# NSF BIO Directorate and the Division of Biological Infrastructure

Worcester Polytechnic Institute

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# **Topics**

- NSF organizational structure
- The BIO mission
- BIO directorate structure and Division identities
- Recent general changes in BIO solicitations
  - No-deadline for submissions
  - Understanding the Rules of Life
  - Division of Biological Infrastructure realignment
  - The INTERN Dear Colleague Letter
- New DBI solicitations for research resources (IIBR and ICB)
- Proposals
  - Review Criteria
  - Process
  - Decisions

# Describing NSF & the BIO Directorate



Alexandria, VA (2017)

# The BIO Mission

Enabling discoveries to understand life
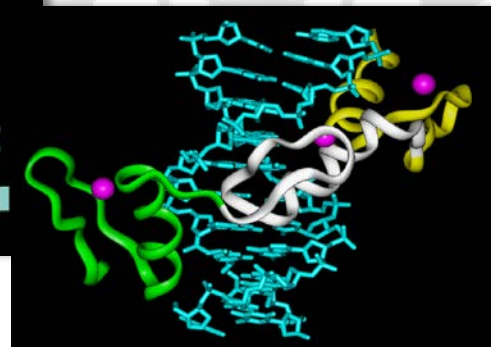
# BIO Priorities, Core +

**Strengthening** research that addresses *Grand Challenge questions*
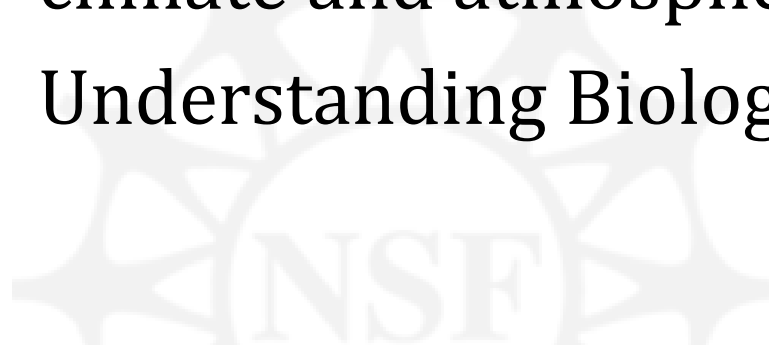
1. **NSF-wide collaborations** to advance research in *Cognitive Science and Neuroscience*

2. **Stimulating** *research at the interface* of the biological, mathematical and physical, and engineering sciences

3. **Supporting** *cyberinfrastructure*, such as the National Ecological Observatory Network (NEON).



RESEARCH AT THE INTERSECTION OF THE PHYSICAL AND LIFE SCIENCES

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES
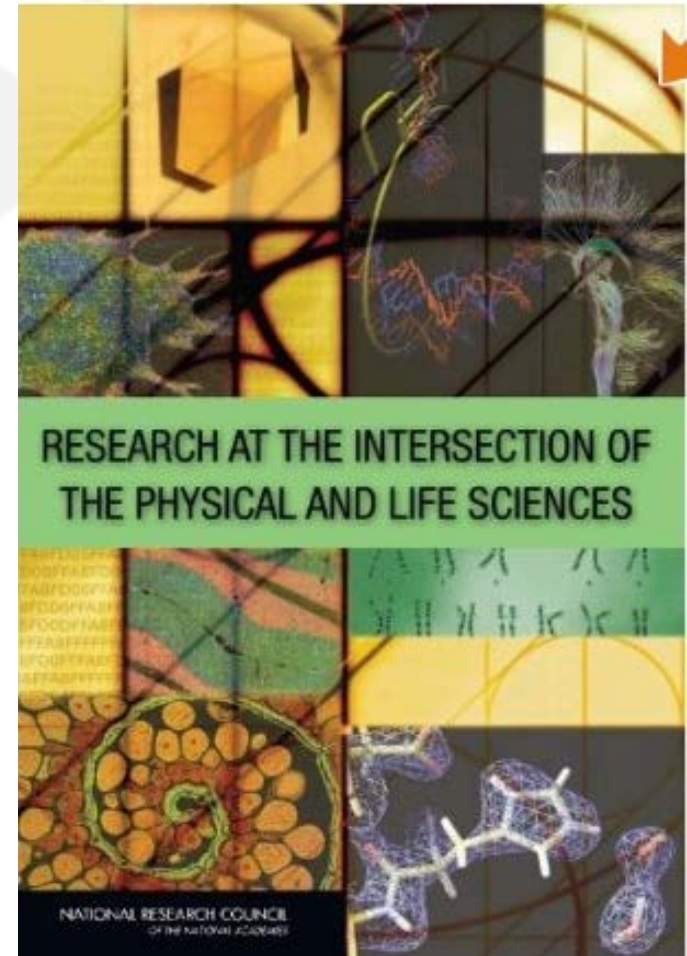
http://www.nap.edu/catalog.php?record_id=12809

# Grand Challenges

- Systems and Synthetic Biology: Synthesizing life-like systems

- Cognitive Neuroscience: Understanding brains

- Genomes to Phenomes (understanding the Rules of Life): Predicting traits from genomes (and genomes from traits).

- Deciphering interactions between earth and its climate and atmosphere

- Understanding Biological Diversity

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Biol. Sci.

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Engineering Sci.

Geosciences

Math & Phys

Social, Behav. & Econ.

Education & HR

Budget, Finance & Award Management

Information Resource Management

# Bio Divisions/Clusters/Programs



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)

# Recent changes that apply BIO-wide

- No-deadline policy: the **core** programs in all of the divisions have gone to a no-deadline submission policy for applications.
- A new cross-cutting theme: Understanding the Rules of Life.
  - Interdivisional within BIO (Rules of Life, 2+ divisions must be involved)
  - Cross-directorate
    - Epigenetics (https://www.nsf.gov/pubs/2018/nsf18600/nsf18600.htm)
    - Synthetic Cell Ideals Lab (https://www.nsf.gov/pubs/2018/nsf18599/nsf18599.htm)

# No Deadline Submissions

- A year is the federal fiscal year: Oct 1 – Sept 30
  - Exception in 2018: from release of solicitation to Sept 30, 2019 will be in 2019 budget
- Core programs are included but special programs and cross-directorate programs still have deadlines
- Limits (currently): One proposal per year to a Division's core programs solicitation and one to the BIO Directorate to the Understanding the Rules of Life initiative.
  - Rules of Life (RoL) proposals must be relevant to programs in at least two Divisions
    - Designate the targeted programs with keywords on the keyword page
  - Cross-cutting initiatives: Understanding the Rules of Life (URoL) proposals must address either Epigenetics or The Synthetic Cell.

# Big Ideas: Understanding the Rules of Life

- The Big Idea is Predicting Phenotype
- What theoretical constructs explain and allow us to predict the characteristics of living systems
  - At any scale: molecular and sub-cellular components, to cells, whole organisms, communities and biomes.
  - As causal, mechanistic, and/or predictive relationships between the genomic and epigenetic makeup, the environmental experience, and the phenotypic characteristics of biological systems
- Contrary to the Rules of Life track that applies to multi-BIO-Division proposals called Rules of Life, proposals responding to these solicitations are not part of the caps.

# Understanding the Rules of Life – Big Ideas: Synthetic Cell

- NSF solicitation 18-599: Building a Synthetic Cell
  - Due date:
    - Preliminary proposals: Dec 28, 2019
    - Full proposals: May 13, 2019
  - Submit to BIO/EF
  - Theme: design and manufacture viable synthetic cells from non-living molecules.
    - Rationale: This will transform our understanding of cellular processes, the molecular mechanisms that build and carry out the function of systems that reproduce life-like traits. It will also deepen out understanding of the self-assembly of life-like systems, soft condensed matter, and the physics and chemistry of life that lead to cellular components, cells and multicell systems.
  - Grand Challenge: designing, fabricating, and validating synthetic cells that express specified phenotypes.
  - Approach: An Ideas Lab, intensive workshops focused on ways to address the grand challenge problem.
- This must be a multi-directorate proposal, preproposals must be submitted and accepted before full proposals will be entertained.
- Funding of 4-6 proposals with a solicitation budget of $10million USD. The lab event itself will occur between Mon Feb 25th – Friday Mar 1st 2019 in Northern Virginia, for 5 days.

# Understanding the Rules of Life – Big Ideas: Epigenetics

- NSF solicitation18-600: Epigenetics
  - Due date: Feb 1, 2019; Submit to BIO/EF
- Theme: cross-directorate research that aims to understand "the relationship between epigenetic mechanisms associated with environmental change, the resultant phenotypes of organisms, and how these mechanisms lead to robustness and adaptability of organisms and populations".

- URoL: Epigenetics projects must be interdisciplinary across NSF Directorates (i.e. at least two from: biology, chemistry, computer science, engineering, geology, mathematics, physics, social and behavioral sciences).
  - Training and outreach efforts should emphasize unique opportunities enabled by the interdisciplinary scope.
- Submission Tracks:
  - Track 1 - Total budget up to $500,000, duration up to 3y
  - Track 2 - Total budget up to $3,000,000 duration up to 5y

# Qualifying for the Rules of Life track

- Proposals must identify quantitative rules that operate across scales of time, space and complexity, as well as constraints that limit their action in some dimension.
  - Identify interactions causal to and of utility in prediction and forecasting outcomes
  - Identify and characterize emergent properties as complexity increases.
  - Examine the interactions of biotic and abiotic factors quantitatively and across many scales
    - Example: Nitrogen cycling incorporates biotic and abiotic materials and environmental variables that operate at the ecosystem level.
- Proposals must
  - Address fundamental questions that are of interest to programs in at least two of the Divisions in the BIO directorate, or in two distinct Directorates, that cross scales represented as orders of magnitude in time, space or complexity
  - Propose to develop tools/resources to further such research
  - Train the next generation of Biologists to have the skills and understanding needed to take on this type of research question
  - Foster interdisciplinary, convergent research in the life sciences

# DBI Mission: Core Research vs Infrastructure

- Core programs focus on research advances by individual labs in the subject area.
  - Computational/statistical/ML methods may be developed but they are tuned to the lab's data and needs.
- Infrastructure research is intended to move research forward for many labs doing Biological research supported by NSF (ie not biomedical or ag)
  - Generalizes beyond data and methods of a single investigator
  - There is a software testing and documentation plan
  - There is a software dissemination plan
  - There is a training plan
- Infrastructure Research (innovation) vs Capacity
  - Research innovation leads to a working prototype (if successful)
  - Capacity leads to hardened code/instrumentation/collection/field station usable by many

# Recent changes in DBI

- The Division of Biological Infrastructure has re-defined its Research Resources cluster to encourage consideration of the maturity of the resource (innovation vs capacity building) and mixed development of hard resources and CI to support their use
  - IIBR (18-595) is for innovation
  - ICB (18-594) is for capacity building
  - Coming: sustaining resources

# 18-594 Infrastructure Capacity for Biology (ICB).

- The core programs are
  - Collections in Support of Biological Research (CSBR),
  - Cyberinfrastructure for Biological Research (CIBR),
  - Improvements to Field Stations and Marine Labs (FSML),
  - Instrument Capacity for Biological Research (ICBR),
  - RUI proposals in these areas are counted towards the cap.
  - Joint US-UK (BBSRC) proposals in the core subject areas are counted as being to the core.
- Not included as core programs are Career proposals, Conferences and workshops, Research Coordination Networks (RCN), EAGERs, RAPIDs, and supplements such as REU, INTERN, RET, RAHS, ROA.

# 18-595 Infrastructure Innovation for Biological Research (IIBR)

- Subject focus areas (themes) include biological informatics, new instrument development with associated methods and multidisciplinary approaches that merge the two.
  - RUI proposals in these areas are counted as being to the core
  - Joint US-UK (BBSRC) proposals in the core subject areas are counted as being to the core
  - IIRB can be a relevant division in a RoL proposal.
- Not included are Career proposals, Conferences and workshops, Research Coordination Networks (RCN), EAGERs, RAPIDs, and supplements such as REU, INTERN, RET, RAHS, ROA. .

# 18-587 DEB, Division of Environmental Biology

- A PI can submit a proposal, to a core program in the Division, and a proposal in which that program contributes to the RoL track.
  - The core programs:
    - Ecosystem Science (ES),
    - Evolutionary Processes (EP),
    - Population and Community Ecology (PCE),
    - Systematics and Biodiversity Science (SBS) Included in the one-proposal limits are also
    - Joint US-UK and US-Israel proposals in the core subject areas.
    - Long-term Research in Environmental Biology (LTREB), Opportunities for Promoting Understanding through Synthesis (OPUS)
    - RUI proposals (Research in Undergraduate Institutions)
  - A special DEB Core track is Bridging Ecology and Evolution (BEE)

# 18-587 DEB, Division of Environmental Biology

- Not included are Career proposals, Conferences and workshops, EAGERs, RAPIDs, INTERN, Ecology and Evolution of Infectious Diseases (EEID), Research Coordination Networks (RCN), Dimensions of Biodiversity (DIB), Dynamics of Coupled Natural and Human Systems (CNH), Long-term Ecological Research (LTER), Macrosystems Biology and Early NEON Science (MSB-NEON) , and supplements such as REU, INTERN, RET, RAHS, ROA.

# 18-585 MCB, Molecular and Cellular Biology (MCB) caps

- A PI can submit a proposal, to a core program in the Division, and a proposal in which that program is a partner in the RoL track.
  - The core:
    - Cellular Dynamics and Function (CDF),
    - Genetic Mechanisms (GM),
    - Molecular Biophysics (MB),
    - Systems and Synthetic Biology (SSB)
  - Included in the one-proposal limit are RUI proposals
- Not included are Career proposals, Research Coordination Networks (RCN), Conferences and workshops, EAGERs, RAPIDs, and supplements such as REU, INTERN, RET, RAHS, ROA.

# 18-586 IOS, Integrative Organismal Biology (IOS) caps

- A PI can submit a proposal, to a core program in the Division, and a proposal in which that program contributes to the RoL track requirement.
  - The core:
    - Behavioral Systems (BS),
    - Developmental Systems (DS),
    - Neural Systems (NS),
    - Physiological and Structural Systems (PSS),
    - Plant Genome Research Program (PGRP),
    - Plant Biotic Interactions (PBI).
  - Included in the one-proposal limits are also
    - Joint US-Israel (BSF) proposals in the core subject areas.
    - RUI proposals
- Not included are Career proposals, Enabling Discovery through Genomic Tools (EDGE), Mid-Career investigator Awards (MCA-IOS), Accomplishment-Based Renewal (ABR), Research Coordination Networks (RCN), Conferences and workshops, EAGERs, RAPIDs, and supplements such as REU, INTERN, RET, RAHS, ROA.

# Other Acronyms

- Career proposals (faculty early career development) – for assistant professors within 5 years of first tenure-track position. Limits vary- usually ~$400-500k over a 5-yr period.

- EAGERs: Early Concept Grants for Exploratory Research (untested, a single high-risk idea). $300k, 1-2 years.

- RAPIDs: Rapid Response Research which focuses on projects where there is urgency with respect to availability of data, equipment, facilities. $200k, 1 year

- REU, RET, RAHSS, ROA. Research Experience for Undergraduates, Research Experience for Teachers, Research Assistantships for High School Students, Research Opportunity Award. Limits vary – ask the cognizant program officer.

- INTERN: Non-Academic Research Internships for Graduate Students (a new DCL). $55k for 6-month support of a student (applicant is PI of an NSF award supporting that student, not the student. Student can be MS or PhD and can be international).

# Research in Undergraduate Institutions

- Contact the cognizant program officer as requirements vary by Directorate and program.
- The proposal may contain a Research Opportunity Award component.
  - The ROA allows a faculty member to travel to another lab at a research-intensive institution
  - This can be requested as a supplement
- The goal is to support research by faculty at primarily undergraduate institutions (PUIs), or shared instrumentation. The proposal should include
  - How this expands the faculty member's professional research development and career
  - Show how research capacity is improve at the home institution
  - Show how the research methods and results are incorporated into coursework/educational activities for students.
- Eligible institutions award Associates, BAs, BSc, MS in NSF-supported fields, but <20 Ph.D. or D.Sci. degrees in the past 2yr.

# The INTERN Dear Colleague Letter

- The DCL supports Non-Academic Research Internships for Graduate Students
  - Conditions: https://www.nsf.gov/pubs/2018/nsf18102/nsf18102.jsp
- The idea: most students will not go on to academic careers; practical experiences inform good choices; a professional scientist has many career options
  - Industry – research labs as well as start-ups
  - Government agencies and national labs
  - NGO and policy think-tanks
  - Journalism/publishing/science communication
- Eligibility –
  - Foundation-wide program
  - These are supplements to existing NSF awards, students must have been supported on those awards;
    - This supplement has a defined cap that can be greater than 20% of the grant total: $55k per student, max of 2 supplements per grant
    - GRFP awardees may apply
  - Both MS and PhD students are eligible EXCEPT that CISE/OAC and MPS/AST will only support PhD students.
  - Students must be in good standing in their graduate program
  - Required supporting docs: mentoring plan/partnership collaboration terms/IP sharing agreements in place

# Where does my proposal fit?

- Look at the core programs in the different BIO divisions and identify one that seems the best fit
- Look at the Awards database for grants made in that program – does your idea map to the general focus area of these proposals?
- Look up the current cognizant program officers for your best-fit program (POs rotate so make sure it is up to date)
- Send a 2-page description of your idea to that PO and request to set up a time to discuss your idea with him/her.
- Note: Co-review is commonly done - we are sensitive to interdisciplinary research and finding the best home for interesting ideas, but someone has to accept the proposal when it comes in.

# DBI team – who ya gonna call?

- Peter McCartney, Program Director (permanent)
  - pmccartn@nsf.gov
- Reed Beaman, Program Director (permanent)
  - rsbeaman@nsf.gov
- Jennifer Weller, Program Director (IPA = rotator)
  - jweller@nsf.gov (703-292-7121)
- Rob Fleischmann (permanent)
  - rfleisch@nsf.gov
- Steve Ellis (permanent)
  - stellis@nsf.gov)

# IIBR Program Overview

- Infrastructure Innovation for Biological Research (IIBR) (high-risk, high payoff) supported by NSF
  - Subject focus areas (themes): biological informatics, new instrument/sensor development with associated methods, multidisciplinary approaches that merge the two

- Expected products
  - Publicly available code* or designs (prototype level), papers
  - * code does not have to be Open Source or free, but you do have to explain how it can be obtained and under what terms.

# ICB Programs Overview

- Infrastructure Capacity for Biology (ICB).  There are 4 core programs (lower-risk, high payoff)
  - Collections in Support of Biological Research (CSBR)
  - Cyberinfrastructure for Biological Research (CIBR)
  - Improvements to Field Stations and Marine Labs (FSML)
  - Instrument Capacity for Biological Research (ICBR)
- Expected Products
  - Maturity: a well-tested, publicly accessible resource
  - Awareness: dissemination plans for sharing the resource's presence
  - Training plans: bring the target research community to use the resource correctly
  - Sustainability plan: a mode by which the target research community contributes to maintenance of the resource
  - Publications and original research beyond members of the production team

# The Review process

- Expert reviewers are asked to read and comment on the proposal

- Expert reviewers discuss the proposal and provide a summary of the discussion and an overall ranking – this results in a *recommendation* about funding

- Program Officers consider rankings and other criteria to make funding *recommendations*

- Division managers and the Division of Grants and Contracts decide whether to accept the recommendations

- Award and Decline notices go out

# Reminder: NSF-Wide Review Categories

- Intellectual merit
  - Significance of the research, appropriateness of methods, qualifications of the investigator and mentor, suitability of the host institution
- Broader impacts*
  - Broad scientific advances, education, training, benefits to society wrt security, safety or economics, outreach, promoting under-represented participation in scientific enterprise
  - * if the science does not pan out, what benefit will accrue to society?
  - Have a look at NABI if you need some ideas: https://broaderimpacts.net/

# Balancing IM and BI

- The science is pre-eminent: explain the potential to advance basic scientific knowledge (IM) and benefit society, eg with better nutrition or medical interventions or education and training (BI)

- Creative, original or transformative concepts count for both categories

- Well reasoned and organized work plan and *assessment methods for both categories*

- Qualifications of the team and institution, for both activities

- Adequate resources to carry out the project – include a budget for BI activities if reasonable

# Returned without Review

- Types of proposals NOT considered
  - Clinical biomedical studies (e.g. treatment outcomes) are not funded by BIO so DBI will not consider those application areas as part of IM
  - Agricultural applications (e.g. breeding for better yield) *purely for economic outcomes* is not funded by BIO as part of IM
  - Proposals judged unresponsive to the solicitation criteria

# DBI-Specific Review Criteria

- Proposal must explicitly show how work will advance BIO research
  - Because this is Infrastructure, it must clear that it will serve *multiple* BIO – Core investigators (Core = the other NSF Bio divisions)
  - Fundamental work might cross Core Divisions
    - E.g. general bioinformatics methods for managing omics data (e.g. for handling volume of data or data integration).
- How will Impact on community be measured (assessment!)
  - Identify community, show need for work, show effectiveness of product and training and outreach efforts
- Plan for product availability (does not have to be OS)
- Provide explicit Management plans for:
  - Roles and Responsibilities, including for training and outreach
  - Schedules and milestones, risk mitigation
  - Communication and data management

# DBI-Infrastructure Innovation Solicitation

- High novelty and potential impact
- Scope: one discrete or 2-3 tightly coupled problems
- Outcomes expected:
    - publication of new methodologies,
    - proof of concept
    - prototype
- Purpose: Take on challenging, *high risk* problems
- Proposal type implies: Shorter timelines, less complex management plans, PhD students and post-docs on team
- Note: you may request wet-lab materials or develop sensors for data collection for *validation* purposes

# DBI-Infrastructure Capacity Solicitation

- **Low** risk, predicated on existing working prototype, demonstrated scientific value
  - Not necessarily created with ABI Innovation
- Demonstrated demand for scaling up some aspect of the prototypes performance
- Purpose: to develop a 'finished' software project using sound software engineering principles
  - resulting in a product with demonstrable impact in advancing BIO research (assessment!)
  - Proposals must have: Usability tests, design quality steps, good Software Engineering practices, test plans, a very detailed management plan, user engagement plans, code/documentation/tutorial dissemination and support plans, how will product be sustained once grant is over.
- Proposal implications: budgets larger, durations longer, scientific software programmers on team but not always PhD students or post-docs

# DBI-Infrastructure Sustaining *

- Very low-risk wrt to functionality and existing user group. A mature product must exist that has proven value for enabling science to a BIO Core community – it is critical for their success

- Support for on-going operations and maintenance only
  - Code migration/updating may be justified
  - No new features (those are innovation)

- Budgets are small

- Duration planned to provide an independent long-term maintenance plan  after the term of this grant that does not equal another ABI Sustaining grant.
  - Be creative – we are looking for more successful examples!

* Solicitation is not yet released.

# Other Documentation - 1

- Data management plans – read as a Product Management Plan for code, data, documentation and any BI products as well (workshops, tutorials, lectures, etc.) and assessment outcomes.

  - What type of license will be used? Where will code be posted and managed? How will data be shared? Will standards be applied, if so which ones? Will there be restrictions?

- Post-doc Mentoring plans – not all post-docs will have academic appointments available.

  - How are you preparing them for other jobs? What University resources are available for post-docs? What type of personal mentoring are you doing? This needs to look personalized, even if you use a template as a starting point.

# Other Documentation - 2

- What not to have: no letters of support are allowed, only letters of collaboration, and those must use the very restricted assurance provided on the template.

- Check the new template for recording conflicts of interest based on academic relationship, collaboration and co-authorship.
  - Be reasonable with respect to co-authorship if you are on a very high-author-count paper – only list those co-authors that you actually know and would recognize at a meeting.
  - Why? If you cite COI with every person who helped author (for example) a review paper, there may be very few researchers remaining who are qualified to review your proposal.

# Panel Ranking Levels

- Each proposal is placed in *one* category
  - **Outstanding** - highest priority, no weaknesses
  - **Highly Meritorious** – a priority, no fatal flaws but there might be a discussion about the scope of an aim, for example
  - **Meritorious** – this is potentially fundable but reviewers found serious weaknesses, generally this means a revision* is recommended
  - **Non-Competitive** – the idea itself has serious flaws

  * NSF does not, formally, accept 'resubmissions'

# Panel Discussion Summary

- Does *not* restate the reviewer comments – it explains what points were made in the discussion, both highs and lows, that led to the final ranking

- Agreement is not required: in that case the summary explains the differences of opinion that the discussion did not resolve

- The goal is that a PI should understand the basis for the award/non-award recommendation and if not awarded has a clear idea as to how the proposal can be made better

# Funding Decisions and Timelines

- Reviewers are *advisors* not decision -makers
- Award decisions will be based on:
  - Reviewer/Panel recommendations
  - Portfolio balance (Core Divisions equally served, types of institutions, types of PIs, etc. )
  - Program priorities for BIO year to year
  - Other considerations (e.g. Congressional mandates)

- What does this mean? High ranking proposals might not be funded when lower ranking proposals are.
  - The program officers have to fully justify these decisions based on objective criteria in a Review Analysis

# Thanks for your attention!

- Questions?
- Comments?
- Slings and Arrows?