

## Developing an Appreciation for Careers in Research Through the Texas Research Experience Program

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### Abstract

The Texas Research Experience (TREX) Program at The University of Texas at Austin has produced valuable research opportunities during the academic year for more than 280 undergraduate minority engineering students. TREX provides students with a unique opportunity to establish strong links with faculty, gain hands-on laboratory experience, and develop an appreciation for research careers in academia and industry. Hosted by the Equal Opportunity in Engineering (EOE) Program for more than 11 years, this paper captures lessons learned over the years and describes how to create a successful undergraduate research program on your campus. Along with an overview of the TREX program and its benefits, the following essential program components are covered in detail: program funding, partnerships with faculty, promoting the program, the application and selection process, student placement, managing the progress of multiple research projects, and project close out requirements. In addition, student perspectives on the benefits of the TREX program have been incorporated into this paper.

The EOE Program at UT Austin was established in 1970 for the recruitment, retention, and academic development of Hispanic, African American, and Native American students interested in pursuing careers in engineering. EOE supports students historically underrepresented in engineering and strives to increase the number of minority engineering graduates from UT Austin through comprehensive support programs that address outreach and recruitment, academic enrichment, leadership, and professional development.

As a result of EOE programs such as TREX, the minority student enrollment for the College of Engineering has increased substantially over the past 32 years, from 94 in 1971, to 912 in Fall 2003, which represents 17.5 percent of the total undergraduate enrollment<sup>1</sup>. Our vision is to create a student body at UT Austin's College of Engineering that reflects the demographics of the college age population within the state of Texas, 35 percent ethnic minorities.

### Introduction

The Texas Research Experience (TREX) Program was created at The University of Texas at Austin in 1992 to provide technical learning experiences for African American, Hispanic, and Native American undergraduate students enrolled in the College of Engineering. TREX was initiated to address the following challenges: (1) lack of African American, Hispanic, and Native American students pursuing graduate degrees in engineering; (2) large percentage of African American, Hispanic, and Native American engineering students with limited exposure to and/or involvement in research projects on campus; (3) African American, Hispanic, and Native American engineering students with limited knowledge about career opportunities in research; and (4) establishment of mentor/mentee relationships between faculty and students. Over 280

students have participated in the TREX Program since its creation. The TREX Program provides students with the opportunity to establish strong links with faculty, gain hands-on laboratory experience and develop an appreciation for research careers in academia and industry. The objectives for the TREX Program include the following: (1) provide a hands on learning experience for minority engineering undergraduates; (2) expose minority engineering undergraduates to research techniques and get them involved in the College's research community; (3) enhance the students technical background and communication skills in their chosen field; (4) increase students' interest and knowledge regarding graduate education; and (5) encourage minority engineering undergraduates to attend graduate school and increase the number who receive graduate degrees.

Over the past 11 years, more than 280 undergraduate minority engineering students participated in the program and have completed poster presentations and oral presentations to summarize the results of their research projects. Many of the TREX students have presented at national conferences, including the National Conference for Undergraduate Research, the SHPE National Technical Paper Competition, the NSBE Graduate School Conference, the Graduate Engineering Council Conference, and the UT System LSAMP Conference.

### **Program Overview**

Through the TREX Program, minority engineering undergraduates have the opportunity to experience and contribute to ongoing research at The University of Texas at Austin, a Tier I research institution. While participating in the TREX Program, students gain an appreciation for careers in research and academia as well as receive individual mentoring from faculty members and graduate students. Through these relationships, TREX participants learn about opportunities that may be available to them during and after a graduate education. This experience builds their confidence and convinces them that pursuing a graduate degree is both valuable and feasible.

TREX participants receive a \$2,600 research stipend (\$1,300 per semester) and are required to spend an average of 10-14 hours per week on his/her research project during the academic year. In addition, TREX participants are required to develop a research proposal plan at the beginning of the program that clearly defines the project and ensures that the student, faculty and coordinator expectations are met. Finally, TREX participants are expected to: attend monthly group meetings, maintain a daily research journal, submit monthly progress reports and a final technical report, and prepare a poster and oral presentation.

### *Planning and Preparation*

The administrative aspect of the TREX Program is managed by staff from the Equal Opportunity in Engineering (EOE) Program at UT Austin. The EOE program coordinator promotes the TREX program to students, selects the candidates, works with faculty to place students on research assignments, distributes the research stipend, monitors student progress on research projects, and collects program evaluations. Table 1 details the project timeline for TREX.

Table 1. TREX Program – Project timeline for 2002-2003 academic year.

<b>Proposed Due Date</b>	<b>Task</b>
April 1-30	• Preparation of application materials & website
May 15	• Email sent to invite students that qualify for program

August 1	<ul style="list-style-type: none"> <li>• Deadline for submitting applications</li> </ul>
August 14	<ul style="list-style-type: none"> <li>• Evaluate applications &amp; select TREX participants</li> </ul>
August 15	<ul style="list-style-type: none"> <li>• Letters &amp; emails sent out to prospective TREX students</li> </ul>
August 28	<ul style="list-style-type: none"> <li>• Students confirm participation</li> <li>• Students submit requests for faculty mentors</li> </ul>
August 28- September 6	<ul style="list-style-type: none"> <li>• Faculty assignments completed</li> </ul>
September 4	<ul style="list-style-type: none"> <li>• Program begins w/ Fall orientation meeting</li> </ul>
September 13	<ul style="list-style-type: none"> <li>• First meeting with faculty member</li> </ul>
September 27	<ul style="list-style-type: none"> <li>• Deadline for submitting research plans</li> </ul>
Monthly meetings	<ul style="list-style-type: none"> <li>• 15<sup>th</sup> of each month – progress reports due</li> </ul>
October 15	<ul style="list-style-type: none"> <li>• Graduate School Info Luncheon – GEM Program</li> <li>• Mid-semester faculty evaluations due</li> </ul>
December 16	<ul style="list-style-type: none"> <li>• End of semester faculty &amp; student evaluations due</li> </ul>
January 23	<ul style="list-style-type: none"> <li>• Spring orientation meeting</li> <li>• Present guidelines for final report &amp; oral presentation</li> </ul>
March 16	<ul style="list-style-type: none"> <li>• Mid-semester faculty evaluations due</li> </ul>
April 21-30	<ul style="list-style-type: none"> <li>• TREX poster presentation &amp; oral presentations</li> </ul>
May 5	<ul style="list-style-type: none"> <li>• Final reports due</li> <li>• End of year faculty &amp; student evaluations due</li> </ul>

### *Budget*

The primary challenge faced while implementing TREX was securing adequate funding to support the program. Over the past 11 years, the TREX Program has been funded by several grants from the National Science Foundation and corporate foundations such as: Ford Motor Company, Applied Materials, and The Boeing Company. Table 2 details the final expenses from the 2002-2003 TREX Program.

Table 2. TREX Program Expenses for 2002-2003 academic year.

<b>Item</b>	<b>Expense</b>
Research Stipends (13 Participants @ \$2,600 each)	\$33,800.00
Supplies, Copies, & Postage	\$1,062.00
National Conference Registration & Travel	\$1,715.00
<b>TOTAL</b>	<b>\$36,577.00</b>

### *Application and Selection Process*

During the month of May, the EOE program coordinator begins the recruitment process to identify prospective TREX participants for the upcoming academic year. In order to be eligible for the TREX Program, students must have completed 30 credit hours with a 3.00 cumulative GPA. In addition, candidates must have completed Calculus II, Physics II, and Physics Lab II. Students who meet the minimum qualifications receive an email and letter from the EOE program coordinator, inviting them to apply for the TREX program.

Prospective TREX participants can access all program details and the application packet online at: [http://www.engr.utexas.edu/eoe/tx\\_res\\_experience.cfm](http://www.engr.utexas.edu/eoe/tx_res_experience.cfm). In order to apply for TREX, students

must submit the following items: (1) a completed application; (2) a one-page statement outlining the student's interests and goal; (3) an official academic transcript; and (4) a letter of recommendation from a faculty advisor.

Completed TREX applications are evaluated by the EOE program coordinator using a combination of objective and subjective criteria. Table 3 details the criteria and point system used to select TREX participants.

Table 3. TREX Program – Criteria for Candidate Selection.

<b>Objective Criteria (maximum 45 points)</b>		
<b>Category</b>	<b>Division</b>	<b>Points</b>
Cumulative GPA (maximum 10 points)	=4.0	10
	>3.9	9
	>3.8	8
	>3.7	7
	>3.6	6
	>3.5	5
	>3.4	4
	>3.3	3
	>3.2	2
	>3.1	1
	>3.0	0
Physics Lab (maximum 20 points)	A	20
	B	15
	C	10
Classification (maximum 15 points)	Senior	15
	Junior	10
	Sophomore	5
<b>Subjective Criteria (maximum 50 points)</b>		
<b>Category</b>	<b>Division</b>	<b>Points</b>
Letter of Recommendation (maximum 25 points)	Very High	25
	High	20
	Average	15
	With Hesitation	10
Personal Statement (maximum 25 points)	Clarity	Up to 10
	Reasoning	Up to 10
	Language & Grammar	Up to 5

*Phase I – TREX Program Orientation & Start Up*

Students selected for the TREX Program are notified by mail during the month of August. Once the student has reviewed TREX Program conditions, they are required to sign and return the letter of acceptance enclosed in the award packet. Program conditions for each participant include but are not limited to the following: (1) must enroll in 12-15 hours of classes and labs each semester; (2) must spend an average of 10-14 hours a week on his/her research project; (3) must attend TREX orientation meeting and monthly group meetings; (4) must submit a research proposal plan, monthly progress reports, and final technical report; and (5) prepare an oral

presentation and poster presentation. In addition, TREX participants are encouraged to search the College of Engineering website to learn more about the numerous research programs on the UT campus. When making research project assignments, the EOE program coordinator strives to accommodate students' interests and requests to work with specific faculty members.

#### *Phase II – TREX Program Maintenance*

Initially, TREX participants prepare and submit a three page research proposal plan, developed with assistance from the sponsoring faculty member, which clearly defines the project and scope of work. The research proposal plan ensures that expectations for all stakeholders (student, sponsoring faculty member, and EOE staff) are met at the end of the research project. In order for the EOE program coordinator to monitor the progress of student research projects, TREX participants are required to maintain a research journal with daily entries describing research activities as well as submit monthly progress reports. In addition, the EOE program coordinator hosts monthly group meetings that provide students with the opportunity to discuss research challenges, receive information regarding engineering research careers, and benefit from presentations made by faculty and industry representatives.

#### *Phase III – TREX Program Close Out*

At the conclusion of the research experience, TREX participants summarize the results of their research project with a 15-minute oral presentation and poster presentation. TREX participants are also required to write a 10 page technical report describing the results of their research project.

### **Program Assessment**

In an effort to maintain a high quality undergraduate research program, student and faculty evaluations are administered four times throughout academic year (mid-semester and end of semester during the fall and spring). Feedback is collected to evaluate the overall TREX program as well as student performance. Student performance is assessed using the following: (1) evaluation of research proposal plan; (2) meeting participation and attendance; (3) evaluation of monthly progress reports; (4) evaluation of poster and final technical report; and (5) feedback received from faculty and graduate student mentors. Program evaluation is assessed using the following: (1) end of semester surveys; and (2) focus groups.

EOE received 35 TREX applications and selected 13 students to participate in the 2002-2003 TREX Program. Upon completing the TREX Program, these 13 students have proceeded down the following paths: (1) 10 are still enrolled in the undergraduate engineering program at UT Austin; (2) two graduated and are working in industry; and (3) one graduated and enrolled in graduate school at UC Berkeley.

#### *Participant Feedback*

Thirteen students participated in the TREX program during the 2002-2003 academic year. Research topics ranged from vehicle crash tests to fire dynamics. TREX participants provided the following testimonials about their personal experience in the 2002-2003 TREX Program.

“My TREX experience has been fascinating to date. I am honored to be working in one of the best optics labs in the country. I have learned so much in the last month and would definitely

recommend this experience to everyone.” – Oluseye Aliu, Senior Electrical Engineering, “Polarization Sensitive Optical Coherence Tomography (PS-OCT) for Glaucoma Detection”

“The TREX program has definitely been a positive experience that has led me to consider graduate school and possible a career centered on research.” – Christina Castanon, Junior Civil Engineering, “Environmentally Friendly Sulfonated Hydrocarbons”

“Working with a team that is designing something which is completely original and that may be implemented within a short period of time is very invigorating.” - Joan Hanson, Senior Architectural Engineering, “Tensegrity Building Structures”

“TREX is a great program that has given me exposure to research and development that I wouldn’t have been able to experience otherwise.” – Justin Henry, Junior Electrical Engineering, “Construction of Equipment for Use in Microelectronic Research”

“The TREX Program has been a great experience. To actually get an opportunity to apply what I’ve learned over the past couple of years and to take a glimpse at what I might be doing for the rest of my life is almost too good to be true.” – Eddie DeGracia, Senior Mechanical Engineering, “Microscale Laser Materials Processing”

### **Opportunities for Future Enhancements to Program**

The TREX Program has generated positive results over the past 11 years. However, there is always room for improvement. Opportunities to enhance the existing program include the following: (1) communicating to students and faculty the importance of developing research proposal plans as soon as possible to avoid delaying student research activity; (2) continuous effort to make sure that TREX participants are working in a wet lab environment; and (3) limited ability to track career paths for TREX participants after they graduate from The University of Texas at Austin.

### **References**

1. The University of Texas at Austin, Office of Institutional Studies, Website URL [http://www.utexas.edu/academic/oir/], site visited January 12, 2004

### **Biographical Information**

ANDREA OGILVIE is the Director of the Equal Opportunity in Engineering Program at UT Austin. She came to UT as Director in July 2001 after six years in industry where she worked as a Structural Engineer for KBR and HDR Engineering, Inc. designing petrochemical and commercial structures, respectively. Andrea received her BS Civil Engineering degree from UT in May 1995 and her Texas Professional Engineering License in February 2001.