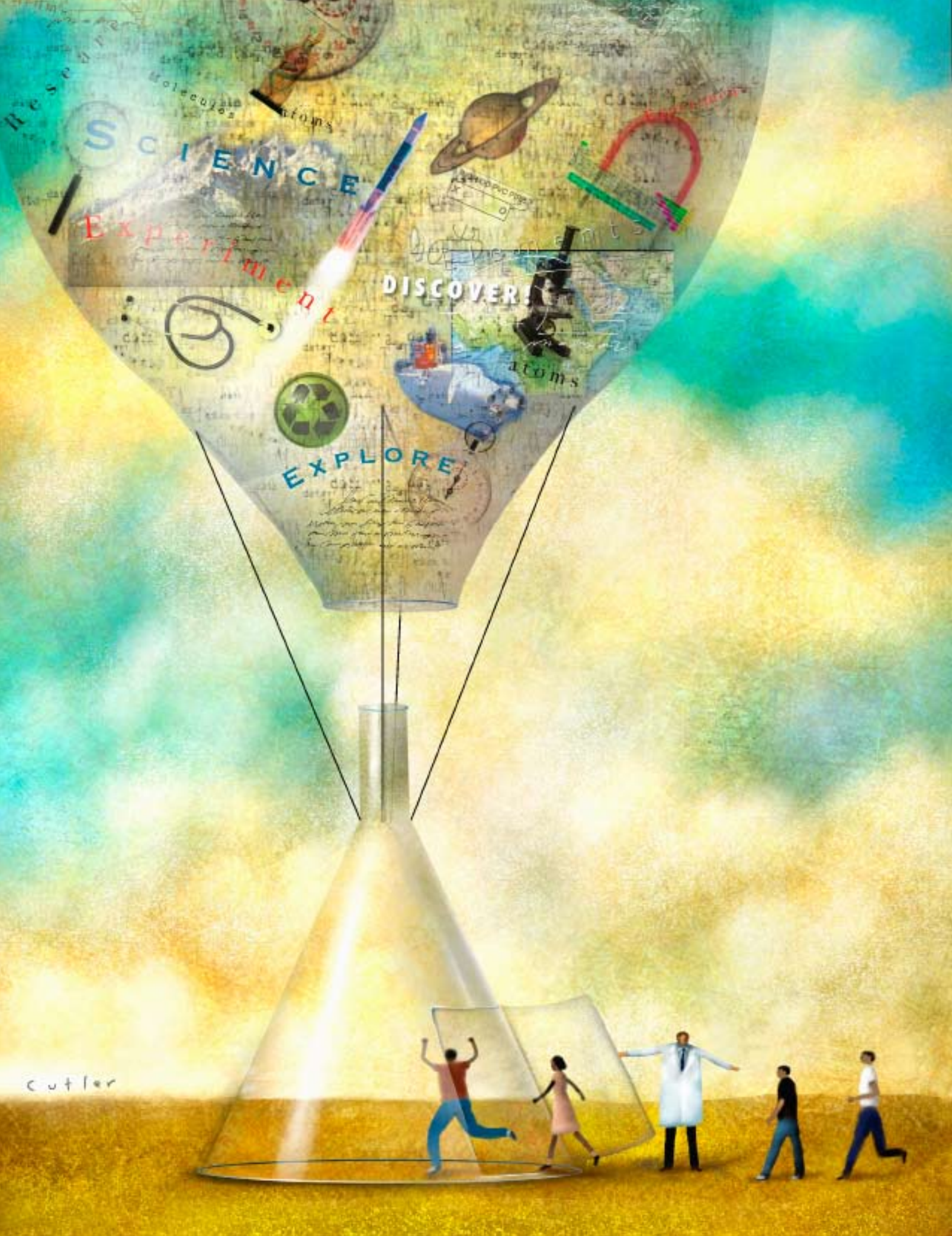
SCIENCE
Experiment
DISCOVER!
atoms
EXPLORE
cutler

College Design Prodigies

Northwest students take hands-on learning to new heights | By David Volk

Six Western Washington University students buzz around an off-road vehicle that looks more like an unfinished cage on wheels than a conveyance. The tires are attached; the engine is good to go; but there are still hundreds of details to address before the job is finished, not the least of which is adding a place to sit.

The students arrived at 8 a.m., after working until 1 a.m. Now it's just after 1 p.m., and they're so focused on the task at hand that a casual observer might think they were cramming for some sort of odd final exam, but they're prepping for an even more important test: the Baja SAE. Sponsored by the Society of Automotive Engineers, the competition of student-designed vehicles involves hill climbing, endurance and maneuverability.

"We'll be ready at 6 a.m. The question is, Will we get to go home tonight?" crew member Tobin Hood says, as the group rushes to check off items on a lengthy list of final adjustments they need to make on their two vehicles before they and professor Steve Fleischman load the vehicles into a flatbed the next morning and leave for the competition. The event, whose location rotates, is taking place this year at the South Dakota School of Mines and Technology in Rapid City.

Finishing the Baja SAE entry is all in a day's classwork for students at WWU's Vehicle Research Institute in Bellingham, 90 miles north of Seattle, where students get hands-on, real-world experience even before they graduate.

At colleges throughout the Northwest, students are attending engineering programs that call on them to develop and design new products or innovate existing ones. This practical experience helps the students assimilate information they've learned during lectures, and in some cases leads to com-

Students at Western Washington University's Vehicle Research Institute design cars such as the biodiesel hybrid Viking 23, left, which was developed in 1993 and has been refined almost every year since. Below: They also design off-road vehicles that are judged on features such as traction and durability.

mercially viable products. For instance, in 1985, students at the Vehicle Research Institute created the prototype of an engine that institute staff say is still being used in the Subaru Legacy.

Two other examples of the region's many notable college-design programs are Montana State University's Senior Design Capstone program and the University of Idaho's Capstone Design Program.

Rideable Vacuum

It may not be world peace, exactly, but if it weren't for the capstone program at Montana State University's Department of Mechanical and Industrial Engineering in Bozeman, the world might have been deprived of its first riding vacuum cleaner.

The department requires its students to complete a senior design project before graduation. The requirement helps young engineers get ready for life after college, says professor Vic Cundy. "We feel it's the last step in preparing them for the real world. You're going to go out as an engineer, and you're going to do this [on a regular basis]. We want them to experience as much of the real world as they can before they get out of here."

A student team at Montana State University in Bozeman designed this riding vacuum cleaner to help the housekeeping staff at a Billings hotel clean the conference/meeting space more quickly and efficiently.

To provide that real-world experience, Cundy invites industries and entrepreneurs to send him information on problems they are coping with, and he passes the information on to students so they can engineer a solution. Local inventors and businesspeople who have what they believe are viable ideas also turn to the program for technical expertise.

One woman who submitted a problem was 2000 MSU graduate Shelley Thomson, who now owns the Track Nine Digital Photography shop at a Billings hotel where she had worked while in college. She observed that the hotel could use more vacuum power, and in 2005 she asked the university for help.

As 2006 graduate Mitch Cowen tells it,

Students from the University of Idaho in Moscow are working on projects such as a water-filtration system for people in Africa, and a baby monitor to indicate breathing problems.

Thomson had already found a way to hook two vacuums together to increase the amount of conference/meeting space the cleaning staff could cover per hour, but it was still taking too long to do the job.

"These conference centers are so big, it takes a day to clean them, so she approached us with the idea of creating a riding vacuum cleaner that would fit through a regular doorway," Cowen says. Thomson wanted the vacuum to be light, be able to make tight turns and be able to pick up silverware as it went.

"I saw a need for a riding vacuum cleaner after years of watching countless labor hours poured into the task of preparing the large ballroom space for parties and conventions," says Thomson. "Most ballrooms are 10,000 square feet or larger, and all hotels have dozens and dozens of large hallways that lead to their guest rooms."

Cowen's team spent a whole semester designing a solution, determining what materials were necessary, their cost and how to build the vacuum. The challenges included designing the electrical system, determining the cleaner's speed, deciding how many times the brush head should hit the floor and determining how to provide the necessary battery life, because using a cord for power wasn't practical.

Resolving the challenges took so long, the student team barely finished in time

for the school's annual design fair in December 2006. The resulting three-wheeled contraption was 35 inches wide and 50 inches long, with three vacuum-cleaner engines, the ability to turn on a dime, a filtration system that used regular furnace filters, and four hours of battery life to power it all.

"It was the hit of the fair," Cowen says. "We did demonstrations every 15 minutes. We'd take a bunch of cookies and forks and whatever we could find, and we would pick it all up at full speed. It was pretty cool. We had a big crowd all day."

Thomson has the patent rights to the device and the option to further design the body, he says. "We didn't have time to make it look pretty, just make it work."

Thomson is working to patent the vacuum cleaner and looking for investors to help make the product commercially viable.

The project showed Cowen that there was more to engineering than he thought, while making him a more attractive job prospect to HDR Engineering, the Billings firm that hired him. Although he now designs high-voltage transmission lines, the experience prepared him for the administrative aspects of engineering, including budgeting, planning and bookkeeping, he says.

"I don't think you should have an engineering curriculum without this kind of program, because it is the culmination of everything you've learned in the last four years."

More Than Just Potatoes

The University of Idaho in Moscow has a similar program, the 27-year-old Capstone Design Program, that extends to all departments within the College of Engineering.

One success that UI School of Engineering spokesman Matt Strange likes to describe was a project for J.R. Simplot, the large Boise-based food-and-agribusiness corporation often credited with inventing the world's first commercially viable frozen french fries.

Last year Simplot asked the School of Engineering to help the company develop a better way to sharpen knives in the assemblies at one of its french-fry-processing plants.

Under normal circumstances, water pushes potatoes through a pyramid-shaped blade tree, which slices the vegetable into french-fry-size pieces. To ensure consistent quality, the blades have to be changed multiple times a day.

Pan Pacific Hotel
1/3 sq. 4/C

Hilton Garden Inn
1/3 sq. 4/C

KLD investment
1/3 V. BW

Although it was relatively easy to replace the blades quickly, sharpening the dull blades for reuse took substantially longer because each blade had to be sharpened individually by workers elsewhere in the plant, according to UI mechanical engineering department professor Steven Beyerlein.

After studying the process and experimenting with a variety of material-handling concepts over three months, the young designers created an automated device, with a cartridge, that sharpens an entire set of 24 blades in 10 minutes. The only worker involvement is loading the cartridge.

Not all problems are resolved as quickly, however. Some issues are too complex to solve in a year, so each new student team builds on the work of prior teams, Strange says. Developing a water-filtration system to provide safe drinking water for semi-nomadic Maasai people in Africa is an example of a long-term project.

Another ongoing project is development of a new baby monitor for Idaho National Laboratory, a U.S. Department of Energy research-and-development site.

During this past school year, electrical engineering student Jeff Otto worked with students from the departments of computer engineering, biological systems engineering, mechanical engineering, and clothing, textiles and design to develop an inexpensive, in-home monitor to detect when a baby might be at risk for sudden infant death syndrome.

INL wanted a monitor that could detect when a baby stopped breathing, says INL Engineering Manager Dale Wahlquist, who proposed the baby-monitor project to the capstone program. It took a while to come up with the right type of sensor to use, Otto says. The solution came to one of the team members in a dream: Because a baby's chest contracts and expands as it breathes, all the team had to do was loop thin wire through a piece of elastic in the clothing the baby wore across his/her chest. The elastic would stretch and contract as the baby breathed, and the wire would be a conduit for sending an electrical signal to a base unit that could then send an alarm to a receiver in the parent's room if the baby stopped breathing.

The design included sensors at the upper chest and the abdomen, two on each side, to maximize the system's effectiveness even if the baby's movements caused his/her clothing to shift or bunch up.

Determining the sensor system was just part of the battle, though. The team also

had to figure out how to integrate the wire into the clothing while making it removable so the wiring wouldn't be damaged by washing.

There are plans to have other students do further work on the baby-monitor project this fall, with a goal of ultimately bringing to market a monitor that costs around $100, according to mechanical engineering professor Don Elger, who was the team adviser on the project.

Although Otto will be going to grad school and isn't looking for a job, he says he still feels the experience helped prepare him for the real world.

"This class single-handedly was the most beneficial, most valid experience I've had in college. It was a taste of real-life engineering, which is a lot better than what I had before," he says. "I was getting completely waterlogged by lecture classes. I can't begin to express my enthusiasm for capstone programs."

Taking the Show on the Road

The Vehicle Research Institute at Western Washington University could well be one of the region's most specialized design programs. The projects at the Bellingham-based program focus on transportation.

Students at WWU don't wait until their senior year to work on design projects. Instead, the projects are mixed in with classwork from the start. In addition, students who choose to work on a vehicle that will be entered in a competition such as the Baja SAE may put in 40 to 50 extra hours a week, for six to eight months, in addition to their regular classload.

Over the past 33 years, VRI students have built more than 40 experimental cars emphasizing fuel efficiency and safety. Since the institute's founding in the mid-1970s, students have designed cars that run on alternative fuels such as biodiesel and biomethane, and on solar power.

The program also emphasizes composite materials that decrease weight and increase fuel efficiency. While the auto industry as a whole has been trying to build cars that come in under 3,000 pounds, WWU students in the program have already designed and built a car that tips the scales at just 830 pounds, says Institute Director Eric Leonhardt.

The lightweight vehicles haven't caught on with automakers yet because the composite materials are better suited to lower-volume production levels than to mass production of cars, he says.

continued on page 94

continued from page 90

Last year, VRI students developed a way to extract biomethane from waste at a local dairy farm and convert it into fuel for a hybrid car. It may be a while before biomethane enters the mass market, however, because VRI is still working on the technology and determining whether it should be owned and sold by farm owners, a farm cooperative or even a utility district.

Another product the students helped design that may eventually make its way to the market is an ultralight kayak that was created last year to help set a record for a 24-hour endurance event. Even when fully outfitted, the soft-top, hard-bottomed boat weighed just 17 pounds, in contrast to comparable craft that usually weigh between 20 and 24 pounds. Although the boat experienced technical difficulties on the water, it allowed the kayaker to row 146 miles in a day.

The institute hopes to find investors to help further refine the design and possibly make it commercially viable.

One WWU product that has made it into commercial use at a Michigan plant where new Ford Mustangs are produced is a tool that spring 2005 graduate James Waltman helped design. Called a cross-car hood-setting jig, the tool rests on the fender when a car is on the assembly line and helps workers align the hood before it is bolted in place.

The new tool became necessary when Ford changed its Mustang body style on cars for the 2005 model year. The car company had already designed a tool, but it proved to be too heavy and cumbersome for the assembly-line workers, and also posed some safety risks. So a VRI graduate who worked at Ford contacted WWU for help.

"The weight reduction was pretty daunting," says Waltman. "We were supposed to knock more than half the weight off [reducing it from 40 pounds to 12], and it's not a small piece."

Ford needed the jig to be 50 inches long by 14 inches wide while still being stiff and durable. Leonhardt and Waltman were able to meet the weight-and-dimensions requirements by making the jig out of carbon fiber and aluminum.

Waltman says he enrolled in the VRI because he wanted to work with cars, but by the time the project was done, he was so interested in carbon fiber that he ended up taking a job using the composite material at Adam Aircraft Industries, a small-aircraft and very-light-jet manufacturer in Colorado.

"The jig project absolutely helped me get the job," Waltman says. "The Mustang project was a pretty close match to what I'm doing now."

While Waltman's project led to a happy outcome, the WWU students who went to the Baja-vehicle competition in May weren't as fortunate in the short term. They placed fifth in the design category and second in the rock crawl, but they came in 32nd place overall out of a 90-car field after problems with the shock mounts—which hold the shock absorber to the frame of the car via bolts—caused the frame to fail during the endurance event, and a joint problem developed during the maneuverability competition, says Tyler Douthit, one of the car's designers.

"It was a pretty severe failure, but we were able to get it going in an hour or so," Douthit says.

Oregon State University upheld the honor of Northwest college designers, capturing second place overall, thanks to good scores in categories ranging from design, cost and speed to traction, maneuverability and durability. Auburn University in Alabama came in first.

Douthit doesn't view WWU's placement as a defeat, though. Instead, the experience taught him the importance of making sure physical models match computer models and the need for stringent field testing. It also helped prepare him for the real world. And the vehicle's relatively high rank despite its problems taught him another significant lesson:

"Don't throw in the towel right away. Keep on fixing it. Always finish the race. We had some failures, but we were able to fix them."

Such lessons are part of the point of programs such as those in Idaho, Montana and Washington, according to Elger, the University of Idaho professor.

"Our fundamental mission in life is to develop people. If you're a CEO of a company and you hire one of these kids, they can do the same [types of design things] for your firm. That's the whole idea. What we want to do is make the economic pie bigger. The way we want to do that is to develop people who are extraordinary." ■

David Volk lives in Seattle.

The American Society for Engineering Education Website, www.asee.org, is a source of further information about design programs at various colleges.