

Expanding Interest in Science and Engineering in the Greater Knoxville Area

Submitted By

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Summary of DAG Project

ASME DAG Funding: \$ 2000 **Total Project Budget to Date:** \$ 2500

Partnering Organizations:

The American Society of Mechanical Engineers (ASME) student chapter at the University of Tennessee, Knoxville (UTK) is involved in a broad range of activities related to mechanical engineering and other areas including invited talks from industry and academia, robotic design competitions, industry tours and so forth. The UTK ASME chapter includes undergraduate and graduate students that welcomes all concentrations of engineering

UTK Graduate Association of MABE Engineers (GAME) – an organization that represents all of the graduate students within the Mechanical, Aerospace, and Biomedical Engineering department at UTK. This organization represents a diverse group that includes international students, minorities, and women.

Society of Women Engineers (SWE) – an organization that represents the population of women in the College of Engineering at UTK. This society includes undergraduate and graduate students that welcomes all concentrations of engineering.

Bredesen Center for Interdisciplinary Research and Graduate Education (CIRE) – a prestigious multidisciplinary energy Ph. D. program at the University of Tennessee and Oak Ridge National Laboratory.

Attendance:

School or Program	Date	Module	Women	Minorities	Total
John Hay Elementary	11/21/2014	Non-Newtonian Fluid	23	17	49
South Clinton Elementary	12/18/14	Non-Newtonian Fluid	15	4	33
Maryville Christian Academy	03/11/15	Plasma and Non-Newtonian Fluids	96	26	171
John Hay Elementary	05/15/15	Electricity and Magnetism	23	17	47
South Clinton Elementary	05/19/15	Polymers	16	4	34
Sub-Total			173	68	334

Future outreach opportunities in planning stage:

Boys & Girls Club Vestal Non-Newtonian Fluid – June 2015

Boys & Girls Club Vestal Polymers – July 2015

Boys & Girls Club Vestal Electricity and Magnetism – August 2015

Boys & Girls Club Vestal Renewable Energy – September 2015

Boys & Girls Club Vestal Robotics – October 2015

John Hay Elementary – November 2015

South Clinton Elementary – December 2015

ASME Section/Region Reps: 8 (ASME) 9 (CIRES) 7 (GAME) 2 (SWE)

Project Title: Expanding interest in science and engineering in the greater Knoxville area

Project Description:

Our project entailed creating engaging science demonstrations for several interesting STEM topics. Upon creation of these modules, we worked to develop relationships with local area schools to foster ongoing science day programs. Each module was designed to be applicable to a wide variety of grade levels and align with the Tennessee state curriculum. The ultimate goal of the project was to spark interest in science, technology, engineering, and math related fields by providing stimulating hands on science demonstrations.

Project Goal/Objective and How Achieved:

Our project aims to spark interest in science, technology, engineering, and math (STEM) related fields by providing insightful and interesting demonstrations. We achieved this by developing and

carrying out enriching demonstrations directly related to the Tennessee state curriculum that are outside the capabilities of standard classrooms. We have developed lessons for non-Newtonian fluids, polymers, robotics, renewable energy, electricity and magnetism, and plasma.

The objective is to demonstrate real world applications of complex scientific principles, based on Tennessee state curriculum, to students in local area schools and after school programs. We sparked interest in STEM fields by including the students in exciting and engaging hands-on demonstrations. Additionally, we took care to select schools and programs with diverse student bodies and focused on areas of low socio-economic status so that under-served students had an opportunity to learn about and ultimately be inspired to pursue STEM careers.

The project was carried out by visiting several local classrooms. We provided a lesson plan and thought provoking worksheets to accompany our demonstrations. We divided each class into small groups. Each group was led by an engineering student from UTK in order to facilitate participation from all students and give more individualized help. A discussion period was included in each session to encourage students to problem solve and think like engineers.

These demonstration modules were fully developed and are easily repeatable. UTK ASME and the UTK Graduate Association of MABE engineers will continue this outreach for many years to come.

Evaluation of Program's Success:

We have performed four of the developed modules in local area classes: non-Newtonian fluids, plasmas, polymers, and electricity and magnetism. The supplies for the two additional modules, renewable energy and robotics, have been ordered and the accompanying lesson plans are under development. The program has had significant interest from a variety of organizations. It has been featured in the department magazine, and an article in the local newspaper is currently being written. The publicity has been great for raising awareness with local schools and encourages future collaborations. Our future goals include making the modules readily available to other organizations to encourage similar demonstrations in additional area schools. We believe adaption by other organizations as a key indicator for measuring the perceived value of our modules.

This past year with each school visit we asked teachers to evaluate our lessons in several key areas including: level of the material covered, alignment with Tennessee state curriculum, student engagement, and generated student excitement towards STEM fields. Additionally, students' grasp of materials covered is assessed through worksheets given to the students with questions pertaining to the material covered.

Every classroom we have visited has requested additional science day demos and have scheduled future visits. Additionally, numerous teachers at each school have approached us and sought in-class demos for their respective classes. The strong interest in repeat events and from other teachers suggests that our project has been successful.

In discussions with teachers following the demonstrations they indicated the occurrence of elevated science test scores on standardized tests. Furthermore, they reported a noticeable increase in interest in science among their students. They have relayed that several students now say they want to become engineers, which is the ultimate goal we hoped to achieve. We have already begun to use the positive feedback to expand our program into other schools and programs.

Other Comments/Observations/Pertinent Info:

The groups represented by this report would like to take this opportunity to sincerely thank the American Society of Mechanical Engineer's Diversity Action Grant for the generous funds allocated for the execution of our project.

We feel that our outreach science days have helped instill interest in STEM fields. Below are some photos taken during our science days.



Michael, an ASME undergraduate student, shows students how speaker vibrations affect the non-Newtonian fluid during the small group hands-on portion of the demonstration, during the December 18th visit to South Clinton Elementary.



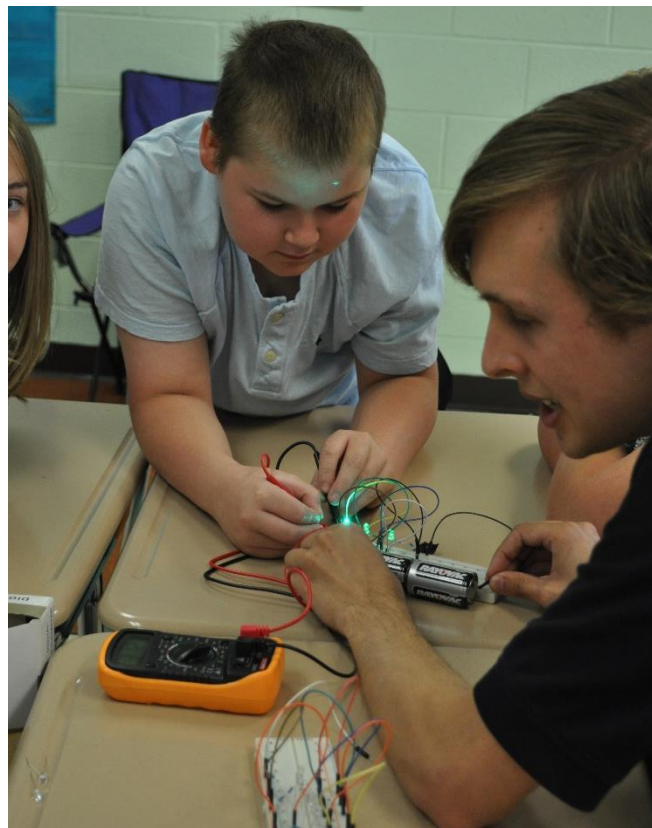
Bredesen Center graduate students Mallory and Amanda lead hands on non-Newtonian fluid demonstrations.



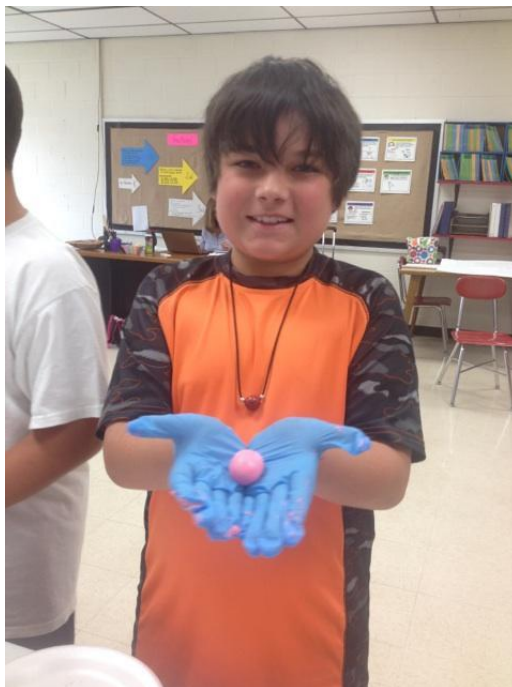
A student at John Hay Elementary is shown some “hair raising” science during the electricity and magnetism module by Mitch, a Bredesen Center graduate student.



Reza, graduate student member of ASME and GAME, helps a student assemble a basic motor during the electricity and magnetism module.



Andy, a vice-president of GAME and graduate student member of ASME, GAME, and CIRE, helps a student use a multi-meter to measure voltage across LEDs.



A student at South Clinton Elementary shows a polymer bouncy ball he made under the guidance of graduate student volunteers.



Alan, a vice-president of GAME and graduate student member of GAME and CIRE, shows students examples of super absorbent polymers.

Appendix*Itemized Budget*

Module	Item	Vendor	Item subtotal
Bank fee	Wire In Fee		\$5.00
ALL	Edsal Adjustable Shelves	Amazon	\$76.44
E & M	LEDs (pack of 80)	Amazon	\$4.43
E & M	1280pc Resistor variety pack	Amazon	\$8.97
E & M	Bar Magnets (pack of 2)	Amazon	\$7.95
E & M	Enameled Copper Wire	Amazon	\$16.40
E & M	AC DC Volmeter Multimeter	Amazon	\$28.47
E & M	Motor Model	Amazon	\$11.02
E & M	Rayovac D Batteries (pack of 12)	Amazon	\$15.23
E & M	2oz Ferrofluid and magnets	Amazon	\$28.86
E & M	1lb Iron Filings	Amazon	\$17.72
E & M	Solderless BreadBoard	Amazon	\$14.50
E & M	Van de Graaff Generator	Amazon	\$208.12
E & M	120 breadboard jumper wires	Amazon	\$9.99
E & M	Motor Model	Amazon	\$45.00
E & M	Tinsel strands	Amazon	\$12.25
E & M	Wire 20 Gauge 50ft	Amazon	\$16.31
Non-Newtonian	50lb. Bag of Cornstarch	WebstraurantStore	\$96.87
Non-Newtonian	6qt bins (pack of 12)	Amazon	\$31.10
Plasma	Plasma globe	Amazon	\$77.98
Plasma	Spectrum Tube Xenon	Amazon	\$19.87
Plasma	Spectrum Tube Krypton	Amazon	\$20.32
Plasma	Spectroscope	Amazon	\$36.88
Plasma	Spectrum Tube Helium	Amazon	\$18.47
Plasma	Headphones	Amazon	\$10.11
Plasma	Spectrum Tube Neon	Amazon	\$26.96
Plasma	Plasma globe	Amazon	\$38.95
Polymer	Food coloring	Amazon	\$9.17
Polymer	Penn Racquetballs (pack of 12)	Amazon	\$19.98
Polymer	1lb. Bag of Water Beads	Amazon	\$19.00
Polymer	Elmer's glue 4oz bottle	Amazon	\$7.40
Polymer	1lb. Sodium Polyacrylate	Amazon	\$20.59
Polymer	Borax 76oz box	Amazon	\$25.98
Polymer	Nitrile Glove (small)	Amazon	\$15.16
Polymer	Nitrile Glove (xsmall)	Amazon	\$21.44
Polymer	Elmer's Glue Gallon refill	Amazon	\$18.57

Polymers	Isopropyl alcohol	Kroger	\$1.74
Polymers	Metal tongs	Kroger	\$2.87
Polymers	Ceramic bowl	Kroger	\$4.91
Polymers	Leather gloves	Kroger	\$10.91
Polymers	Dry Ice 5.96lb	Kroger	\$8.14
Polymers	Foam Cooler	Kroger	\$4.25
Polymers	Nitinol Memory Wire	Amazon	\$14.95
Polymers	Silly Putty	Amazon	\$9.95
Polymers	Plastic cups	Kroger	\$6.54
Polymers	Plastic spoons	Kroger	\$3.69
Polymers	Measuring spoons	Kroger	\$5.45
Polymers	Isopropyl alcohol	Kroger	\$8.70
Polymers	Dry Ice 21.63lbs	Kroger	\$29.55
Polymers	Water Glass 1 Gal.	Amazon	\$29.66
Polymers	Denatured Alcohol 1 qt.	Amazon	\$8.72
Renewable Energy	Renewable Energy Education set	Amazon	\$291.90
Robotics	380mAh Li rechargeable batteries	Amazon	\$35.70
Robotics	Robo Car Kit for Arduino	Amazon	\$99.00
Robotics	Raspberry pi 2 kit	Amazon	\$84.99
Robotics	4 channel remote control	Amazon	\$35.00
Robotics	Quadcopter parts receiver	banggood	\$31.98
Robotics	Quadcopter propeller blades	banggood	\$3.92
Robotics	Quadcopter hollow cup motor	banggood	\$16.84
Robotics	Arduino starter pack	adafruit	\$71.52
Robotics	Infrared Sensor	adafruit	\$2.15
Robotics	Mini remote controller	adafruit	\$5.45
Robotics	Nunchucky breakout adapter	adafruit	\$3.30
Robotics	Nunchuck controller	adafruit	\$16.52
Robotics	MeArm	Hackaday	\$49.97
Robotics	Arduino R3 uno	adafruit	\$58.97
		TOTAL	\$ 2,018.70

The funding for the excess expenditures was provided by the Mechanical, Aerospace, and Biomedical Engineering Department at the University of Tennessee, Knoxville.