

Socorro Middle Schoolers and New Mexico Tech Students Design, Build, and Race Gravity-Powered Cars

Julie Dyke Ford, Dominic Gallegos, Casper Huang

Mechanical Engineering Department
New Mexico Tech

Robinson Ford

Cottonwood Valley Charter School

Abstract

Originally conceived of and proposed by a 6th grade student, the Soapbox Derby Program began in 2018 and involved 10 middle school students working with college student coaches in small teams to design, build, test, and refine gravity-powered cars. With a budget of \$500 per team (thanks to fundraising efforts initiated by the 6th grader), each of the four teams had freedom to design and build a unique car. The program successfully culminated in a race on the New Mexico Tech campus golf course in April. Building on last year's success, this year's program has extended to include 15 middle school students, representing three area schools. The goals for the Soapbox Derby Program are to teach middle school students the engineering design process through a hands-on project. The program provides the college student coaches with the opportunity to serve as mentors for the next generation of engineers.

Introduction

As noted in *The Engineer of 2020*, there is considerable value in devoting efforts towards recruitment in engineering fields and enhancing public understanding of engineering¹. Initiatives to increase exposure to engineering concepts at the middle school level have been documented in the literature²⁻⁶. Of these prior efforts, programs that extend beyond periodic classroom visits or single day events, while requiring heavier logistics and resources, have yielded successful results^{2,5,6}. These programs are often resource-rich, with funding from federal sources and/or private industry.

Our program was *not* initiated by university or K-12 faculty seeking federal support for STEM curricula, and it lacks industry or government sponsorship. Our program was initiated by an 11-year old with a passion for automotive design and the naïve idea that if you work hard and ask for help, you can get an educational program off the ground. Now in our second year, the program has already expanded, and we're pursuing avenues (such as the NSF's Research Experiences for Teachers program) to support continued future growth. We recognize the value in acquiring support beyond our community so that the program can benefit from formal assessment and resources to further develop infrastructure to expand the program's impact potential. The model we share reflects a grassroots approach towards engineering outreach at the middle school level. Still in its infancy, we believe our program provides a valuable example for initiating a STEM outreach program even when broader support structures aren't yet in place.

New Mexico Tech/Cottonwood Valley Charter School Soapbox Derby Program

In the summer of 2018, a rising 6th grade student at Cottonwood Valley Charter School (CVCS) in Socorro, NM sought permission from his principal to permit an afterschool club focused on building gravity-powered cars. In addition, this student presented to staff at New Mexico Tech (NMT) to share his vision. Once CVCS and NMT greenlighted the idea, junior and senior NMT Mechanical Engineering students were asked to volunteer as coaches. Spanning the course of an academic year, the Soapbox Derby Program offers a hands-on afterschool activity for middle school students to learn and apply early engineering concepts in the designing, building, testing, and refining of gravity-powered cars. Their efforts in this year-long program culminate in a Spring race on the NMT campus. A brief [video](#) features footage and shows the cars and participants from the 2019 race.

In the future, the program will integrate more formal assessment to measure benefits for the participants. Through informal assessment via observation, the students involved have learned multiple valuable introductory engineering concepts. These concepts include working through the steps involved in the engineering design process, from initial brainstorming documented in their engineering notebooks to performing simple calculations, to being exposed to modeling software such as SolidWorks and Inventor. During the build phase, students gained hands-on skills of carefully measuring and using simple tools such as hammers, screwdrivers, and drills. Some of the teams were even trained to use more complex machinery such as belt-sanders, jig-saws, and miter saws as well as metal inert gas welding.

In addition to the benefits this program offers for the middle school students, there are benefits for the college student mentors as well. Their own understanding and appreciation of the design process is reinforced as they guide others through it. The importance of an engineering notebook, making accurate measurements, providing clear information for ordering parts, and applying problem-solving skills towards inevitable challenges experienced throughout the process is magnified each week as they meet with their small team.

References

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JULIE DYKE FORD is Professor of Mechanical Engineering and Technical Communication at New Mexico Tech. She coordinates the Mechanical Engineering Design Clinic, a unique capstone design sequence that involves a four semester requirement, beginning in the junior year. She also directs the Soapbox Derby Program.

DOMINIC GALLEGOS is a senior mechanical engineering student at New Mexico Tech. His undergraduate education experience includes explosives and aerospace engineering which he hopes to continue into graduate school. He has served as a soapbox derby coach/mentor for the past two years.

CASPER HUANG is a mechanical engineering student at New Mexico Tech, minoring in both Chemistry and Biology. He is involved in tutoring math and science at a local middle school and is a coach for the Soapbox Derby Program

ROBINSON FORD is a seventh grade student at Cottonwood Valley Charter School. He is very interested in automotive design. He started the Soapbox Derby Program and is serving as a mentor as well as participant this year.