

IGERT

INTEGRATIVE GRADUATE
EDUCATION AND
RESEARCH TRAINEESHIP



2006-2007
ANNUAL REPORT

IGERT

INTEGRATIVE GRADUATE
EDUCATION AND
RESEARCH TRAINEESHIP

2006-2007
ANNUAL REPORT



PREPARED FOR

The Division of Graduate Education
IGERT Program

PREPARED BY

Susan Brown
Einstein Fellow

Judith Giordan
*Professor of Practice,
University of Southern Mississippi
IGERT Program Officer*

ACKNOWLEDGMENTS

First and foremost, the authors would like to thank Dr. Carol Van Hartesveldt, IGERT Program Officer, for her tireless and invaluable contributions to the IGERT program overall and to this work specifically. Her guidance, energy and dedication to the goals of IGERT are an inspiration to us all!

The authors also sincerely thank Dr. Dean Gerdeman, currently of the U.S. Department of Education, for his invaluable contributions during his time as an AAAS Fellow in the Division of Graduate Education at the NSF to crafting the upgraded web-based data collection on which this report is based; Macro International, most specifically Mr. Kazi Sayeem and his colleagues, for diligently developing and managing the web-based survey from which the data for this report were taken; Mr. Kent Franklin, Einstein Fellow with the IGERT program for his contributions; and, Dr. Umesh Thakkar for his work on identifying the alignment of IGERT projects with NSF cyber-infrastructure initiatives. The authors also thank the leadership of the Directorate of Education and Human Resources and the Division of Graduate Education for their support of this effort and the IGERT Coordinating Committee (ICC) for their ongoing efforts on behalf of the IGERT program.

This publication is dedicated to the ongoing efforts, accomplishments, and diligence of the IGERT PIs, Co-PIs, faculty, coordinators, and (most of all) trainees — without whom none of the excellent progress and contributions of IGERT to science, technology, engineering, math, and indeed the nation, would be possible — and to the STEM academic community for their ongoing interest in IGERT as illustrated by the number of pre and full proposals the program continues to receive even now in its tenth year!

TABLE OF CONTENTS

2	IGERT At-a-Glance
4	Executive Summary
7	CHAPTER 1: Transformative Interdisciplinary Research Achievements
25	CHAPTER 2: Transformative Achievements in Education – IGERT Trainees
33	CHAPTER 3: Informing the World – Influencing STEM Knowledge
41	CHAPTER 4: Trainees – Broadening Participation
47	CHAPTER 5: IGERT Looking Ahead FY 2008-2009
53	APPENDIX 1: Methodology and Conceptual Framework
55	APPENDIX 2: Photo Credits

IGERT AT-A-GLANCE

The Integrative Graduate Education and Research Traineeship (IGERT) program is the National Science Foundation's (NSF) flagship interdisciplinary graduate training program and has been in the vanguard for the last decade in stimulating a new paradigm in graduate education. The touchstones for summarizing information regarding the program are the NSF Strategic Plan and the IGERT Solicitation, the latter of which states that *"IGERT was developed to meet the challenges of educating U.S. Ph.D. scientists and engineers who will pursue careers in research and education, with the interdisciplinary backgrounds, deep knowledge in chosen disciplines, and technical, professional and personal skills to become, in their own careers, leaders and creative agents for change. The program is intended to catalyze a cultural change in graduate education, for students, faculty, and institutions, by establishing innovative new models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries. It is also intended to facilitate diversity in student participation and preparation, and to contribute to a world-class, broadly inclusive, and globally engaged science and engineering workforce."*

BACKGROUND AND OVERVIEW

Program inception: 1998

Location at NSF: Division of Graduate Education in the Education and Human Resources Directorate

Number and types of IGERT competitions: One preliminary proposal competition and one invitational competition per year. Approximately 450 preliminary proposals; ~100 invited to submit full proposals and ~20 awards.

IGERT meetings: IGERT holds two meetings per year: One Principal Investigator's (PI) meeting each spring and one new PI orientation meeting in the fall.

NSF IGERT oversight and governance:

The IGERT program is overseen by the IGERT Coordinating Committee (ICC) composed of representatives from each NSF directorate and IGERT program officers in the Division of Graduate Education (DGE).

IGERT funding: IGERT is funded through allocations from all Directorates of the NSF and some offices.

Directorates for Biological Sciences (BIO)
Computer and Information Science and Engineering (CISE)
Education and Human Resources (EHR)
Engineering (ENG)
Geosciences (GEO)
Mathematical and Physical Sciences (MPS)

Social, Behavioral, and Economic Sciences (SBE)
Office of Polar Programs (OPP)
Office of International Science and Engineering (OISE)

Number of IGERT grants awarded since program inception:
195 awards

Number of IGERT trainees over all 195 grants to date:
4,232 trainees

Distribution of IGERT grants by state: 40 states plus the District of Columbia have a total of 195 IGERT grants. Thirty (15%) of the grants to date are located in 15 Experimental Program to Stimulate Competitive Research (EPSCoR) states.

Institution distribution for the 195 IGERT grants since inception:

96 institutions

- 46 institutions have had 1 grant
- 25 institutions have had 2 grants
- 10 institutions have had 3 grants
- 9 institutions have had 4 grants
- 4 institutions have had 5 grants
- 1 institution has had 6 grants
- 1 institution has had 7 grants

IGERT partner institutions:

18 institutions have been a partner on one occasion, 3 have been partner institutions three times, for a total of 21 partner institutions and 27 different partnerships.

International funding: IGERT PIs have the option of requesting funds for the opportunity for trainees to participate in international experiences. 84 IGERTs of the 195 have received additional funding for the international component.

ANNUAL REPORT 2006-2007

- Number of IGERT grants reporting in 2007: 136
- Number of IGERT grants awarded in 2007: 20
- The IGERT Coordinating Committee (ICC) names and directorate alignment for the 2006-2007 reporting period are:
 BIO: Judy Skog; Anita Klein
 CISE: Ken Whang; Sirin Tekinay
 EHR: Roosevelt Johnson; Dan Maki
 ENG: Cynthia Ekstein; Scott Midkiff

GEO: Barbara Ransom; Lina Patino
 MPS: Dean Evasius; Uma Venkateswaran
 OPP: Fae Korsmo; Martin Jeffries
 SBE: Pat White; Rita Teutonico
 OISE: Rick Nader
 BFA: Pamela Green
 EHR: Carol Van Hartesveldt; IGERT Program Officer and ICC Co-Chair; Judith Giordan; IGERT Program Officer
 SBE: Frank Scioli; ICC Co-chair

- All IGERTs are based on interdisciplinary research themes that cut across all directorates. The percentage* of thematic alignments as identified by the PIs of the 136 IGERTS reporting in 2006-2007 with the NSF directorates:

60% align with BIO
 52% align with ENG
 42% align with MPS
 37% align with SBE
 31% align with CISE
 18% align with GEO
 1% align with OPP

* Due to the interdisciplinary nature of the research, percentages will not add to 100.

TRAINEES 2006-2007

- Number of trainees funded during the 2006-2007 reporting year: 1,519 trainees
- Number of trainees graduated with a Ph.D. during the 2006-2007 reporting year: 154 trainees

TRAINEE QUALITY

In the 2006-2007 annual survey, PIs were asked to compare the quality of their IGERT trainees to their other graduate students. 95% of IGERT PIs rated IGERT trainees as superior or better than their usual graduate students.

EXECUTIVE SUMMARY

The goal of this report is to provide to the stakeholders and community of the IGERT program an overview snapshot and a better understanding of the IGERT program overall through the lens of the compiled annual reports of the individual IGERTs active in 2006-2007. The report summarizes the input of the 136 individual IGERT project annual reports for the 2006-2007 collection period submitted on the web-based reporting system for IGERT. As a purely descriptive report, no recommendations for the program's future or evaluative conclusions are drawn.

Report Framework and Results Overview

The IGERT Solicitation acts as the basis for the many unique aspects of the IGERT program and the NSF strategic plan forms the framework in which the IGERT solicitation operates. For the NSF strategic goal of discovery, IGERT generates cutting edge interdisciplinary research that transforms landscapes of scientific understanding from unidimensional to multidimensional, advances scientific knowledge, and links interdisciplinary research with innovative interdisciplinary education to create a unique and well-rounded interdisciplinary graduate training experience. For the NSF strategic goal of learning, IGERT works diligently to ensure broadened participation across underrepresented groups in science, technology, engineering, mathematics (STEM) disciplines; supports the public's better understanding of science and technology; reaches out to K-12 students and undergraduates in order to help bridge critical educational junctures; and ensures that IGERT trainees have a global perspective and are prepared for 21st century careers.

Topics for summation were derived using the IGERT Solicitation and NSF Strategic Plan as the guidelines. (See Appendix 1) The topics aim at addressing four key points of importance in both the IGERT Solicitation and NSF Strategic Plan:

1. Transformative research achievements and discoveries based on cutting-edge interdisciplinary science, technology, engineering, and math.
2. Innovative interdisciplinary graduate education with curricular options, courses, interactions, and partnerships, including methodologies for developing trainees with the technical, professional, and personal skills to become leaders and creative agents for change in a globally engaged science and engineering workforce.
3. Informing the general public, undergraduates, and K-12 students about the innovative science in IGERTs.
4. Broadening participation in STEM graduate education.

Summary of Selected Highlights from Each Topic

1. Transformative research achievements and discoveries based on cutting-edge interdisciplinary science, technology, engineering, and math. The 136 IGERT projects submitting annual reports in 2006-2007 reported a total of 335 distinct research achievements—defined as accomplishments of significant impact.
 - The achievements reported pertain to the interdisciplinary research of each IGERT and cut across all the Directorates of the NSF. Overall, the validation of these achievements, in academic terms, resulted in a total of 811 journal publications; 345 conference publications; 1,171 conference presentations; 52 book chapters and 14 books; 31 patents; and 61 patent applications.
 - The interdisciplinary themes of the 136 reporting IGERTs cut across critical research investment areas including sustainability, the environment and ecology; computational science and engineering, applied and

interdisciplinary math; human and social dimensions of new science and technology; nanoscience engineering and technology; energy, with a focus on alternate and renewable sources and conservation; materials science and engineering; bioinformatics; civil infrastructure monitoring and improvement; entrepreneurialism; neuroscience – biology and psychology; climate changes, impacts and factors; biological evolution and development; diverse device development; and sensing, signals and signal processing – engineering math and science.

2. Innovative interdisciplinary graduate education with curricular options, courses, interactions, and partnerships, including methodologies for developing trainees with the technical, professional, and personal skills to become leaders and creative agents for change in a globally engaged science and engineering workforce.

- One-hundred twenty-two (122) of the 136 IGERTs reported 328 educational achievements for their IGERTs directly addressing developing new degrees and unique courses, workshops and seminars for trainees and other university students.¹
- One-hundred sixteen (116) of the 136 IGERTs have reported prior industrial and governmental partners or collaborations; 21 (18.1%) reported active

ties in 2006-2007 with industry ranging from industrial provision of facilities for research, research collaborations, and exchange of personnel.

- Thirty-nine (39) (33.6%) of the 116 IGERTs reporting active partnerships or collaborations in 2006-2007 report having partnerships with nonindustrial organizations including government labs and agencies, universities, foreign entities, and nonprofit organizations.
- Forty-three (43) (31.6%) of the 136 reporting IGERTs described 82 different funded international experiences, and a total of 98 IGERTS (72.1%) reported some type of international activity in the 2006-2007 reporting year. International activities range in scope from internships in foreign countries, to volunteer activities, to presentations at international conferences, and research.

3. Informing the general public, undergraduates and K-12 students on the innovative science in IGERTs.

- Through outreach activities, 68 IGERTs reported a total of 175 instances of involvement with K-12 and 20 IGERTs reported 44 instances of involvement with undergraduates.
- IGERTs reported 688 instances of outreach to groups including government, local organizations, industry, and the general public. Activities ranged from radio and television interviews to websites, lectures, field trips,

and museum presentations and exhibits.

4. Broadening participation in STEM graduate education.

- One-thousand five-hundred nineteen (1,519) trainees were funded in 2006-2007 by the IGERT program overall across 136 active IGERTs.
- One-hundred fifty-four (154) trainees received their doctoral degrees through the 136 active IGERTs reporting in 2006-2007 (84 males, 65 females, 5 whose gender was not reported. Nine were underrepresented minorities.)
- When IGERT PIs were asked to compare the quality of their IGERT trainees to their other graduate students, 95% of PIs rated their IGERT trainees as superior or better than their usual graduate students.
- Overall, for race/ethnicity IGERTs exceed national data for 52% of all fields; are equal to national data for 38% of all fields; and are only slightly behind national data in 10% of all fields.
- For females, when broken down by field, IGERT is engaging more females into nontraditional fields for the gender. IGERTs exceeded national data for females in 79% of fields and were slightly lower in 21% of fields.

¹ Note: Not all IGERTs necessarily report educational achievements in every year. Some IGERTs are newly starting and others are in a no-cost extension, and thus may not have new educational achievements to report.