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linking education to careers

JANUARY 2018

**CAD/CAM/CNC**  
*and Chocolate!*

**Reinvigorating**  
**a High School Woodshop**

**New**  
**Internship**  
**Models**  
**Help Close**  
**Skills Gap**

# technically speaking

Vanessa Revelli [vanessa@techdirections.com](mailto:vanessa@techdirections.com)



Over the past few years, escape rooms have grown in popularity. If you aren't familiar, Wikipedia defines an escape room as a "physical adventure game in which players solve a series of puzzles and riddles using clues, hints, and strategies to complete the objectives at hand. Players are given a set time limit to unveil the secret plot which is hidden within the rooms. Escape rooms are inspired by "escape-the-room"-style video games, and games are set in a variety of fictional locations." This month Paul D. Camp Community College, with the help of the Youth Career Center of Hampton Roads, put their own spin on this fad—Escape the School.

Over 60 students worked in teams to learn more about careers by building contraptions, safeguarding products, and solving various puzzles. They faced nine career-themed "escape rooms," each with a 30-minute timer, which required groups to use clues, teamwork, and problem-solving skills to complete objectives, said high school career coach Susan Stubenrauch.

In these rooms, they found career possibilities in fields like engineering, manufacturing, and building trades, Stubenrauch said.

"Students come in that don't know what they want to be," she said. "They just have ideas or pieces. They don't see how they can turn those into professions or careers." Active-duty military, retired shipyard engineers, medical specialists and others volunteered to supervise the students and guide them with their own career experiences.

"It's a really good way of having fun while solidifying that knowledge, rather than the traditional lecture format," said youth services director Christina Brooks. "We're always looking for new and exciting ways to teach

career education."

One classroom featured maritime pipe fitting, welding, and shipbuilding using graham crackers and paper towel rolls. Teams worked to keep their "pipes" from leaking water so their graham crackers would hold tight with icing. Other rooms had students align laminated text of HTML computer code to properly build a website on the floor, and students combining pipes and boxes with tape for descending marbles, and celebrated when they succeeded in the engineering exercise.

"That's been a favorite," Brooks said. "They get so into it."

Teamwork was another challenge for the students, at least at first. "We were all just diving into it, but then we learned to slow down and work with each other," said junior Sarah Scott.

Another room at the school was prepared for Virginia Education Wizard, a tool to help students check out career paths—what requirements are needed to get the job they are interested in. Doing this after the students spent time in all the rooms allowed them to look into the careers they had just learned about.

"Some kids don't know what they actually want to do, but this gives us ideas," said sophomore Sydney Stubenrauch.

*Vanessa Revelli*

## techdirections

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**About the cover:** In the two-year Machine Tooling Technics program at Chippewa Valley Technical College, students spend the first eight weeks learning how to use the manual equipment and devices, such as depicted in this photo. Photo courtesy Mastercam. Cover design by Sharon K. Miller.

# the news report

**Vanessa Revelli**

vanessa@techdirections.com

## Design it Digital CAD Contest

Design it Digital is a fun new online student design competition. Students are presented with three hypothetical scenarios in which a client is asking for a custom piece of furniture:

**Scenario 1**—A young couple has just moved into a loft apartment in an old industrial building. They have one large room for their bedroom area, living area, and kitchen with a small bathroom attached. The couple would like to have some more storage and some privacy between their bed and the kitchen area.

**Scenario 2**—An eccentric business person lives alone in a large home with 7 cats. This client loves their cats so much they are looking for

someone to make them a custom bed with a built-in cat habitat.

**Scenario 3**—A sci-fi movie fanatic wants to make the ultimate entertainment center to hold their brand new 70" flat screen TV and electronics. This client wants the entertainment center to be something unique to impress their friends.

Students can choose their favorite client project and design a solution using any CAD and rendering software. This contest introduces students to challenges that designers face when making a custom piece of furniture. It also highlights the use of CAD software in our industry and provides an opportunity for AWFS® member companies to get involved with students and schools. Our focus is to engage young people into think-

ing about the many career opportunities available in the wood industry.

The competition is open to students in North America: middle/high school (grades 6-12) and postsecondary (judged separately), with entries due May 31, 2018.

Schools must register before students may submit their entries: <https://www.surveymonkey.com/r/DID2018>

### Prizes—Postsecondary:

**1st Place:** \$1,000.00 (USD), a Semi-Pro HVLP Spray System from Fuji Spray, Cabinet Vision software from Vero, an AccuMaster Digital Fraction Caliper, and a Measure Master Pro Calculator from Calculated Industries.

**2nd Place:** \$500.00 (USD), a Castle 100 Pocket Hole Machine from Castle Inc, Cabinet Vision software from Vero, an AccuMaster Digital Fraction Caliper, and a Measure Master Pro Calculator from Calculated Industries.

*Vanessa Revelli is managing editor of **techdirections**.*

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3rd Place: \$250.00 (USD), a mini-Ligno E/D from Lignomat moisture measurement, Cabinet Vision software from Vero, an AccuMaster Digital Fraction Calipers, and a Measure Master Pro Calculator from Calculated Industries.

**Prizes—Middle/High School (grade 6-12):**

1st Place: \$1,000.00 (USD), a Semi-Pro HVLP Spray System from Fuji Spray, an AccuMaster Digital Fraction Caliper, and a Measure Master Pro Calculator from Calculated Industries

2nd Place: \$500.00 (USD), a Castle 100 Pocket Hole Machine from Castle Inc, an AccuMaster Digital Fraction Caliper, and a Measure Master Pro Calculator from Calculated Industries

3rd Place: \$250.00 (USD), an AccuMaster Digital Fraction Caliper, and a Measure Master Pro Calculator from Calculated Industries

For complete details, visit <https://did2018.artcall.org/>

**Study Shows CTE Courses Provide Slight Boost for High School Success**

According to a recent survey being published in the *American Education Research Journal*, students who take career and technical education courses during their junior or senior year in high school are 1.5% more likely to graduate on time and 1.6% less likely to drop out of high school for each CTE course taken. The results for high school seniors was even greater at 2.1% more likely to graduate on time, and 1.8% more less likely to drop out of the CTE classes they were taking.

Conversly, the rates were lower in earlier grade levels. The survey found that taking CTE courses during freshman and sophomore years had only a small impact on on-time graduation and dropout rates.

“We believe that later high school CTE course-taking exhibits a stronger relationship with increased graduation and decreased dropout because as students approach the end of high school, they are faced with making decisions regarding postsecondary options,” said Jay Plasman, a Ph.D.

candidate at the University of California Santa Barbara and co-author of the paper with Dr. Michael Gottfried, an associate professor of education at UC Santa Barbara.

“CTE offers an option that is not necessarily reliant on further education, and this may appeal to students as a way to gain skills that will be directly relevant after high school.”

Plasman also suggested that CTE courses are often stressed as being “more educationally engaging” than

regular courses and “designed to promote relevance of high school courses as they relate to the real world.”

“It may not be improving the chances of going to college, but neither is it hurting students’ chances of going to college,” Plasman said. “In future research, we do plan on examining the link between high school CTE course-taking and career outcomes, which will provide more clarity into how CTE relates to outcomes beyond high school.” ©

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## The Biological Supercapacitor

Don't you hate it when your smartphone runs out of power when you need it the most? To alleviate this low-power catastrophe, you probably carry a back-up battery, and a charging cable, to keep your smartphone off life support (power saving mode). As much a pain as the above scenario might be, imagine how a person feels when they are told that the battery in their pacemaker needs to be replaced, and this battery update requires surgery.

In the 50+ year history of pacemakers, the device, and its battery power source, have seen many improvements. It has shrunk dramatically in size so it is now about the size of a U.S. 50¢ coin, with about half of that real-estate taken up by its battery. The pacemaker's battery powers the electrical stimulation that is necessary to correct the patient's irregular heartbeats.

A recent materials science break-

*Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit [www.technologytoday.us](http://www.technologytoday.us) for past columns and teacher resources.*

through of a new biologically friendly electrical energy storage device



Images courtesy Islam Mosa, University of Connecticut, and Maher El-Kady, UCLA

**Photo 1—Artist rendering shows what a 3D image of a patient's working heart might look like during a medical scan to see if the pacemaker, and its biological supercapacitor, are functioning properly.**

might soon be able to replace the battery now found in pacemakers (Photos 1 & 2). This new electrical storage device is completely made up of materials that are biologically compatible with our internal chemistry. It won't cause infections, or allergic reactions, making it perfectly safe for it to be used inside animals or people to power medical devices. The researchers that developed the technology also indicate it should never need to be replaced since it has no parts that can wear out or, over time, lose its ability to hold an electrical charge.

The biological supercapacitor was developed in a joint project that was funded by the National Science Foundation and other bioengineering and health institutes. Scientists at UCLA and the University of Connecticut worked together to develop what they are calling a biological supercapacitor that could soon make implanted medical devices work without a battery.

A capacitor is an electrical device that can store electricity for short periods of time. It cannot store as much energy as a battery, so capacitors need to constantly be re-energized. To keep their biological supercapacitor ready to perform its electrical stimulation of the patient's heart, it is constantly being recharged to full capacity. The electrical energy to recharge it comes from the electrolytes of the animal,

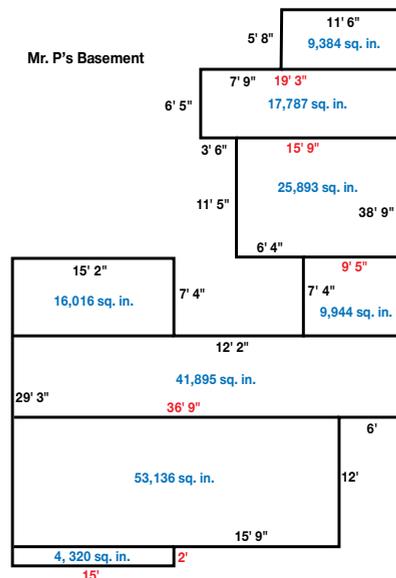
## More than Fun Answers

### Problem Basement

First, determine the lengths of the two sides of the basement that were left blank. The length of the bottom segment is 15' and the length of the small vertical segment is 2'.

Divided the basement into rectangles and then find their areas. First, convert all the lengths to inches. See the diagram below (the areas are given in blue, the missing sides in red).

The total area is 178,375 square inches or 1,238.7 square feet.



### Word Scramble Challenge

INPUT OXYGEN  
MITER SALIVA

When unscrambled, the letters in the squares read:

**IMAGINATION**

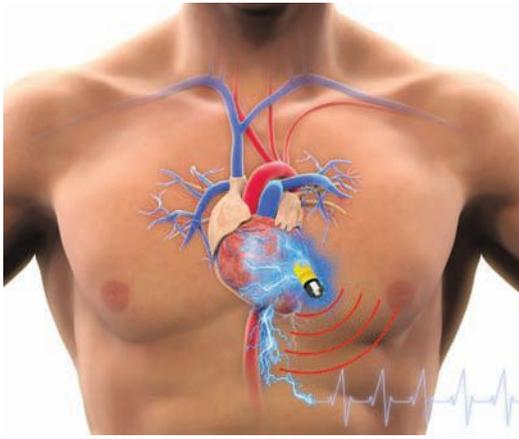
Albert Einstein once quipped: "Imagination is more important than knowledge" How far would he have reached without it?

### Changing Times

You need 9 coins:

4 pennies, 1 nickel, 2 dimes, 1 quarter, 1 half dollar, or

4 pennies, 2 nickels, 1 dime, 1 quarter, 1 half dollar.



**Photo 2—If animal and human trials have positive results, a biological supercapacitor might one day remove the need to use batteries inside the human body to power pacemakers and other medical devices.**

or human body's, biological fluids.

To always guarantee enough energy for recharging, they also developed a small energy harvester. Energy harvesting is the process of scavenging energy from an existing energy source. For example, solar panels generate electricity from

sunlight which makes solar panels an energy harvester. The energy harvester, installed alongside the biological supercapacitor, converts body heat, and physical motion, into electricity.

The team built their supercapacitor using layers of graphene, and human proteins, so their device contains no ingredients which are not biologically compatible with the human body. It is the inclusion of human proteins that makes the supercapacitor a biological device. Graphene is a one-atom-thick sheet of carbon

that is harder than a diamond, unbelievably flexible, and a great conductor of heat and electricity. It was discovered in 2004 and it is currently finding its way into all kinds of new and even old technologies.

Without any other viable power source available, batteries have been

used in pacemakers even though they contain chemicals and metals that could be toxic if the battery leaks. But just like your smartphone battery, all batteries eventually lose their ability to hold a charge. Since all surgeries have chances of infections, an electrical power system that won't need replacement would certainly be superior to one that might leak and/or eventually wear out, creating the need for emergency surgery.

Before this technology is approved for people it will need to go through more animal testing, and eventually human trials. If testing goes as planned, you can expect many new implantable medical devices will use biological supercapacitors, and energy harvesters, as their power source.

### Taking It a Step Further

Working in teams of three or four, research how graphene is being used today. Also identify all the different ways we harvest energy from existing natural or human-made systems. ☺

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**Dennis Karwatka**

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## Gutzon Borglum and Mount Rushmore

A person who creates large sculptures in stone has many technical difficulties to overcome. Project design and scheduling are important early activities. Operational challenges include removal and polishing of the stone, selection of specialized tooling, and development of safety equipment. Gutzon Borglum had years of sculpting experience in 1927 when he began reshaping Mount Rushmore in South Dakota.

Borglum was born in 1867 in St. Charles, ID, about 100 miles northeast of Salt Lake City, UT. His father was a country doctor and Borglum was raised in a family of nine children. Borglum's teachers noticed his drawing ability. They encouraged his artistic work, but Borglum's parents disapproved and he struck out on his own at the age of 17.

He earned money as he could while trying to sell his paintings and learn his trade. Borglum was studying with a painter in Los Angeles in 1885 when he met Elizabeth Putnam, who was also a student. They married in 1889 and traveled in Europe, where Borglum studied and exhibited his work. His paintings often featured dynamic scenes

*Dennis Karwatka is professor emeritus, Department of Applied Engineering and Technology, Morehead (KY) State University.*

from America's Old West. Borglum was influenced by the French sculptor Auguste Rodin (1840-1917), a good friend whose most famous work is *The Thinker*.

New York City's Metropolitan Museum of Art bought Borglum's award-winning sculpture *Mares of Diomedes* in 1906. It was the first sculpture by a living American that the museum purchased. Borglum admired Abraham Lincoln and he chiseled a huge likeness of Lincoln's head from a three-foot cube of



**Gutzon Borglum**

marble in 1908. That sculpture is in the Capitol crypt in Washington, DC. Also in Washington is Borglum's large bronze statue of Union General Philip Sheridan, which Borglum completed the same year.

Borglum and his first wife divorced in 1908. He married Mary Williams the next year. They had three children, including Lincoln (1912-1986), who would later serve as his assistant on Mount Rushmore. Before that, Borglum became involved with a project that was to include several Confederate soldiers chiseled onto Stone Mountain in Georgia. But he had a falling out with the sponsors and resigned in 1925. Those in charge removed his partially completed work and started over again with another sculptor.

State and federal laws were established in 1925 permitting "colossal sculptures" on public lands, and the state of South Dakota invited Borglum to talk to the Rapid City Commercial Club in 1924. They eventually came to an agreement on the location and style of the subjects. Borglum's massive Mount Rushmore

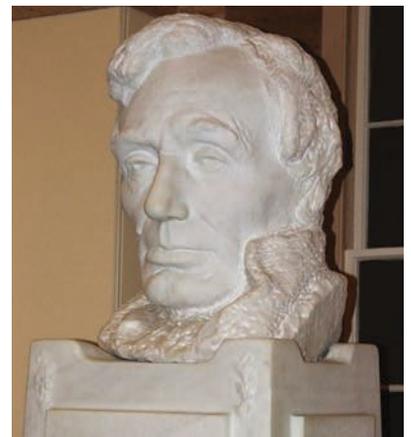


**Left, Borglum's painting *Running Out the Storm***

**Below, Borglum's sculpture of Abraham Lincoln**



**Borglum's *Mares of Diomedes***





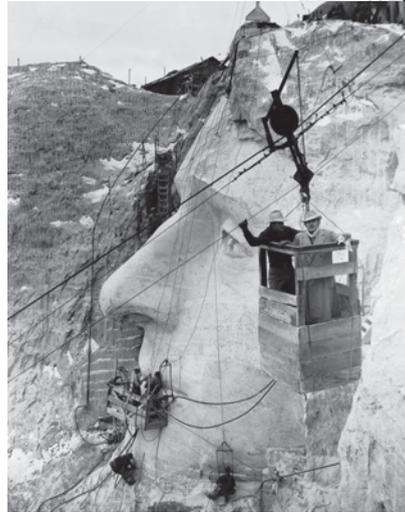
Left, Borglum with an early model of Mount Rushmore



Borglum, at left, supervising work on Mount Rushmore in 1929



Borglum, at left, in a harness he designed, working on Mount Rushmore in 1935



Gutzon Borglum (right) and his son Lincoln inspecting Mount Rushmore

harnesses that Borglum designed and used himself. Not one worker was seriously injured or killed during the 14-year-long project.

Borglum's son Lincoln was often on site and became his assistant in the late 1930s. Borglum died in 1941 and Lincoln finished the closing phases of the work that year. The older Borglum had completed over 30 major sculptures during his lifetime.

The 1959 motion picture *North by Northwest* featured an exciting conclusion on the face of Mount Rushmore. The scenes were filmed using backgrounds at the MGM Studio in Culver City, CA. The actors were never on the face of the real Mount Rushmore. ©

carving was to include four presidents: George Washington, Thomas Jefferson, Abraham Lincoln, and Theodore Roosevelt.

Borglum first constructed a large model in his on-site studio. He employed a 1:12 scaling ratio using a stick that extended over the tops of the model and Mount Rushmore. The sculpting began in 1927 when

Borglum was 60 years old.

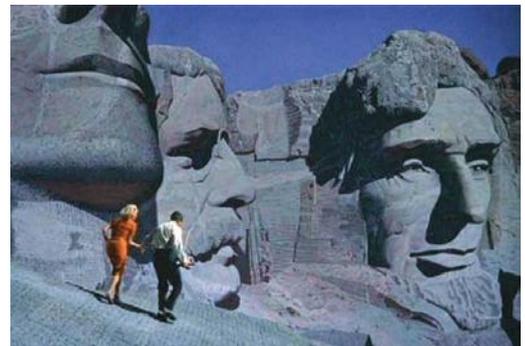
There were no textbooks on mountain carving and he invented new methods. He used precise dynamite charges and developed specialized pneumatic tools that allowed workers to remove and smooth large quantities of granite. Over 400 people were employed on the project, many of whom worked hanging from safety

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Left, two F-18 Hornet fighter aircraft pass by Mount Rushmore



Cary Grant and Eva Marie Saint on the set of *North by Northwest*

# Chippewa Valley Tech Students Bond with Local Industry

By Barry Van Name

**S**TUDENTS graduating from the machine tooling technics program at Chippewa Valley Technical College (CVTC) start out with more than a two-year technical diploma. They have also earned a position or internship with one of the many manufacturing shops and plants in the surrounding Eau Claire, WI, community.

Unique to the program is that it is year-long, with five entry dates during the year—August, October, January, March, and June—with a class graduating every eight weeks. There are sixty students in the program, twelve in each class.

To assure plenty of CNC machine time for each student, the 13,000 square-foot shop area has 13 Haas CNC turning centers, all of which have a Y-axis and live tooling, and 20 Haas CNC vertical mills, four of which have 12,000 rpm spindles and can be fitted with rotary-trunnion tables for 5-axis milling. “We’re a Haas Tech Center,” says instructor Dave Thompson. “To keep pace with the advancements in automated manufacturing, we have 60 seats of Mastercam® software in our CAD/CAM labs, so each student has his or her own station.

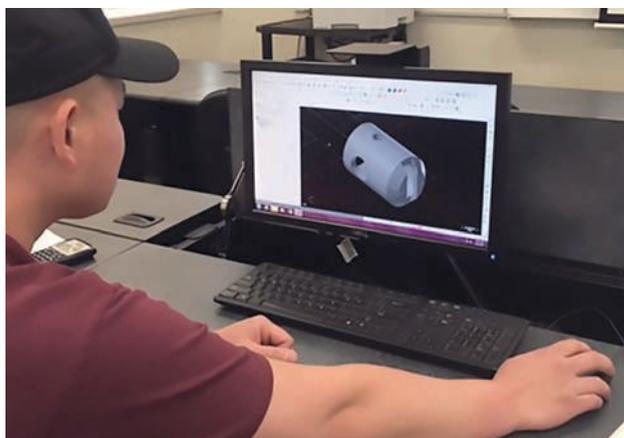
“We’re very grateful for the support both Haas and Mastercam have given us. The equipment, software, and even advancements in the program itself are due, in great part, to

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*Barry Van Name is an editorial associate with Lynn Gorman Communications LLC, specializing in technology education and industry topics.*

our local industry. We have an advisory committee comprised of shop owners and managers who tell us what our students will need to know to compete for jobs in the manufacturing community. They say that the features of the Haas machines will make them comfortable with what

they’ll find in most plants, while Mastercam programming software is what is in place throughout Wisconsin’s industrial sector. Our intent is to prepare students to get jobs, and we use the software and hardware that will give them the best preparation for success.”

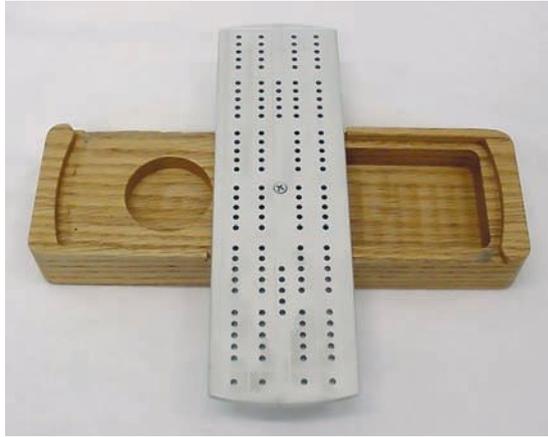


**Student Pha Vang uses Mastercam to program a part that will be produced on a Haas CNC turning center.**



**A student checks her program on one of the Haas verticals before initiating the start button.**

**Aluminum cribbage board top created with all G-code with sub programs and loops and wood cribbage board base made using G-M code on a Haas mill**



then allow them to be creative. Our injection molding equipment is pretty basic, but is very sufficient for our needs.”

At this point in the course, students will start getting into some of the advanced machining processes, such as Mastercam’s Dynamic Motion technology, including dynamic milling and turning. The technology lets the students experience fast cycle times when machining their projects, while giving the college the benefits of extended life for their tooling with less wear on the mills and turning centers.

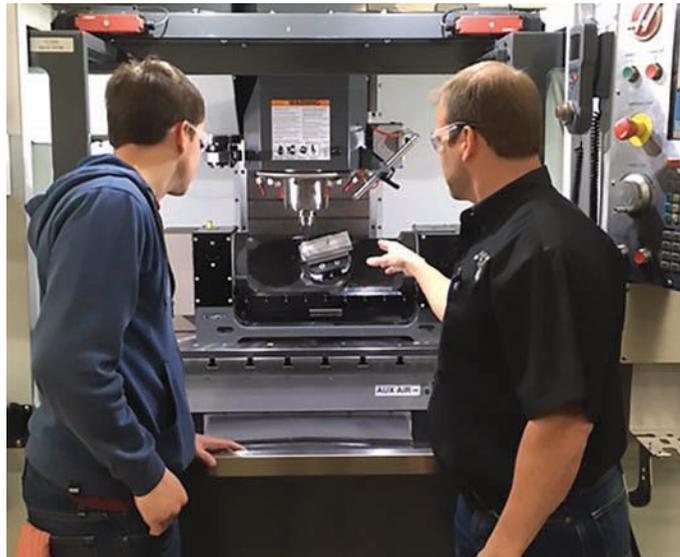
Mastercam generates toolpaths in a manner that is different from traditional CAM toolpath generation. The software takes into consideration not only the area from which metal is to be removed, but also the changing condition of the material throughout the various stages of machining. “This gives the students the advantage of faster machining times,” says Thompson, “with smooth, precise cutting operations that give their projects a professional look.”



**Students made an injection mold to create the plastic case for the fishing lure. Programmed by a CVTC student in Mastercam and produced on a Haas CNC mill.**

After being exposed to an overview of manual machining in their first semester, learning the processes of milling, drilling, and turning, students are introduced to CAD/CAM. “One of our claims to fame is that we go really deep into understanding G and M codes in programming,” says Thompson. “When the software gives students a code, they can read that code easily, and understand what’s going on in the program. As machinists, they may have to manually edit the program, adding or deleting certain information. Understanding the codes gives them confidence in achieving a good result.”

The next step in the course is to introduce 2D CAM with some drafting software. “Once they understand the drafting aspect,” says Thompson, “they’ll learn how to program basic toolpaths for what they have drawn, primarily facing and contouring. Then, we’ll get into 3D CAM, learning about 3-dimensional surfaces and importing their designs from SolidWorks® CAD programs.



**Instructor Dave Thompson reviews 5-axis swarf milling operation with student Travis Sand.**

“One of the projects they have to do at this stage is to design and build an injection mold body and cavity out of aluminum and then, using the shop’s molding machine, produce a plastic product. The students will design a 3D part within certain size restraints. We’ll walk them through basic designs and

Once they get into 5-axis machining, the projects become more complex. “Students are given a blueprint for each 5-axis part,” says Thompson. “For a milling project, I’ll introduce them to swarf milling, where the side of a cutter is used to mill a part as the X, Y, Z, B (rotary) and A (tilt) axes all move

in a continuous path that has been programmed. A neat thing here is that the entire operation has been performed in simulation before the toolpath program is loaded into the

The college's relationship with local industry extends well beyond having several individuals serving on the advisory committee. Because of the reputation gained through the

accommodating each student with a work schedule that does not interfere with their college schedule. It is understood that the students will not be offered full-time employment, or receive advancements within the company, until they complete our program. There are also several internship programs available at firms in the region for students in their fourth semester."

Not all students in the program go directly into the job market. Some continue their education toward a four-year degree. "A popular school for those continuing on," says Thompson, "is University of Wisconsin-Stout. Here, students can have credits earned at CVTC applied toward a degree in, for instance, Industrial Management."

Whether at the end of their education at CVTC, or beyond, Mr. Thompson's graduates have stepped out onto an interesting and very productive career path. ☺



**Students must learn how to measure the parts they produce on the machine tools to assure accuracy of their work.**

mill, which builds confidence and is a terrific time saver.

"For a turning project, they'll machine a hammer handle out of 1018 steel, and then create a head cap out of aluminum, using the live tooling to inscribe their name or design around the edge. Again, simulation graphics proves the program and allows them to make corrections before downloading the program. Students are given a blueprint for the 5-axis parts."

All students in the program must take a course in precision measurement. "We have a full complement of measuring equipment," says Thompson. "In addition to conventional calipers, micrometers, and height gages, for instance, we have state-of-the-art CMMs (coordinate measuring machines). First, the students spend eight weeks learning how to use the manual equipment and devices, followed by eight weeks learning the software for the CMMs.

"Students must learn how to measure the parts they produce on the machine tools to assure accuracy of their work. They spend 16 hours a week in the lab, and 4 hours online. Everything they do, in the lab and online, directly relates to their projects." Measurement is important because some of their milling and turning operations must be held to 0.0005" and some grinding operations to 0.0003".

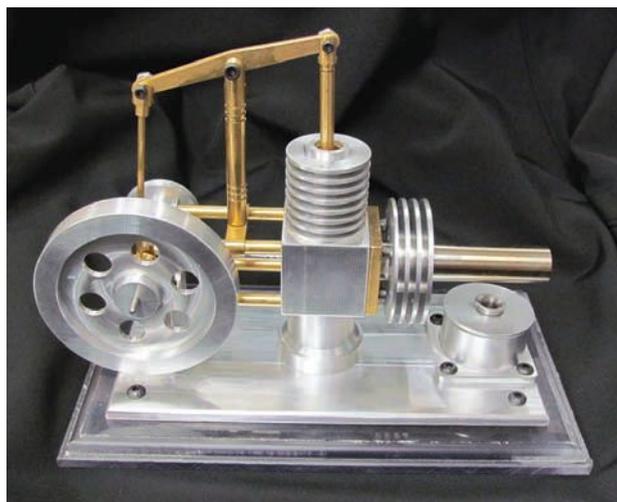
thoroughness of the machine tooling technics program, manufacturing companies in the region look to the college to fill an ever-growing need for qualified programmers and machine operators.

"Right now," says Thompson, "there are seven jobs available for each graduate. We concentrate on both mold work and precision components because most of the industry in our region is comprised of mold builders and contract manufacturers.

"Our students are usually working in local companies by their second semester, with the companies



**Above, aluminum bike wheel programmed by a CVTC student in Mastercam and produced on a Haas CNC mill.**



**Left, Sterling Engine, a group project. Parts made on Haas lathe and mill.**

# Want help jump-starting your curriculum for the new year?

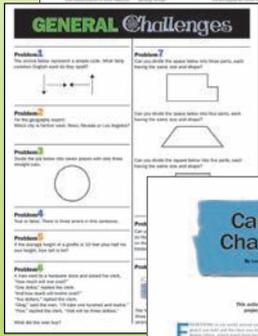
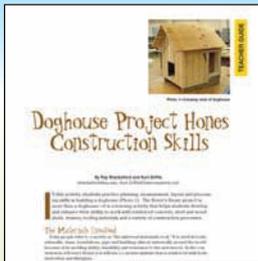
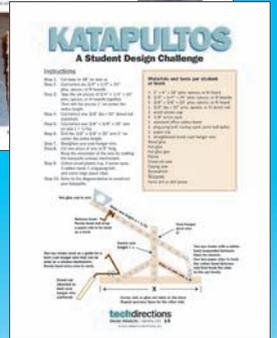
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# NYSTEEA and Chocolate Mold-Making for STEAM

By Jeanne Taylor

**I**n the 52 years that the New York State Technology and Engineering Educators Association (NYSTEEA) has been meeting, there have been a lot of changes in the design software and equipment available to teachers and students. Schools have been adding digital fabrication equipment, including CNC, to their classrooms and pursuing a hands-on teaching model.

ShopBot Tools attended this year's two-day BSTEM event in Malta, NY, which included sessions on everything from elementary robotics to model railroading as a STEAM activity. During the mornings and breaks throughout the day, educators had a chance to see a Handibot in action, as well as understand the workflow that aligns closely with what they are teaching day-to-day in the classroom.

ShopBot Tools sponsored the Awards Dinner, held at the Automobile Museum in Saratoga Springs. In a brainstorming session a few weeks before the event, Sallye Coyle and

*Jeanne Taylor is responsible for planning, development, and implementation of all ShopBot Tool, Inc's marketing strategies, marketing communications, and public relations activities, both external and internal.*



**The tastiness of making mistakes—the HDPE mold machined beautifully, but getting the chocolate out of the mold was a problem.**

I decided to create a gift for each attendee. Sallye has been playing

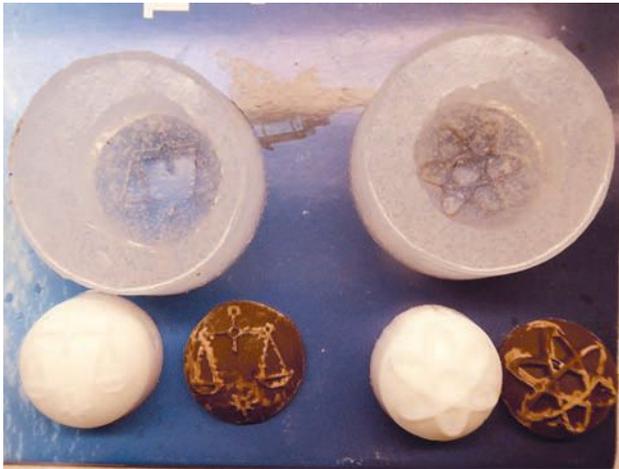
with using ShopBots to create molds and models for casting materials such as aluminum and glass. Why not demonstrate ShopBot's capability to machine in 3D by creating small molds to cast chocolate for an end-of-meal treat? We had no idea what we were getting into.

The first step was to prototype the mold (negative space) that we would pour the melted chocolate into. Since we intended for people to eat the chocolate, we started with food-grade HDPE, the solid material that plastic cutting boards are made out of. It machined beautifully, and the melted chocolate flowed into the mold without any problems.

However, after it solidified, both

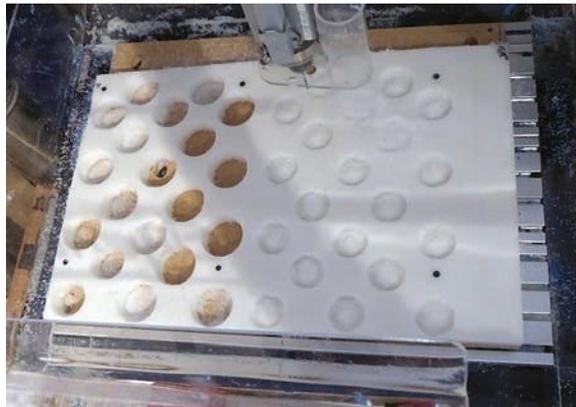
**The ingredients for our experiment required different types of chocolate and mold release sprays.**





**Silicon molds were successful in producing chocolate shapes, but the mold release left discoloration.**

**A sheet of chocolate molds**



kinds of chocolate we tried were too brittle to release easily from the rigid mold, even with a mold release agent. Hardship prevailed: we had to eat all the chocolate that broke as it was removed from the prototype molds.

The next step was to create a model (positive space) that resembled the actual shape the chocolate would take. Then, a two-part food-grade silicon material was poured around the model so it would become the mold. The silicon remains flexible after it sets, so a brittle material can be popped out.

In the first tries, we tested two types of mold release: PAM and coconut oil. The finished product came right out of the mold with both, but the top of the chocolate was discolored with unappealing white streaks. When no mold release was applied, the chocolate still came out of the mold easily and retained its rich, dark color.

We now had a functional mold, but our prototyping showed us another problem with going into

small scale production: the two-part silicon mold material was just too expensive and the process itself too time-consuming for us to make 150 molds. While a flexible material



**The alternate giveaway being cut, a set of rack and pinion gears**

such as gelatin came out of the rigid molds, it just was not as appealing as chocolate. So, we came up with other options for the giveaway that included ShopBot-cut rack and pinion gears, which also explained how the tools are made.

The project didn't turn out the way we had initially hoped. How-

ever, the prototyping process was a great example of many things that engineering teachers are trying to convey to their students: design thinking, learning from failure, iteration, record keeping, and decision making. Cost effectiveness is another important consideration that needs to be put into the equation.

Sallye used *Aspire*, a 3D design and machining software, to design her molds and models. *Aspire* is the "big sister" to *VCarve Pro*, the 2D CAD and 2D/3D CAM software that comes bundled with every ShopBot and Handibot. She machined the prototypes and did small scale production of the molds, models, and gifts on a ShopBot Desktop.

The day after the dinner, several teachers came up to thank ShopBot and reveal how the evening's talk had inspired them. One teacher said that, in 27 years of coming to the NYSTEEA conference, no one had ever talked about food. He had a grant to create a garden to engage kids who would not otherwise be drawn into science and engineering.

Others learned that 3D models can be realized in more ways than with 3D printers, and that it is important to have a suite of digital fabrication tools available, including

a ShopBot or Handibot CNC. Having the right tools in the classroom/lab allows students to follow through on their ideas from CAD design to mock-up to tangible item, and to learn from their mistakes and revise. In fact, it is the mistakes that can lead to some of the greatest successes. ©

# Reinvigorating a High School Woodshop

By Rich Christianson  
richsonmediapro@gmail.com

**A**LITTLE more than a decade ago, high school woodworking instructor Bert Christensen felt he needed a reality check.

“Around 2005 I started to feel like things were moving past me and I began to wonder what a woodworking teacher should be teaching, and where to look for answers,” said Christensen, who heads up the woodworking and construction programs at Westosha Central High School in Paddock Lake, WI.

Christensen began his search by reaching out to the woodworking program directors of Madison Area Technical College in Madison and Fox Valley Technical College in Oshkosh, WI. Those connections in turn led him to join WoodLINKS USA, which has since been absorbed into the Woodwork Career Alliance of North America (WCA).

Westosha Central High School formally joined the WCA as an Education institution in 2011. Soon after, Christensen was among the first woodworking instructors to become

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*Rich Christianson is the communications manager for the Woodwork Career Alliance of North America and has more than 30 years of reporting on the industrial woodworking industry.*

a WCA accredited skills evaluator (ASE). Being an ASE empowers him to certify that a student has achieved specific woodworking skills for which they earn credits toward their Sawblade certificate, the first rung of

curriculum around the WCA Woodworking Skill Standards. They give me absolute confidence that I am teaching kids the right things in the right progression. In the first level a student learns how to safely push a board through a saw. In higher levels they set up and operate other machines.”

Adopting the WCA credentialing process has brought more structure and purpose to the program, Christensen said. “Earning a Sawblade certificate gives the kids who advance through the program something to aim for and lets parents know that we are doing something that is recognized by the industry.”



**Coffee tables made by students of the award-winning Westosha High School woodworking program.**

the WCA's credentialing program.

Getting involved with the WCA has helped guide the development of a more relevant curriculum for the school's four-year woodshop program, Christensen said.

“Being a part of the WCA has brought more credibility to our woodworking program because it was developed by industry professionals. We're basing our



**Advanced woodshop students are given free rein to tackle more complex projects, such as this wooden electric guitar.**

## About the Westosha High Woodshop Program

About 85 of the 1,100 students enrolled at Westosha Central High School are participating in one of the four year-long woodworking courses ranging from Woods One –Introduction through Woods Four–Advanced. Eleven of the students are enrolled in Woods 3. In addition to working on their Sawblade certificates, they qualify to earn two college credits through a partnership with Madison College.

“Most of the kids in our program get involved because they want to learn woodworking as a hobby,” Christensen said. “But some begin to see the potential of a woodworking career after they take a field trip to Madison College’s well-equipped cabinet shop.”

The Westosha High woodworking shop is about 3,000 square feet; a separate lumber storage area and a classroom are attached to the shop. Key equipment includes a SawStop table saw, a pair of Delta table saws, a Delta shaper, and a Routakit CNC

router. “It was a bit of work to put the router together, but we saved about \$5,000, which is a huge deal consid-

boards to 6’ tall by 8’ wide entertainment centers. “Some of our students make things for the community. For



Students of the Westosha Woods program enjoy a field trip to Madison College’s well-equipped cabinetmaking training center.

ering our yearly budget,” Christensen said. “We’re fortunate that we do get a reasonable chunk of money from Perkins funding to support our program.”

Student projects range from skate-

example, we made a sound system cart for a local grade school’s theater program. They got a \$2,000 cart in exchange for providing \$300 in materials,” Christensen said.

Students who enroll in Woods 3

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are given a lot of leeway to “build what they want,” Christensen said. “In Woods 2 I throw a lot of stuff at them like making a cabinet with a drawer and two raised panel doors assembled with dados, rabbets, and screw pockets, and using European hinges and ball bearing drawer slides. For my Woods 3 kids I’m more there for guidance and advice than anything.”



A student demonstrates the correct and safe operation of a miter saw.

## Using Video as a Skills Evaluation Tool

Because Christensen teaches five woodworking classes a day, there just isn’t enough time to physically evaluate every skills demonstration of each student working toward his WCA Sawblade certificate. “I’ve already been using online platforms where the students

can go to find course paperwork and resources, so it wasn’t much of a stretch to have the kids shoot videos of their demonstration of an operation.”

Christensen said he makes it clear to students about the level of quality and attention to detail the video must contain so that he can critique



A student examines his handiwork of a cutting board he made.

their skills. “They edit and upload the videos to YouTube so that I can watch them whenever I have time. If necessary I can watch the video with a student and point out where something is wrong, or could be improved. It’s worked out really well.”

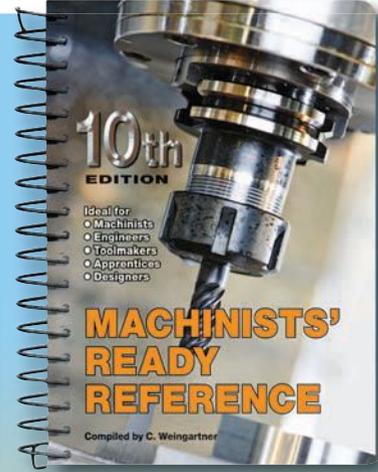
## Looking to Grow

Christensen said he is thankful for the support of the school board, administration, and community for supporting career and technical education at Westosha High. He is well aware that many high school woodworking programs across the country have closed down in the last couple of decades.

“I think all concerned recognize that even if a student is not going to become a woodworker, that there is a lot that they learn from using their brains and hands to make something. Those kinds of skills are universally applicable to a lot of career opportunities.”

While the Westosha High woodworking program is relatively healthy, Christensen is always looking for ways to attract more students into the program. This fall he introduced a new course titled Women and Woodworking. Only four students signed up this fall, but it’s a starting point to build on in future years.

Learn more about the Woodwork Career Alliance of North America at [www.WoodworkCareer.org](http://www.WoodworkCareer.org). ©



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# Mercy CTE High School Re-Envisions Workforce Development

At the nation's only Catholic vocational high school, a focus on preparing graduates to be workers finds root in rigorous, faith-based instruction.

By Autumn A. Arnett  
aarnett@industrydive.com

**C**HRISTIAN Aument, a vice principal at Mercy Career & Technical High School—the nation's only Catholic co-educational CTE high school—said he is amazed by recommendation letters written by teachers to accompany student applications that detail a student's inability to complete work on time, lack of focus and motivation, and lack of interest in school as good reasons why the student would be a good fit at Mercy.

"There are still some teachers out

---

*Autumn A. Arnett is the editor of Education Dive, an online publication that provides news, trends, jobs listings and resources for educators and administrators in higher education and K12. She has contributed to a number of publications, most recently Diverse: Issues In Higher Education, HBCU Digest and The Atlantic, largely around issues of diversity and access in higher education.*

there who think that a career and technical education is for a student who couldn't cut it anywhere else," he said.

But Sister Susan Walsh, who serves as principal of the Philadelphia high school, said "People's long-time thoughts about career and technical education don't hold now."

"It's not that these students are unintelligent at all," said Sister Rosemary Herron, who serves as Mercy's president. "They're very creative, but most haven't been taught the way they learn best."

"There's a lot of rigor to the theories in all of these shops," Walsh said.

Students can choose from cosmetology, building trades (like construction or electrical jobs), business, culinary arts, nursing or computer technology.

Take, for instance, the cosmetology students' anatomy and physiology coursework, and the formal business plans seniors create as their thesis projects, which have to include

research on all of the appropriate laws and regulations, as well as cost and profit margin calculations and detailed proposals on running their own salons.

What's different, Walsh said, is Mercy's approach to "combining the rigor with their creativity."

"There's a lot of art and expression with all of these shops," she said.

But with increased attention on career and technical education from the federal government and a continual pushback from industry leaders against students who graduate from college unprepared for the workforce, the tide is changing around CTE.

"There's a push for career and technical education that wasn't there for a long time," Aument said.

## Embracing Project-Based Learning and Collaborative Learning

One of the keys of a new bill making its way through Congress this

week is encouraging increased collaboration between secondary and postsecondary institutions as well as industry and community organizations. At Mercy, teachers say they wouldn't be able to effectively train students if not for the partnerships with local universities, nonprofits and employers.

Business students, for instance, partner with local university students to solve real-world problems in creative ways. One group of 11th grade students was planning a fashion show for dogs to raise awareness for a local animal shelter—until they ran into problems with permitting and liability insurance requirements. And last year, these same students designed and distributed scarves for homeless individuals in the city to store their belongings and keep them warm.

Students in the computer technology program receive instruction in everything from how to troubleshoot end-user technical problems to graphic design. They recently presented a logo design to a major corporation headquartered in the city, and the company will soon unveil the student's logo as part of its brand package.

Participants in the building trades are leading the way on campus renovations, from wiring the networks and electricity in the new rooms to physically building out the spaces. And students in the culinary arts are pairing with one team from the business division, a local nonprofit, and a major grocer in the city to provide education to the city's residents around healthy, inexpensive cookout options for the upcoming Memorial Day holiday.

"Learning is happening, and it's relevant to them," Herron said. "You still have to do Shakespeare, you still have to do math and social studies," but there's the freedom to allow students to explore their passions and "support that passion and also give them transferable skills."

At Mercy, the faith-based mission of the high school adds special attention to character development, self-awareness, and connecting to something bigger than one's self—all recognized tenets of strong social-emotional learning programs. In fact, said Herron, competence, compassion, and empathy are the three ideals on which all education at Mercy is centered.

"We want to provide for our students not just skills to make a living, but life skills," Welsh said.

### Freedom to Try New Things

Despite seemingly very specific career tracks, Herron said it is important that Mercy is "preparing our students for jobs that don't exist yet," which means constantly



reviewing curricula with career advisory counsels several times each year to make sure students are getting the most relevant, current, and, most importantly, well-rounded instruction.

"Where some of our [students'] parents and grandparents are in one career path their entire lives, our students will not be," she said.

"I applaud the push the country's going through now, wanting the students to be employable. Our students are marketable, they're ready to be employees," Walsh said.

But despite the fact that all of the students graduate with both work experience and professional certifications in their fields, most actually go on to pursue some type of higher education, school officials said. Many choose to work while pursuing addi-

tional degrees or certificates—95% of the school's population is considered at-risk and come from low-income families—but the majority enroll in community college or four-year institutions right after graduation.

And that is exactly the idea, Herron said.

"We don't want their education to stop here, we want it to continue in some form," she said, adding that most students will stay in the city of Philadelphia, and school leaders hope students will invest their skills into the city.

Herron said one of the keys to success at Mercy is having faculty members who are "always looking for student success, and that's what we're about. Anything we can do around student success ... if it's legal and moral and we can afford it, then we can try it."

"That's the beauty of an independent school," she said: having the flexibility to say, "if it's for the betterment of students, then let's try it."

The "let's try it" attitude permeates to students, too.

"They're going to be out in the workforce soon enough; we want them to be able to go out and take

risks," said Lori Aument, who co-leads the business program with her cousin, Mary Ruskey.

As a result, she said, students show a lot more extra initiative outside of school. "I just feel like they're taking these little incremental steps and getting more confidence," she continued. "Those are the kinds of employees people want," she added.

But it isn't just the students who are learning to take risks and learn, experiment, repeat.

"We had to reconfigure the way that we teach," Ruskey said. "We're no longer the center of attention [in the classroom]. We're now facilitators who are here to empower them to be changemakers."

"We're all learning," she added. "They're all teaching us." ☺

## Divided We Learn

# After Decades of Pushing Bachelor's Degrees, U.S. Needs More Tradespeople

*California budgets millions to rebrand long-disparaged vocational education*

By Matt Krupnick

**A**T a steel factory dwarfed by the adjacent Auto Club Speedway, Fernando Esparza is working toward his next promotion.

Esparza is a 46-year-old mechanic for Evolution Fresh, a subsidiary of Starbucks that makes juices and smoothies. He's taking a class in industrial computing taught by a community college at a local manufacturing plant in the hope it will bump up his wages.

It's a pretty safe bet. The skills being taught here are in high demand. That's in part because so much effort has been put into encouraging high school graduates to go to college for academic degrees rather than for training in industrial and other trades that many fields like his face worker shortages.

Now California is spending \$6 million on a campaign to revive the reputation of vocational education, and \$200 million to improve the delivery of it.

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*Matt Krupnick is a freelance reporter and editor who contributes regularly to The New York Times and the Hechinger Report. This article was originally published on The Hechinger Report website, [www.hechingerreport.org](http://www.hechingerreport.org). The Hechinger Report is a nonprofit, independent news website focused on inequality and innovation in education.*

"It's a cultural rebuild," said Randy Emery, a welding instructor at the College of the Sequoias in California's Central Valley.

Standing in a cavernous teaching lab full of industrial equipment on the college's Tulare campus, Emery

**"All throughout high school, they made it sound like going to college was our only option."**

*Derrick Roberson,  
who is training to become  
an electrician*

said the decades-long national push for high school graduates to get bachelor's degrees left vocational programs with an image problem, and the nation's factories with far fewer skilled workers than needed.

"I'm a survivor of that teardown mode of the '70s and '80s, that college-for-all thing," he said.

This has had the unintended consequence of helping flatten out or steadily erode the share of students taking vocational courses. In California's community colleges, for instance, it's dropped to 28% from 31% since 2000, contributing to a

shortage of trained workers with more than a high school diploma but less than a bachelor's degree.

Research by the state's 114-campus community college system showed that families and employers alike didn't know of the existence or value of vocational programs and the certifications they confer, many of which can add tens of thousands of dollars per year to a graduate's income.

"We needed to do a better job getting the word out," said Van Ton-Quinlivan, the system's vice chancellor for workforce and economic development.

High schools and colleges have struggled for decades to attract students to job-oriented classes ranging from welding to nursing. They've tried cosmetic changes, such as rebranding "vocational" courses as "career and technical education," but students and their families have yet to buy in, said Andrew Hanson, a senior research analyst with Georgetown University's Center on Education and the Workforce.

Federal figures show that only 8% of undergraduates are enrolled in certificate programs, which tend to be vocationally oriented.

U.S. Sen. Marco Rubio, R-Florida, last year focused attention on the vocational vs. academic debate by contending during his presidential campaign that "welders make more money than philosophers." ►

The United States has 30 million jobs that pay an average of \$55,000 per year and don't require a bachelor's degree, according to the Georgetown center. People with career and technical educations are actually slightly more likely to be employed than their counterparts with academic credentials, the U.S. Department of Education reports, and significantly more likely to be working in their fields of study.

At California Steel Industries, where Esparza was learning industrial computing, some supervisors without college degrees make as much as \$120,000 per year and electricians also can make six figures, company officials said.

Skilled trades show among the highest potential among job categories, the economic-modeling company Emsi calculates. It says tradespeople also are older than workers in other fields—more than half were over 45 in 2012, the last period for which the subject was studied—meaning looming retirements could result in big shortages.

High schools and community colleges are the keys to filling industrial jobs, Hanson said, but something needs to change.

“You haven't yet been able to attract students from middle-class and more affluent communities” to vocational programs, he said. “Efforts like California's to broaden the appeal are exactly what we need.”

Aside from marketing the programs differently and making them

will require some post-high school education, according to the state's community college system. Some on the industry side of the equation say that while colleges should have spent the past few decades building tighter bonds with local companies, those companies share the blame for vocational education's tattered reputation.

Residents who have watched manufacturing companies relocate overseas may have not wanted to encourage their children to learn manufacturing-related skills, said Sam Geil, a Fresno, California, business consultant and adviser to the San Joaquin Valley Manufacturing Alliance.

“It doesn't help when industry is moving out and laying people off,” Geil said. “It's the relationship that industry has with the community. Industry could do a better job communicating.”

As with a lot of education challenges, money is also a big problem.

While a humanities class such as English costs a college just \$52 per student credit, a respiratory therapy class costs \$265, according to a 2013 report by the Institute for Higher Education Leadership & Policy. Equipment and trained instructors in some specialty fields can be prohibitively expensive for a college.

With state budgets in constant flux, colleges and experts say it's essential that companies help pay for educational programs that directly benefit them. While that kind of cooperation has been rare, Chaffey College's InTech Center is an example of how it could work.

California Steel chipped in \$2 million for the education center, which it leases to Chaffey for \$5 per year, said Sandra Sisco, the school's director of economic development. Other local companies and colleges have invested, too. The center served about 1,300 students in the past year and plans to grow, she said.

The steel company agreed to work with Chaffey mostly because it was having trouble finding enough trained workers, said Rod Hoover, its human resources manager. And if California Steel's competitors benefit from the classes on the factory cam-

**There are an estimated 30 million jobs that pay at least \$55,000 per year and don't require a bachelor's degree.**

simpler to find and apply for, California is trying to ease the process through which individual campuses can add new programs that could help local businesses. If a region needs respiratory therapists, for example, community colleges will be able to avoid some of the red tape that previously hampered their flexibility to train new therapists.

“We definitely wanted to get out of the colleges' way,” Ton-Quinlivan said.

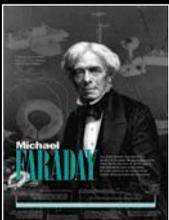
The industrial course in which Esparza is enrolled is run by nearby Chaffey College through the community college's InTech Center, a partnership with California Steel and other local manufacturers. At its completion, Esparza will have new skills he hopes will translate into a promotion and a raise of \$4 or \$5 per hour.

Like his classmates, Esparza, who starts work at 6 A.M., is looking at the class as a moneymaker for him.

“It feels very comfortable for me,” he said. And then, like many Californians, he reflects on his commute. “I don't even have to catch a freeway to get here. How can it get better?”

But it can get better in California, where 30% of all job openings by 2025—more than a million jobs—

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pus, many of which provide skills useful in steelmaking, so be it.

“It was the right thing to do for our community,” Hoover said. “The selfish reason was because we need-

ceptions of vocational education, Sisco said, “That’s not necessarily true.”

Although a large percentage of InTech students are older than tradi-

mentation InTech course as he trains to be an electrician.

Vocational courses in high school were seen as second-class, Roberson said.

“All throughout high school, they made it sound like going to college was our only option,” he said. “After you go to college, where do you go? It can open doors for you, but not as much as they make it seem.”

Career education boosters also say job-focused courses—and accompanying apprenticeships—can provide students with essential “soft skills” such as communication and conflict resolution that foster teamwork and reduce stress. And schools should consider blending traditional college courses with vocational ones, said Sean Gallagher, who recently founded Northeastern University’s Center for the Future of Higher Education and Talent Strategy.

“It’s often either vocational training or liberal arts,” Gallagher said. “But if you look at what employers want, it’s both, and I think that’s often lost in the dialogue today.”

Wire photo: © The Bakersfield Californian/ZUMAPRESS.com



**A California high school student practices welding during a class on advanced agricultural mechanics. California is spending \$6 million on a campaign to revive and improve vocational education.**

ed craft workers and it was inconvenient to send them elsewhere.”

The InTech Center specializes in quick courses that help students like Esparza get ahead in their jobs, Sisco said.

“The reputation of the colleges being archaic and slow is still out there,” she said. As with many per-

tional-aged college students, Chaffey is trying to encourage younger ones to focus early on their career training.

The strategy worked with 17-year-old Derrick Roberson, who graduated in the spring from Montclair High School and is taking an industrial maintenance electrical and instru-

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## Designing New Internship Models to Close the Nation's Cybersecurity Talent Gap

By Charles Eaton

**A**CCORDING to a recent study by Cybersecurity Ventures, cybercrime will more than triple during the next five years.

And the number of cybersecurity professionals employed to keep cybercrooks at bay will not come close to keeping pace with this threat.

Steve Morgan, the analyst who authored the report, predicts there will be more than 3.5 million cybersecurity job openings by 2021, and this cybersecurity skills gap could cost businesses \$6 trillion during the next six years.

How can companies possibly narrow such a cavernous talent gap in less than a decade?

The short answer is to start cultivating cybersecurity talent now. And at CompTIA, we believe one of the most important groups to target is what we call the “next generation of technologists,” the tweens and teens working their way through middle and high school today. Cultivating a new wave of talent from the ranks of

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*As Executive Vice President of Social Innovation for CompTIA and CEO of Creating IT Futures, Charles Eaton leads three philanthropic endeavors for CompTIA, the world's largest IT trade association: CompTIA Giving, Creating IT Futures and NextUp, the organization's initiative to inspire young people to choose technology careers.*

young people is critical to the long-term health of the tech industry, and the U.S. economy as a whole, especially in what we term under-represented groups in tech, such as young women and minorities.

But organizations confronted with a cyber-siege today can't afford to wait too long for tomorrow's talent.

**Cultivating a new wave of talent from the ranks of young people is critical to the long-term health of the tech industry.**



They need accelerated methods for attracting young people to tech jobs in general, and cybersecurity work in particular. One powerful way to meet this challenge is rethinking the traditional high school internship model.

Before delving into details, let's establish a foundation of understanding. Internships need the “4 Ps” to succeed:

- **Project**—Work for the student/ intern that is challenging and valu-

able to the sponsoring business, not generic tasks designed to keep kids busy and save companies labor costs.

- **Place**—A location for the student to use as a base for conducting work, typically a facility operated by the sponsoring company but, in today's digital operating environment,

designated classrooms at schools can serve, too.

- **Personnel**—Engaged individuals from sponsoring companies and schools who guide the student and care about the participant's success.

- **Payment**—Compensation in some form given to the student for investing time and effort. Rewards need not be monetary; the essential elements are the perception of value in the eyes of participants and a

sense of progress toward marketable skills. The shape of these work/study arrangements will vary from school district to school district, but compensation must be tangible. Otherwise, the participant is a volunteer.

From the perspective of my organization, we don't consider any programs labeled "internships" to be valid unless all parties—students,

**Rewards need not be monetary; the essential elements are the perception of value in the eyes of participants and a sense of progress toward marketable skills.**

educational institutions, and sponsoring companies—take away value in the final analysis. And we believe all four of the attributes above must be present to generate mutually beneficial outcomes for all.

That's where many schools get stuck today. Few institutions feel as though the resources to fulfill all 4 Ps are available in today's hectic environment, from teachers on faculty or staff at sponsoring businesses. And when this overwhelmed mindset takes hold, usually it's a showstopper for an internship program. Here are some ways this mentality stalls or stops internships these days in terms of the 4 Ps:

- **Project Ambivalence**—Teachers, corporate executives, and business managers who are pressed for time pose the question, "What could an intern do for a business that has actual value?" and then devote little time to finding an answer.

- **No Virtual Place to Hang an Intern's Hat**—Businesses today operate in an increasingly mobile, virtual environment. Internship design must evolve to match this environment by supplying some type of collaboration platform between schools and sponsoring organizations, or programs fall by the wayside.

- **Too Few Personnel**—Digital transformation—at educational institutions and inside businesses—already consumes the attention of staff and strains available budgets. Supervising and mentoring is perceived as a long-term play that comes at too high a short-run cost.

- **Too Little Payment (Or None at All)**—Per CompTIA's study "Business Relevance of IT in the SMB Market," small to mid-size firms "account for the vast majority of the nation's business entities and serve as a key driver of job growth and innovation." In fact, in many school districts, SMBs are more plentiful than large corporations, providing the backbone of local economies. But the average SMB doesn't feel comfortable shouldering all 4 Ps of an internship program. And in cash-strapped school districts, neither do school administrators.

Do these attitudes and constraints necessarily doom all internships? No. But if we don't become more creative about internship design, an excellent means of nurturing talent could wither and die at a time when businesses need that method to thrive.

The solution to this dilemma is not as complicated as one may expect. Why not divide responsibility for the 4 Ps across more than one entity? Consider these four internship configurations as examples of better fits for today's interns and companies:

- **Advocate Model**—School districts, community colleges and/or non-profit organizations like CompTIA can provide counsel to sponsoring companies about appropriate projects for interns. In some cases, these entities have programs offering templates and guide books.

- **Shared/Managed Model**—Not all employers can facilitate an internship at locations near schools, and some crowded schools can't afford to devote space to these programs either. A shared/managed model allows for part of the internship to be handled virtually in cooperation with the employer's remote work policy. One of the Ps—place—shifts into the mobile realm, with, perhaps,

students working after school from home or local libraries, cafes, and coffee shops, places many students already go to do school work in off-hours.

- **Partner Model**—Some large corporations can't supervise an intern on location. But they can coordinate with their local channel partners, who have available Personnel, to offer students internships. For example, a local IT services provider that supports a big company with Help Desk personnel could provide projects, places, and personnel, while its client corporation supplies some form of payment.

- **Aggregate Model**—SMBs often lack resources to supervise and compensate students and/or lack a large enough workload to keep an intern fully occupied. But SMBs can aggregate resources and projects with other small firms through advocate groups, as mentioned earlier, such

**Place shifts into the mobile realm, with students working after school from home, local libraries, or cafes, places many students already go to do school work in off-hours.**

as a school district or other community organization like a Chamber of Commerce. Payment is aggregated across participating businesses and may be subsidized by the advocate organization. In the same spirit, multiple schools in a district can feed students into internships programs across the region, perhaps even providing busing when necessary.

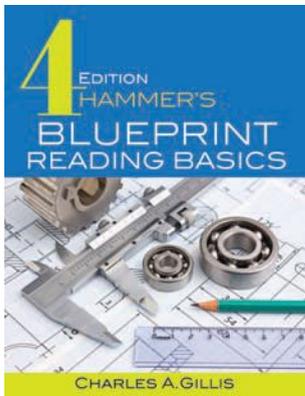
With enough coordination, one can imagine models in which more than one of the Ps is shifted to fit the needs of students, schools, and businesses. That's great, because adjusting to shifting challenges, environments, and requirements is the best way to develop cybersecurity expertise, and eventually close today's expanding talent gap. ☺

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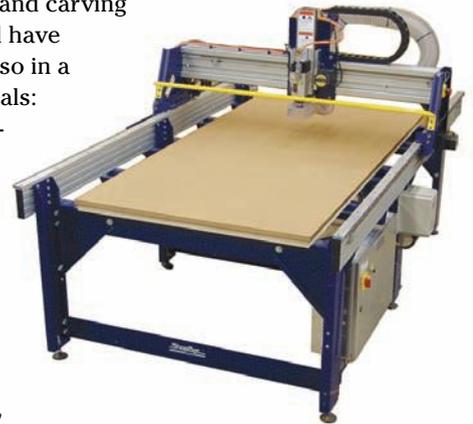
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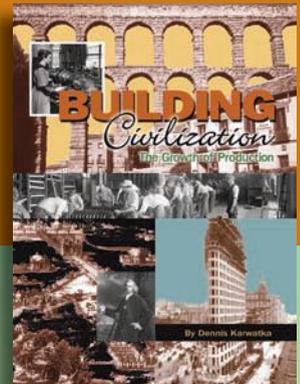
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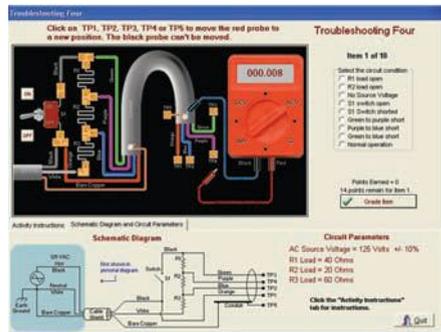
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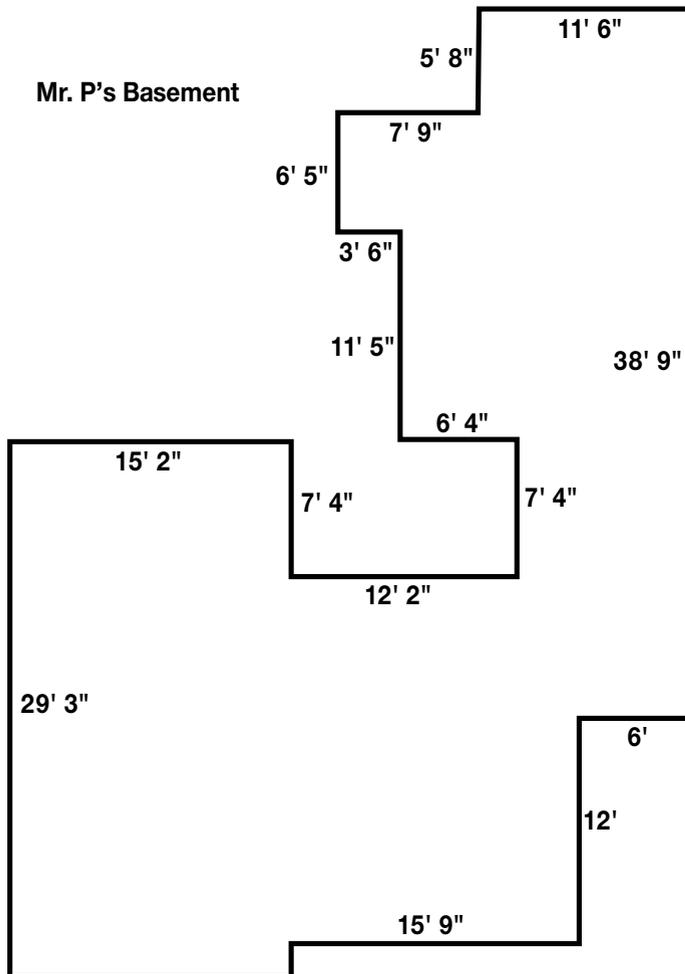


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Puzzle devised by David Pleacher, [www.pleacher.com/mp/mpframe.html](http://www.pleacher.com/mp/mpframe.html)

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## Word Scramble Challenge

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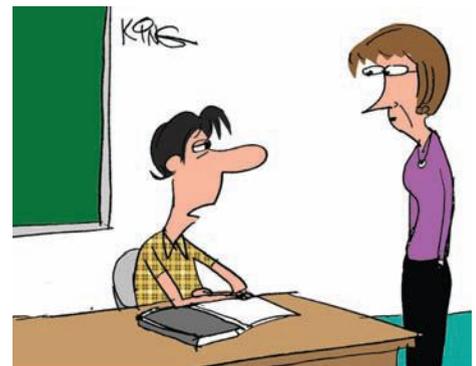
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See answers on page 8.



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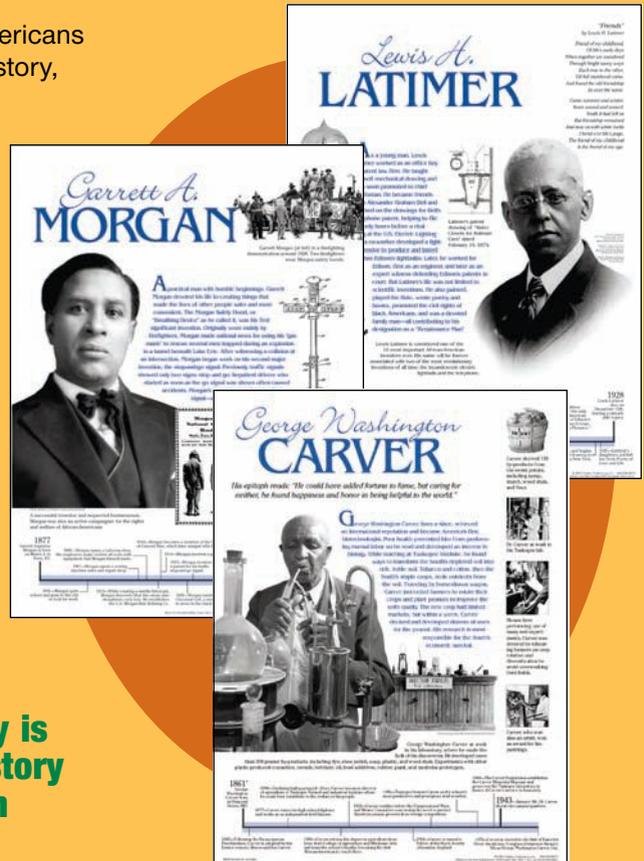
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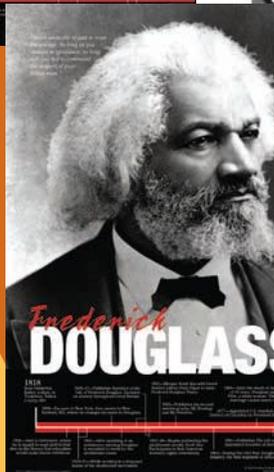
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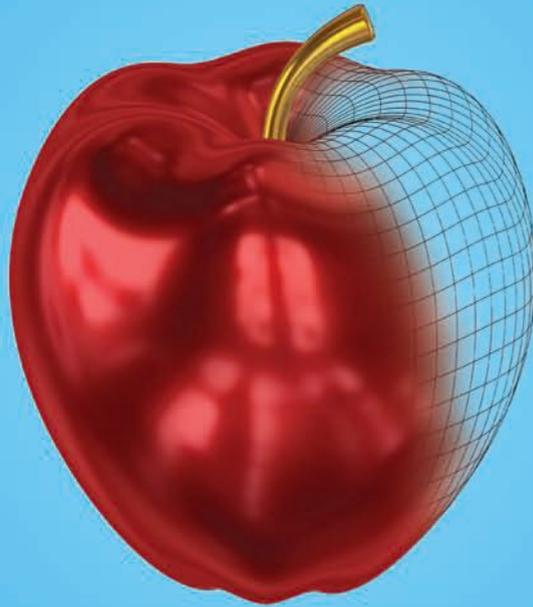
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