Challenges & Competitions Introduction

Michelle Jordan

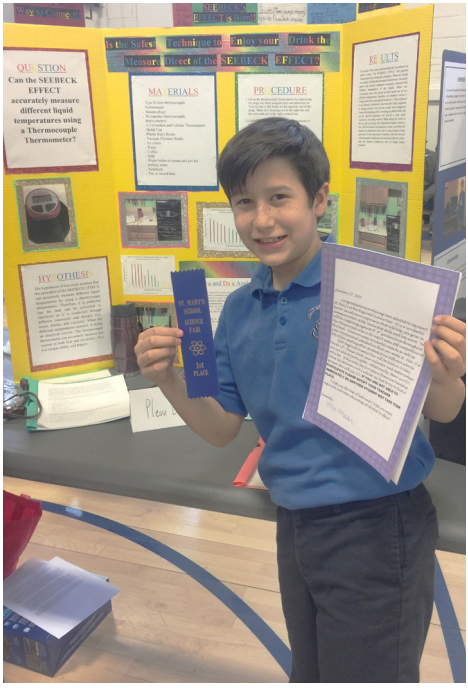
Science fairs and engineering competitions create unique opportunities for children and youth to pursue their personal interests while being mentored by supportive adults. These rich learning experiences usually occur beyond the regular school day and often beyond the school walls. QESST Scholars contribute to these efforts in several ways:

- Volunteering as judges at engineering and science fair competitions, giving feedback on projects, making suggestions for improvement, and encouraging future participation in STEM activities
- Mentoring individual students and small teams for science fairs and engineering competition projects, either in one-to-one settings or in after-school meetings
- Designing solar engineering competitions

Mentoring for Science Fair Participation

One way faculty and scholars conduct outreach is by volunteering as judges at engineering and science fair competitions, giving feedback on projects, making suggestions for improvement, and encouraging future participation in STEM activities. They also mentor science fair participants.

QESST faculty Ganesh Balakrishnan (University of New Mexico) mentored seventh-grade student Matthew Williamson After winning first place at his school's science fair competition in January 2017. Matthew took his project to the University of



New Mexico Regional Science fair competition in March 2017 where he won first prize in the Junior Division in the category of Physics- Specialty Award - with a cash prize of $75, a metal and a certificate.

Matthew's project was entitled, Can the SEEBECK EFFECT accurately measure different liquid temperatures using a thermocouple thermometer? In Matthew's own words,

"Most people do not refer to numbers very well, but they do know their comfort zone. That is why the purpose of this project is to help people understand temperatures better. The hypothesis of this study assumes that the principles of the SEEBECK EFFECT can accurately measure different liquid temperatures by using a thermocouple thermometer. Therefore, it has been predicted that heat can be converted to electricity as it is conducted through different containers and designs (i.e., metal, plastic, and vacuum). When the different temperatures connect, it forms an electrical current. The thermocouple thermometer can accurately measure this current as both heat and electricity. This is a unique ability and feature. The hypothesis of this study was developed through extensive research. Thermocouple thermometers have prompted the use of infrared thermometers with a thermocouple to measure skin temperatures, so why not assume a thermocouple thermometer can measure liquid temperatures through a container. The controls that were tested during this project utilized different liquid temperatures and the thermocouple thermometer. Various liquids (i.e., water, coffee, and milk) were heated in the different containers up to 54.4 ° Celsius. Control of the thermocouple settings and wire were monitored regularly. Interest in this project was sparked after reading a book that teaches how to build a thermoelectric generator to charge your cell phone. That study was far too hard for a seventh grader that has no experience with electrical engineering to study. However, this project is great start to future studies involving electrical engineering."

Matthew also wrote,

"I would really like to Thank my Science Fair Mentor, Ganesh Balakrishnan, with the University of New Mexico's Center for High Technology Materials. He explained things to me so I could understand them and he provided me with a thermocouple thermometer so I could do my experiment. He was so awesome!"

Advice for mentoring high school students

1) Check your students' background knowledge before beginning an activity. High school students are not as well educated college students. Sometime high school students have previous skills and experiences that may help with the upcoming project.
2) Motivation is a big part of the mentoring process. Introducing the importance and significant impact of an activity or project will help the students stay focused and positive.
3) Never ask, "Do you understand?" You will seldom get the answer that will give you the information you need. Instead, try to put the key idea into a specific question that can test if the student understands.
4) Treat students equally. A mentor often has a preference for the "good" students. This is a bad idea. Studies have shown that some students' poor performance is caused by indifference from their mentor.

Xiaodong Meng, QESST Scholar

Designing Solar Engineering Challenges

QESST has a long-standing relationship with the Arizona Math Engineering and Science Achievement (MESA) program. MESA serves middle school and high school students from Title 1 schools throughout Arizona, providing a combination of enrichment activities, hands-on competitions, academic support, industry involvement and supportive community environment. Since its inception in 1970, MESA has a strong partnership with local universities as well as industry. Math and Science teachers from low performing schools are offered free professional workshops. QESST has designed and implemented two solar car challenges for the MESA program. QESST has also provided the equipment necessary for hundreds of students to learn about photovoltaics engineering by participating in solar car challenges. The first challenge entitled, The Solar Car Race, spanned a period of 4 years. Over 300 students participated in this event. During the fall of 2016, QESST faculty, staff, and scholars designed and implemented a new MESA challenge called the Solar Car Obstacle Challenge. Through the solar car obstacle challenge, students have the opportunity to use creativity and innovation as well as engineering practices as they work together to tackle the challenge of building a solar car. QESST's new challenge is more rigorous and requires the participants to learn more PV related content.