Enhancing our Understanding of Agriculture G2P

Genome to Phenome Efforts at NSF

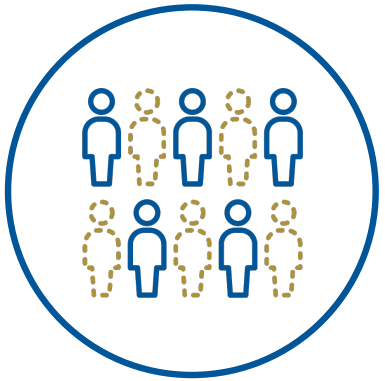
Karen Cone

Acting Division Director, Division of Molecular and Cellular Biosciences (MCB)
Science Advisor, Directorate for Biological Sciences (BIO)
National Science Foundation (NSF)

The Need for Agriculture G2P Research

Changing Environment

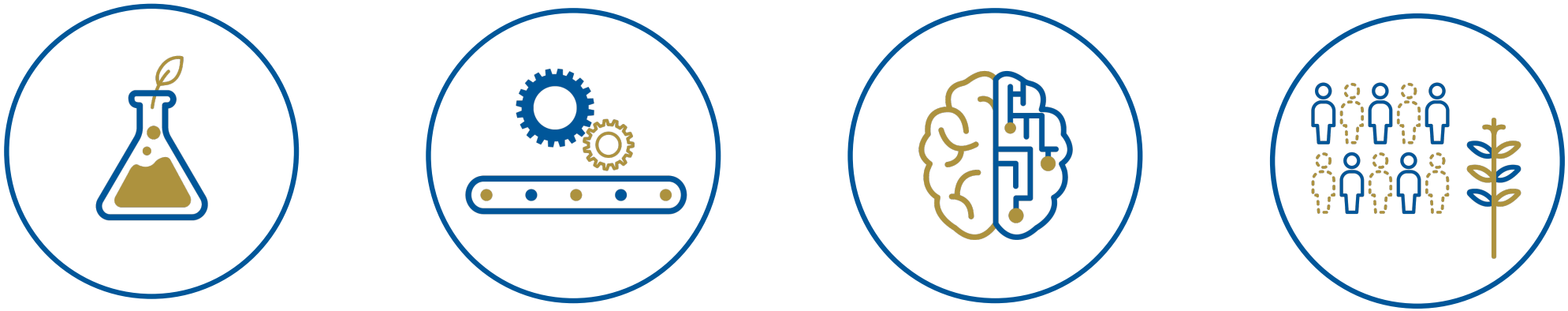
Increasing Disease



Growing Population

Diminishing Resources

The Promise of Agriculture G2P Research



How NSF Supports Agriculture G2P Research

Core Programs

Special Funding Efforts

Centers, Institutes and Infrastructure

Enhancing productivity and resource usage

Sensing, monitoring and decision support

Strengthening networks and eliminating waste

Related Areas of Research Supported by NSF

Enhancing productivity and resource usage

- New crops and food stocks
- Enhanced productivity and resilience
- Water, soil and fertilizer usage

Sensing, monitoring and decision support

- AI for optimal decision making
- Advanced crop and disease monitoring
- Forecasting, prediction and modeling
- Sensor and tool development

Strengthening networks and eliminating food waste

- Consumer education
- Food, energy, water systems
- Waste recycling and elimination
- Supply chain research in manufacturing

Related Areas of Research Supported by NSF

Enhancing productivity and resource usage

Sensing, monitoring and decision support

Strengthening networks and eliminating food waste

- Convergence research
- Use-inspired research
- Translational research
- Team science
- Workforce training/education
- Broadening participation

Interagency Connections and Industry Engagement

National Human Genome Research Institute

- Artificial Intelligence (AI) Institutes
- Enabling Discovery through GEnomics (EDGE)
- Ecology and Evolution of Infectious Diseases (EEID)
- Long-term Ecological Research (LTER) and National Ecological Observatory Network (NEON) (*complements LTAR)*
- Plant-Biotic Interactions

- Science and Technology Centers
- Engineering Research Centers
- Industry-University Cooperative Research Centers
- Convergence Accelerator
- Regional Innovation Engines
- America's Seed Fund powered by NSF (SBIR/STTR)

NSF Centers Related to Agriculture G2P

ERC

CASFER
Center for Advancing Sustainable and Distributed Fertilizer Production

IoT4Ag
The Internet of Things for Precision Agriculture
an NSF Engineering Research Center

STC

cropps
Center *for* Research on Progammable Plant Systems

STEPS
Science and Technologies for Phosphorus Sustainability

IUCRC

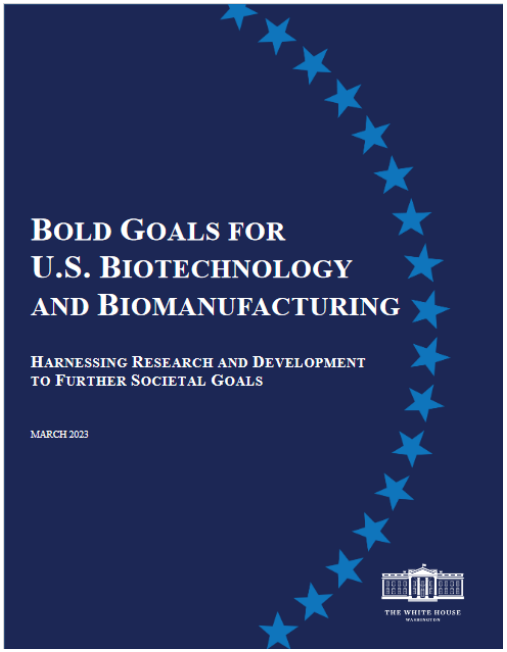
WGRC I/UCRC
A PUBLIC-PRIVATE CONSORTIUM

Convergence Accelerator: Track J

- Developing use-inspired solutions to:
  - enhance regenerative agriculture practices and
  - provide nutritious, equitable, and affordable food options
- $11 million investment
- 16 multidisciplinary teams

https://beta.nsf.gov/news/nsf-spurs-use-inspired-research-technology

Biotechnology & Biomanufacturing Executive Order and Bold Goals

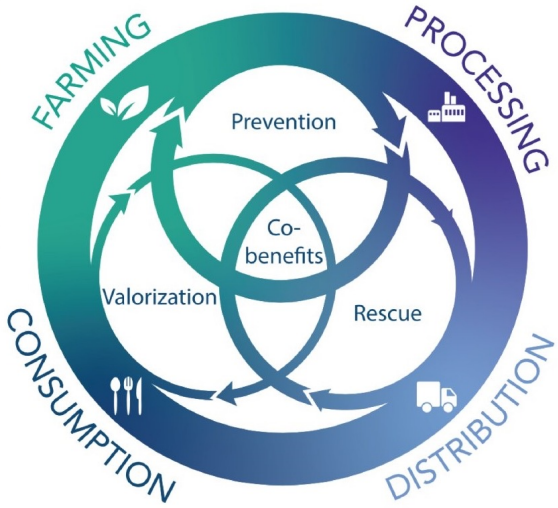


- Cross-agency effort to outline Bold Goals for the bioeconomy in response to EO
  - Includes cross-cutting efforts outlined by NSF and food and agriculture needs outlined by USDA
  - Highlights research & development needs to achieve the Bold Goals
- Future reports on data and data infrastructure needs


NSF

Back-up Slides

RECIPES Research Network



Multiscale Resilient, Equitable, and Circular Innovations with Partnership and Education Synergies (RECIPES) for Sustainable Food Systems Research Network

- *American University in partnership with Johns Hopkins University, Morgan State University, Ohio State University and Rochester Institute of Technology, with other educational institutions, governmental and non-governmental organizations and others.*
- This network will investigate the causes of food system waste, develop sustainable solutions like rescuing and repurposing unused food, and advance systemic security and reliability.
- The focus is on the Great Lakes, Mid-Atlantic, Southeast, and California -- areas that grow regional foods and have different seasonal crops -- to create typologies and generalized models that could transform food systems across the nation.

Image credit: Liz Sisk, Liz Sisk Illustration

Regional Innovation Engines (RIE)

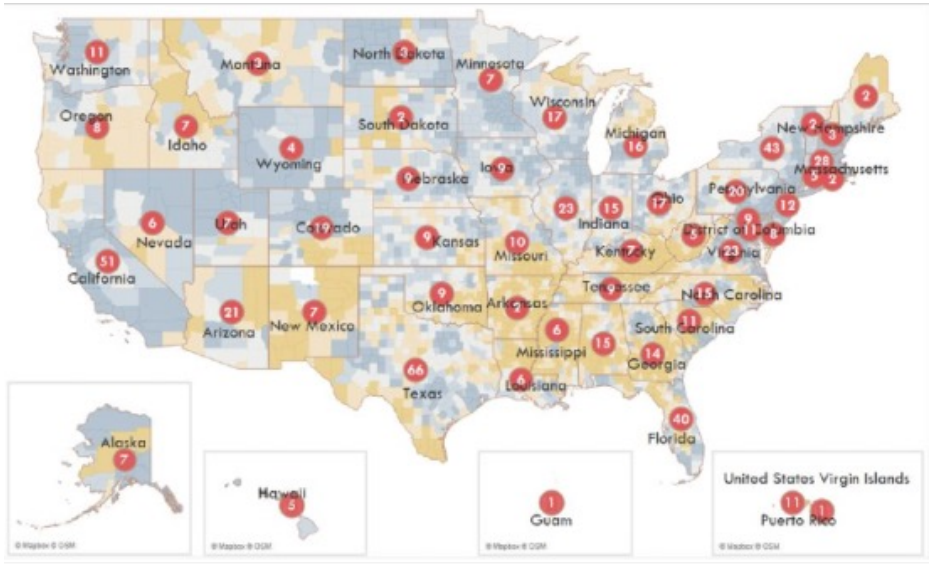
Will create regional-scale innovation ecosystems

Organizations were required to submit a concept outline with top-line information on their proposed topic areas, partners and geographic footprints.

NSF published nearly 700 concept outlines that are advancing to the next step.

-33 concept outlines mention "food"

NSF anticipates funding the first NSF Engines in 2023.



Key NSF Programs and Centers/Networks

Enhancing Productivity and Resource Usage

New Crops and Food Stocks

- Systems and Synthetic Biology
- Cellular and Biochemical Engineering
- Plant Genome Research Program (PGRP)
- Environmental Sustainability
- Convergence Accelerator: Track J
- IUCRC
  - Center for Environmental Sustainability through Insect Farming (CEIF)
  - Science Center for Marine Fisheries (SCeMFis)

Enhanced Productivity and Resilience

- Plant Genome Research Program (PGRP)
- Convergence Accelerator: Track J
- IUCRC
  - Wheat Genetics Resource Center (WGRC)
- Plant-Biotic Interactions (*joint with USDA-NIFA)*

Water, Soil and Fertilizer Usage

- Building Synthetic Microbial Communities for Biology, Mitigating Climate Change, Sustainability and Biotechnology (Synthetic Communities)
- Science and Technology Centers
  - Science and Technologies for Phosphorous Sustainability (STEPS) Center
- IUCRC
  - Water Equipment and Policy Center (WEP)
- ERC
  - Center for Advancing Sustainable and Distributed Fertilizer Production (CASFER)

Key NSF Programs and Centers/Networks

Sensing, Monitoring and Decision Support

AI for Decision Making

- Convergence Accelerator: Track J
- AI Institutes (*joint with USDA-NIFA, DOD, NIST, industry)*
  - AI Institute for Research on Trustworthy AI in Weather, Climate, and Costal Oceanography (AI2ES)

Disease and Crop Monitoring

- Biosensing
- Ecology and Evolution of Infectious Diseases (EEID) (*joint with USDA-NIFA and NIH)*
- Signals in the Soil (SitS)
- STC (Center for Research On Programmable Plant Systems (CROPPS))
- ERC (Internet of Things for Precision Agriculture (IoT4Ag))
- Convergence Accelerator: Track J
- SBIR/STTR

Forecasting, Prediction and Modeling

- National Ecological Observatory Network (NEON)
- Long-Term Ecological Research (LTER)
  - Cedar Creek Ecosystem Science Reserve
  - Kellogg Biological Station
  - Konza Prairie
  - North Temperate Lakes
  - Northeast U.S. Shelf
- Ecology and Evolution of Infectious Diseases (EEID) (*joint with USDA-NIFA and NIH)*
- SBIR/STTR

Sensor and Tool Development

- Division of Biological Infrastructure (DBI)
- Enabling Discovery through GEnomics (EDGE)

Key NSF Programs and Centers/Networks

Strengthening Networks and Eliminating Waste

Food, Energy Water Systems (and Socio-environmental)

- Dynamics of Integrated Socio-Environmental Systems (DISES)
- Sustainable Regional Systems
  - Transforming Rural-Urban Systems: Trajectories for Sustainability in the Intermountain West Research Network
- Innovations at the Nexus of Food, Energy and Water Systems (INFEWS) (*joint with USDA-NIFA*)
- Convergence Accelerator: Track J

Waste Recycling and Elimination

- Innovations at the Nexus of Food, Energy and Water Systems (INFEWS) (*joint with USDA-NIFA*)
- Sustainable Regional Systems
  - Multiscale RECIPES (Resilient, Equitable, and Circular Innovations with Partnership and Education Synergies) for Sustainable Food Systems
  - Transforming Rural-Urban Systems: Trajectories for Sustainability in the Intermountain West Research Network
- Convergence Accelerator: Track J