Division of Graduate Education

Directorate for Education and Human Resources
National Science Foundation

August 17, 2012

Doris Carver
Program Director

Division of Graduate Education

- The Division of Graduate Education (DGE) supports U.S. graduate students and innovative graduate programs to prepare tomorrow's leaders in science, technology, engineering, and mathematics (STEM).

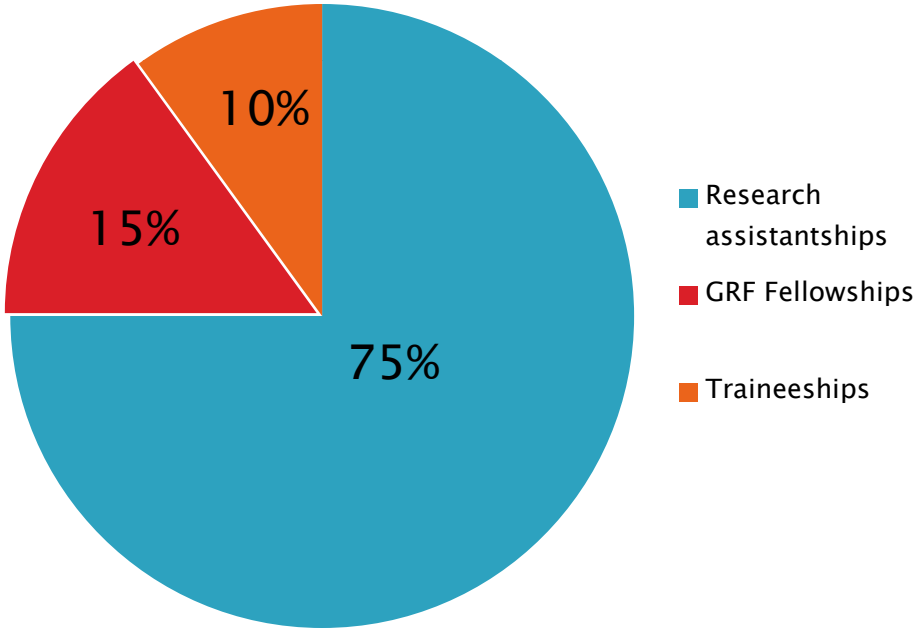
Division of Graduate Education Portfolio

- Graduate Research Fellowship Program (GRFP)
- Integrative Graduate Education and Research Traineeship Program (IGERT)
- NSF Graduate STEM Fellows in K-12 Education (GK-12)*
- Science Master's Program*

** No new competition*

NSF's Support of Graduate Students

- NSF funds an estimated 42,000 graduate students annually.



NSF Graduate Research Fellowship Program

nsf.gov/grfp
www.nsfgrfp.org

GRFP

- Initiated in 1952 – oldest NSF program
  - Celebrating 60th anniversary this year
- Approximately 6,500 active fellows on "tenure" (receiving stipend and cost of education allowance)
  - Enrolled in 235 different U.S. institutions
- Over 46,000 Fellows since 1952
- Highly successful individuals
  - Over 30 Nobel Laureates
  - Approximately 450 members of National Academy of Sciences
  - Contributes to diversity in STEM workforce
  - Higher PhD completion rates for fellows compared to non-Fellows

GRFP Goals

- *Select, recognize and financially support individuals early in their careers with the demonstrated potential to be high achieving scientists and engineers*

- *Broaden participation in science and engineering of underrepresented groups, including women, minorities and persons with disabilities*

GRFP Features

- **Flexible**: choice of project, advisor & program
- **Unrestrictive**: No service requirement
- **Portable**: Any accredited institution
  - MS ⟶ PhD

- 2010: 2,000 Fellowships
- 2011: 2,000 Fellowships
- 2012: 2,000 Fellowships

~12,000 Applications – ~17% success rate

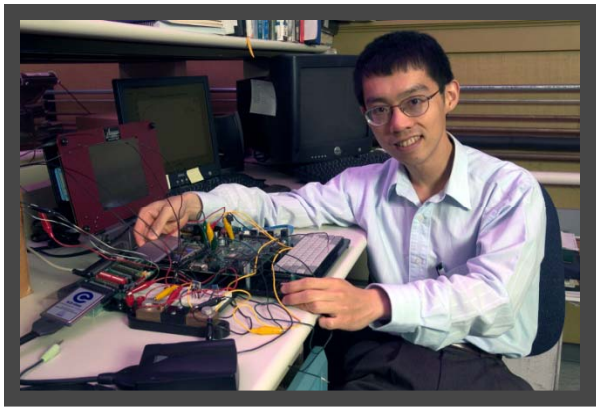
GRFP

- Three years of support over a five year period

- Funding
  - Annual stipend of $30,000
  - Annual cost of education allowance of $12,000 paid to institution

- Additional resources
  - Cyberinfrastructure access via XSEDE
  - Opportunities to participate in funded international professional development activities

GRFP Eligibility



- U.S. citizens and permanent residents
- Early-career graduate students
- Pursuing research-based MS and PhD in NSF supported fields
- Enrolled in accredited institution in US

Academic Levels

- 1: Seniors/baccalaureates; no graduate study
- 2: First-year graduate students
- 3: Second-year grad students
  - ≤ 12 months of graduate study by August 1
- 4: >12 months graduate study
  - Interruption in graduate study of 2+ years

Academic levels evaluated together

When to apply?

- During the senior year of college (Level 1)
- After graduating from college and prior to entering graduate school (Level 1)
- During the first year of graduate school (Level 2)
- Prior to completing the Fall term of the second year of graduate school (Level 3)
  - Must have completed no more than 12 months of full-time graduate study or its equivalent as of August 1, 2012. There is no credit hour limit for students who have completed only full-time graduate study; eligibility for full-time students is based on the length of time enrolled in the graduate program.
  - Part-time graduate study, or a combination of part-time and full-time graduate study, must have completed no more than 24 semester hours or 36 quarter hours or their equivalent as of August 1, 2012.

Ineligibility

- Those who do not hold US citizenship, national, or permanent resident status by the application deadline (November 2012)
- Those who were previously awarded a fellowship from the NSF GRFP and accepted it
- Those who have declined the offer of the NSF GRF and who did not notify NSF by the published deadline (May 1st) for accepting the Fellowship
- Those who have earned any graduate or professional degree (by August 1 2012)
  - Exception: applicants who have completed a joint BS/MS program and have not completed any further graduate study outside the joint program
- Current NSF employees

NSF-Supported Fields of Study

- Chemistry
- Computer & Information Science/Engineering
- Engineering
- Geosciences
- Life Sciences
- Mathematical Sciences
- Physics and Astronomy
- Psychology
- Social Sciences

Ineligible Programs

- Practice-oriented professional degree programs, joint professional degree-science programs (MD/PhD and JD/PhD), or medical, dental, law, and public health programs are not eligible. Examples of typical ineligible degree programs include MBA, MPH, MSW, and ED

Ineligible Areas of Graduate Study and Research

- Counseling
- Business administration or management
- Social work
- Education (except in science and engineering education in an NSF-supported discipline)
- History (except in history of science)
- Clinical study
  - patient-oriented research
  - epidemiological and behavioral studies
  - outcomes research
  - health services research

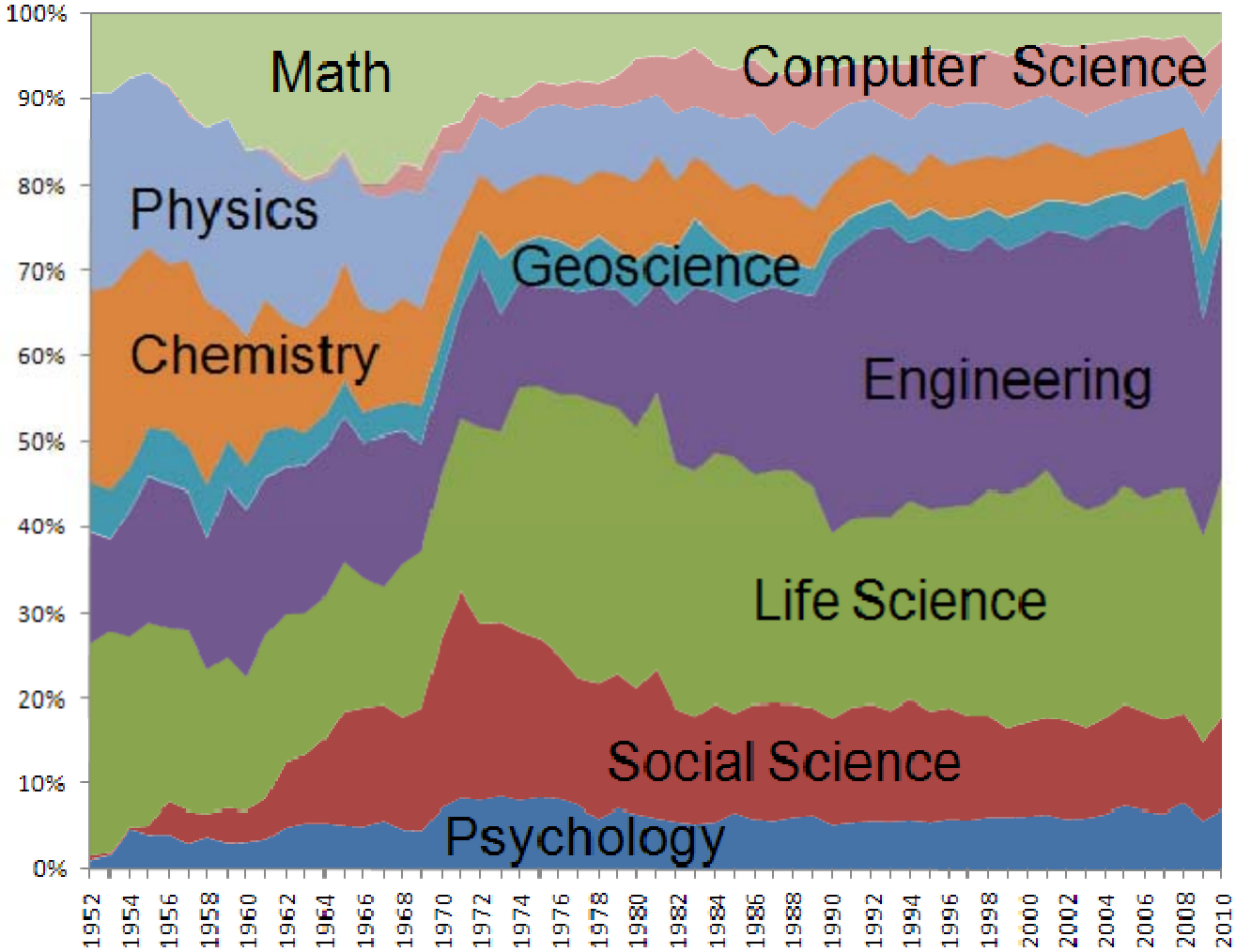
Ineligible Areas of Graduate Study and Research

- Research with **disease-related goals**:
  - work on the etiology, diagnosis or treatment of physical or mental disease
  - abnormality, or malfunction in human beings
- …….
- Exception
  - research in bioengineering, with diagnosis- or treatment-related goals, that applies engineering principles to problems in biology and medicine while advancing engineering knowledge is **eligible** for support.
  - bioengineering research to aid persons with disabilities also is **eligible.**

Materials Research (new in 2012)

- Biomaterials
- Ceramics
- Chemistry of materials
- Electronic materials
- Materials theory
- Metallic materials
- Photonic materials
- Physics of materials
- Polymers
- Materials Research, other (specify)

Fields of Study Over Time



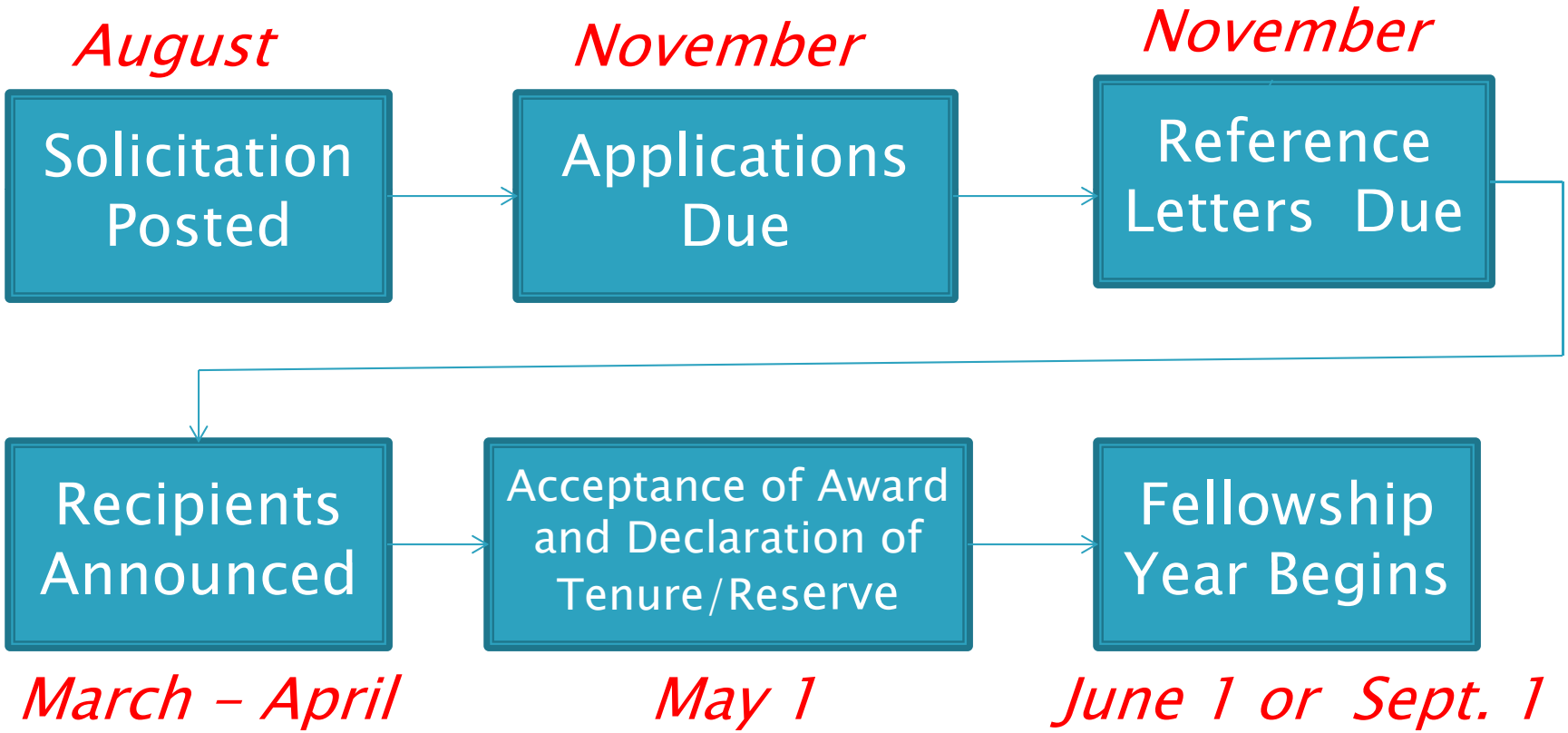
GRFP Application

- Application preparation
  - Start early
  - Read Solicitation
  - Read Solicitation again
  - Read NSF GRFP websites

GRFP Solicitation

- Program Description
- Award Information
- **Eligibility requirements**
- **Application preparation and submission instructions**
- **Application Review Information Criteria**
- Award Administration Information
- …

General GRFP Applicant Timeline



General GRFP Timeline

- Application Submission

- Reference Writer's Submission

Award Announcement

- Work on essays
- Contact references

GRFP Application

NSF FastLane

- Personal statement (2 pages)
- Previous research experience (2 pages)
- Proposed plan of research (2 pages)
- Three letters of reference
- Transcripts

- Completed graduate study (Level 4)

Interrupted Study

- Extenuating Circumstance- Level 4
  - Applicants who have completed more than 12 months of graduate study and who have not earned a graduate degree may be considered eligible if they have had an interruption in graduate study of at least two consecutive years prior to November 2012. To be eligible, applicants must have completed no additional graduate study by August 1, 2012.
  - A separate statement is needed to explain the reason for the interruption of studies of more than 2 years (Extenuating circumstance essay).

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Personal Statement Essay

*Fellows are expected to become **globally engaged knowledge experts and leaders** who can contribute significantly to research, education, and innovations in science and engineering.*

- Purpose is to demonstrate your **potential** to satisfy this expectation
- Ideas and examples not confined to the discipline that you have chosen to pursue.

Personal Statement Essay

- Describe the **experiences** that contributed to your preparation and desire to pursue advanced study in STEM

- Describe your **leadership potential**
  - how you see yourself currently or in the in future **contributing** to research, education, and innovation in science and engineering

- Describe **career aspirations** and **goals** you hope to achieve

Previous Research Experience Essay

- Describe any scientific **research activities** in which you have participated:
  - Undergraduate research programs
  - Research experience gained through summer or part-time employment
  - Work-study programs
  - Other research activities, either academic or job-related
- Describe any activities that you believe have prepared you to undertake research

Previous Research Experience Essay

- Explain the **purpose (aims)** of the research and your specific **role** in the research
  - include the extent to which you worked **independently** and/or as part of a **team**
  - include what you **learned** from your research experience

- Describe how you disseminated your results (i.e. conference, symposium, publication)

Proposed Research Essay

- Present a complete plan for a **research project** that you plan to pursue during the Fellowship period
- Statement should demonstrate **understanding** of research design and methodology
- Statement should explain the relationship to your previous research, if any

Proposed Research Essay

- Format:
  - Introduction and problem statement
  - Hypothesis
  - Methods to test hypothesis
  - Anticipated results or findings
  - Expected significance and broader impacts
  - Short list of important literature citations
- Your proposed plan must be in fields within NSF's mission (i.e. Field of Study)
- Proposed research reviewed to assess your potential for graduate level research

Application Review

- Three Essays
  1. Personal (up to 2 pages)
  2. Research experience (up to 2 pages)
  3. Research proposal (up to 2 pages)

- All three essays are reviewed in accordance with the NSF Merit Review Criteria.

  Collectively they should satisfy the two criteria:
  - Intellectual Merit
  - Broader Impacts

Intellectual Merit Review Criterion

- **Criterion**
  - "Demonstrated intellectual ability and other accepted requisites for scholarly scientific study, such as the ability to:

    (1) plan and conduct research;

    (2) work as a member of a team as well as independently; and

    (3) interpret and communicate research."

- **Assessment in GRFP can include:**
  - Academic performance & background (grades, curricula, GRE)
  - Awards/honors
  - Communication skills
  - Research experience
  - International experience
  - Independence/creativity
  - Publication/presentations
  - Research plan
  - Choice of institution
  - References

Broader Impacts Review Criterion

- Criterion
  - "Contributions that:

    (1) integrate research and education at all levels, infuse learning with discovery, and assure that the findings are communicated in a broad context and to a large audience;

    (2) encourage diversity, broaden opportunities, and enable the participation of all citizens, underrepresented minorities, and persons with disabilities – in science and research;

    (3) enhance scientific and technical understanding; and

    (4) benefit society."

- Assessment in GRFP can include:
  - Prior accomplishments
  - Community outreach
  - Impact on society
  - Future plans
  - Leadership potential
  - Individual experiences
  - Integration of research and education
  - Potential to reach diverse audiences

References

- Select reference writers carefully
  - Provide information about potential, prior research experience…
- Possible to request up to 5 references
- Reference writers submit reference letters.
- Applicant responsible for ensuring that three letters of references are submitted by the published deadline
  - Three reference letters are required for a complete application.

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NSF FastLane

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Application Review Process

- Applications
  - reviewed by panels of disciplinary and interdisciplinary scientists and engineers and other professional graduate education **experts**
  - **assigned** to panels based on the applicant's chosen Field(s) of Study and the discipline(s) represented
- Applicants
  - advised to select the Field of Study most closely **aligned** with the proposed graduate program of study and research plan

GRFP Reviews

- Panels of faculty, experts in fields of study
  - Read and review applications
- Each application has multiple reviewers
- Applications evaluated based on individuals (holistic approach)

NSF Review Criteria

National Science Board

GOVERNING BOARD OF THE NATIONAL SCIENCE FOUNDATION & POLICY ADVISORS TO THE PRESIDENT AND CONGRESS

- Two National Science Board-approved criteria
  - Intellectual Merit
  - Broader Impacts
- Provide an overall rating

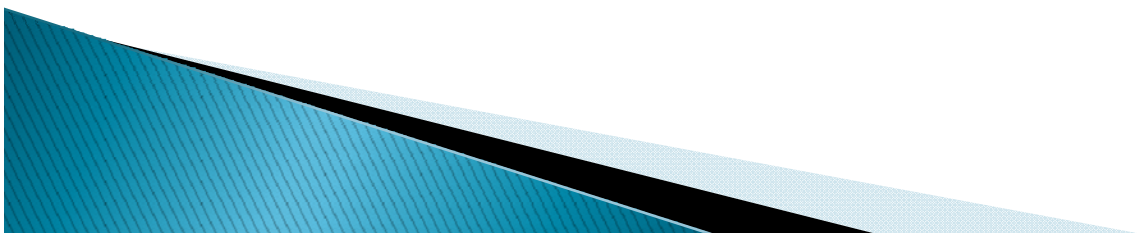
- Panels of disciplinary experts

GRFP Resources

- NSF GRFP Website (nsf.gov/grfp)
  - Solicitation and links
- NSF GRFP FastLane Website (fastlane.nsf.gov/grfp)
  - Application, guides, announcements
- GRFP Website (nsfgrfp.org)
- Current & former fellows
- Phone & e-mail
  - 866-NSF-GRFP (673-4737)
  - info@nsfgrfp.org
- Program Officers
  - Gisele Muller-Parker
  - Doris Carver

NSF Graduate Research Fellows

Questions?



Integrative Graduate Education and Research Traineeship Program (IGERT)

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21st Century Grand Challenges

- Research themes and questions that have the greatest potential to advance STEM disciplines and to promote human wellness and sustainability

- Inherently interdisciplinary and complex
  - Involve not just science and engineering, but also policy, government, and geopolitics

Examples of Grand Challenges

- Develop food plants to adapt and grow sustainably in changing environments
- Expand sustainable alternatives to fossil fuel
- Develop and manage smart grids
- Provide access to clean water
- Manage the nitrogen cycle
- Restore and improve urban infrastructure
- Develop better forecasting and proactive mitigation strategies for invasive species
- Reverse engineer the brain
- Manage and utilize data effectively

Addressing Grand Challenges

- Plans to tackle grand challenges should include:
  - Systematic training for future scientists and engineers to take on these challenges
  - Strategic support for interdisciplinary research
  - Cultivate innovation

Some Realities of Educational Institutions

"colleges and universities have evolved an organizational structure that is tightly coupled to traditional disciplines (Clark 1984) and thus ill equipped to foster interdisciplinary research, teaching, and learning"
Borrego et al. 2012

"The organizational culture of the university is one divided by disciplinary ways of thinking and behaving" (Holley 2009)
Cited by Borrego et al. 2012

Interdisciplinary Research and Training

What is NSF doing to promote interdisciplinary research and training?

NSF and Interdisciplinary Research

- NSF has a long history of encouraging interdisciplinary research (IDR)
  - support for proposals that are submitted in response to targeted IDR solicitations and for unsolicited proposals

- CREATIV (Creative Research Awards for Transforming Interdisciplinary ventures)
  - Launched in November 2011 (requests up to $1M, up to 5-yr duration)

  - "INSPIRE is aimed to encourage cross-disciplinary science. INSPIRE will help to break down any disciplinary barriers that may exist within NSF and encourage its program managers to use new tools, collaboration modes and techniques in the merit-review process to widen the pool of prospective discoveries that may be hidden from or circumvented by traditional means."
    NSF Director Subra Suresh

- INSPIRE (Integrated NSF Support Promoting Interdisciplinary Research and Education)

  - established to address some of the most complicated and pressing scientific problems that lie at the intersections of traditional disciplines

- .....

NSF and Interdisciplinary Graduate Student Training – IGERT

- NSF awards IGERT awards to institutions that develop innovative, interdisciplinary doctoral training and research programs in science, technology, engineering, and mathematics (STEM) disciplines
- IGERT initiated in 1998
- Created to address national need for greater emphasis on interdisciplinary training in graduate education

Purpose of IGERT

"catalyze a cultural change in graduate education, for students, faculty, and institutions, by establishing innovative models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries"

NSF 2010

IGERT Program Focus

- Interdisciplinary research experience
- Deep knowledge in chosen disciplines
- Innovative educational plan
- Technical, professional, and personal skills

IGERT Program Focus

- Develop career skills desired by both academic and non-academic employers
- Catalyze sustainable institutional change in graduate education for the training of future scientific research workforce
- Focus on Broadening Participation

IGERT Program Features

- Encourages experiments that may result in changes of existing models for Graduate Education
- Emphasizes integration of research and education experimentation
- Provides a substantial increase in resources for enhanced impact

IGERT Program Features

- Provides a framework wherein institutions, through PIs, can propose programs with enough flexibility to accommodate students' desire to design an education plan to match his/her career goals

- Provides a means for program performance assessment

IGERT

- IGERT data – 1998 to present
  - 278 awards
  - 122 different lead institutions
  - 43 states, DC, and Puerto Rico
  - >5,200 PhD students have been supported
  - Some institutions have had multiple awards (9 is the highest so far)
- Most recent competition had 154 proposals, ~18 awards (11.6%)

IGERT Funding Information

- 5-year awards (up to $3.5M)
- Up to $700K per year
  - Part of the first year may include equipment
- Supplemental International Training Component $50K per year for years 2-5

IGERT Funding Information

- Competitive Incentive Fund $200K (innovative activities)
- Graduate student stipend $30,000
- Cost of education expenses $12,000
- Full indirect cost rate

Intellectual Merit

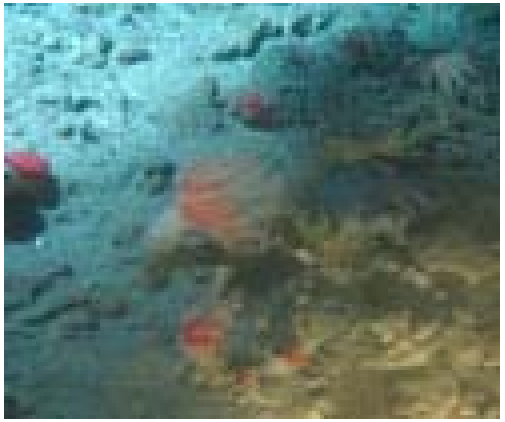
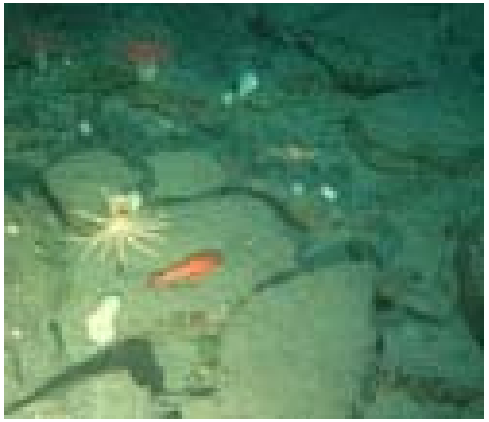
- How important is proposed activity to advancing knowledge and understanding within its own field or across different fields?
- How well qualified is the proposer to conduct the project?
- To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts?
- How well conceived and organized are proposed activities?
- Is there sufficient access to resources?
- If international activities are proposed, are they relevant and do they benefit applicant?

Broader Impacts

- How well does activity advance discovery and understanding while promoting teaching, training and learning?
- How well does the proposed activity broaden participation of underrepresented groups?
- To what extent will it enhance infrastructure for research and education?
- Will results be disseminated broadly?
- What may be the benefits of proposed activity to society?

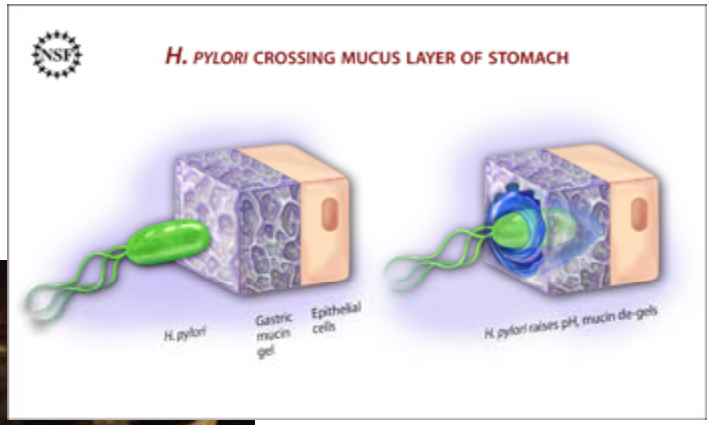
IGERT Program Cycle

- May 1 Letter of Intent (Mandatory)
- July 2 Full Proposal (One per institution)

Sample IGERT Themes

- Smart sensors and integrated devices
- Biosphere-atmosphere research
- Molecularly designed materials
- Assistive technology
- Sequential decision-making
- Urban ecology
- Astrobiology
- Alternate Energy
- Nanotechnology




engineering
anthropology
applied
behavioral
bioinformatics
biology
business
change
chemistry
climate
cognitive science
computational science
computer
computer science
earth science
ecology
economics
education
electrical engineering
energy
entrepreneurship
environmental
environmental science
genetics
genomics
geography
geoscience
health
information
information science
management
materials
materials science
mathematics
medicine
modeling
neuroscience
physics
policy
political science
psychology
public
research
social science
sociology
statistics
sustainability
systems
technology
water

Challenges for IGERT Trainees

- Managing an interdisciplinary curriculum with disciplinary depth
- Having a critical mass and support group
- Finding role models
- Counseling to secure faculty positions

Challenges for IGERT Faculty

- Departmental requirements
- Cultural differences among departments
- Administrative load on PI, faculty
- Release time or credit for faculty teaching
- Recognition for interdisciplinary teaching at (tenure or) promotion

Challenges for IGERT Institutions

- Rewarding interdisciplinary graduate education by faculty
- Hiring new faculty outside traditional disciplines
- Rewarding interdisciplinary research by young faculty
- Overcoming resistance or inertia
- Sustainability

IGERT Opportunities

- Create a culture for graduate students that transcends departmental and disciplinary boundaries
- Encourage experiments that may result in changes of existing models for graduate education
- Integrate interdisciplinary training and research

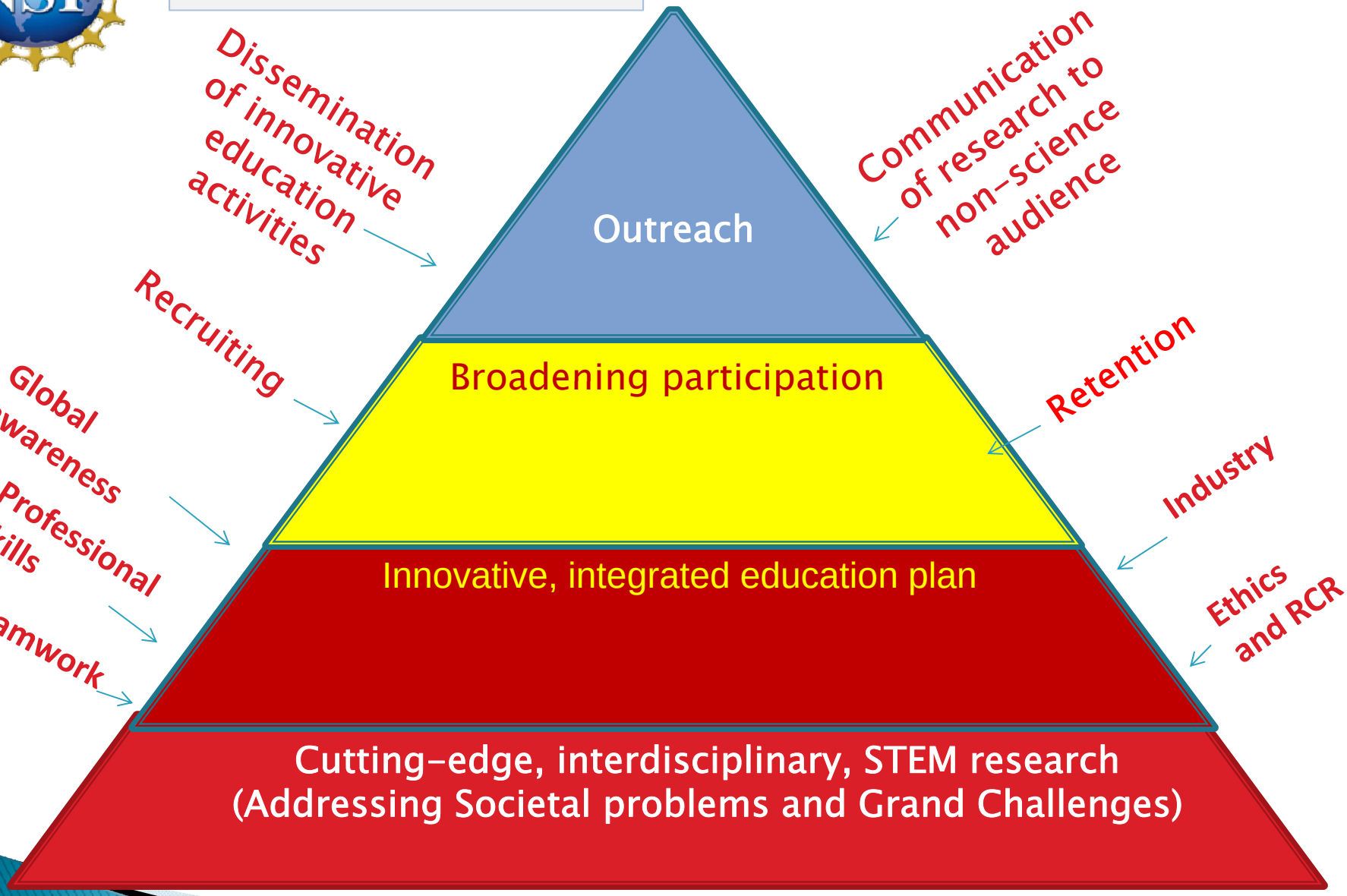
IGERT Opportunities

- Emphasize broadening participation
- Emphasize acquisition of transferrable professional and personal skills that are useful for both academic and non-academic careers
- Catalyze institutional change

IGERT CIF21 Track

- Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) and IGERT
  - addressing fundamental challenges in
    - 1) core techniques and technologies for advancing big data science and engineering;
    - 2) analyzing and dealing with challenging computational and data enabled science and engineering (CDS&E) problems, and
    - 3) researching, providing, and using the cyberinfrastructure that makes cutting-edge CDS&E research possible in any and all disciplines.

- Separate Competition
  - Letter of Intent July 4
  - Full Proposals August 6


Dissemination of innovative education activities
Communication of research to non-science audience
Outreach
Recruiting
Broadening participation
Retention
Global awareness
Professional skills
Industry
Innovative, integrated education plan
Ethics and RCR
Teamwork
Cutting-edge, interdisciplinary, STEM research
(Addressing Societal problems and Grand Challenges)

IGERT Resources

- NSF IGERT Website (nsf.gov/grfp)
  - http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12759
- http://www.igert.org
- Phone & e-mail
  - 703 292 8696
  - igert@nsf.gov
- Program Officers
  - Richard Boone
  - Carol Stoel
  - Richard Tankersley

NSF's Support of Graduate Students

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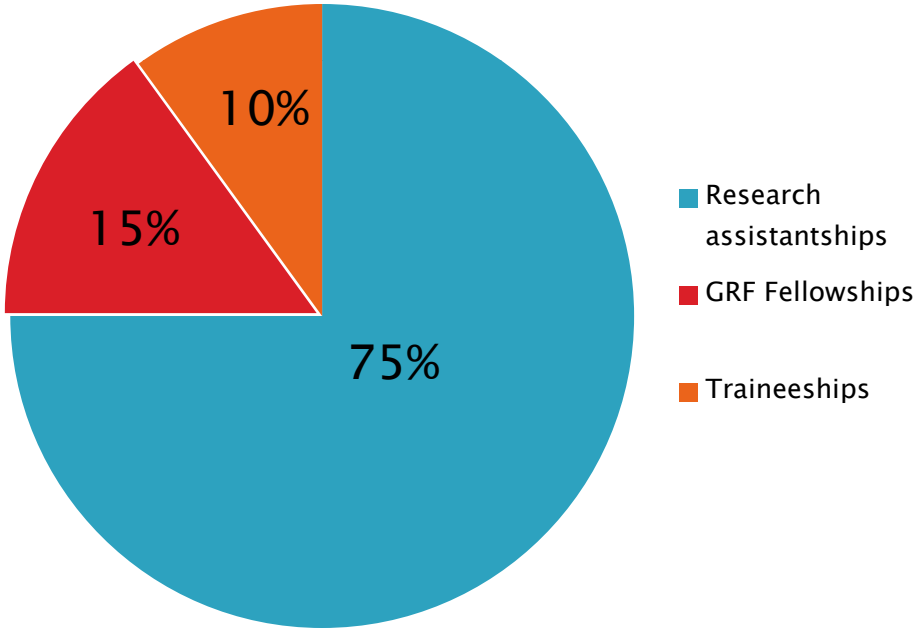

Other NSF Funding Opportunities for Graduate Education

- East Asia and Pacific Summer Institutes for U.S. Graduate Students (EAPSI)
- NSF Science, Engineering and Education for Sustainability Fellows
- Alliances for Graduate Education and the Professoriate
- Centers of Research Excellence in Science and Technology
- Federal Cyber Service: Scholarship for Service (SFS)
- Grant Opportunities for Academic Liaison with Industry
- NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)
- ……

Questions?