Evolution and Impact of Student Research and STEM Career Awareness Programs funded by the Howard Hughes Medical Research Institute

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The first HHMI grant term was five years from September 1, 1994 to August 31, 1999. Initially, the outreach programs were limited to two science education programs. The UTMB Summer Science Camp I for 7th & 8th graders and the Summer Science Camp II for 9th & 10th graders were established to provide Galveston County area students' opportunities to enrich the quality of hands-on science experiences and exposure. Each science camp curriculum adhered to the goal of quality science enrichment by including activities that enhance students’ general knowledge base and interest in biology and related-sciences. The curricula also provided exposure to the latest scientific investigations, career presentations and tours to specific research-rich laboratories while simultaneously strengthening the students’ general thinking and problem-solving skills through a series of computer-based and problem-based activities.

The initial Summer Science Camp I for 7th & 8th grade students started in 1993 with funds provided by the Harris & Eliza Kempner Fund (a local foundation). The Howard Hughes Medical Institute funding for this camp began in 1996. The funding allowed for expansion of this single summer session, 6-week program into two, 4-week summer sessions. Upon program inception, the Summer Camp I geographic service area included the city of Galveston only. With HHMI funding, the geographic area expanded successively each year to include all nine independent school districts in Galveston County. Camp I participant numbers expanded from 20 in 1993 to 53 in 1998. Since the initial beginning of the Summer Science Camp II for 9th & 10th graders in 1995, Camp I students have increasingly progressed into the more advance Camp II program.

HHMI funding for program implementation of Summer Camp II began in 1995 as mentioned previously. The camp was initially a 7-week, ½ day program. To date, the Science Camp II program has seen growth in the following areas: number of applicants and participants; an enriched and keenly structured curriculum content; and number of faculty and graduate student participants serving as teaching resources. In 1995, the programs beginning year, 11 students participated. The program years 1996, 1997 and 1998 saw student increases of 17 students, 14 students, and 19 students, respectively. The number of UTMB faculty, students from the Graduate School of Biomedical Sciences and the Summer Undergraduate Research Program, serving as consultants that provided student participants and their counselors with structured background information, career development information, and positive examples for role models increased by 30%.

The undergraduate student counselors that were hired and underwent an extensive two-day training to teach specific concepts to the students in both programs majored in science disciplines and attended major universities.

The second HHMI grant term was from September 1, 2003 to August 31, 2007. This period of HHMI funding resulted in the largest expansion of student and teacher programs offered by the Office of Educational Outreach. The number of students and teachers stimulated by HHMI funded educational activities increased significantly. A truly unique aspect of the proposed programs was the synergy created by combining the talents of both faculty and
students in our four schools with the Office of Educational Outreach at UTMB. This type of collaboration fulfilled the need for providing high-quality outreach programs for K-12 students and teachers locally (Galveston County) and possibly throughout a significant portion of the southeast region of the state of Texas. During this HHMI funding period, the activities were divided into three integrally interrelated and interdependent programmatic components as follows: (1) Student Research Component-Summer Science Camp I for 7th & 8th graders involved forty to fifty students per year for 2-4 week sessions; Summer Camp II for 9th & 10th graders provided fifteen students per year in one seven-week session; Summer Research Program for High School Students enabled twenty 11th & 12th grade students to work independently for 8 weeks in research laboratories of UTMB faculty members as preceptors; (2) Student Career Awareness Component-Middle and High School students were exposed to the full spectrum of career options available within the biomedical sciences at a stage early enough on the educational ladder for 30 students to make good career choices by participating in the Pathfinder’s Program. The Saturday Biomedical Science Academy hosted approximately seventy 4th, 5th and 6th graders’ and the Expanding Your Horizons in Math and Science Career Exploration Conference enabled 150 girls to experience careers through women presenters; and (3) Science Teacher Professional Development Component—This component had several customized programs to accommodate the diverse needs of K-12 teachers: (1) Over 100 K-12 teachers participated in hands-on, curriculum coordinated science education workshops at UTMB throughout the academic year to enhance further the inclusion of biomedical science as well as meet the state and national standards in curricula. (2) Annual Regional Science Teachers Conference provided an average of 250 regional teachers (K-12) per year with a variety of high quality, professional development workshops from expert educators from across the U.S.A.

Our science education programs have been shown to be effective in increasing teacher content knowledge thereby making the teachers more effective communicators to the students in the classroom as well as an aid to students choosing science majors in college and/or careers in STEM. These programs address a great need in this country to prepare a competent scientific workforce to meet the biomedical challenges of the future.

The third HHMI grant term was for six years from September 1, 2007 to August 31, 2013.

Overview-Student Programs

The overall goal was to promote student interest in science early in their formal education with the belief that a solid foundation in science must be established to enhance the probability of their pursuit of a future scientific and/or STEM-related career. The objectives were to: 1) provide students with science enrichment experiences that increase their scientific knowledge, critical thinking ability, and lab skills; 2) enhance career awareness of potential future biomedical, health, and STEM-related careers; 3) provide an interconnecting series of programs that serve as a pipeline to channel students into future careers. The following programs were funded by HHMI:

- Saturday Biomedical Science Academy (4-6th grade students)- enabled students to experience fun, hands-on lab activities from a variety of biomedical and other scientific fields.
- STEM QUEST Science Camps I & II (formerly, Summer Science Camps for 7-10th grade students)- students engaged in hands-on, inquiry-based experiments and problem solving activities that included the following areas: Biomedical Sciences; Biology; Biotechnology; Chemistry; Forensics; Engineering challenges and Independent Research Projects.
• High School Summer Research Program (10th-12th grade students)- an 8 week summer research experience in a faculty mentor’s laboratory culminating in a formal poster presentation of research results in an "on campus" public forum.

• Pathfinders/Biomedical and Health Careers Summer Academy (10th-12th grade students)- Participants explored various biomedical and health careers at UTMB through campus tours, presentations, and a variety of hands-on activities in state-of-the-art learning facilities. Participants also learned about the educational requirements for these careers, how to academically prepare for them, and admission processes.

• STEM Career Conference for 5-8th grade girls- a one day annual event where professional women from a variety of STEM careers provided hands-on career exploration workshops. (This was not held in 2013 due to lack of available funding).

Overview-Teacher Programs
The objective of the teacher professional development component was to equip teachers with the content knowledge, instructional skills, and materials to engage students in meaningful science learning experiences that will improve students’ scientific literacy and inspire them to pursue Science, Technology, Engineering and Mathematics (STEM)-related careers, with particular emphasis on biomedical-related subject areas. In addition, teachers were provided with professional development and mentoring to assist them in the implementation of the Texas Essential Knowledge and Skills (TEKS) and National Science Education Standards to better prepare their students for future success. This component included a STEM Education Conference in Galveston, Teacher Professional Development Workshops, and an Education Resource Center. By renewing and igniting the excitement as well as wonder of science in teachers, the teachers subsequently passed this on to their students, particularly if they have follow-up support and received full support by their school districts. The following programs were funded by HHMI:

• Teacher Professional Development workshops – a variety of biomedical, biotechnology, biology, chemistry, pedagogy, and other workshops provided based on teacher needs assessment surveys.

• Annual Science Education Conference/2012 STEM Education Conference-provides workshops, science education vendors, door prizes for teachers.

• Education Resource Center- loans equipment, kits, and supplies to teachers to enable implementation of effective hands-on laboratory activities free of charge.

Outcomes-Student Programs
• Participating students in all programs showed statistically significant gains in science content knowledge.

• Participants in HHMI funded programs produced winning projects at Galveston County Science and Engineering Fair as well as regional and state science fairs.

• Longitudinal studies showed program participation showed-74% of participants pursued STEM majors in college, 66% indicated the programs influenced their career choice, 31% - participated in HHMI funded OEO programs more than once.

• Estimate of number of students participating in our program = 2,382 (6 years).

• Significantly impacted student career awareness, choice of future career, attitudes toward science

• Served ethnically diverse, underserved, and economically disadvantaged populations.

Outcomes-Teacher Programs
• Teacher participants consistently demonstrated significant gains in science content knowledge.
• Significant gains in student standardized test scores were demonstrated for participating teachers.
• Enabled, empowered teachers to implement hands on, inquiry based activities in class as well as project based learning activities. Significant improvement in teacher skills observed.
• Our teachers have indicated in surveys that their participation in the professional development has benefited them greatly and increased their success in the classroom. Many teachers indicated they not be able to do their jobs effectively or at all without the support and materials received.
• Virtually 100% of participating teachers implemented proven practices (activities) in classrooms as determined by surveys and classroom observations.
• Estimate of teachers reached through HHMI funded programs over last 6 years = 2,432.
• Estimate of number of students reached through participating teachers = 135,000 (6 years).

Additional Impacts
• HHMI funding enabled programs to be developed, established, and modified over time to meet student and teacher needs in the area
• Provided a strong foundation to enable us to be competitive for and to establish our Southeast Regional T-STEM Center, Career Connections-Profession Sessions online series, and online Virtual Laboratory.
• Enabled OEO to survive and prosper during difficult times (Navigant and Post-Ike) when major Reductions in Force (RIFs) at UTMB occurred several times.
• Estimated total teachers and students reached by our programs during all HHMI funded periods: (1) Student participants = over 4,000; (2) Teachers = 3,700; (3) Students reached through teacher participants = 200,000.