Academic Mentoring Workshop

Writing Competitive Research Proposals

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Adapted from various, past NSF Program Directors' Presentations

University of Southern California

First Principles

- *Get to know the agency's programs in your area*
  - Lay of the land
- *Review program "summary of awards"*
  - Past trajectory
- *Get to know your program officer(s)*
  - Current trajectory
- *Participate in agency-sponsored workshops*
  - Help set future trajectories
- *Serve on review panels and as an ad hoc reviewer*
  - Exposure to lots of proposals and many proposal evaluators
- *Stay informed*
  - NSF email updates: Daily Digest Bulletin
- *Develop good proposal-writing habits*

Types of Proposals

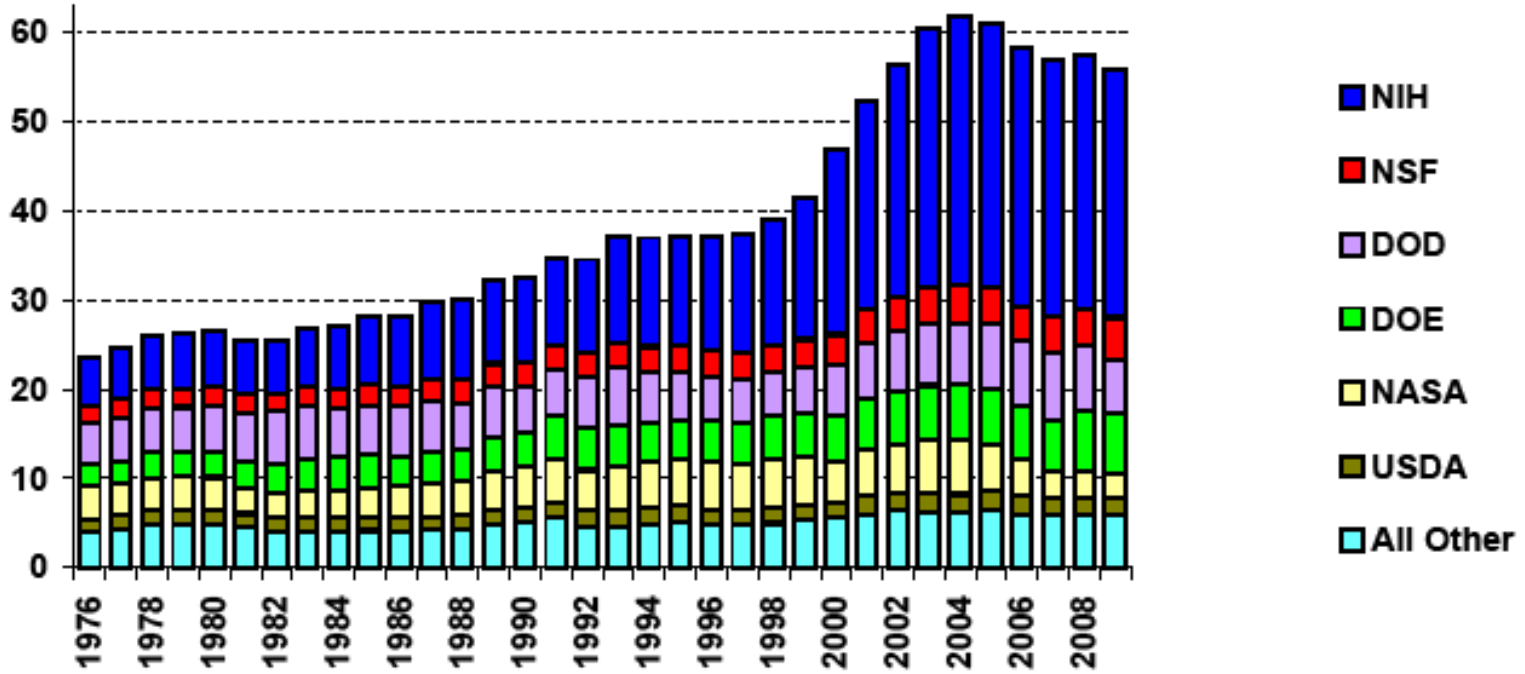
- *Research*
  - Single-investigator (e.g., small)
  - Multi-investigator (e.g., medium, large, centers)
- *Research Infrastructure*
  - NSF MRI, CRI
- *Education*
  - Curriculum Development, Training, Advancement (IGERT, ADVANCE)
- *Special Opportunities*
  - NSF EAGER, FASED, RAPID, Conferences/Workshops, Int'l Travel
- *Supplements*
  - Standard NSF supplements, REUs, RETs, ROAs
- *Translational*
  - NSF SBIR, STTR, I-Corps

Outline

- ✓ First Principles and Types of Proposals
- Funding Agency Information: NSF
- Research Proposal Preparation
- Proposal Merit Review
- Tips for Writing Competitive Proposals

Trends in Research by Agency, FY 1976-2009 *

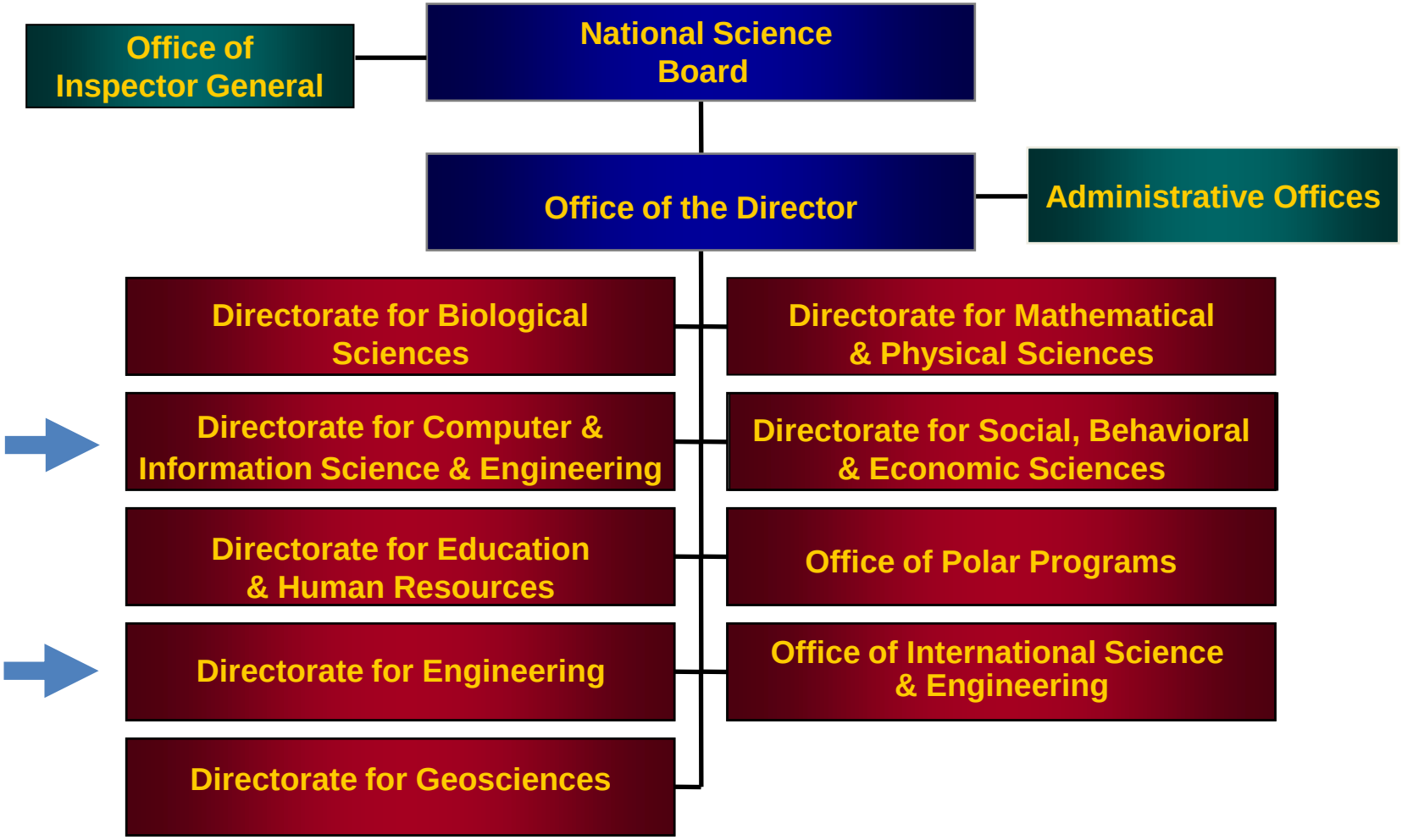
in billions of constant FY 2008 dollars



Source: AAAS analyses of R&D in annual AAAS R&D reports.
* FY 2009 figures are latest AAAS estimates of FY 2009 request. Research includes basic research and applied research. 1976-1994 figures are NSF data on obligations in the Federal Funds survey.
FEBRUARY '08 PRELIMINARY © 2008 AAAS

2009 DOD does not show additions Congress inserts in the appropriations bill

AAAS

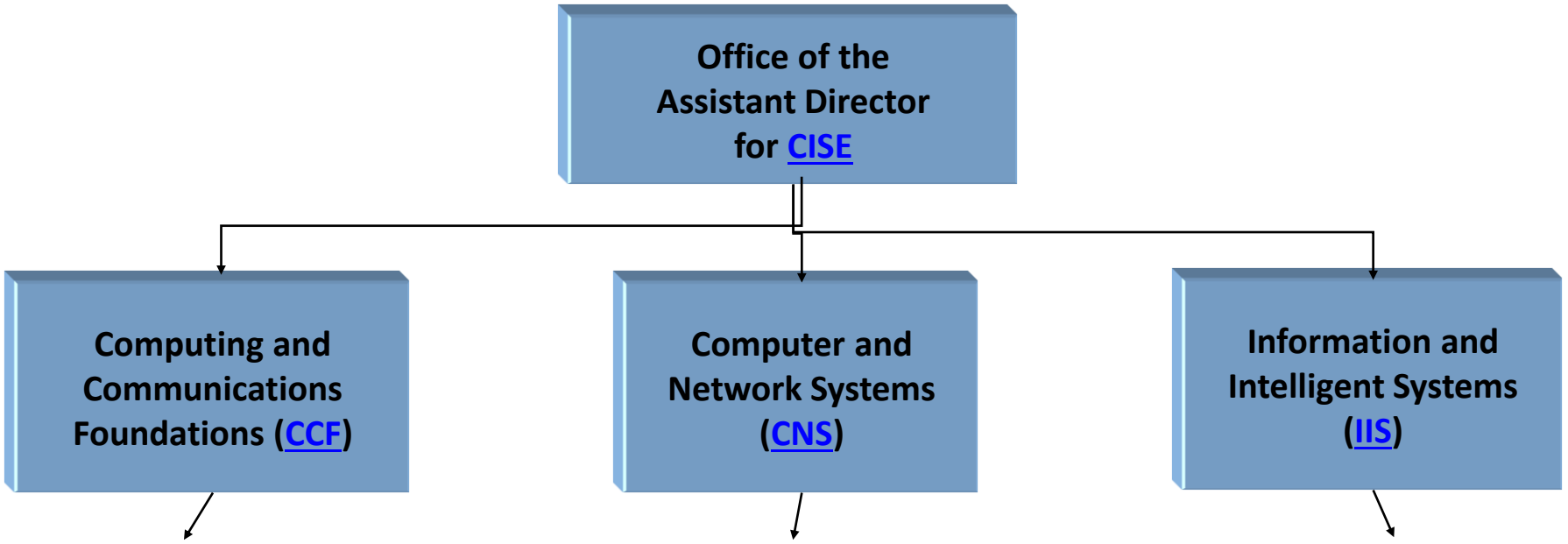


NSF Budget Request: http://www.nsf.gov/pubs/2014/nsf14041/nsf14041.pdf

NSF FY'15 budget request: *$7.3 billion* (~1% over appropriated FY'14 level)

- **CISE 2014 budget request: *$950 million* (~10% increase over FY'13 level)**
- **ENG 2014 budget request: *$911 million* (~10% increase over FY'13 level)**

NSF CISE Directorate

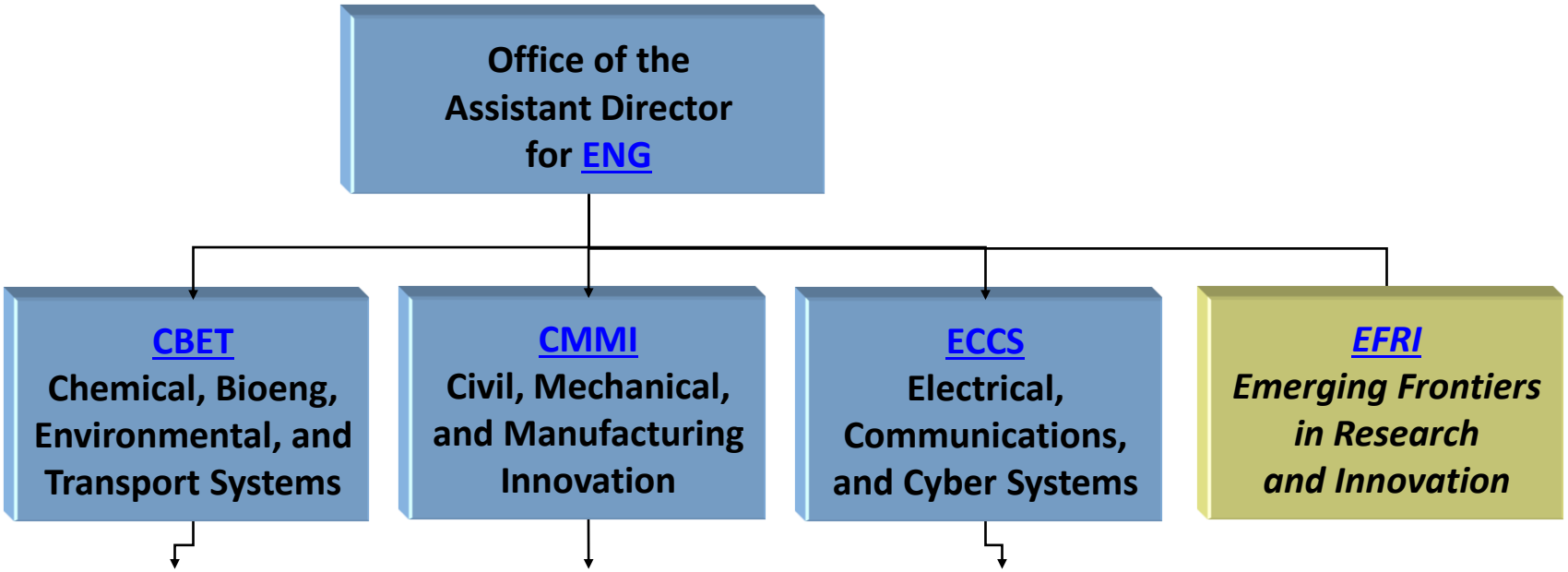


❖ **Division of Advanced Cyber-infrastructure (ACI)**

Crosscutting CISE, NSF Emphasis Areas

- EiC
- I-Corps
- CPS
- XPS
- SaTC
- SCH
- NRI, CE21
- CRI, MRI
- REU, RET
- CAREER
- ADVANCE
- IGERT, GK-12

NSF ENG Directorate



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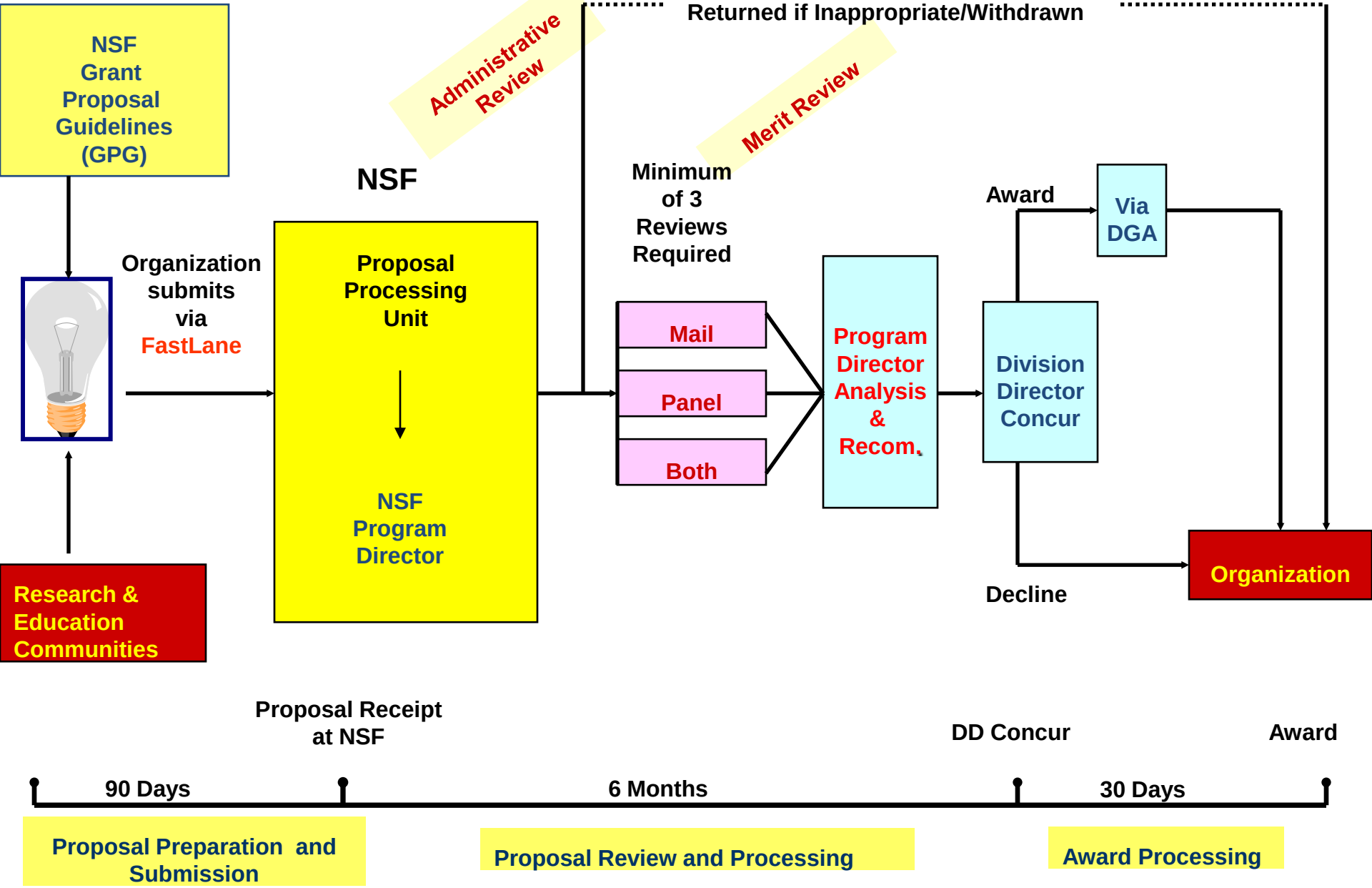
NSF Proposal Submission Preliminaries

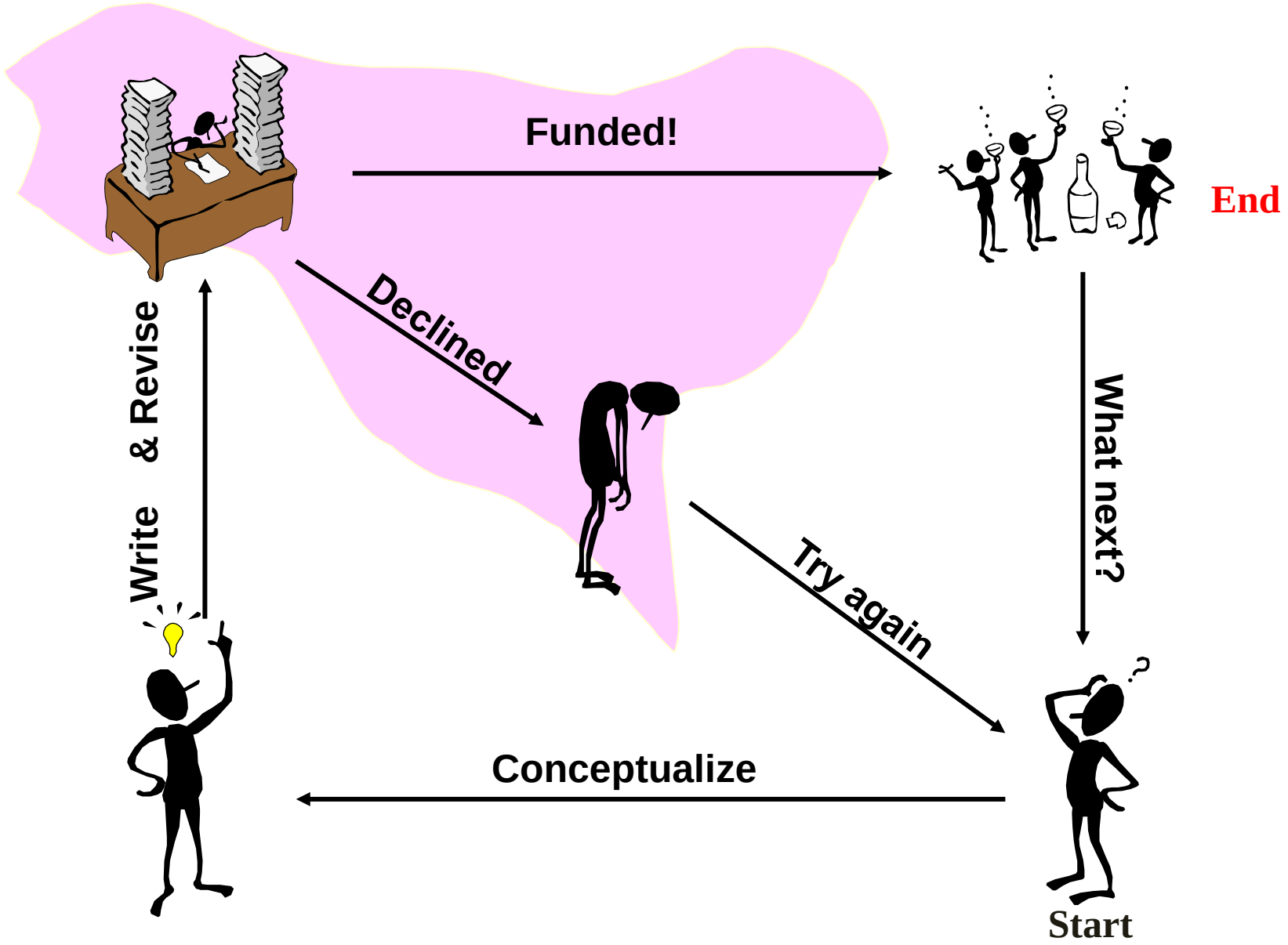
- *Who can submit NSF proposals?*
  - Universities and colleges
  - Non-profit, non-academic organizations
  - For-profit organizations
  - State and local governments
- *What to submit?*
  - Letter of Intent, Preliminary Proposal, Full Proposal
- *When to submit?*
  - Target date, deadline, and submission window
- *Where to submit proposals?*
  - FastLane (https://www.fastlane.nsf.gov)
  - Grants.gov (http://www.grants.gov)
- *Why submit?*
  - Enables the advancement of research and education
- *How to know about funding opportunities?*
  - Program Descriptions, Program Announcements, Dear Colleague Letters, and Program Solicitations

NSF Proposal Review and Award Process & Timeline

http://www.nsf.gov/bfa/dias/policy/merit_review/



Proposal Life Cycle

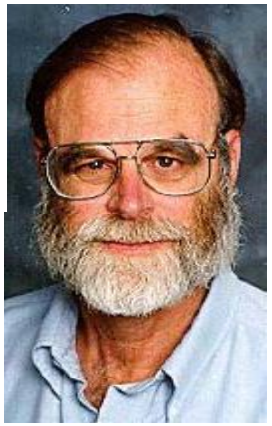


Writing Research Proposals

A *fundable proposal* describes a good idea and attainable goal, well expressed and motivated, with a clear indication of methods for pursuing the idea, evaluating the findings, making them known and having broad impact.

Properties of a Research Goal

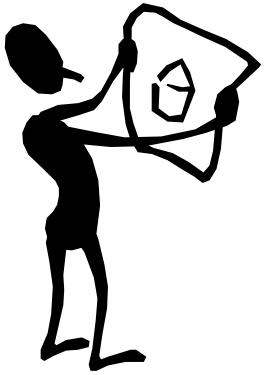
- Simple to state
- Not obvious how to do it
- Clear benefit
- Progress and solution are testable
- Can be broken into smaller steps
  - So that you can see intermediate progress



By Jim Gray, Turing Award Winner

http://research.Microsoft.com/~Gray/talks/Turing2.ppt

Step 1: Carefully Read the Program Descriptions and Solicitations



- *Find the right program early!*
  - It's better to do this well before you write rather than after you get your reviews back
- *Talk with Program Director to make sure your ideas fit in the program*
  - If the Program Director (PD) tells you that your ideas are too narrow or don't fit the program, look for other sources
- *Make sure your project is worthwhile, realistic, well-planned, and innovative*

Step 2: Develop Your Good Idea

- *Key Questions*
  - What do you intend to do and how will you do it?
  - Why is it important?
  - What does the literature provide?
- *Make sure the idea is innovative and exciting*
  - Survey the literature
  - Talk with others in the field
- *Convince people you can accomplish it*
  - Obtain preliminary data to support feasibility
  - Determine available facilities and resources
    - What infrastructure do you have to work with?
    - With whom will you work (students, collaborators, industry partners)?

Step 3: Prepare the Submission

- *NSF Grant Proposal Guide (GPG)*
  - http://www.nsf.gov/pubs/policydocs/pappguide/nsf14001/gpgprint.pdf
- *Preparation and submission instructions*
  - Proposal format and contents
  - collaborative proposals from multiple institutions
    - One submission with "sub-awards" from lead institution
    - Separate simultaneous proposal submissions (FastLane)
  - Return without review criteria
- *Review criteria and review process*
  - Withdrawal
  - Invite/Not-Invite, Encourage/Not-Encourage, Award/Declination
- *Post Award Processes*

NSF Proposal Merit Review Criteria

http://www.nsf.gov/bfa/dias/policy/merit_review/resources.jsp

- The *Intellectual Merit* of the proposed activity
  - Creativity, originality, and potentially transformative
  - Potential to advancing knowledge and understanding within and across fields
  - Conceptualization and organization
  - Qualifications of investigators
  - Access to resources
- The *Broader Impacts* of the proposed activity
  - Discovery while promoting teaching, training and learning
  - Participation of underrepresented groups
  - Enhancement of infrastructure for research and education
  - Dissemination of results to enhance scientific/tech understanding
  - Benefits to society
- Program-specific merit review criteria
  - Some programs have additional review criteria in solicitation

NSF Proposal Contents

- Cover Sheet and Certifications
- **Project Summary (*one page max*)**
- Table of Contents
- **Project Description *(typically 15 pages max.)***
- References cited
- Biographical Sketches (*2 pages/Senior Investigator*)
- Budget and Budget Justification (*3 pages max.*)
- Current and Pending Support (*all sources*)
- Facilities, Equipment and Other Resources
- Supplemental Documentation
  - all proposals must include *Data Management Plan*
  - support for postdocs require *Postdoc Mentoring Plan* (1 page)
  - add'l allowed docs may vary by programs and directorates
- Single Copy Documents

Project Summary

- *This one page summary is critical*
  - Not an abstract; a self-contained description of the activity
  - May affect which program or panel will review your proposal
  - Must address both *Intellectual Merit* and *Broader Impacts*
- *Written in third person*
- *Intellectual Merit*
  - Describe the scientific/engineering problem and its importance
  - State the overall objective and specific aims of the project
  - Describe how the objectives and aims will be achieved
- *Broader Impacts*
  - Educational & outreach activities; infrastructure; dissemination of results; underrepresented groups; benefits to society

Project Description

- Typically a maximum of 15 pages (preliminary proposals fewer)
- Objectives and expected significance
- Relation to present state of knowledge
- General plan of work
- Experimental methods and procedures
- Broader impacts
- Results from prior agency-sponsored support
  - required, if applicable (5 pages max., typically fewer)
- (Optional: relation to your longer term goals)
- URLs not to be used; unlimited references--add'l pages
- Unbudgeted substantial collaborations documented
  - letters of commitment in supplementary documents

Project Description (Possible Outline)

- Introduction (~2 pages)
- Related Work and Research Scope (~2-3 pages)
- Proposed Research (~5-6 pages)
- Research Plan (~2 pages)
  - How proposed techniques will be evaluated
  - Experimental set-up/tools/methods
  - Timeline of major milestones (by year)
- Broader Impact (~1-2 pages)
  - Research Community/Industry
  - Education and Outreach to broaden participation
- Results from Prior NSF Support (~1 page)
- References (unlimited pages, but typically < 6 pages)

Project Description (Tips)

- *Know your audience – reviewers, Program Director!*
  - Write accurately, concisely, and clearly
  - Make it easy for reviewers to like your proposal
  - First few pages engage or lose the audience
  - Figures and tables help get points across clearly
  - Some reviewers (particularly on interdisciplinary proposals) may not be experts in your specific field
  - Paint a coherent, compelling picture

Biographical Sketch

- *Limited to only two pages—prescribed format*
- *Professional preparation*
  - undergrad and grad degree institutions, postdoc institution(s)
- *Appointments*
  - reverse chronological order
- *Products—citable/accessible publications, data sets, SW, patents, etc.*
  - up to 5 closely related
  - up to 5 other significant
- *Synergistic activities*
  - up to 5 examples that demonstrate broader impact, service
- *Collaborators & other affiliations (for COIs)*
  - collaborators, co-authors (last 4 yrs) & co-editors (last 2yrs)
  - graduate and postdoctoral advisors
  - thesis and postgraduate-scholar advisees (past 5 years)

Budget

- Budget should be
  - for each year of support requested
  - reasonable; request what is needed
  - for personnel, equipment (>$5K), travel, participant support and other direct costs (sub-awards, consultants, materials & supplies publication costs) consistent with USC policies
  - for cost of educational activities associated with research, where appropriate
- A separate budget needed for each sub-awardee
- No NSF expectation of cost sharing component
- Budget must be accompanied by Budget Justification for direct cost line items (3 pages max.)
  - 2 months salary maximum in any one year (from all NSF grants)
  - admin staff salaries counted in indirect cost (few exceptions)

Current and Pending Support

- *List all current and pending support, including the proposal being submitted*
  - Fed, state, local, foreign, industrial, private
  - all funded activities requiring a portion of your time
- *Be careful of overlap*
  - perceived overlap could be detrimental in review
  - same work not to be funded twice!
- *Concurrent submissions of same proposal (not BIO)*
  - allowed to submit to multiple programs (but bad idea) and agencies
  - must withdraw proposal if gets funded elsewhere
- *Resubmission of prior proposals*
  - if funded before, must include last period in current/pending list
  - if declined before, must be revised substantially for resubmission; otherwise can be returned without review

Supplementary Documentation

All materials included in merit review (seen by reviewers)

- *Data Management Plan (2 pages max.)*
  - required of *all* proposals (can say "no plan needed")
  - must conform to dissemination/sharing policy
- *Postdoctoral Researcher Mentoring Plan (1 page max.)*
  - required if postdoc support is requested
  - description of mentoring activities
  - included in merit review
- *Program-specific Management Plans*
  - typically for large and center-scale proposals
- *Letters of Commitment*
  - unbudgeted collaborations of significance
  - "letters of support"; *note:* endorsements *not* to be included

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Review Criteria: Intellectual Merit

- *Objectives, method/approach, potential impact compelling?*
- *How important is the activity to advancing knowledge and understanding within the field or across different fields?*
  - —***Significance** of expected results*: Incremental? High impact? High-risk but high-gain?
- *How well qualified are you to conduct the research?*
  - —Not necessary to have track record on specific topic, but ***quality** of prior work* usually a consideration, as are ***preliminary results***
- *How creative and original are the concepts and ideas?*
  - —Should be ***ground-breaking*** in some aspect
- *How well conceived and organized is the proposed activity?*
  - —*Well-articulated **problem*** and *well-structured research **plan***
- *Is there sufficient access to resources?*
  - —Should have ***access*** to equipment, facilities, human capital, …

Review Criteria: Broader Impacts

- Does the activity advance discovery and understanding while *promoting teaching, training and learning*?
- Does the activity *broaden the participation* of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?
- Will it *enhance the infrastructure for research and education*, such as facilities, instrumentation, networks and partnerships?
- Will the *results* be *disseminated broadly* to enhance scientific and technological understanding?
- What may be the *benefits* of the proposed activity *to other disciplines and society* as a whole?

Evaluation: Ad Hoc and Panel Reviews

- *A minimum of 3 reviews per proposal (typically 4 or more)*
  - A *score* of ***E***, ***V***, ***G***, ***F***, ***P*** is given by each reviewer
  - *Comments* on intellectual merit and broader impacts
  - Typically, a recommendation to fund (or not) is given
- *Panel Review:*
  - Proposals are discussed and ***evaluated collectively***
  - ***Proposal summary*** is written—couple of sentences
  - Intellectual merits are described: *strengths, weaknesses*
  - Broader impacts are described: *strengths, weaknesses*
  - *Improvements* may be suggested (optional)
  - ***Panel recommendation***: *Highly Competitive (HC), Competitive (C), Low Competitive (LC),* ***Not Competitive (NC)***
- *Comments intended to help the PI(s) improve proposal for next competition*

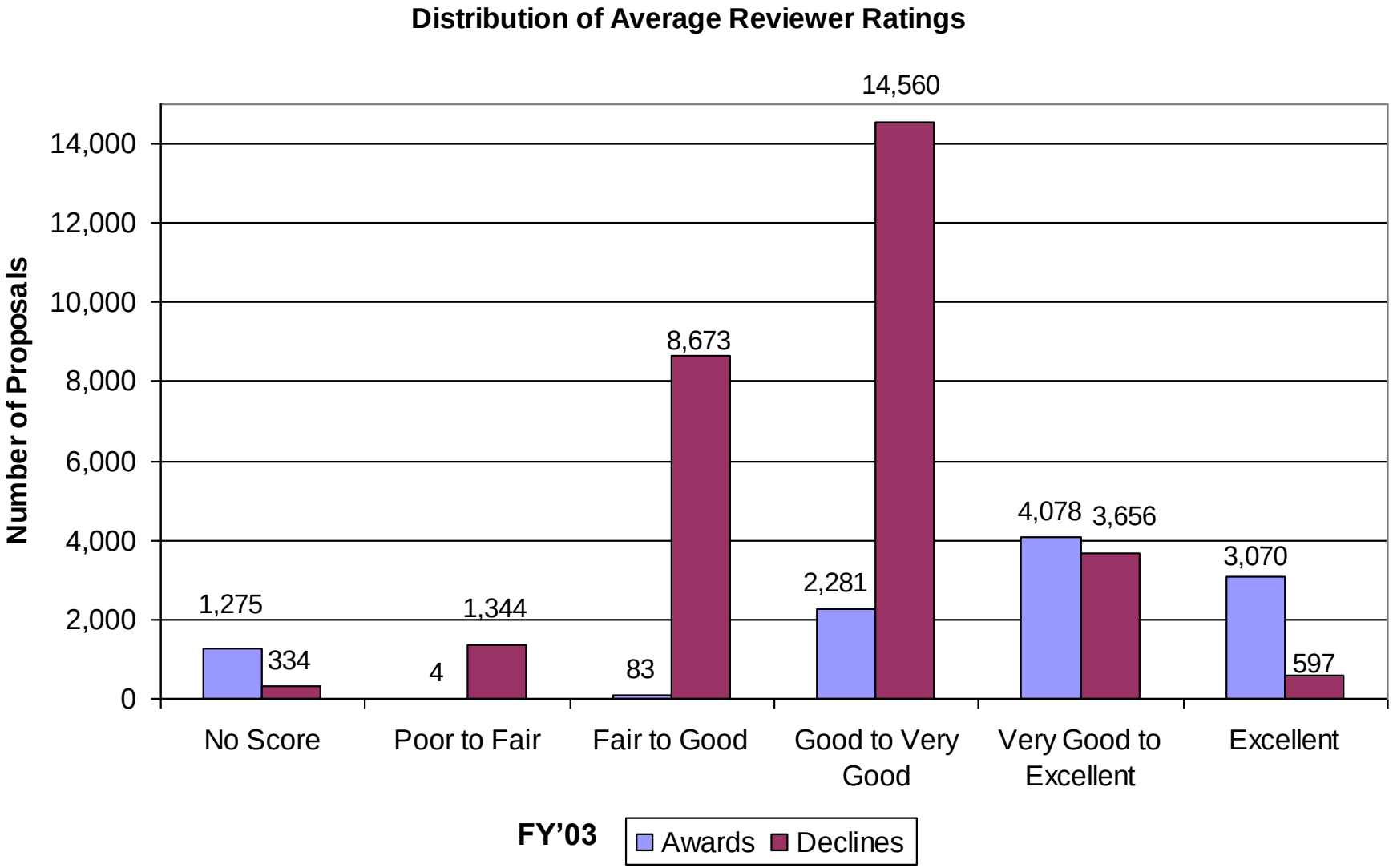
Basis for Decisions: ***Reviewer Input***

- *Reviews*
  - Content/justification of the reviews by reviewers oftentimes is more important than just the rating
- *Panel Ranking*
  - Proposals (competitive ones) often ranked by panel
- *Program Director uses reviews and panel summary/recommendation in award decisions*
  - Fairness
  - How substantive are the reviews
  - Technical problems raised in the reviews
    - major vs. minor issues
  - Reasons for the reviewers' concerns or enthusiasm

Basis for Decisions: ***Other Considerations***

- *Program Director uses other information in addition to reviewer input in making award decisions*
  - Innovation and creativity
    - High risk, high reward projects
  - Breadth of research areas
  - Priority areas and systems
  - Demographics, diversity along many dimensions
    - Broadening participation
    - Institutional impact: EPSCOR, MSI, PUI, etc.
    - International collaborations
  - Integration of research & education
  - Balanced Portfolio of funded projects

NSF Proposal Review Ratings



FY'12 Research Grant Proposals: 41,400 Proposals, 7,800 Awards (19% success)

3 years average duration, $161,200/yr average

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Access Available Help

- *Proposal Writing Workshops and Resources:*
  - http://www.cis.temple.edu/NSFCareer2013 (March 15, 2013, Temple University, Philadelphia)
  - http://www.clarku.edu/offices/research/pdfs/NSFProposalWritingTips.pdf
- *Read:*
  - Sponsoring agency publications
  - Successful proposals
- *Look before you leap:*
  - Serve as a proposal reviewer and panelist
- *Talk with people in-the-know:*
  - Current and former Program Directors
  - Successful colleagues, mentors, reviewers

Be Reasonable

- *Start early and get feedback*
  - Write, rewrite, and rewrite again…
- *Be aware of the research scope:*
  - "Too ambitious" or "Too narrow"
- *Be honest and up-front:*
  - Address issues instead of trying to hide them
  - Acknowledge possible experimental problems and have alternatives

Make It Easy for Reviewers

- *Know your audience:*
  - All reviewers may not be experts in your specific field
- *Simplify and streamline:*
  - Make sure you get your main idea(s) across
- *Pay attention to details:*
  - Run the spell checker and proof-read
  - Prepare clear photos, graphs, etc.
  - Make the font size as big as you can (*minimum of 6 lines per inch with 1" page margins!*)

Why Do Some Proposals Fail?

- *Absence of innovative ideas*
  - At best, provides only incremental advances
  - Not exciting or cutting edge
  - "just another proposal about"
- *Errors*
  - Unclear or incomplete expression of aims
  - Faulty logic or experimental design
  - Less than rigorous presentation
- *Unrealistic, sloppy or incomplete*
- *Resources and facilities not in place*
  - PI qualifications/expertise not evident
  - Necessary collaborations not documented

Seven Deadly Sins of Proposal Writing

1. Failure to focus on the key problems and payoffs
2. No persuasive structure: *poorly organized*
3. No clear differentiation: *competitive analysis*
4. Failure to offer compelling value proposition: *potential impact*
5. Key points are buried: *no highlights, impact is lost*
6. Difficult to read or appreciate: *full of jargon, too many low-level technical details or not enough details*
7. Credibility killers: *misspellings, grammatical errors, wrong technical terms, inconsistent format, …*

Closing Remarks

- There may be no *"best"* (or only) way to write a competitive research proposal, but many successful ones share similar characteristics
  - *clearly written, well motivated, organized, original, targeted, important, accomplishable, impactful, significant*
- *Funding depends* on many things, some of which are beyond your control
  - availability of funds, portfolio of existing funded research projects, set of reviewers, timing, …
- Be persistent and give your *best effort; success will come!*

Useful NSF On-line Documents

- FY 2015 NSF Budget Request
  - http://www.nsf.gov/about/budget/fy2015
- FY 2014 NSF Budget Request
  - http://www.nsf.gov/about/budget/fy2014
- Grant Proposal Guide (NSF 14-1)
  - http://www.nsf.gov/pubs/policydocs/pappguide/nsf14001/gpg_index.jsp
- Science and Engineering Statistics
  - http://www.nsf.gov/statistics/
- General Information
  - http://www.nsf.gov/

Access Other Sources

- Agency Publications
  - Program Solicitations
  - Grant Proposal Guide (GPG)
  - Web Pages
  - Funded Project Abstracts
  - Reports, Special Publications
- Program Directors
  - Incumbents
  - Former “Rotators”, “IPAs”
- Mentors on Campus
- Previous Panelists
- Sponsored Research Office
- Successful Proposals