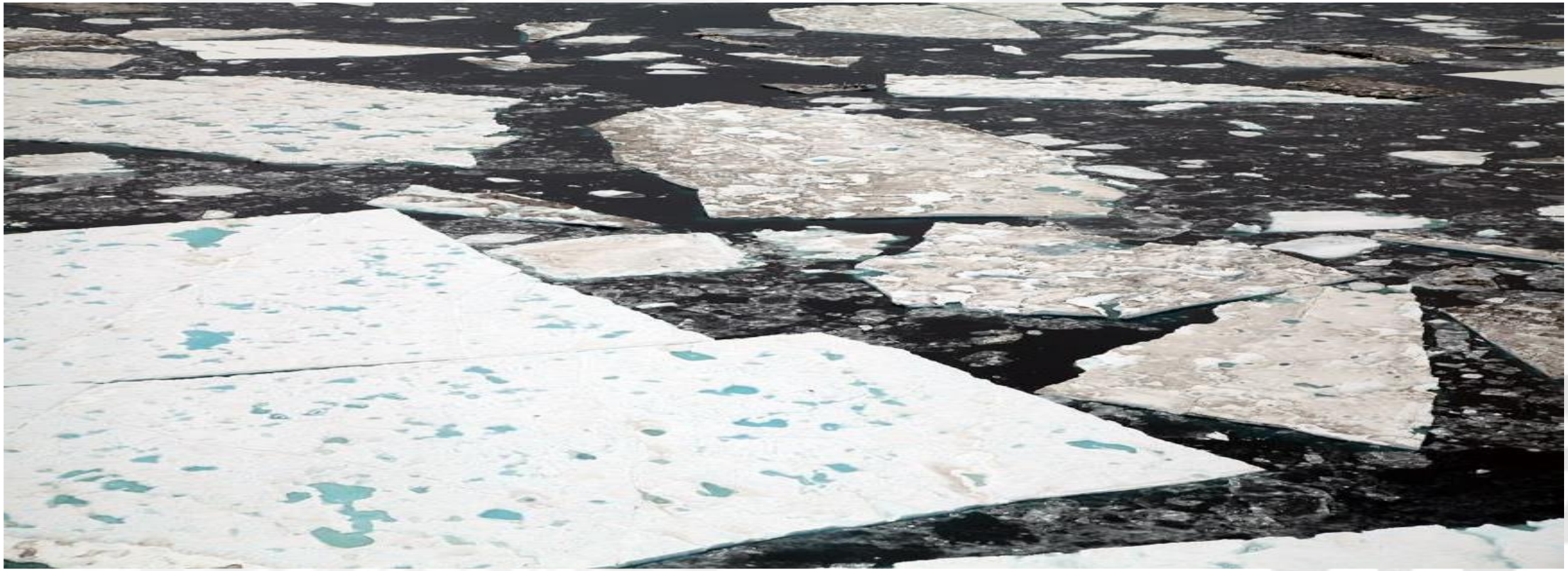
Eligibility:

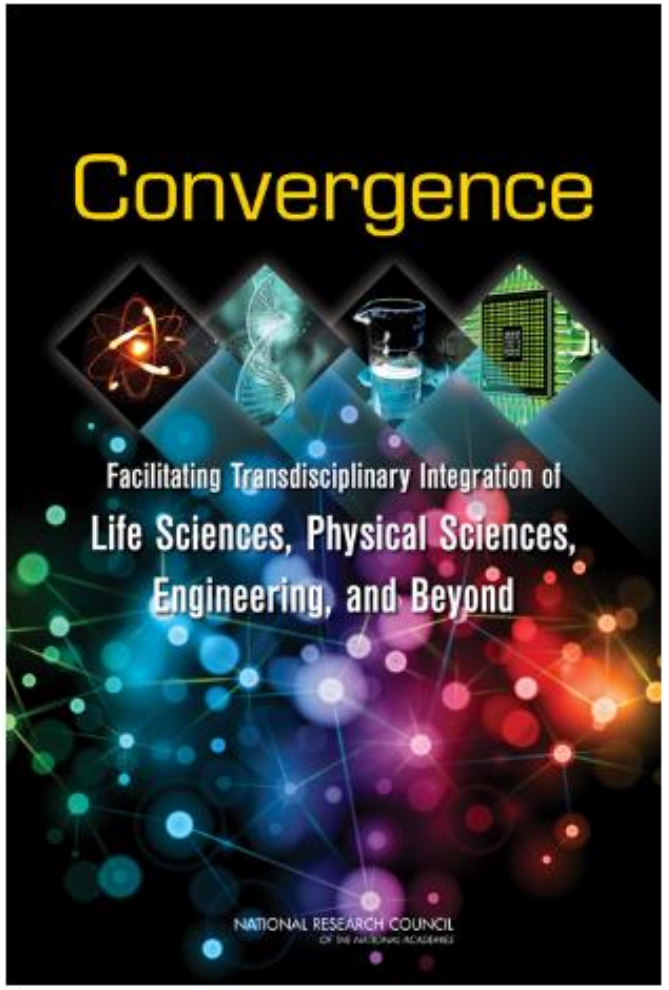
1. Propose strategies to discover, elucidate, or apply a fundamental rule that, when more fully understood, could be used to predict a specific complex aspect of biological systems;
2. Target a specific emergent property, which by definition spans biological scales (spatial and/or temporal scales; levels of biological organization);
3. Generate tools or theory and results that will be broadly generalizable beyond the system under investigation;
4. Be of interest to division(s) in BIO (1+ RAISE, 2+ EAGER), and may involve other directorates.

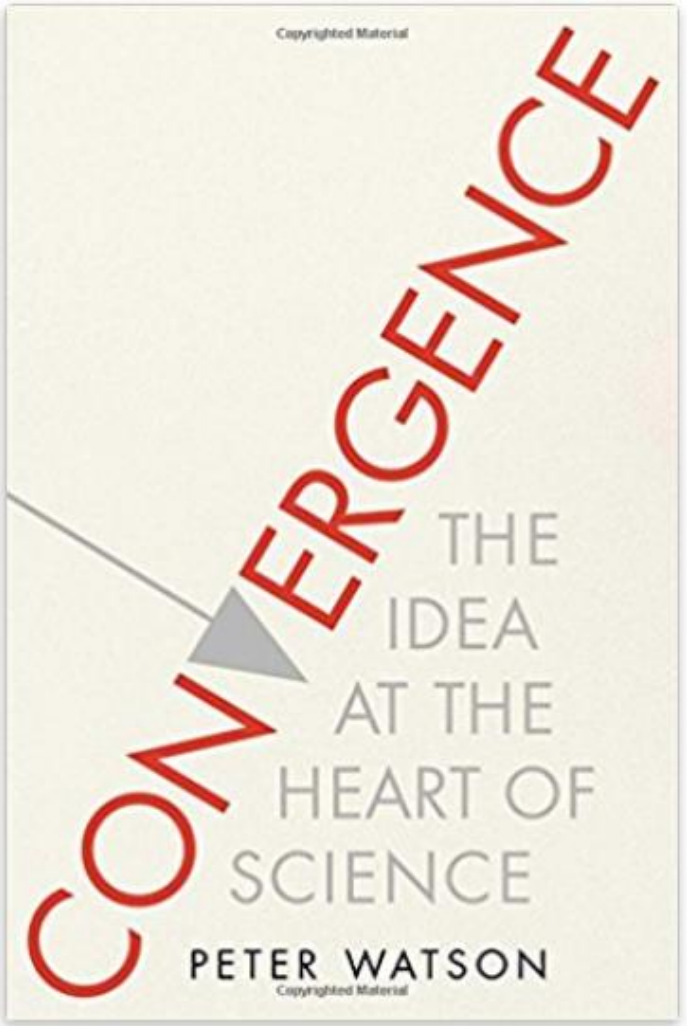
Discussions are underway about potential Rules of Life funding opportunities for FY2019

Navigating the new arctic

Documenting Rapid biological, physical, chemical and social changes.




Convergence
Facilitating Transdisciplinary Integration of
Life Sciences, Physical Sciences,
Engineering, and Beyond
NATIONAL RESEARCH COUNCIL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CONVERGENCE
THE IDEA AT THE HEART OF SCIENCE
PETER WATSON
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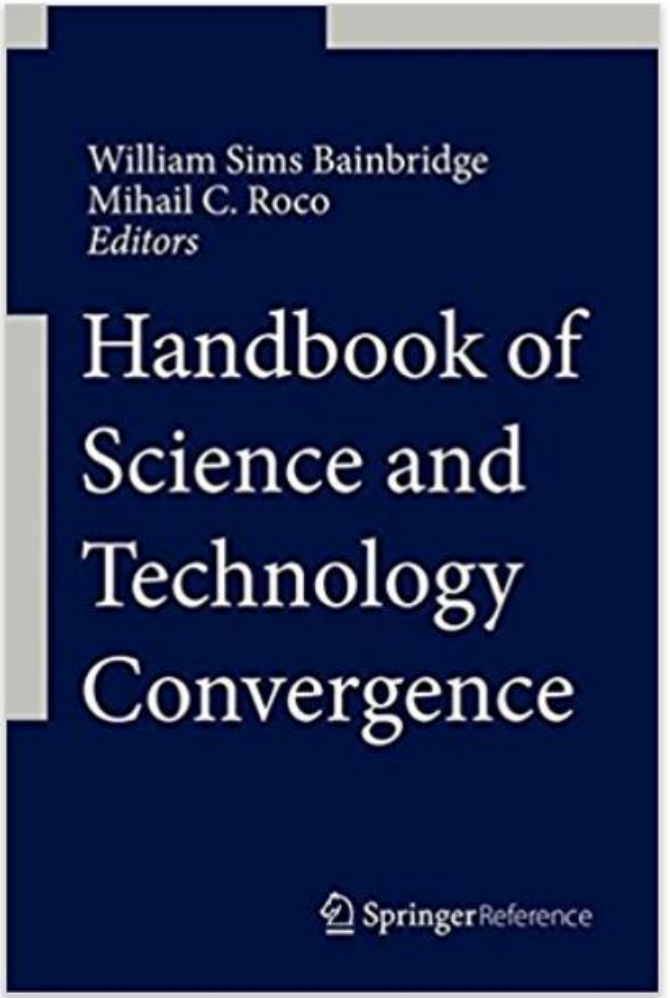
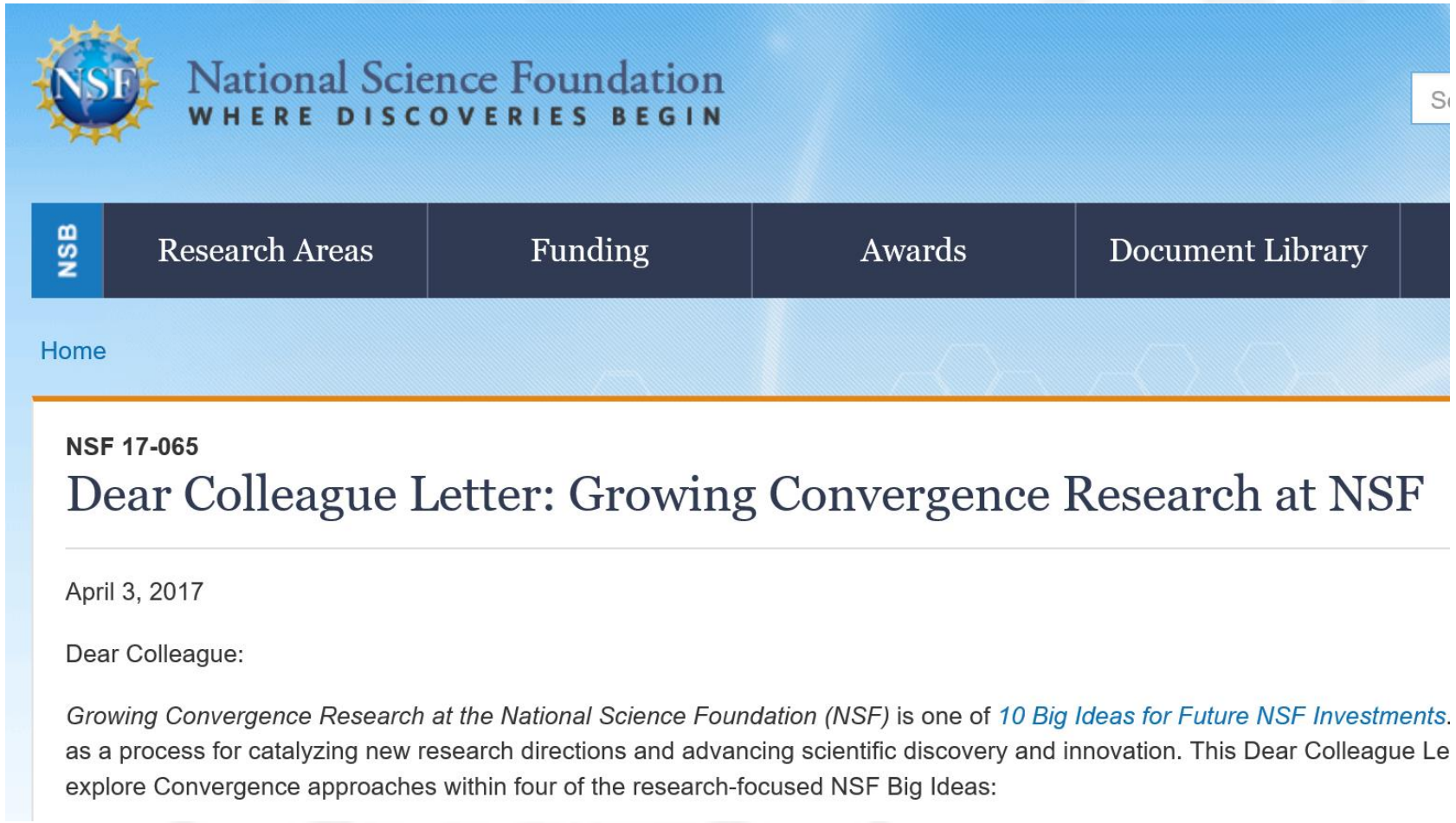

William Sims Bainbridge
Mihail C. Roco
Editors
Handbook of Science and Technology Convergence
SpringerReference

Growing convergent research at NSF



National Science Foundation
WHERE DISCOVERIES BEGIN

NSB | Research Areas | Funding | Awards | Document Library

Home

NSF 17-065

Dear Colleague Letter: Growing Convergence Research at NSF

April 3, 2017

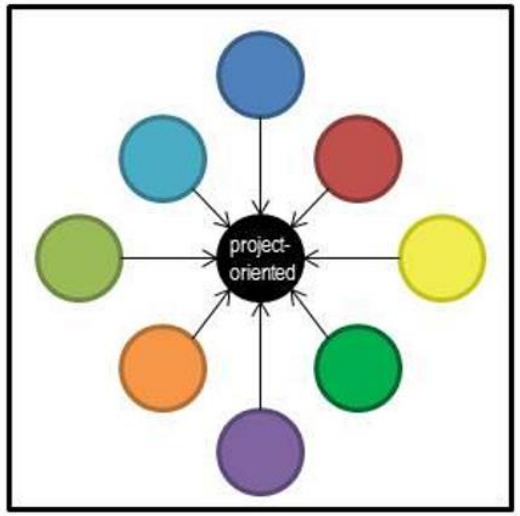
Dear Colleague:

Growing Convergence Research at the National Science Foundation (NSF) is one of *10 Big Ideas for Future NSF Investments*. as a process for catalyzing new research directions and advancing scientific discovery and innovation. This Dear Colleague Le explore Convergence approaches within four of the research-focused NSF Big Ideas:

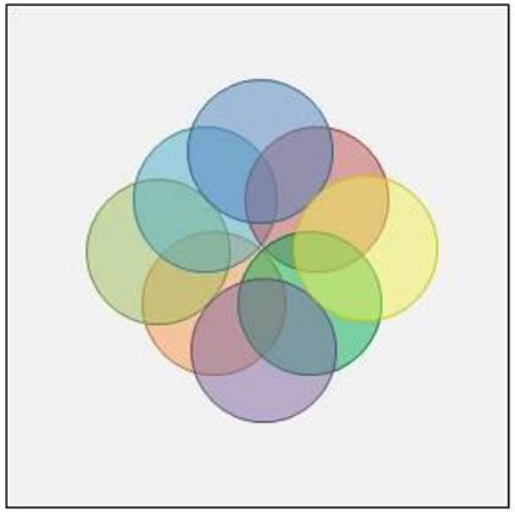
Convergence vs. multi-, inter-, and trans-disciplinary research

Multi- → Inter- → Transdisciplinary

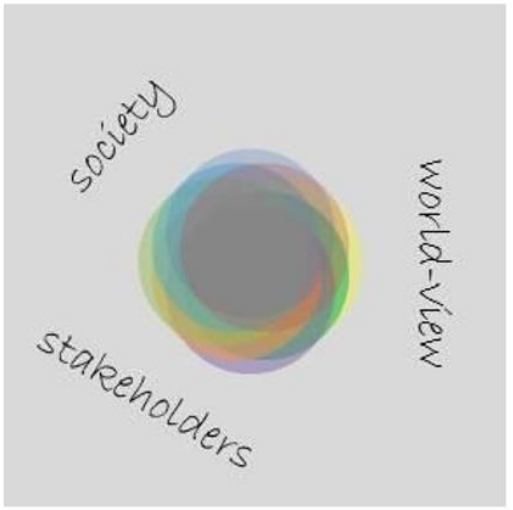
Multidisciplinary



Interdisciplinary



Transdisciplinary



- **Integration:** Separated → Integrated → "Become One"

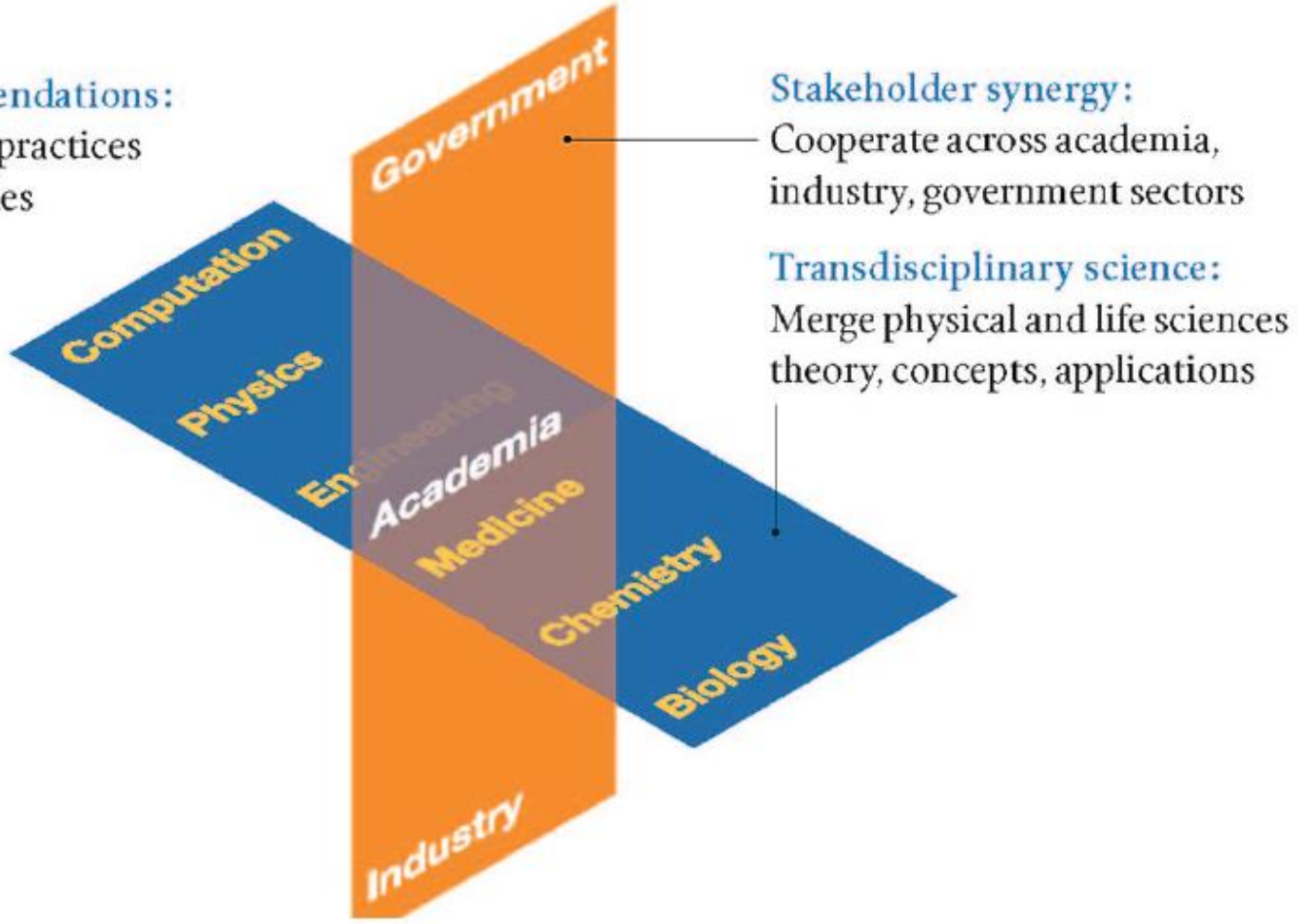
Convergence research: NSF definition

Convergence is the deep integration of knowledge, techniques, and expertise to form new and expanded frameworks for addressing scientific and societal challenges and opportunities.

NSF identifies convergence as having two primary characteristics:

1. ***Deep integration across disciplines.*** As experts from different disciplines pursue common research challenges, their knowledge, theories, methods, data, research communities and languages become increasingly intermingled or integrated. New frameworks, paradigms or disciplines can form from sustained interactions across multiple communities.
2. ***Driven by a specific and compelling challenge.*** Convergent research is generally inspired by the need to address a specific challenge or opportunity, whether it arises from deep scientific questions or pressing societal needs.

Two dimensions of convergent research

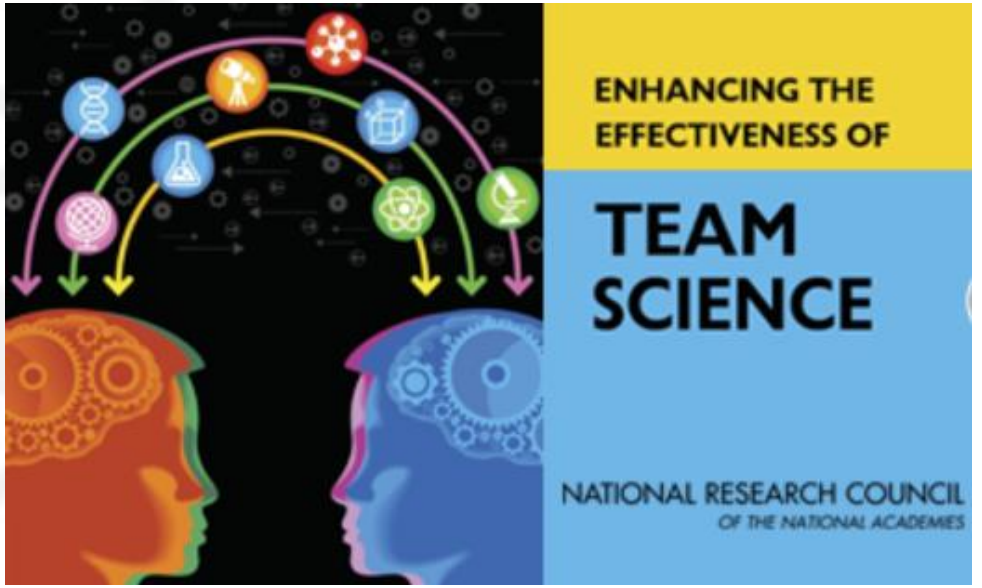


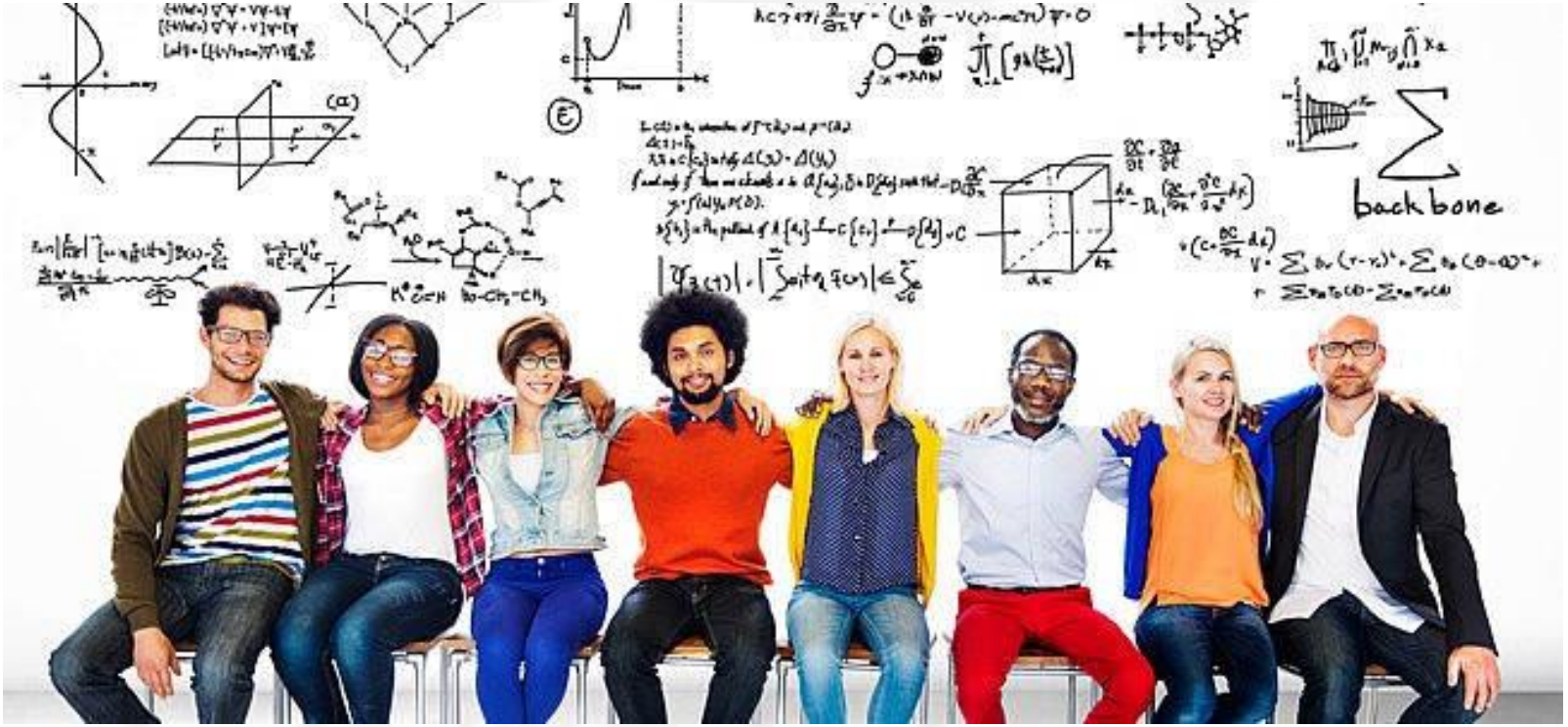
NRC (2012)

NSF 2026


Secret sauce: 360° partnerships
National labs
Academia
Foundations
Industry
Scientific societies
International

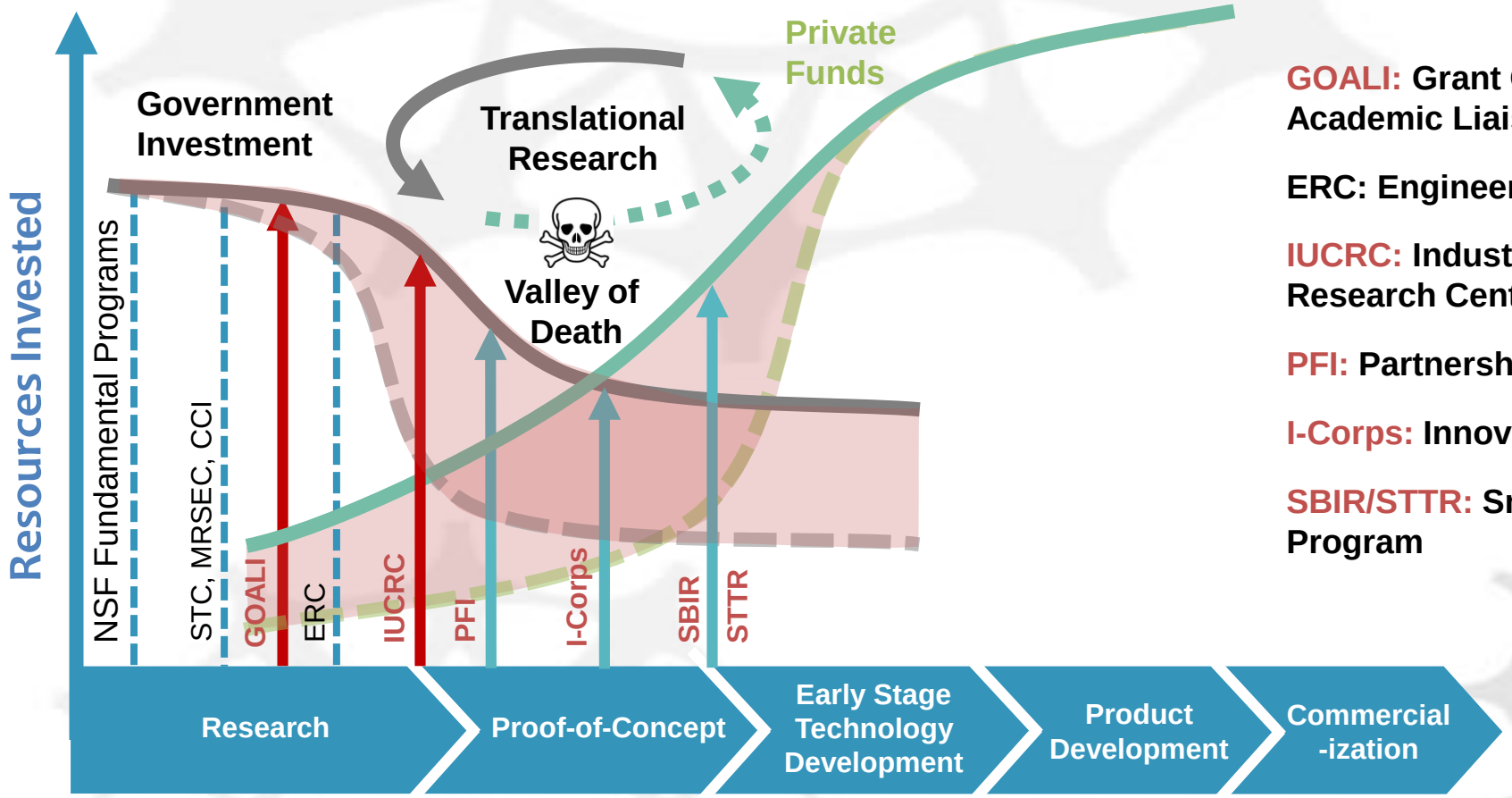

GO TEAM
SCIENCE!


ENHANCING THE
EFFECTIVENESS OF
TEAM
SCIENCE
NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES


backbone

Ivory Tower to Market:

NSF Funding Programs



NSF Fundamental Programs

STC: Science and Technology Centers
MRSEC: Materials Research Science and Engineering Centers
CCI: Centers for Chemical Innovation

GOALI: Grant Opportunities for Academic Liaison with Industry

ERC: Engineering Research Centers

IUCRC: Industry University Cooperative Research Centers

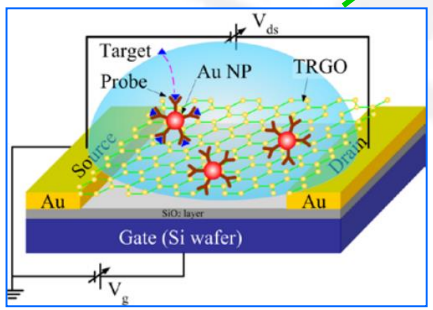
PFI: Partnerships for Innovation

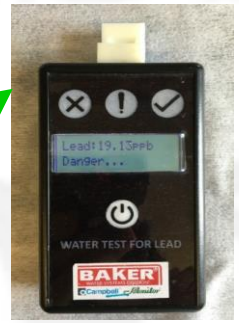
I-Corps: Innovation Corps (Startups)

SBIR/STTR: Small Business Research Program

Technology Translation: A Long Road…

NSF Funding to Elevate Technology Readiness Level (TRL)
-An Example on Graphene Water Sensor Innovation





TRL

NER, Exploratory
CMMI-0609059

Fundamental Research
CMMI-0900509
IIP-1128158

Proof-of-application
I/UCRC
IIP-0968887/1540032

Customer Discovery
I-Corps
IIP-1523470

PFI, Prototype
IIP-1434059
GOALI
CBET-1606057

SBIR
IIP-1345672
NanoAffix

SNM (Scalable NanoManufacturing)
CMMI-1727846

NANOAFFIX

http://www.nanoaffix.com

Making convergent research robust and reliable

Congressional mandate:

SEC. 116. Research reproducibility and replication.

in the American Innovation and Competitiveness Act signed into law in January 2017.

- Repeatability - same team, same data/experimental setup [Bare Minimum]
- Replicability - different team, same data/experimental setup [Common Practice]
- Reproducibility - different team, different data/experimental setup [Gold Standard]

Can we step into the river twice?
Or how can we respond to the reproducibility crisis?

Dimensions of Science

- Theories
- Techniques/Algorithms
- Applications

Dimensions of reproducibility

- Empirical reproducibility (ER)
- Computational reproducibility (CR)
- Statistical reproducibility (SR)

Stodden (2013)

Suggestions to improve GIScience funding

- Increase submissions: discipline-based programs vs. interdisciplinary programs;
- Stay tuned to NSF's new-funding priorities;
- Be open to the variety of funding mechanism;
- Pursue more aggressively on education-based projects at multiple levels;
- Follow the drills of team science;
- Seek funding beyond NSF: Pay attention to other federal $$

Take home message

- Embrace data science and make your research part of the harnessing data revolution;
- Ride on the wave of interdisciplinary/convergence research and take calculated risks to explore the new terra incognita;
- Climbing the ivory tower as well as entering the market place: balancing basic inquiry with efforts towards the markets;
- Practice open science and continue to improve reproducibility and replicability.