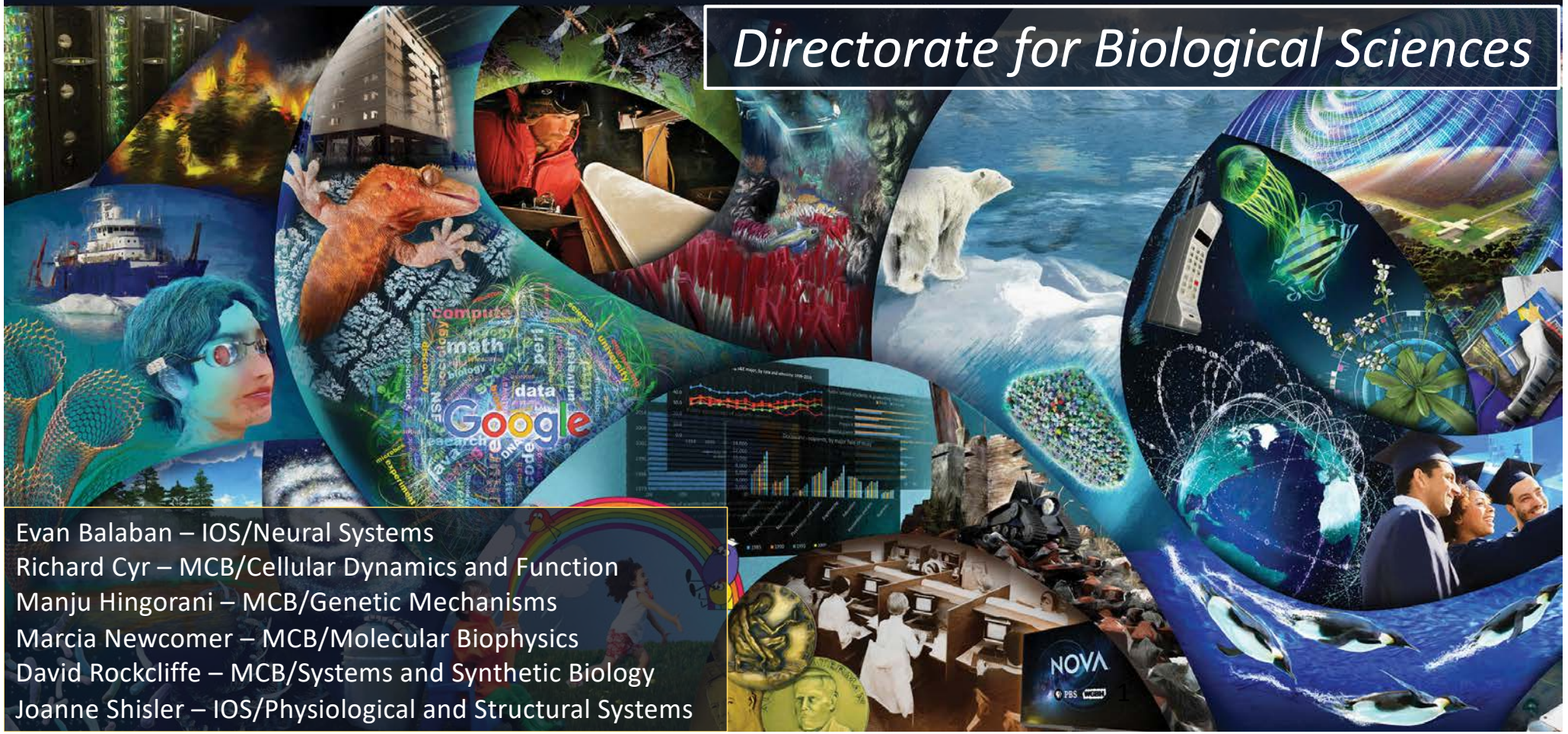
National Science Foundation

Directorate for Biological Sciences



Evan Balaban – IOS/Neural Systems
Richard Cyr – MCB/Cellular Dynamics and Function
Manju Hingorani – MCB/Genetic Mechanisms
Marcia Newcomer – MCB/Molecular Biophysics
David Rockcliffe – MCB/Systems and Synthetic Biology
Joanne Shisler – IOS/Physiological and Structural Systems

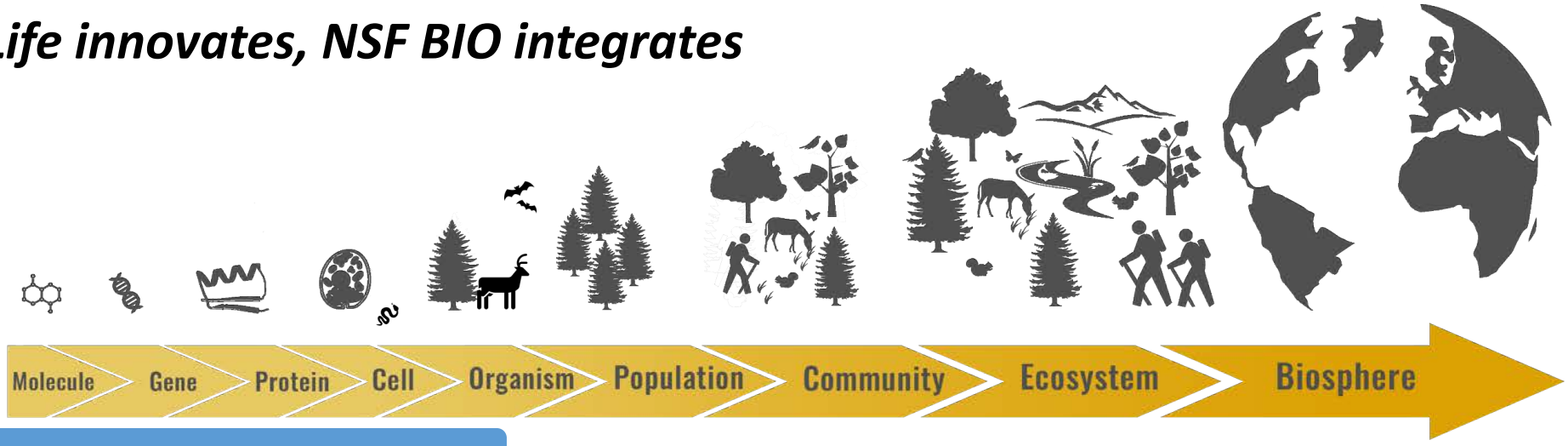
Directorate for Biological Sciences (BIO)

"To enable discoveries for understanding life, advance the frontiers of biological knowledge, increase our understanding of complex systems, and provide a theoretical basis for original research in many other scientific disciplines."



Four BIO Divisions: Biological Research Across Scales

Life innovates, NSF BIO integrates

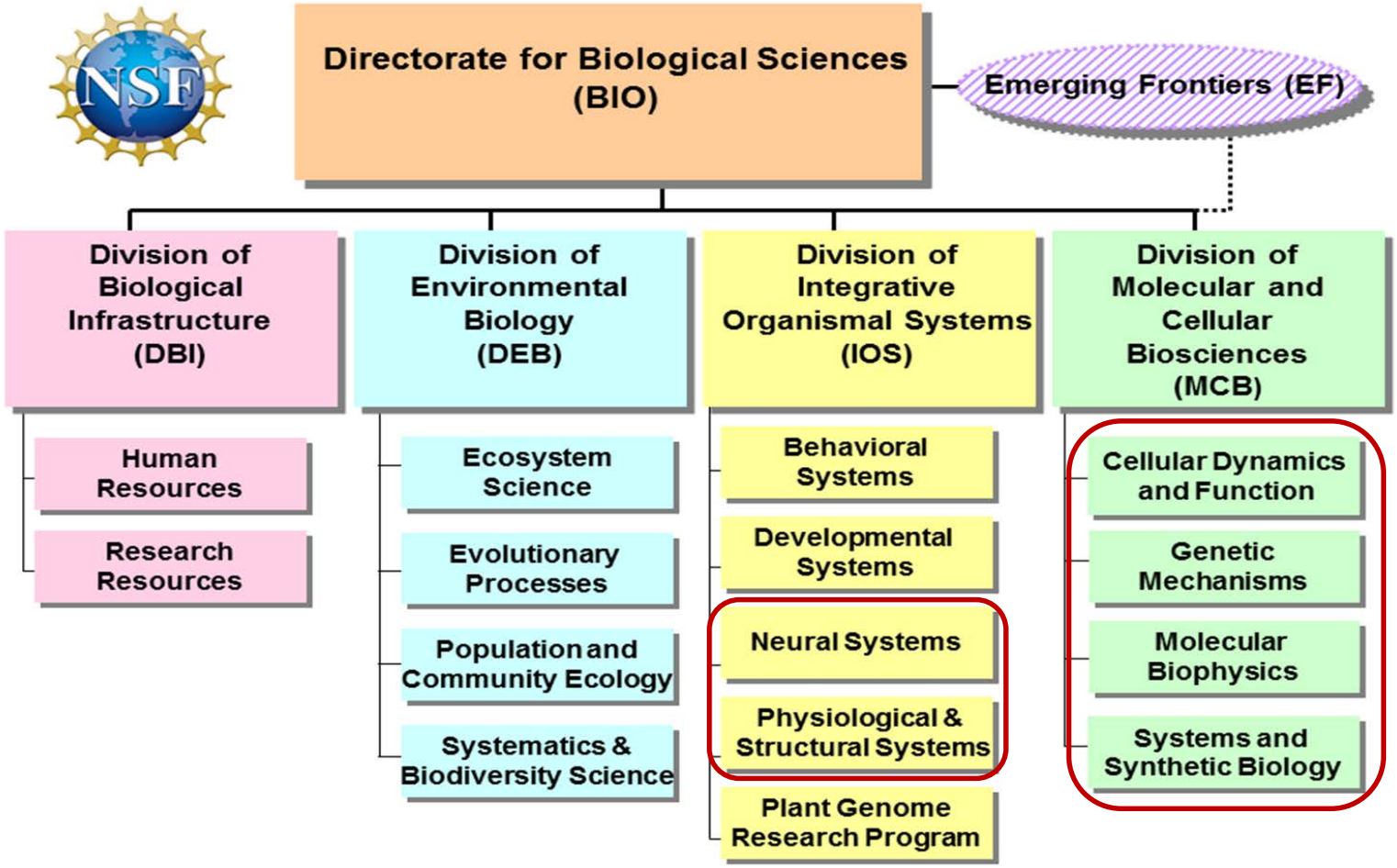


Molecular & Cellular Biosciences (MCB)

Integrative Organismal Systems (IOS)

Environmental Biology (DEB)

Biological Infrastructure (DBI)


Directorate for Biological Sciences (BIO)
Emerging Frontiers (EF)
Division of Biological Infrastructure (DBI)
Division of Environmental Biology (DEB)
Division of Integrative Organismal Systems (IOS)
Division of Molecular and Cellular Biosciences (MCB)
Human Resources
Research Resources
Ecosystem Science
Evolutionary Processes
Population and Community Ecology
Systematics & Biodiversity Science
Behavioral Systems
Developmental Systems
Neural Systems
Physiological & Structural Systems
Plant Genome Research Program
Cellular Dynamics and Function
Genetic Mechanisms
Molecular Biophysics
Systems and Synthetic Biology


NOVA

Integrative Organismal Systems (IOS)

Integrative Organismal Systems (IOS) Core Programs

- **Behavioral Systems**
  - Animal Behavior Program
- **Developmental Systems**
  - Plant, Fungal & Microbial Developmental Mechanisms
  - Animal Developmental Mechanisms
  - Evolution of Developmental Mechanisms
- **Neural Systems**
  - Organization Program
  - Activation Program
  - Modulation Program
- **Physiological & Structural Systems**
  - Symbiosis, Defense & Self-recognition
  - Physiological Mechanisms & Biomechanics
  - Integrative Ecological Physiology
  - NSF-NIFA Plant Biotic Interactions

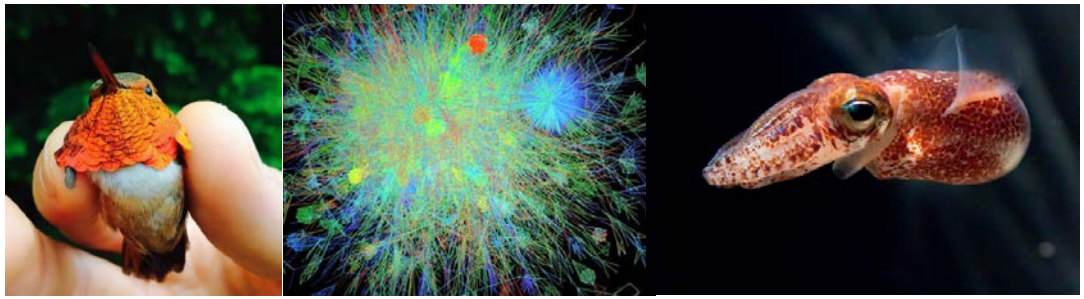
Additional IOS Programs

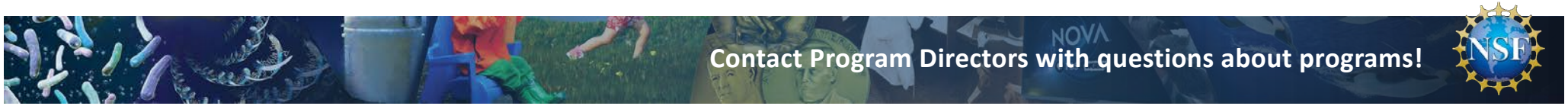
- Enabling Discovery through GEnomic Tools (EDGE)
- Functional Genomic Tools Track
- Complex Multigenic Traits Track
- Plant Genome Research Program
- Research-PGR Track
- TR Tech-PGR Track

IOS IMAGiNE: Integrating Mechanisms of Adaptation with Genes in Networks and across Environments

Integrative Organismal Systems (IOS)

- **Behavioral Systems Cluster**
- **Developmental Systems Cluster**
  - Plant, Fungal & Microbial Mechanisms Program
  - Animal Development Mechanisms Program
  - Evolution of Developmental Mechanisms Program
- **Neural Systems Cluster**
  - Organization Program
  - Activation Program
  - Modulation Program





Neural Systems Cluster

PROGRAM DIRECTORS:

ORGANIZATION
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MODULATION
Edda (Floh) Thiels
ethiels@nsf.gov
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ACTIVATION
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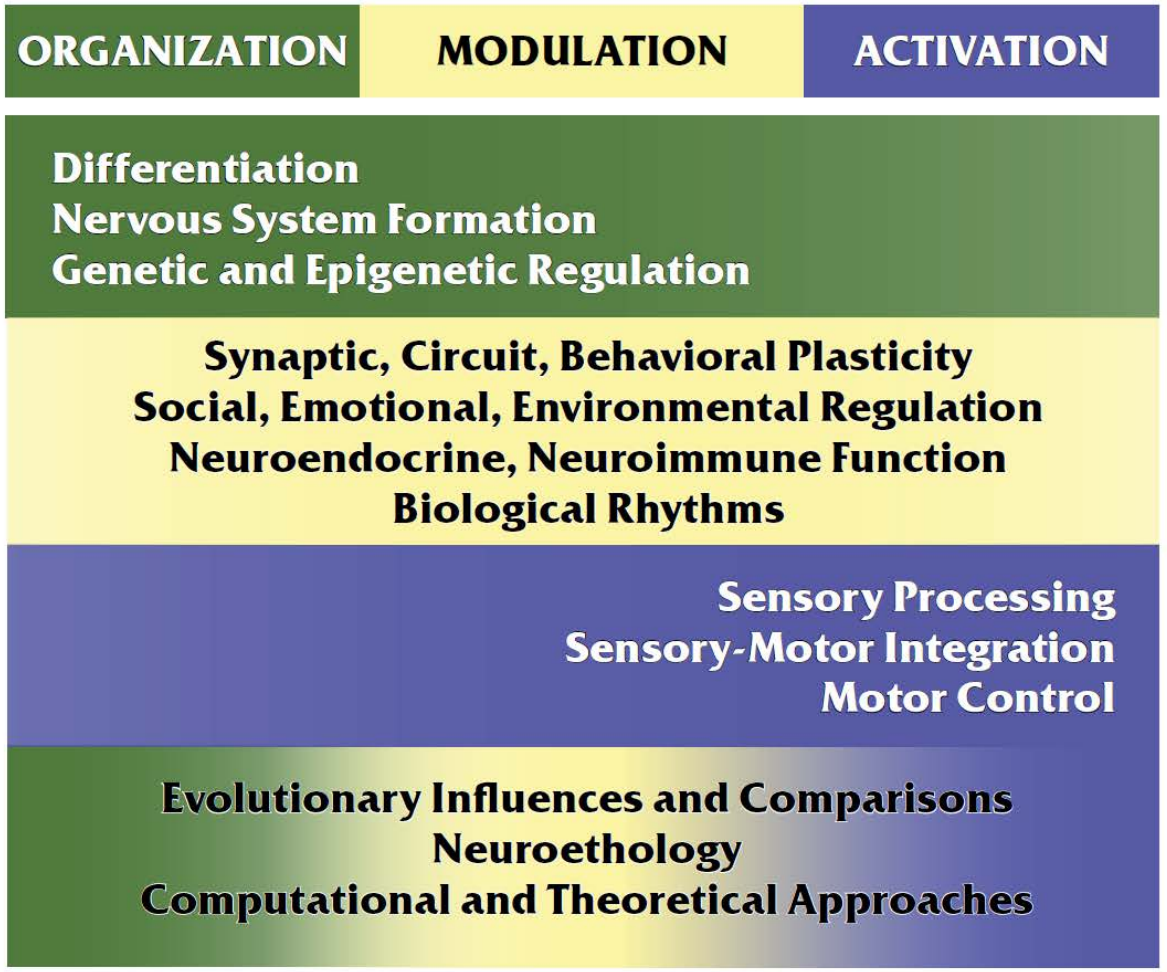
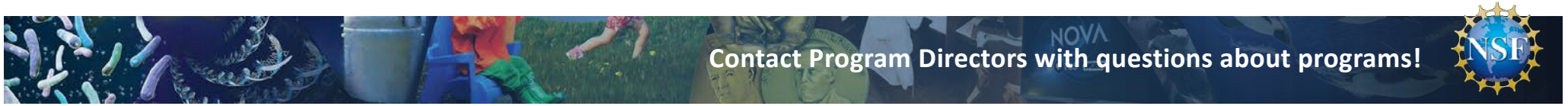


Integrative Organismal Systems (IOS)

- **Physiological and Structural Systems Cluster**
  - Symbiosis, Defense and Self-recognition Program
  - Physiological Mechanisms and Biomechanics Program
  - Integrative Ecological Physiology Program
  - NSF-NIFA Plant Biotic Interactions Program

- **Plant Genome Research Program**
  - Research-PGR Track
  - TR Tech-PGR Track
  - Postdoctoral Fellowships



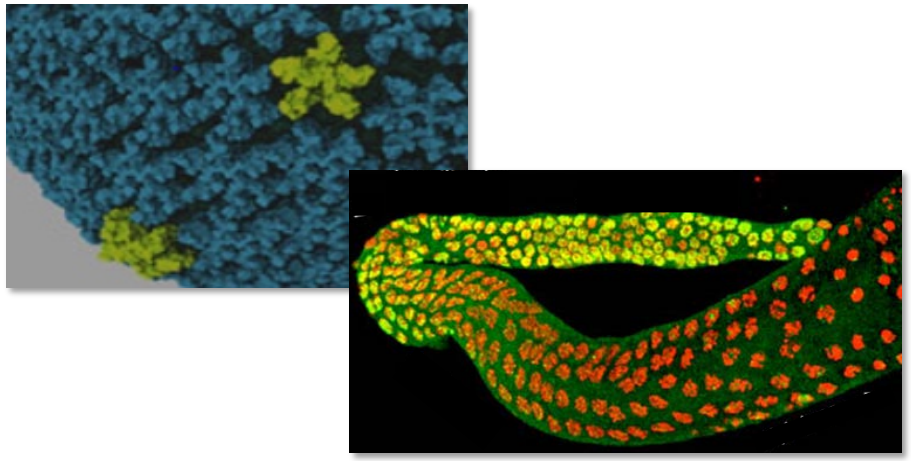
Molecular and Cellular Biosciences (MCB)

Supports quantitative, predictive and theory-driven research to understand complex living systems at the molecular, subcellular, and cellular levels

Encourages use of approaches at intersections of biology with other disciplines

Clusters

- Molecular Biophysics
- Genetic Mechanisms
- Cellular Dynamics and Function
- Systems and Synthetic Biology



The Molecular Biophysics cluster supports research on the interplay between structure, dynamics and function of biomolecules, and the principles governing their interactions, mechanisms and regulation.

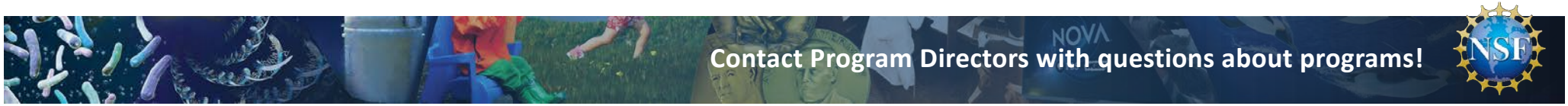
Areas of interest include:

- **Large scale computations with experimental constraints**
- **Development of multiple time- and length-scale molecular dynamics that inform function**
- **Structures and interactions of large biological assemblies in atomic or molecular detail**

The Genetic Mechanisms cluster supports quantitative research on the structure, dynamics, function and evolution of genes and genomes from diverse organisms.

Areas of interest include:

- **Chromatin- and RNA-mediated regulatory mechanisms**
- **Dynamics and spatiotemporal coordination of genome replication, repair, chromatin modification, transcription, and translation**
- **Origin and evolution DNA, RNA and proteins**



The Cellular Dynamics and Function cluster supports research using physical, chemical, mathematical and computational approaches for integrative insight into cellular functions.

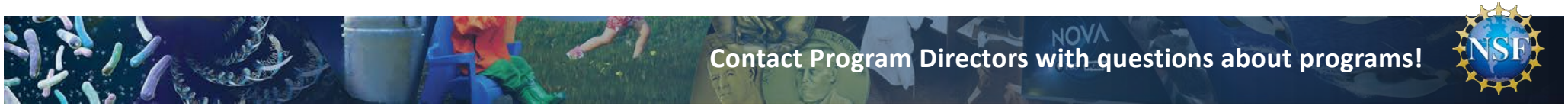
Areas of interest include:

- **Predictive understanding of the behavior of living cells**
- **Evolutionary approaches to rules governing cellular functions**
- **Integration of function with emerging cellular properties across spatiotemporal scales**

The Systems and Synthetic Biology cluster supports research aimed at understanding complex interactions within biological systems across different scales, facilitated by the use of novel experimental and computational tools in systems and synthetic biology.

Areas of interest include:

- **Mechanistic modeling of regulatory, signaling, and metabolic networks**
- **The origins of life, the minimal cell and emergent behaviors**
- **Novel tool development**
- **Molecular to system-wide scale rules of assembly and function**



Cross-cutting Research Areas with High Priority in All MCB Clusters

Integrating Across Scales	**Integrating knowledge from single molecules to molecular machines and from networks to cellular complexity**
Transformative Methods and Resources	**Developing technologies motivated by compelling molecular and cellular biology questions, including biophysical, computational, and synthetic biology-based methods for broad application, and genetic resources for diverse systems**
Molecular & Cellular Evolution	**Discovering mechanisms and theoretical underpinnings of evolutionary changes in molecules, genomes, and cells of all types, including archaeal, bacterial, eukaryotic, along with their respective phages/viruses**
Synthesizing Life-like Systems	**Using synthetic molecular parts and processes to understand the transition from simple to complex and to build novel living systems**
Understanding the Genome	**Applying theoretical, computational, and high-throughput experimental approaches to determine and predict the function of the genome and how structure and dynamics of the genome/epigenome, from linear DNA sequence to 3D architecture, give rise to phenotype**

BIO Division of Environmental Biology (DEB)

Supports basic research projects that contribute to the development of the fields of evolutionary biology and ecology.

This includes biodiversity sciences and evolutionary processes as well as ecosystem and population and community ecology

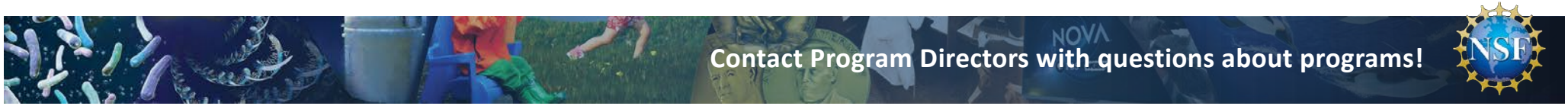
Ecology Clusters

Population and Community Ecology

- Supports research that advances the conceptual or theoretical understanding of population ecology, species interactions, and community dynamics.
- Topics include: mutualist and parasitism, mechanisms of coexistence, community assembly, paleoecology, landscape ecology, conservation and restoration biology, behavioral ecology and macroecology.

Ecosystems Science

- Supports research on ecosystem structure and function across a diversity of spatial and temporal (including paleo) scales.
- Topics include: ecosystem dynamics, resilience, material and energy fluxes and transformations, linkages among ecosystems in space, time and across spatial and temporal scales, roles and relations of ecosystem components.



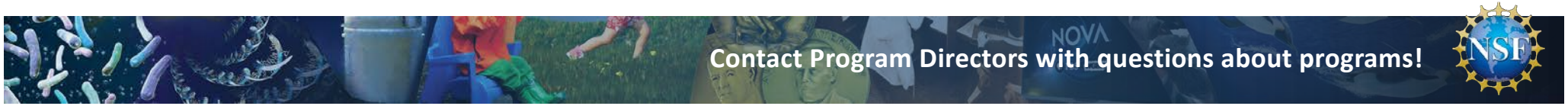
Evolution Clusters

Evolutionary Processes

- Supports empirical or theoretical research that makes inferences about evolutionary dynamics and consequences
- Appropriate scales: molecules to species
- All mechanisms of evolution are of interest

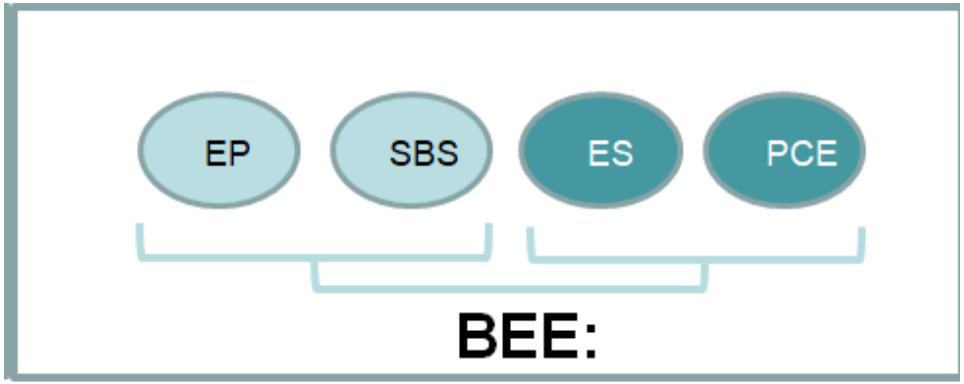
Systematics and Biodiversity Science

- Supports research to advance our understanding of the diversity, systematics, and evolutionary history of extinct or extant organisms in natural systems. Includes:
  - Expeditionary and exploratory research to advance discovery and classification of biodiversity
  - Research to resolve questions of relationships among taxa
  - Phylogeny-based studies of character evolution and comparative biology



BEE: Bridging Ecology & Evolution

- Applies to all DEB core programs
- Targets research that spans ecology and evolution
  - Welcomes proposals that reciprocally address hypotheses in both disciplines



Division of Biological Infrastructure (DBI)

Research Resources

Infrastructure Innovation for Biological Research (IIBR)

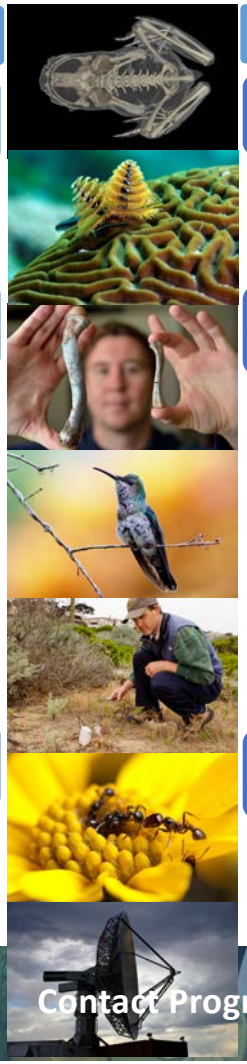
- Supports new and innovative research in biological informatics, instrumentation, and multidisciplinary approaches.

Infrastructure Capacity for Biology (ICB)

- Supports the development or implementation of robust biological infrastructure that serves a significant segment of NSF's research community.
- Four program areas:
  1) Cyber-Infrastructure for Biological Research (CIBR)
  2) Instrument Capacity for Biological Research (ICBR)
  3) Collections in Support of Biological Research (CSBR)
  4) Improvements to Field Stations and Marine Labs (FSML)

Advancing Digitization of Biodiversity Collections (ADBC)

- Supports theme-based digitization of existing vouchered biological collections.



Human Resources

Research Coordination Networks in Undergraduate Biology Education (RCN-UBE)

- Support to establish collaborative networks that improve undergraduate biology education.

  Contacts: sgeorge@nsf.gov, mpauley@nsf.gov

Postdoctoral Research Fellowships in Biology (PRFB)

- Supports individual postdoctoral scholars to pursue their research and training goals.
- Three high priority areas:
  1) Broadening Participation of Groups Under-Represented in Biology
  2) Integrative Research Investigating the Rules of Life Governing Interactions Between Genomes, Environment and Phenotypes
  3) National Plant Genome Initiative

  Contacts: asimcox@nsf.gov, jbarthel@nsf.gov

Research Experiences for Undergraduates (REU)

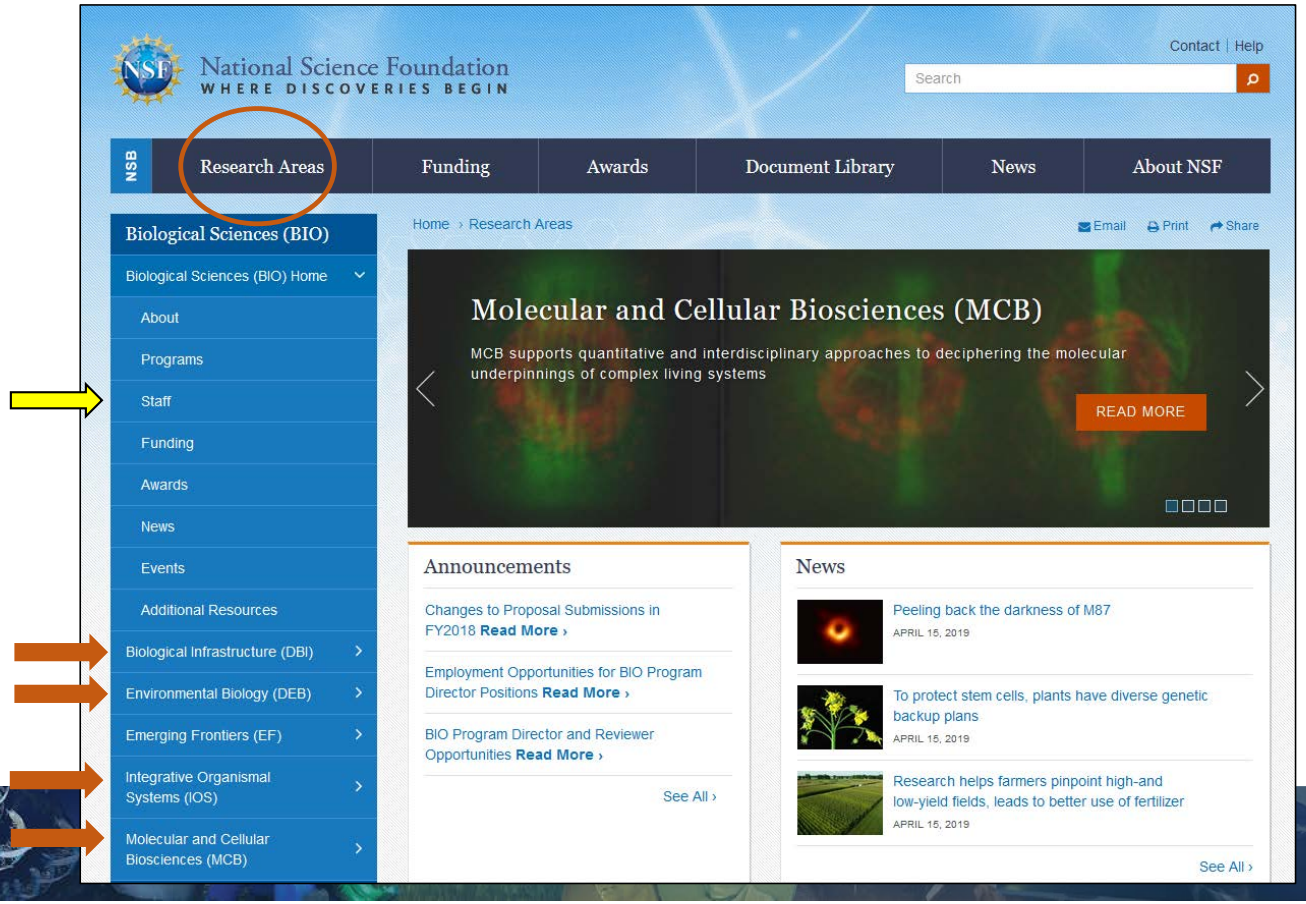
- Supports active research participation by undergraduate students through summer programs and supplements.

  contacts: https://www.nsf.gov/crssprgm/reu/reu_contacts.jsp

Contact Program Directors with questions about programs!

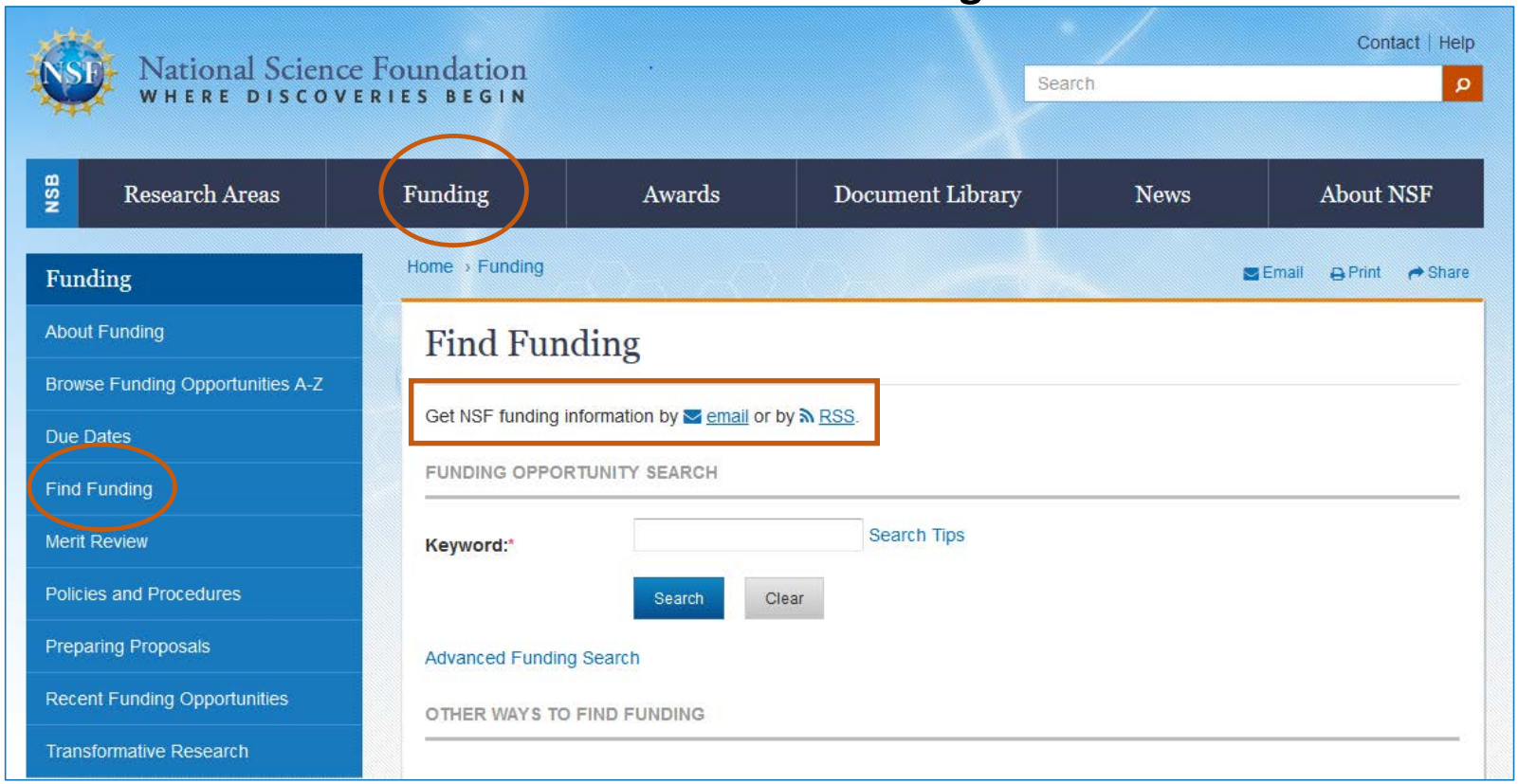
Where to Find Program Information

BIO website: https://www.nsf.gov/dir/index.jsp?org=BIO



Where to Find Funding Information

NSF website: www.nsf.gov



Examples of Targeted Funding Opportunities (BIO wide):

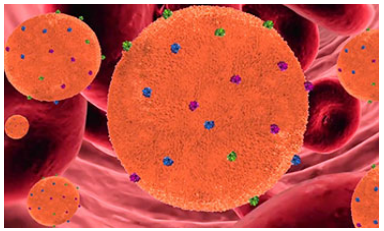
Enabling Discovery through GEnomic Tools (EDGE)

- NSF 20-532
- ***What genes "do"***
- **Tools** for research in non-model bacteria, fungi, plants and animals
- Research to understand the **causal** mechanisms connecting Genotype & Environment to Phenotype

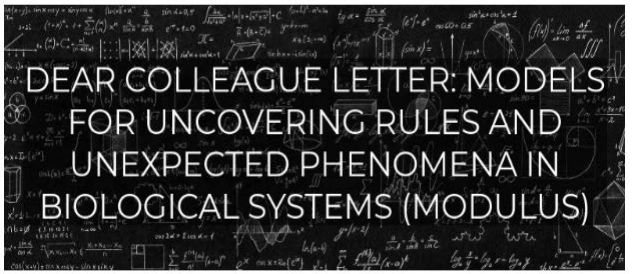
contact: BIOEDGE@NSF.GOV

Examples of Targeted Funding Opportunities (MCB)

- SENTINELS – NSF 20-105 (MCB and CBET)
  - Develop cell/organism-based flexible biosensing platforms for surveillance and response to emergent infectious diseases



- MODULUS – NSF 19-054 (MCB and MathBio)
  - Push boundaries in Systems and Synthetic Biology and Mathematical Biology
  - Develop innovative mathematical methods/models to guide biological exploration
  - Encourage new collaborations b/w mathematical and biological scientists



- Transitions – NSF 20-505 (MCB)
  - Opportunity for mid-career scientists to expand or transition their research programs in new directions

BIO Blogs and Virtual Office Hours

- **IOS blog**
  https://iosblog.nsfbio.com/
- **MCB blog**
  https://mcbblog.nsfbio.com/
- **DBI blog**
  https://dbiblog.nsfbio.com/
- **DEB blog (DEBrief)**
  https://debblog.nsfbio.com/

- DEB, IOS, and MCB all have them!
- Monthly information sessions focused on:
  - New and ongoing funding opportunities
  - Topics of general interest to the various investigator communities
  - Open period for questions from audience members to be answered by program directors in attendance
- Log on information, and dates/times, for Office Hours can be found on our blogs

Follow us on social media!

www.nsf.gov/social

BIO blogs: www.nsfbio.com

BIO Buzz

DBInfo

DEBrief

MCB Blog

IOS InFocus

Contact us!

IOS

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MCB

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- Marcia Newcomer
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- David Rockcliffe
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National Science Foundation

Tips for Writing Competitive Proposals

- Start with describing the big picture, the fundamental question or issue
  - Describe how achieving the goals of your project will lead to progress on the big picture question; your science must be compelling and relevant to fundamental issues
- Experimental plan must be well-matched to hypotheses
  - Are the methods and design the best to test the hypotheses?
- Preliminary data are consistent with the hypotheses
- Newer methods generally require preliminary data or demonstration they work in your hands
- Have you considered alternative experimental outcomes?
- Develop a plan for convincing and significant broader impacts activities

NSF Merit Review Criteria

- Intellectual Merit:
  - Potential for advancing knowledge in/across fields
  - Qualifications of the investigators
  - Creativity and originality
  - Organization of the ideas/experiments
  - Access to resources
  - Potentially transformative research?
- Broader Impact:
  - Promoting teaching, training, and education
  - Enhancement of infrastructure for research and education
  - Community resources and outreach
  - Participation of underrepresented groups
  - Benefits to society

NSF Merit Review Criteria

Try to think like a reviewer --someone not completely familiar with *your* work

Are you covering everything in **Intellectual Merit**?

What Applicants want to convey

- Present a NEW idea
- Explain the expected results and alternative plans
- What you will do, risk mitigation
- Demonstrate your qualifications
  - Preliminary Data
  - Publications

What Reviewers look for

- Advancing the field: is it a big or little step in science?
- Will the negative results be important too?
- Can the applicants do the project?

NSF Merit Review Criteria

Try to think like a reviewer --someone not completely familiar with *your* work

Are you covering everything in **Broader Impacts**?

What Applicants want to convey

- Present a clear, integrated plan.
- Document a history of outreach/impact.
- Show who you will impact and how.
- Describe how you will know it works.

What Reviewers look for

- Connected to the research?
- Can it be executed?
- Targeting an appropriate goal/group?
- Will it have an impact and *how will the PI know*?

What Makes a Proposal Competitive?

- Potential for high impact
- New, original ideas
- Focused, feasible project plan
- Articulated knowledge of subject area, published relevant work
- Experience in essential methods or approaches, and/or collaborator expertise
- Sound scientific rationale
- Realistic amount of work; sufficient detail; critical approach (acknowledges the pitfalls)

What about Medical Research?

- **Research with disease-related goals** – etiology, diagnosis or treatment of physical or mental disease, abnormality, or malfunction in human beings or animals – **is normally not supported**.

- **Animal models** of such conditions or the **development or testing of drugs** or other procedures for their **treatment** also are **not eligible for support**.

- **Research in bioengineering or information technology**, with diagnosis- or treatment-related goals, that applies engineering or computer science principles to problems in biology and medicine while advancing engineering or computer science knowledge **is eligible for support**.

- **Bioengineering and assistive information technology research** to aid persons with **disabilities also is eligible**.

NSF Proposal & Award Policies & Preparation Guide

https://www.nsf.gov/pubs/policydocs/pappg20_1/index.jsp#A

Enabling Continental Scale Science: NSF's National Ecological Observatory Network, NEON

81
FIELD SITES
- 47 terrestrial
- 34 aquatic

20
ECOCLIMATIC DOMAINS

Also, NSF Centers for:

- Atmospheric Research
- Lake Ecological Observatory Network
- Long-term Ecological Research
- Ocean Observatories
- Polar Observatories

NOVA

www.neonscience.org

NSF