Cicero-North Syracuse High School

Education Success Story

Autodesk® Inventor®

I had planned to go to college for software design, but after working on the hydrogen fuel cell car I realized I really like engineering. Now I plan to pursue a mixed engineering degree.

—Kyle Berezin
Student
Cicero-North Syracuse High School

More MPG.

Cicero-North Syracuse High School students create an innovative hydrogen fuel cell vehicle with the help of Autodesk® Inventor® software.

Project Summary

How do you get high school students excited about engineering? Challenge them to solve a fascinating problem—and then give them the tools they need to do it. At Cicero-North Syracuse High School (Cicero), there's no shortage of scientific enthusiasm. When Shell Oil Company challenged students all over the world to build fuel-efficient vehicles for the Shell Eco-marathon®, Cicero students dove in. Undaunted by the prospect of competing against college teams, the Cicero team created a winning design by wielding the tools they'd gained through Cicero's Project Lead The Way® (PLTW®) curriculum: Autodesk® Inventor® software skills and hands-on engineering knowledge. Developing the car from concept through manufacturing, students experienced the excitement of creation and the thrill of winning. With help from Autodesk Inventor, students on the Cicero team:

- Placed second in class at the 2009 Shell Eco-marathon
- Gained concrete understanding of how to design for manufacturability
- Honed their plans for college and beyond

The Challenge

When Cicero adopted the PLTW curriculum a decade ago, it began teaching Autodesk Inventor software to students in the ninth grade. Martin Miner, a master teacher for PLTW and teacher at Cicero, notes, "Autodesk Inventor opened up a whole new world of modeling for students. We use it extensively in our design and engineering program."

Recently, the school has put its students' skills to the test by participating in the Shell Eco-marathon. Contest participants, high school and college teams from all over the world, are tasked with designing and building the most fuel-efficient, low-emission cars possible. In addition, the vehicles must fall within certain height and weight parameters and include a rigid body that can't be deformed by wind forces. Not only do these challenges stimulate student interest in the project, they serve as a catalyst for learning.

"The car is a classroom on wheels," explains Martin Miner. "Students have a chance to see how fuel and energy conversion work in a real-world application."

Autodesk®

Autodesk® Inventor® software makes it easier for students to make winning design choices.

The Solution

Throughout the year, up to 20 different students worked on the hydrogen fuel cell car, turning to Autodesk Inventor software to complete the design. Miner credits the software with unleashing student creativity. "Inventor lets students explore their ideas," he says. "As teachers, we just try to stay out of their way so they can learn to think creatively about engineering problems as they design."

Iterative Design Process

At the beginning of the project, students pored over the specifications and rules published by Shell to get a handle on the design parameters. As the vehicle's design progressed, they repeatedly confirmed that it met the Eco-marathon guidelines. For example, the team had to balance aerodynamics with requirements for a rigid car body. Cicero senior Kyle Berezin exported Inventor model data into open-source fluid dynamics software to assess the body's aerodynamics. Berezin and his teammates even consulted aerospace engineer William Bilbow at WMB Enterprises about the aerodynamics of the car by walking him through digital prototypes of the body design. "Inventor was helpful every time we needed to make a decision," says Berezin. "It gave us confidence that we were making smart choices. And once we settled on a soapbox-like shape, it was easy to make changes to our design."

"The students had a very iterative design process," adds Miner. "Inventor is very helpful not only because it lets students change their designs without redoing everything, it keeps track of every iteration so they can see how the design has evolved."

Designing a Viable Vehicle

Throughout this iterative design process, assessing design manufacturability was critical. The vehicle had to be fabricated mostly out of scraps with tools already available in the school's shop. JPW Structural Contracting Inc., a local welding company, welded the aluminum frame after students cut and tacked the frame together. The students manufactured most of the parts on the car, including the steering mechanism and the PVC-foamboard body. With each design iteration, students had to verify that they had the tools and materials needed to manufacture it.

"We had 10 awesome frame designs, but we couldn't build them due to our limited shop resources," says Miner. "Throughout this project, the students learned how to adjust for these limitations in the design process—they began to really see the connection between design and manufacturing."

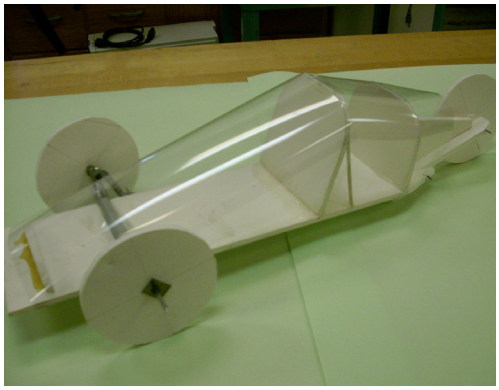
Visualizing the Finish

Using the visualization capabilities in Autodesk Inventor, students designing the car were able to communicate effectively with shop students responsible for the fabrication. "Our engineering students could pull up the digital prototype on a computer to show the students working in the shop," says Miner. "They'd say, 'This is what I want to do—can you make it happen?' If something needed to be changed, they'd do it right there. All the students got to see the process unfold."

Not only did visualization help facilitate communication between the shop floor and designers, it boosted student excitement about engineering. "With Inventor, students can picture something in their heads and very quickly bring it to life," says Miner. "They spin it around and see how parts go together. Once they learn how to make animations, it's very difficult to pull them away. They love being able to see how their ideas will work."

The Result

In April 2009, Cicero put its hydrogen fuel cell car to the test at the Shell Eco-marathon. The fuel mileage competition required a student to drive a course seven times at a minimum speed using as little fuel



as possible. Competing against highly competitive colleges, the high school proved its mettle. "It was our first national event and we took second place in the hydrogen fuel cell prototype class right behind Penn State," Miner boasts. "The students felt incredible about their accomplishment. They experienced the whole process, from initial design to competition—and earned the right to brag that they'd bested North Carolina A&T State University. It doesn't get much better."

What's more, the project helped turn students like Kyle Berezin into the next generation's engineers. "I had planned to go to college for software design, but after working on the hydrogen fuel cell car I realized I really like engineering," says Berezin. "Now I plan to pursue a mixed engineering degree."

Miner concludes: "Through this project working with Autodesk Inventor, students are getting a better idea of what they want to do after high school. Learning about engineering in a hands-on environment—it's priceless."

For More Information

To learn more about Autodesk Inventor software, visit **www.autodesk.com/inventor**.

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>
> —Martin Miner
> Teacher
> Cicero-North Syracuse High School

Images courtesy of Cicero-North Syracuse High School.

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