



The Tufts University Center for
Engineering Educational Outreach

STOMP Annual Report 2006-2007



STUDENT TEACHER OUTREACH MENTORSHIP PROGRAM

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PROGRAM MANAGER'S EXECUTIVE SUMMARY

July 17, 2007

This report is a documentation of the efforts and accomplishments that STOMP has accomplished over the past year. It provides information on what we do and how we do it, as well as a sense of the spirit with which we pursue our work.

STOMP places college students (STOMP fellows) in K-12 classrooms to collaborate with the teacher in developing and implementing interactive engineering lessons. STOMP also develops resources to aid educators in long-term sustainability of engineering education. The goal of STOMP is for both of the partners (teacher and fellow) to benefit from the relationship – where as the teacher gains knowledge of engineering and the fellow gains communication and teaching skills.

With our growing success, the Student Teacher Outreach Mentorship Program (STOMP) at Tufts University has been inspiring other universities and industries to become part of the STOMP network. STOMP has grown this past year to include programs at University of Colorado and University of Hawaii, endeavors that were developed from a STOMP seed grant given to universities who displayed the ability to sustain the program in future years.

STOMP, at Tufts University, Massachusetts Institute of Technology, Princeton University, and Littleton High School, as well as I-STOMP at National Instruments and Raytheon, have continued to flourish and expand during this past academic year and now reaches over 1000 students in K-12 classrooms each year.

STOMP at Tufts University has also dedicated much of its effort this past year to documenting curriculum that will help universities and industries start STOMP programs in their areas. STOMP at Tufts University has also created a Teacher Manual to aid new teachers in introducing engineering subjects to their classrooms. The Teacher Manual contains helpful advice for the engineering classroom environment, as well as details about how STOMP works.

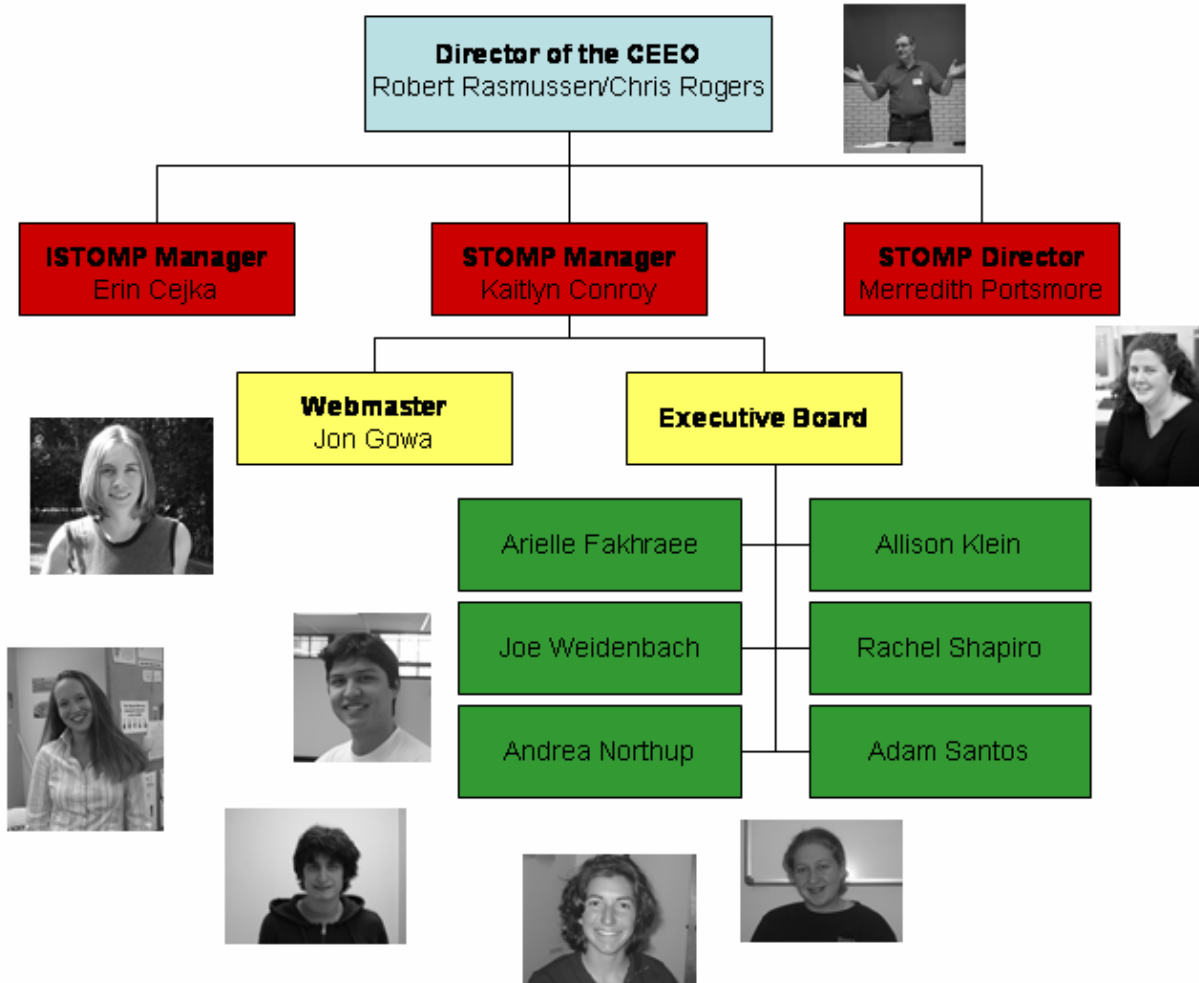
STOMP at Tufts University conducted a successful fund drive throughout the past year, attaining numerous gifts and sponsors as we continue to work towards our goal of a ten-year level of sustainable funding.

Kaitlyn Conroy
STOMP Program Manager, 2006-2007

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STOMP People



Purpose and Goals

The mission of STOMP is *IMPROVING K-12 EDUCATION THROUGH ENGINEERING*. We accomplish this by supporting teachers in integrating engineering into the classroom and through the formation of STOMP programs at other universities.

OUR GOALS

- Increase technological literacy and awareness of engineering's importance for society
- Give K-12 students skills that make learning effective and enjoyable
- Inspire student excitement about learning math and science
- Influence educators and the education of future educators

OUR APPROACH

- Teach science, technology, and math using engineering as the learning vehicle
- Teach the engineering process as an interdisciplinary process
- Teach students how to use their math and science knowledge to design solutions

OUR PHILOSOPHY

We believe that the skills and values we help students and educators develop are connected to the improvement of our world – a place where excitement about learning engineering, math, and science will help to create:

- A higher quality of life
 - Greater environmental responsibility
 - A healthier, more humane society for all
-

What is STOMP?

STOMP is an outreach program that started at the Center for Engineering Educational Outreach (CEEEO) at Tufts University in 2001 from a generous grant from the LLL foundation for 3 years. STOMP sends undergraduate and graduate fellows (engineering students) into K-12 classrooms to teach engineering through hands-on activities. STOMP fellows work with the classroom teacher to create an engineering curriculum that reaches across all disciplines, peaks the students' interest in engineering, and improves the students' problem-solving skills. As part of the initial funding for STOMP, the LLL foundation asked that STOMP investigate the sustainability and dissemination of the program.

For sustainability, the program focuses on how student outreach can be run as efficiently and inexpensively as possible. By keeping low costs, the Tufts University program can sustain a large number of fellows on a small budget and new programs can get started for as little as \$10,000. In addition, STOMP at Tufts University took the initiative to use excess resources (LEGO materials and student labor) to run workshops that generate funds to help sustain the program.

STOMP also works to develop resources to aid educators in long term sustainability of engineering education. STOMP at Tufts University is developing manuals to aid in the growth of STOMP programs at other universities. Among these manuals, there is information for how to begin and manage a STOMP program, what the STOMP fellows need to know, and how the teacher is an integral part of the program.

STOMP's Impact at a Glance

STOMP at Tufts University

800	The average annual number of K-12 students directly impacted by STOMP since 2001.
5600	The total number of K-12 students impacted by STOMP since its 2001 inception
35	The average annual number of graduate and undergraduate involved in STOMP
3780	Number of hours STOMP fellows spent in classrooms this year
40	Average annual number of teachers participating in STOMP
370	Students participating in our workshops since 2004
20	Number of female STOMP fellows in 2006-2007
14	Number of male STOMP fellows in 2006-2007
4	Number of freshman STOMP fellows
16	Number of sophomore STOMP fellows
6	Number of junior STOMP fellows
4	Number of senior STOMP fellows
4	Number of graduate STOMP fellows

STOMP outside Tufts University

While the Tufts University chapter of STOMP has been very successful in supporting engineering education in communities local to Tufts University, we have also been actively promoting the formation of new chapters. STOMP is working to become a replicable model for other universities, and STOMP at Tufts University grants seed money to other universities who show interest in creating a new chapter and the ability to sustain the program. STOMP at Tufts University has also created Industrial STOMP (I-STOMP) for engineering and technology companies. I-STOMP trains employees of engineering and technical companies to become volunteer classroom mentors. STOMP also now includes a high school chapter, where high school students work with classes in local elementary schools where there is no local university. By increasing the number of STOMP and I-STOMP partners, we can increase the impact of the STOMP approach. Currently, STOMP and I-STOMP have a combined 8 chapters: Tufts University, Princeton, MIT, University of Colorado at Boulder, University of Hawaii, Littleton High School, National Instruments, and Raytheon.

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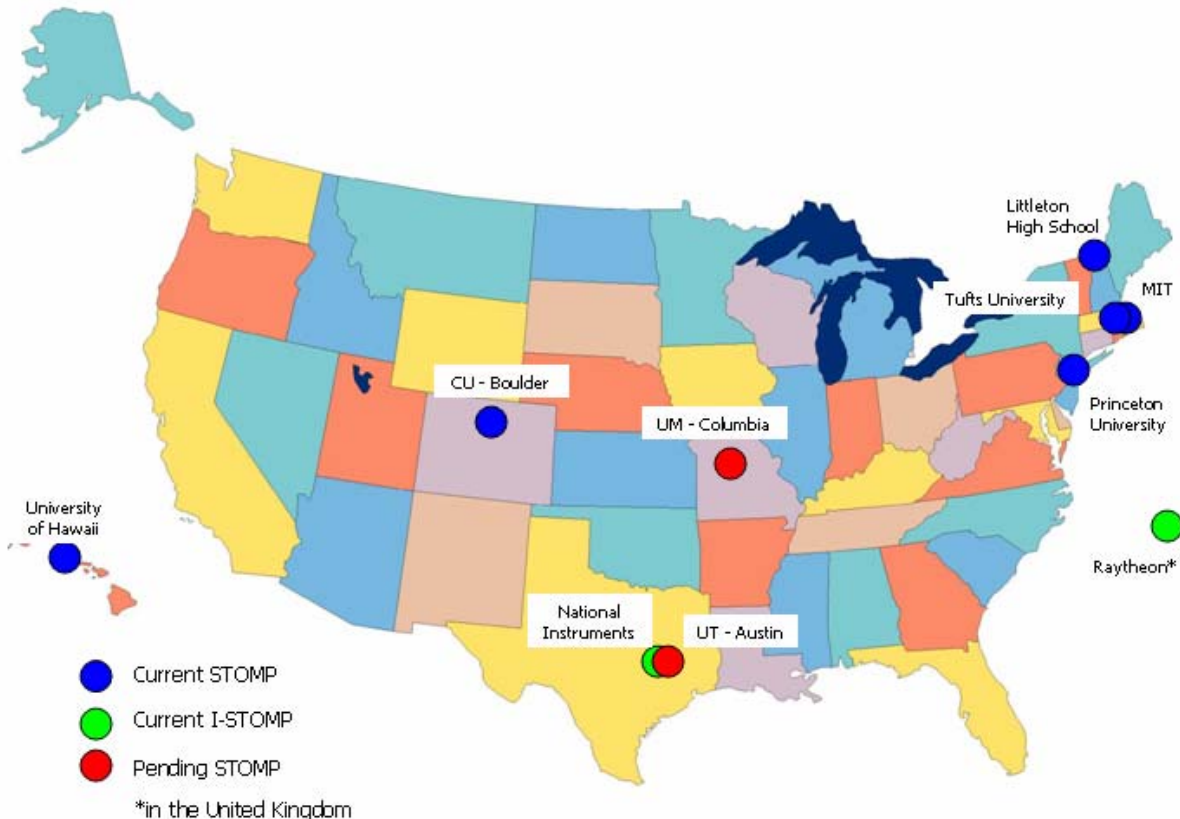
Expanding Local Classrooms

STOMP at Tufts University worked during the 2006-2007 school year to expand the classrooms local to its Medford/Somerville campus. To accomplish this, STOMP met with the curriculum coordinator of Somerville Schools to try to integrate engineering curriculum across the school district. This meeting was extremely successful as STOMP was in 14 classrooms in Medford and Somerville during the spring semester of 2007. STOMP hopes to continue this relationship with the Medford and Somerville Schools to integrate a district-wide engineering curriculum at the elementary level.

STOMP at Tufts University also continues to support the Josiah Quincy Upper School in Chinatown near the Tufts University Medical School. This STOMP school has been very successful and, this year, added a new fourth grade classroom.

Expanding STOMP Nationwide

STOMP Locations



Produced by the Geographic Research Lab
University of Alabama

STOMP at other Universities

With the success of STOMP at Tufts University, the CEEO has initiated a plan to expand STOMP to other universities. Universities interested in starting a STOMP program are granted a start-up stipend allowing them to initiate the purchasing of equipment and to pay their volunteers. The Tufts chapter provides support in assisting new STOMP programs. To date, STOMP programs have been established at four universities: Princeton University, Massachusetts Institute of Technology, University of Colorado at Boulder, and University of Hawaii; and one high school: Littleton, NH.

PEEK – The Princeton chapter of STOMP exists under the name Princeton Engineering Education for Kids (PEEK). Through a combination of both a gift from Princeton's Center for Innovation in Engineering Education, the National Science Foundation, and the CEEO, the program was started by two undergraduate students, Kristen Bethke and Jim McQuade, in 2003 modeling the STOMP program. Currently run by Dr. Clancy Rowley and a team of officers, the program has written curriculum for K-4 classrooms. PEEK also has a number of events each year including Engineering nights at local elementary schools, LEGO clubs, and LEGO competitions.

<http://www.princeton.edu/~peek/>

STOMP @ MIT – The MIT chapter of STOMP is an official student organization at MIT within the Association for Student Activities. STOMP @ MIT was started in 2006 by a graduate student, Kristen Bethke, now a doctoral student in education at Tufts University. The program is not only supported by the CEEO, but also by the Massachusetts Space Grant Consortium and the administrative support of the MIT Edgerton Center and Public Service Center. This year, MIT members led weekly LEGO engineering sessions at seven sites in the Cambridge and Boston area: the Haggerty School in northwest Cambridge, Banneker Charter Public School in north Cambridge, the Frisoli Youth Center in east Cambridge, Newton Community Education, Mason-Rice Elementary in Newton, Cambridge Science Club for Girls, and Trotter Elementary School in Dorchester. Members also taught two sessions of LEGO engineering at MIT's Splash! educational event for grade 6-12 students from all over the U.S.

<http://www.stompnetwork.org/mit>

CU STOMP – The Colorado chapter of STOMP is a program run through the Physics Education Research @ Colorado under Dr. Noah Finkelstein. The CU STOMP program currently partners with the Science Discovery Center at CU Boulder and the I Have a Dream Foundation to run summer camps working on LEGO robotics, Stop Action Moviemaking (SAM) video, to study states of Matter. Funding for this program is provided not only by the CEEO but also by the Colorado PhysTEC and the STEM-Colorado Program.

<http://www.colorado.edu/physics/EducationIssues/STOMP/>

STOMP @ HI: Aquabotica – The Hawaii chapter of STOMP was an effort started in 2006 by one of the University of Hawaii's math professors, Dr. Monique Chyba, in order to give children a hands-on learning opportunity while delving into the world of underwater autonomous robotics. Aquabotica focuses exclusively on underwater robotics and is run in collaboration with

Ocean & Resources engineering and Autonomous Systems Laboratory. Two different programs have been developed so far; one for children in first and second grades and the other for children in third, fourth, and fifth grade. STOMP @ HI has established their program as a course that students at the University of Hawaii can take for credit.

<http://www.stomphawaii.com/>

Littleton High School STOMP – Littleton High School in Littleton, NH is paving the way for the High School STOMP model. William Church, a physics teacher at Littleton High School and a recently accepted doctoral student in education at Tufts University, received the 2005 Christa McAuliffe Sabbatical Award. With this award, he had the opportunity to investigate how STOMP could be implemented at the high school level. The model that he constructed is an alternative STOMP Physics class for juniors and seniors at Littleton High School. These students learn physics through their participation in STOMP. Students are trained along with elementary and middle school teachers with the latest classroom technologies. Children love having older students in the classroom, the high school students get a chance to experience teaching and use their technological know-how, and the teachers get much-needed help which due to their location cannot be provided by a university. Bill's efforts have led to a number of surrounding schools establishing high school STOMP models as well as the beginnings of a center in Littleton, NH called the White Mountain Center for Applied Science.

<http://www.stompnetwork.org/littleton>

Industrial STOMP (I-STOMP)

Industrial STOMP is a sustainable educational outreach program for helping engineering and technology companies support math, science, technology, and engineering (MSTE) K-12 education in communities where the company has a significant presence. The program has a strong emphasis on elementary school education and works as a cooperation between Tufts University's Center for Engineering Educational Outreach (CEEEO) and the local company site. The program uses LEGO Mindstorms for Schools technology to combine hands-on design projects with required MSTE content.

- **National Instruments**

National Instruments began an employee volunteer outreach program over five years ago to work with local K-12 classrooms using LEGO Mindstorms for Schools technology. In 2005, NI partnered with Tufts I-STOMP to refine and improve their volunteer training and evaluate their program. Since its inception, over 300 NI employees have been trained to work in K-12 classrooms in Central Texas.

- **Raytheon Systems Limited**

In 2005, an I-STOMP chapter was created at Raytheon Systems Limited in Harlow, United Kingdom. Through I-STOMP, 20 Raytheon volunteers have established a self-sustaining outreach program that supports the Brookland Junior School with an introductory engineering curriculum. All 9 teachers at the school have been trained with the materials and curriculum so that every student in grades 3 to 6 is engaged in engineering.

STOMP Scholars

The STOMP Scholars program is an opportunity for graduate students based in an academic engineering discipline, in which they receive a fellowship for coordinating the work of STOMP undergraduate and graduate engineering students in K-12 classrooms.

- Andrew Mueller, a graduate student in Mechanical Engineering, developed a set of acoustic engineering curriculum for fifth and sixth grade science programs. He designed the curriculum such that teachers could continue to use the materials in the future, without Mr. Mueller present in the classroom.
- Jennifer Kang integrated components of her research growing tissue cells into Malden High School Chemistry and Biology courses.
- Larissa Winney implemented robotics-based engineering projects into the third, fourth, fifth, and sixth grade Technology Education curriculum at the Ferryway School in Malden, Massachusetts.
- Nicole Braun worked with a doctoral student in an early-childhood classroom, assisting with an engineering-based curriculum designed specifically for young children.

STOMP Assessment

STOMP at Tufts University has been developing a method for determining the effect that STOMP has on the fellows citizenship and communication skills as well as a deeper understanding of engineering related concepts. A preliminary study was conducted during the 2006-2007 school year with a group of 12 STOMP fellows and a control group of 7 undergraduate students in an introductory engineering course entitled *Prototyping Home Robots*. By using a control group, a separation could be made between the effect of participating in STOMP and the effect of just being a part of the Engineering school at Tufts University.

The research conducted consisted of a set of two surveys, knowledge assessments, and observations for both the experimental group and the control group. The two surveys primarily focused on the student's confidence in explaining math, science, and technology content to a member of the general public. The knowledge assessment focused on the student's ability to describe and apply the engineering design process. The observations were conducted within the student's setting in order to monitor their behaviors.

The results of the STOMP assessment will be presented at the American Society for Engineering Education annual conference in June of 2007. The research will continue next year involving a larger population spanning out to multiple universities to obtain statistically significant results. The logistics of a control group are also being discussed in order to determine how beneficial participation in a program like STOMP can be.

Resource Development

- *Teacher manual* – STOMP at Tufts University has been actively addressing the need for teachers to have an understanding of engineering curriculum as well as the engineering classroom environment prior to having the STOMP students in their classroom. STOMP at Tufts University has developed a teacher manual for the teachers we work with to have a

clear understanding of the roles and responsibilities of the teacher and the STOMP fellow as well as the progression through STOMP for the teacher. One of the goals of STOMP is that the teacher will continue teaching the engineering curriculum without the STOMP fellows; therefore, the teacher manual is an excellent reference for the teacher to have once the STOMP fellows have left. The teacher manual is one of the manuals that STOMP at Tufts University has created to aid in the expansion of STOMP nationwide. These manuals (Management Manual, Fellow Manual, and Teacher Manual) can be dispensed to universities and industries to aid them in developing their own STOMP program.

- *Development of curriculum* – STOMP at Tufts University created two new curriculum units that can be distributed to other universities and industries who are interested in beginning their own STOMP programs. The curriculum units can be used as a whole or individual activities can be pulled out for a specific session. These units are expected to be ready for distribution in fall 2007 or winter 2008.

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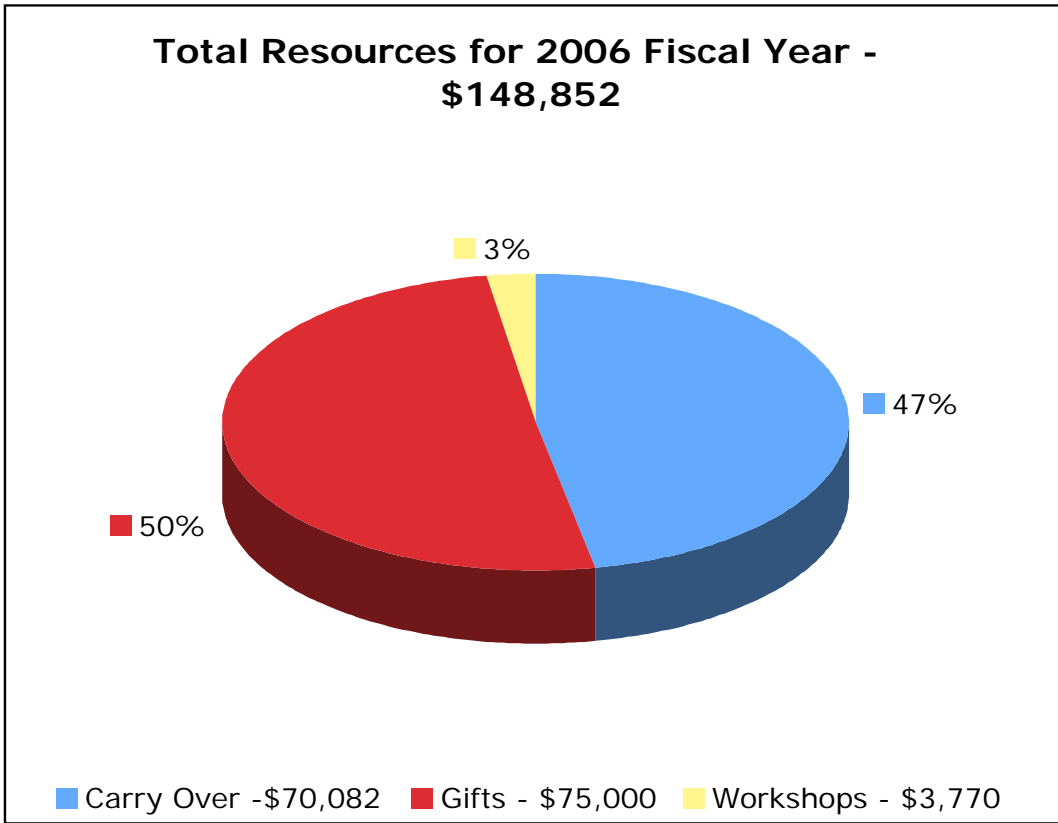
Publications and Presentations by STOMP Authors

- Carberry, A., Portsmore, M., Rogers, C. (in press). *The Effects of STOMP on Students' Attitudes and Understandings Toward the Engineering Design Process*. Proceedings of the Annual Conference of the American Society for Engineering Education. Honolulu, HI.
- Cejka, E., & Rogers, C. (2006). *Impacts of Industry Employee Volunteering in K-12 Classrooms*. Proceedings of the Annual Conference of the American Society for Engineering Education. Chicago, IL.

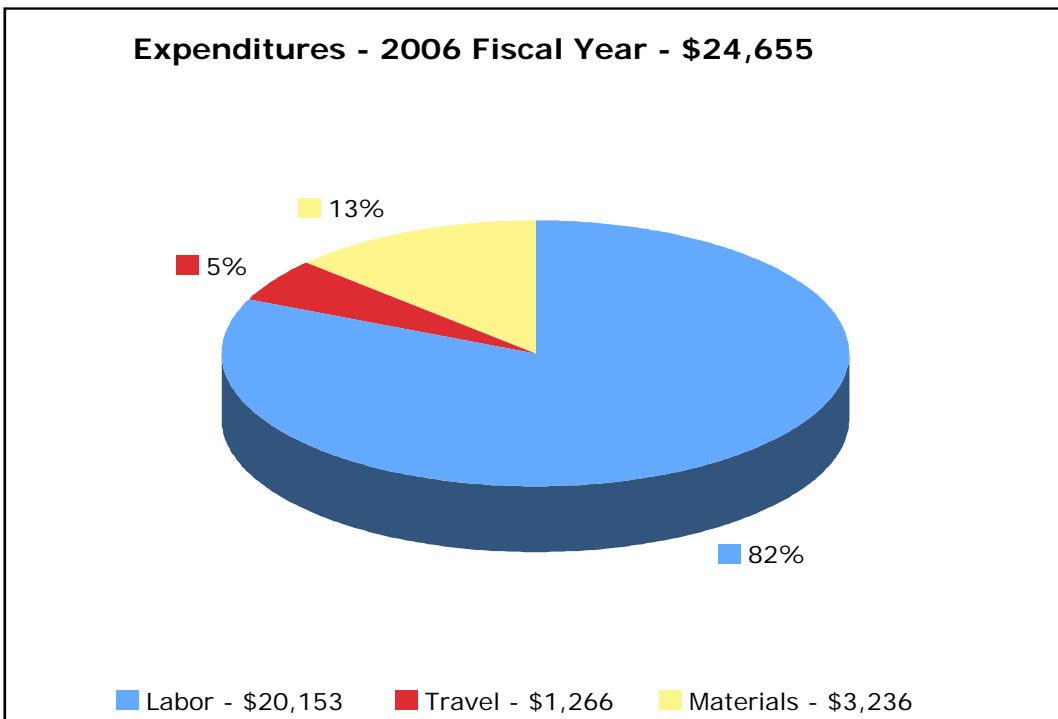
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Total Resources



Allocation of Resources



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STOMP Gift Challenge

STOMP at the Center for Engineering Educational Outreach (CEEEO) was originally funded in 2001 by a generous grant from the LLL foundation for 3 years. STOMP also received a small grant from UCCPS in 2002 to further support the program. One of the charges of the LLL foundation was for STOMP to look at sustainability and dissemination. STOMP at Tufts University took this charge seriously. For sustainability, the program focused on how student outreach could be run as efficiently and inexpensively as possible. STOMP fellows are paid \$10/hour and with the proper support materials and training each fellow costs just under \$1,000 per semester in the classroom. This low cost means the Tufts University program can sustain a large number of fellows on a small budget and that new programs can get started for as little as \$10,000. In addition, STOMP at Tufts University took the initiative to use excess resources (LEGO materials and student labor) to run workshops that would generate funds to help sustain the program.

In terms of dissemination, STOMP at Tufts University focused on documenting the program in ways that would easily allow others to adopt the program. Three major manuals were written – Fellow, Management, and Teacher – to support all the elements of the program. The manuals contain checklists, worksheets, and sample plans to aid any program in getting started. STOMP at Tufts University is currently working on the development and documentation of more curricula.

The LLL Foundation was pleased with the success of STOMP and was interested in working with Tufts University to fund STOMP for an additional 10 years. STOMP was issued a \$200,000 challenge grant (\$150,000 from the LLL foundation and \$50,000 from an anonymous donor), which they pledged to donate a total of \$200,000 if Tufts University Development could raise enough money to match the funding. The \$400,000 in combined funding would fund not only STOMP at Tufts University but also 10 STOMP programs at other universities. Tufts University Development has been working hard for this challenge. Development was denied grants from American Honda Foundation, Verizon Foundation, and Toyota Foundation, but they are in serious conversation with BAE systems and Agilent Technologies and continue to seek other corporate grant opportunities. This year, Tufts University Development secured over 57% of the needed funding to meet the challenge and expects to complete the challenge in fiscal year 2008.

<u>Donor</u>	<u>Committed</u>	<u>Received</u>	
<i>Ni</i>	\$50,000	\$50,000	*Over 5 years
<i>Stacy Morse*</i>	\$50,000	\$10,000	
<i>Anonymous</i>	\$15,000	\$15,000	
Total	\$115,000	\$75,000	