Teacher: Patrick Smallwood

Course: Clean Energy Technology

School: The Center for Advanced Technical Studies, Lexington and Richland Counties, South Carolina

Principal: Bob Couch

Hands-On, Real-World Projects Pay Off For Students

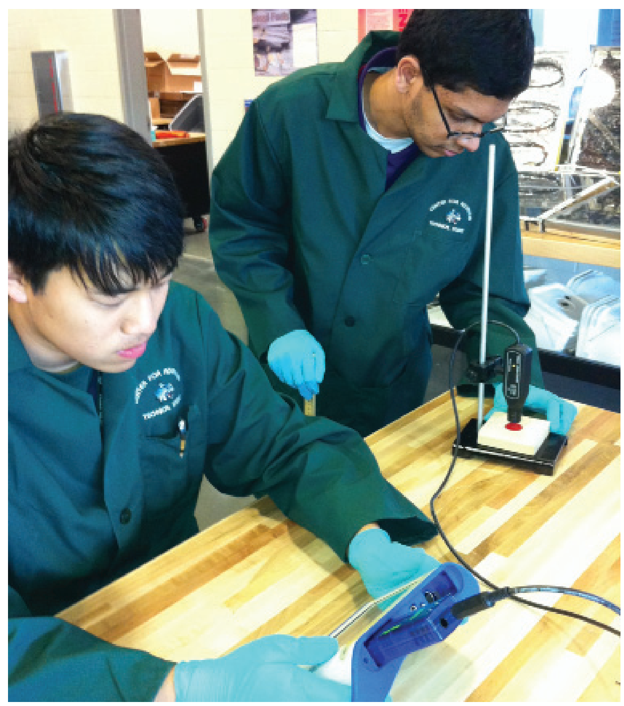
Patrick Smallwood's alternative energy class isn't your ordinary classroom. Students get a chance to be creative, do hands-on, real-world projects. They work in groups to research, design, build and evaluate technology systems. Students must also collect and analyze data and write the results of their work following the standards of "peer reviewed journal article." It's not easy. But students say it's fun, and they're learning a lot. One student says, "Our class is different because it is more hands-on and we learn by doing projects, not by lecture."

Students engage in hands-on learning techniques that make math and science come to life with industry- standard tools, National Instruments' LabVIEW for Education software and myDAQ hardware. LabVIEW and myDAQ together with project-based curriculum and equipment create fully integrated technology platforms for showing students real-world lab experiences.

Smallwood is a South Carolina instructor teaching Course 2 of the Clean Energy Technology program being developed by SREB and the state of South Carolina as part of SREB's Advanced Career initiative. "It is the clean energy application course, and it looks at some of the clean energy issues that the class did not get to do in Course 1," said Smallwood. In Course 1 (clean energy systems and technologies), students built a solar panel from scratch, and they built a solar hot water heater. They also made biodiesel fuel from recyclable vegetable oil and designed their own wind turbine blades to look at improving electric generator efficiency.

It is Course 2 that now has students excited. Students are working on a nuclear battery project. Smallwood describes it this way:

"This is the nuclear energy and power project where the students have to create their own nuclear battery. They are using a simulated radioisotope, and they are trying to take the heat that is generated and turn it into electricity. They are making a power device similar to a military portable power pack. The goal is to make an energy efficient nuclear battery device that is small, lightweight and keeps the hot side hot and the cold side cold. Portable power is becoming more valuable.



Students measure radiation emitted from radioactive sources.

"During phase 1, they [students] had to read materials, do background research and complete some small-scale lab activities. The purpose was to do research in order to get familiar with nuclear technology, vocabulary and background and to introduce them to the terminology of the different types of radiation and isotopes. They did some small-scale, basic lab activities in radioisotopes and radiation. They had to present their findings orally as a group using PowerPoint."

Smallwood says students are working together in phase 2 of the project. "They are collecting preliminary data, studying the prototype, and devising and practicing task management within the team. They are doing short scientific tests of one to two hours. It involves measuring the temperature of the thermal electric generator (hot side hot and the cold side cold) and the voltage measurements of the power outlet to determine how much power the battery is producing over time (staying constant or dropping off). This is the initial prototype of a nuclear battery. Students will present a 3D drawing and initial data, and they will receive peer reviews and critical feedback for improvement. In the final phase, they will adjust their design by making modifications from the shorter one- to two-hour scientific tests and do a final run- through [test] of 12 hours. Then they will summarize and include their findings in the final engineering report," said Smallwood.

Student displays the voltage produced by a functioning solar panel.

Aha Moments

Probably the biggest shock in this program is "how engaged and excited students are to come in and do the work each day."

When asked what has surprised him most, Smallwood said, "Students will say, 'Oh, so that is what they meant in that class,' and they are referring to a biology or physics topic that they [students] really didn't understand because they never did an authentic experiment with real materials. This happens numerous times."

Applying the same technologies used by universities and industry, "I have the chance to design classroom opportunities to help students get the concepts and realize when they're actually going to use this in the future," said Smallwood.

Smallwood also thinks students are benefiting from group work and collaboration. "My class has ordinary run of the mill students and national merit scholars. They are all trying to find their niche, and they have figured out that in a group they can contribute just as much as the other students in different ways."

Probably the biggest shock in this program is "how engaged and excited students are to come in and do the work each day. One of my biggest challenges as an educator is to get students to go through the work to get to the learning, and they are ready to do it every day. They walk in the door, and they are prepared to get out in the lab and get to work. The other thing is they are the first group to complete the pilot projects, and it has been successful. I've been able to take teams of students and ask them to build a solar panel from scratch; and then at the end when they all work, it speaks volumes about what we are able to do," said Smallwood. "My students are learning skills and technologies that prepare them for future careers and classes in STEM."

What Students are Saying

"I feel like I am learning more in this course than in any other courses because I am doing projects."

Student prepares a protective layer of cushioning for fragile silicon cells that are used as part of a student-created Solar Photovoltaic Panel.

Students, no doubt have the same positive experiences and impressions. One student said, "I enjoy the hands-on projects. We get to come up with our ideas and be creative and to improve upon our own ideas." Another student said, "A lot of my other classes involve sitting and taking notes and we take quizzes and tests; whereas, for this class, our teacher gives us an assignment, and we take it to the lab and work with our teams independently. He lets us have our own creative ideas, and he doesn't interfere with what we want to do. We learn from our mistakes, and we can be creative. For example, the toughest assignment was building the solar hot water heater. Our design had a lot of leaks in it. The water didn't flow all the way through, and it took a long time to sort out all the kinks. We solved it by going through several designs and using a wide range of different materials (foil, caulk, sealant types, tubing).

We got the idea from collective brainstorming, reading design articles and researching other models to make our own. We try to make improvements which results in a lot of trial and error. It's a deeper learning. I feel like I am learning more in this course than in any other courses because I am doing projects."

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