Engaged students stay in school, have better grades, and are more likely to take rigorous courses and complete high school on time (Archambault, Janosz, Fallu, & Pagani, 2009; Skinner, Kindermann, & Furrer, 2009; Walker & Greene, 2009). At-risk students, however, demonstrate a weak pattern of school engagement that often leads to dropping out of school—the ultimate form of disengagement (Alexander, Entwisle, & Kabbani, 2001). In the Anderson, Oconee, and Pickens (AOP) area in upstate South Carolina, we’re finding success with our at-risk students by engaging them in three STEM challenges: Sailboat (ITEEA), JetToy (SAE), and Glider (SAE).

Our STEM Challenges

The Sailboat Challenge begins with second graders visiting a local marina to build understanding of the real world of sailing, wind, waves, and weather. Upon returning to school, students are challenged to build a Styrofoam sailboat that can float down a classroom “river” in 15 seconds or less. This project-based learning challenge is a chance to introduce physics, engineering, and problem-solving principles in a way that young children enjoy and understand. In addition to the design of the boats, students are responsible for keeping an engineering journal and a budget sheet to track progress. Teams work together to beat the clock. Some schools offer prizes to teams with the fastest sailboats. The Sailboat Challenge is part of an instructional guide, “Technology Starters,” created by the International Technology and Engineering Educators Association (ITEEA).

The JetToy Challenge is for our fifth graders. This challenge uses “A World in Motion” kits designed by the Society of Automotive Engineers (SAE). In this challenge, a fictitious toy company asks students to design a balloon-powered vehicle that will appeal to other children. Students use inexpensive and recycled materials to design a balloon-powered JetToy capable of performing well in different events on a track. Working in design teams, students build and test model JetToys using different nozzles. Then, they collect and analyze data to understand the effect of nozzle size on the performance of the cars. The teams and their balloon-powered toy cars compete first in school-level challenges. Winners then progress to district-level competitions, and last to a regional AOP competition. Two winning teams advance to the international JetToy Challenge held each year in Detroit, Michigan, sponsored by SAE.

Another AOP event is an eighth-grade Glider Challenge. In this challenge, also part of “A World in Motion” curriculum, students explore the relationship between force and motion and the effects of weight and lift on a glider. Winning teams from participating middle schools compete with their gliders in several categories, including distance, accuracy, and artistic design. This past year, the AOP Glider Challenge was held at a Lockheed Martin hangar, so students could experience a genuine career connection to flight.

Our Results

In all of our STEM challenges, students use principles that professional engineers use. It’s awesome to watch their excitement as they plan, design, and sometimes struggle to figure it all out. They learn complex scientific concepts while being completely engaged. Most importantly, they learn how to work in small teams to solve problems and accomplish goals. While our challenges are academic, students are learning how to listen to other people’s ideas and work together. We believe that this is especially important for at-risk students.

On nearly every winning team, we see special needs and at-risk students taking leadership roles. One of the JetToy teams that recently went to the international competition in Detroit had a special education student. This boy had never left the city, much less the state. His team went on to win the entire international competition. It was the first time he experienced something this positive and memorable at school, and his perception of himself and school will never be the same.

It’s a lot of work to pull off these challenges. Teachers have to tolerate a certain degree of controlled chaos in order for real problem-based learning to occur. They also need support at the district and regional level. Our state test scores, however, show this type of learning pays off. In Pickens County, 91.4% of our fifth-grade students met state science accountability standards in the forces and motion unit, and over half scored exemplary (Palmetto Assessment, 2012). We’re looking to add more challenges next year and believe our efforts will eventually impact our graduation rate. Our teachers are sold!

Are you up for the challenge?

—Barbara J. Nesbitt, PhD

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