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MAY 2019

Career Success through Ag Tech Training

Creativity Is Key in Fresno CNC Classes

Build a Simple Solar Cooker

SkillsUSA Conference Preview

technically speaking

Vanessa Revelli vanessa@techdirections.com

I received a very interesting press release about the Goodyear tire company and how they are supporting STEM. I thought I would share it with you for my final column of the publishing year. Happy summer to you all. Thank you for all you do to support STEM and your students.

STEM Career Day is designed to inspire and open doors for students who may not have had the chance to immerse themselves in science, technology, engineering, and mathematics (STEM). Goodyear creates these opportunities by introducing students to STEM in their formative years and incorporating dedicated STEM professionals who encourage them to pursue opportunities in the field. This day-long event is split between two locations, one for high school, and another for middle school.

"All of us at Goodyear take great pride in our long history of encouraging young people to pursue careers in the STEM fields, which are core to our business and our ability to continually innovate our products and services," said Chris Helsel, senior vice president and chief technology officer. "Our outstanding STEM professionals of today are dedicated to inspiring and motivating the STEM professionals of tomorrow."

At the high school STEM Career Day, students will experience a free roaming expo-style event with a Rube Goldberg Challenge™, in which the winners will receive grant awards. There will also be tours of the University of Akron (OH) campus, mentoring with local professionals, and students and speakers discussing various topics. Additionally, several scholarships will be awarded to high school seniors.

For the middle school event, students will get a glimpse into the future of mobility, as well as attend a career fair, classroom interactive activities administered by local organizations, and a group hands-on activity.

Goodyear's 20-year history with STEM education began in 1999 with the title "Goodyear Engineering Career Day for Young Women" and was created to inspire young women to consider careers in engineering.

"It was created to introduce engineering to female students and motivate them to pursue a career in this field," said Brandy Moorhead, director, global off-highway product development. "It's essential to introduce young women to engineering, because they often don't know what their options are."

By 2012, Goodyear broadened its program to include a wider audience. The program was renamed "Goodyear Engineering Career Day" to encompass male students.

Three years later, Goodyear extended its scope even further to incorporate all careers in the field of STEM, not just engineering. As a result, the event was renamed Goodyear STEM Career Day and restructured to introduce students to various STEM careers, which brings in approximately 1,500 students each year.

techdirections
A Prakken Publications Magazine

Digital Tech Directions (ISSN 1940-3100) is published monthly, except June, July, and August, by Prakken Publications, Inc., 251 Jackson Plaza, Suite A, Ann Arbor, MI 48103-1955. Executive, editorial, and advertising offices are at PO Box 8623, Ann Arbor, MI 48107-8623, telephone 734-975-2800; fax 734-975-2787. Vol. 78, No. 9.

Subscriptions: individuals: $30 per year; Canadian and foreign: add $20 per year. Canadian GST #R126213487. Single copies $3. Group rate for students in teacher-training institutions available upon request.

Periodicals postage paid at Ann Arbor, MI, and additional mailing offices. Printed in U.S.A.

POSTMASTER: Please send change of address information to Tech Directions, PO Box 8623, Ann Arbor, MI 48107-8623.

Manuscripts should be addressed to: Editor, Tech Directions, PO Box 8623, Ann Arbor, MI 48107-8623. Manuscripts become property of Tech Directions upon letter of acceptance to author and signed copyright release form. Payment made on publication. Electronic copies of back issues available from ProQuest Information and Learning, www.il.proquest.com. Microform copies available from NAPC, www.napubco.com

May 2019

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contents

May 2019
Vol. 78, No. 9

AG TECH

POWER & ENERGY

page 17

MANUFACTURING/ METALWORKING

AUTOMOTIVE

page 22

CTE

CONFERENCE PREVIEW

SPECIAL FEATURES

COLUMNS

About the cover: John Deere's training program teaches students how to troubleshoot, service, repair, and rebuild old and new machines. Photo courtesy of John Deere. Cover design by Sharon K. Miller.

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FFA Teaches Important Skills

When you think of competitions for agriculture students, the picture that comes to mind is kids raising sheep or rabbits, maybe judging dairy cattle.

But there were no animals—and few plants—on the agenda when the FFA Region VIII schools met for the Career Development Events competition at Cannon Falls High School. Instead, it was budgets, ohmmeters, and spot welders for the boys and girls from several southeast Minnesota schools.

"Everyone talks about STEM," said Kevin Brown, the FFA adviser for Southland Schools. "Ag has been STEM for a long time."

While skills such as animal judging and growing crops are important to anyone who might want to make a living at farming, so are agricultural mechanics, farm management, and crops, the three areas of competition for students at the Cannon Falls meet.

"There's a lot of problem solving and higher-level thinking," said Brad Harguth, the FFA adviser at Caledonia. "The things we talk about are how we're going to raise the competency levels of those rigors."

Each student participated in one event category.

Grand Meadow senior Justin Kassel, who has grown up in a rural area and has a family legacy of FFA involvement, said as fun as the competitions can be, he plans to head a different direction after high school.

"My mom works at an elevator, and the guys there would always teach me stuff," he said. With three previous trips to the state FFA competition in his past, Kassel said he plans to study to be a surgical technician in college.

Still, FFA has been a great experience for learning. "You get to know people at the other schools," he said. "It's really fun, the little competitions between us friends that I've met."

Coming to the competitions is a big reason Kristal Brogan's students put in the work in FFA. The FFA adviser for Spring Valley said, "They enjoy coming to competitions. They want to see how well they do against each other in class and against the other schools."

Brogan, like many FFA advisers, makes her students put in some hard work in the classroom to even be eligible for regional competitions, and for her students, they need to add twice as much classroom effort again if they want to go to state.

All that classroom work, Brown said, is to make sure students get the skills that 20 years ago or more were part of the basic knowledge that came with living on a farm. "The basic skill set, generally, is lower than it was 20 or 30 years ago," he said, with Harguth nodding agreement.

That includes everything from knowing how to use an ohmmeter, inserting drill bits in a drill, and even properly holding a hammer.

Which is why skills ranging from agricultural mechanics to farm management—understanding and making decisions on farm budgets—are so important for the future of the industry, Harguth said.

For Mitch Bonow, a junior at Lewiston-Altura High School, his three years in FFA have been about learning the skills he hopes will help him after high school. Bonow, who has been raised on a farm that focuses on organic beef and sheep, competed in agriculture mechanics.

"I want to do something ag-related," he said, talking about his post-high school plans. That might include welding or mechanics. "In ag mechanics, we're learning the different components of things, like a combine, and getting in-depth on engines."

Jeremy Soine, a Cannon Falls junior, added that he hoped to pursue agronomy and agricultural education. He took part in the crops competition, where the focus on learning includes plant and seed identification, grain grading, and practicums in various crop areas including soils, insects, seed analysis, pesticides, fertilizer, and varietal trials.

Metalworking Scholarship from Travers Tool Company

Travers Tool's Metalworking Student Scholarship offers $1,250 in tools for students enrolled in metalworking programs at vocational and technical schools.

Participants must meet the following criteria:

- Enrolled at an accredited high school, college, or university in the U.S.
- Enrolled at the graduate level, undergraduate level, or your final year of high school
- Aged 17 years or older
- Carry a status of "good standing" (i.e. currently enrolled)
- Applications must be received by by December 31, 2019.

Please note:

- Please send your application via email—scholarship@travers.com.
- There is no formal printed application from Travers Tool, all necessary information is on this page.
- No need to print this page; just send your written response and contact information.
- Do not send any letters of recommendation, tax returns, bank balances, resumes or CVs.
- Applicants grant permission for Travers to publish any photos submitted and publicly announce winner

Your application should include:

- Section 1: A personal essay—limited to three paragraphs, and between 500 and 1,500 words—about yourself and your interest in metalworking.
- Section 2: A project review detailing—in writing, with pictures and/or diagrams—a machining project that you completed. It should cover the tools you used, your deployed methods, and it should explain the goal of your completed work.
- First & last name
- Email address

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Shape-Shifting Airplane Wings

When designing an airplane, aeronautical engineers need to consider every surface of the plane because they all effect lift (Fig. 1). Most of the heavy lifting is performed by the airplane's wings. Dr. Sridhar Kota, director of the Compliant Systems Design Laboratory at the University of Michigan, created a way to create machines and surfaces that can change their shape even though they have no joints.

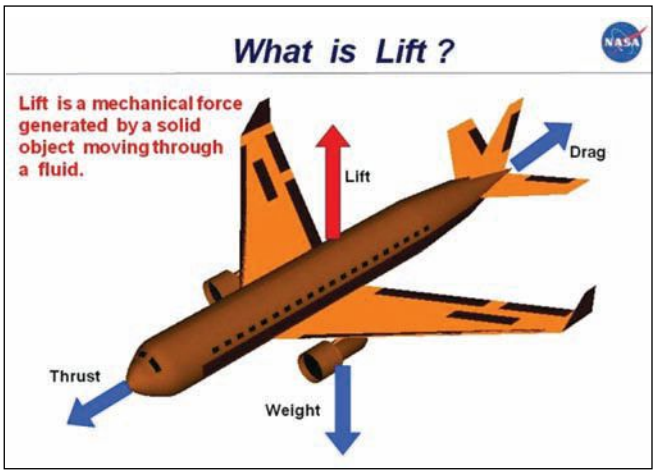

Fig. 1—Lift is a mechanical force created by the interaction of every surface of the airplane with the fluid of air, which is generated by the airplane's engines.

Photos and illustrations courtesy NASA

For an airplane to even get off the ground, it needs the forward motion that is created by its powerful engines. To create lift the rushing turbulent air from the thrust of the engines and the wind from its fast acceleration all streams above and below the airplane's wings.

The air pressure is intensified below the wings by the nose up position of the airplane (angle of attack) and the position of the airplane's wing flaps, which are moveable panels on the trailing edge of the wings. The flaps generate a lot of lift during takeoffs and landings. Without its forward motion and the rushing air, which acts like a high-pressure fluid trying to push the plane's surfaces out of the way, an airplane can't generate lift and fly.

The creation of the shape-shifting airplane wings was a joint project with FlexSys Inc., the company Dr. Kota founded, NASA, and the U.S. Air Force. The test plane (Photo 1) has been outfitted with a set of new wings that have these morphing flaps.

The first iteration of the morphing airplane wing is a redesigned airplane flap that is an integral part of the wings rather than a physical add on. The green area (Fig. 2) shows the location of the ACTE morphing flap (FlexFoil™). You can smoothly run your hand along the wing and you will feel one continuous surface rather than a physical add-on like current wing flaps.

These new flaps can morph their shape to conform to the flight characteristics that the wings need to have during a flight. This breakthrough could eventually eliminate the heavy hydraulic systems and motors that are now used to physically change the surface dynamics of all the mechanical parts of an airplane's wings during the different parts of a flight.

The eventual switch from the current hydraulic systems to new airplane wings with Adaptive Compliant Trailing Edge (ACTE) surfaces in place of flaps, NASA states, "has the potential to save millions of dollars annually in fuel costs, reduce airframe weight, and decrease aircraft noise during takeoffs and landings."

The FlexFoil flap is a seamless section of the wing with a continuous range of motion from 2° to 30° (Photos 2 and 3). So, what was once a mechanical add-on appendage is now a morphing part of the actual wing. Testing of this new technology has been done on the Gulfstream aircraft (Photo 1). Both wings on this plane were replaced and the new ACTE wing

Photo 1—NASA used this Gulfstream airplane to flight test the ACTE morphing wing technology.

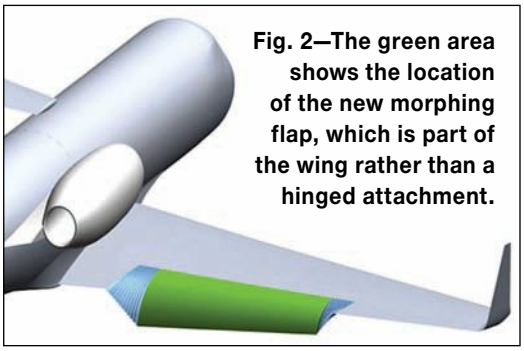

Fig. 2—The green area shows the location of the new morphing flap, which is part of the wing rather than a hinged attachment.

Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit www.technologytoday.us for past columns and teacher resources.

Photos 2 and 3—The morphing flap lies perfectly flat (left) until it needs to be adjusted. It can morph its shape from 2° up to 30° (right) and hold its shape at any degree angle requested by the pilot.

flaps have surfaces that can be shape-shifted along their entire surfaces. When the ACTE flaps bend to force more turbulent air under the wings, there is no gap between them and their connection point on the wing; this greatly reduces noise. Since the FlexFoil flaps can morph their shape from minimal to major amounts, it can make fine to major adjustments to the curvature of the wings. During a flight they can help deliver the ideal lift-to-drag ratios all the time, not just during takeoff and landing.

The goal is to start testing FlexFoil on commercial planes within the next year or two. After that stage is completed, the next goal will be to use ACTE technology to replace the other rigid moving structures in an airplane wing so the entire wing can morph its shape to provide the best lift-to-drag ratios during the entire flight.

Taking It a Step Further

1. In Sci-Fi movies you often see winged spaceships performing the same moves as fighter jets in a dog-fight. Why is the action in the movie impossible?

2. The plan is to eventually replace the other moving rigid structures on an airplane wing so they can all morph their shape. Research what the other moving parts are and what they do.

3. A mind tease posted on Facebook by the SIG Mfg. Model Airplane Co.: Imagine a 747 is sitting on a conveyor belt as wide and long as a runway. The conveyor belt is designed to exactly match the speed of the wheels, moving in the opposite direction. Can the plane take off? Why?

Even More Fun Answers

Cross-Sums

			1 8	2 3		3 1	4 5					
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B	R	A	S	S	A	L	U	M	I	N	U	M	L	X

Nine machine shop terms
AXIS
BALLSCREW
CHAMFER
CHUCK
COOLANT
COORDINATES
GCODE
JIG
PLASMA

Seven materials that can be machined
ALUMINUM
BRASS
COPPER
PLASTICS
STEEL
TITANIUM
WOOD

Six 3-letter machining abbreviations
CAD
CAM
CNC
DWG
DXF
RPM

Three types of machine tools
DRILLPRESS, LATHE, MILLINGMACHINE

technology's past

Dennis Karwatka
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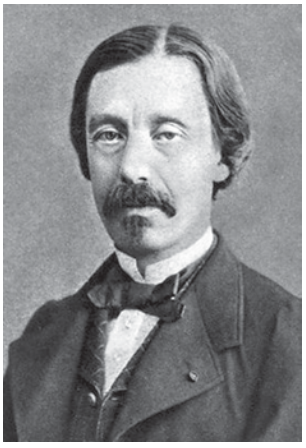
Leon Foucault and His Pendulum

An impressive display in some museums is a tall pendulum that slowly swings back and forth. It often has a series of pegs along the swing diameter that are tipped over by the pendulum as the floor very slowly rotates under it. Known as a Foucault Pendulum, it's named for Leon Foucault who demonstrated the first one in Paris, France, in 1851.

Foucault was born in Paris in 1819 and raised with a younger sister. His father was a successful book publisher who died when Foucault was nine. His mother took over the business and made it even more profitable.

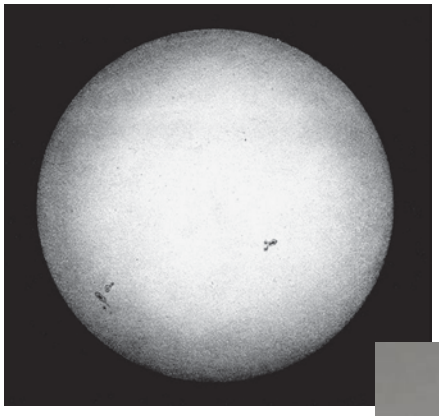
Foucault was a frail and timid child who did not do well in public school. His mother tried tutors and private schools, but Foucault never had classical education. He attended Stanislas College in Paris and earned a general degree. He saw public demonstrations of photography by Louis Daguerre (1787-1851) and developed an interest in it.



Leon Foucault

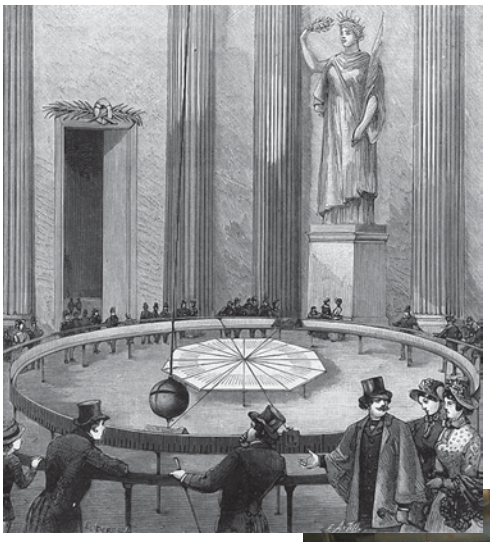
Foucault and a friend devised a method of taking photographs through a microscope. It required close-focusing lenses, mirrors, and a method for concentrating sunlight. The men published a paper on the topic in 1845 that included 80 photographs.

The paper was read by the director of the Paris Observatory who approached Foucault and another friend to ask if they could photograph the sun. The challenge lead Foucault to investigate astronomy, reflector telescope design, and light. Foucault and his friend were successful, producing the first solar photograph in 1845, complete with sunspots. The director was

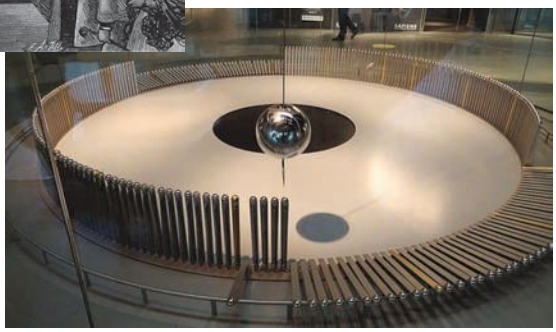


Above, the oldest surviving photo of the sun taken by Foucault

Right, a replica of Foucault's air turbine, with a rotating mirror at its center



Left, the Foucault pendulum first demonstrated at the Pantheon



Right, a Foucault pendulum tipping over pegs in Barcelona

impressed and asked Foucault if he could measure the speed of light. Foucault was not then employed and accepted the challenge.

Others had measured the speed of light, but Foucault wanted a precisely engineered method that was more accurate. It took him a while to devise the method. His hardware included a small mirror that rotated at high speed, a fixed mirror, and a light source. An air turbine designed by Foucault spun a small mirror at an amazing 48,000 rpm.

Foucault aimed a beam of sunlight at the spinning mirror and reflected it to a fixed mirror about 20' away. Using reflection measurements, his 1850 tests resulted in a speed of light only 0.5% lower than the modern accepted value of 299,792 kilometers/sec.

Foucault had tried using small pendulums in clock mechanisms to control his tracking telescopes. He wondered if a very tall pendulum might show that the Earth rotates on its axis. He received permission to demonstrate his idea inside the large Pantheon building in Paris. A steel wire dropped down 220' from the top of the dome and connected to a 62 lb. pendulum bob. In early 1851, Foucault sent an open invitation to the public that stated, "You are invited to see the Earth turn." He pulled the pendulum bob back with a cotton thread, which he carefully burned to set it in motion. As the weight swung, the floor slowly rotated under it, in the first visual proof that the Earth rotated on its axis. Within a year, 39 American museums had Foucault Pendulums swinging in their buildings.

Foucault received Britain's Copley Medal in 1855, a precursor to the Nobel Prize. He was named Physicist for the Paris Observatory that year, his first full-time position. It was created for Foucault by France's Emperor Napoleon III. To add to his major successes, Foucault invented the gyroscope in 1852 and made the first glass reflector telescope in 1857.

Foucault never married and was described as being very polite. The French Academy of Sciences ignored Foucault until they finally granted him membership in 1865. Members of the Academy were apparently annoyed by his lack of formal scientific training. Foucault died in 1868 of multiple sclerosis at the age of 48. His name is one of 72 inscribed on the exterior of the Eiffel Tower.

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

Above, Foucault's larges surviving reflector telescope, now on display in Marseilles

Left, a replica of Foucault's gyroscope

A Shorter Path to a Long Career

John Deere's Two-Year Technician Training Program

IS a four-year college degree right for you? It may not be a requirement before you're able to start a meaningful, full-time career. One of the world's largest equipment manufacturers has been offering interested students a shorter career path to success for nearly 30 years.

This shorter path is a dealer technician training program John Deere started in 1989. Today, the equipment manufacturer partners with 21 community colleges to help educate students in the ever-growing field of technical service. Each year about 450 students graduate with a two-year associate's college degree and real-life experience that stretches beyond the classroom.

The job training program teaches them how to troubleshoot, service, repair, and rebuild old and new machines. The partnership ensures students work on John Deere equipment in their respective college labs. After successful completion of the program and internship with a sponsoring dealership, students have a guarantee of a job upon graduation.

To begin, they first enroll in a two-year program and receive classroom education and a hands-on lab experience. The only requirement for students is to have a high school diploma or equivalent. John Deere dealers then sponsor individual technicians and provide additional assistance in the form of internships and a job after graduation. Dealership sponsors often provide aid to help offset part of a student's tools and tuition cost.

Students also have a choice on whether to focus on agriculture and turf equipment or construction and forestry equipment when they start working. Regardless of their choice, they're able to work with a dealership sponsor and the college to gain the necessary skill and experience required for them to become full-time service technicians.

Dalton Engelhardt is a first-year John Deere Tech student at Northeast Iowa Community College in Calmar, Iowa. He is shown doing a lab project testing planter seed meters.

It was the right path for young Dalton Engelhardt to choose. As a student at Northeast Iowa Community College, Calmar, IA, he decided to enroll in the program. Now, his education and a job are guaranteed in the field he loves—working on John Deere equipment.

Knowledgeable and ambitious technicians who are looking for a career are in high demand at John Deere dealerships, according to Matt Shepheard, program manager service marketing at John Deere.

"Our dealerships around the world are looking for qualified mechanics to fill open positions immediately. This program prepares the technician of today to be able to grow into tomorrow's sales professional, service manager, integrated solutions manager, or other full-time position at a dealership. The possibilities are endless," said Shepheard. "Students can choose to be a service technician for the rest of their life, or they may want to take advantage of other opportunities beyond what they initially trained for."

With these types of training programs, parents and students may have concerns about the cost of tools required. "By participating in our program, students can take advantage of exclusive John Deere discounts and financing offers to help offset some of these costs," said Shepheard.

Article provided by John Deere.

While being trained, students are paid to work at actual John Deere dealerships as part of the curriculum. At the dealership they benefit from working alongside veteran service technicians and learn to deal with actual customers and to manage their equipment repair expectations.

This program prepares the technician of today to be able to grow into tomorrow's sales professional, service manager, integrated solutions manager, or other full-time position at a dealership. The possibilities are endless.

The program and training have evolved through the years. Early on, Shepheard said, there was more emphasis placed on students turning wrenches, rebuilding engines, and understanding hydraulic systems. Today, farm machines are equipped with integrated technology, so students are trained to troubleshoot electronics, install guidance systems, and manage a machine's computer hardware and software. In addition, they can work on the newest transmissions and engines while also working on older machines.

Some of the program's current instructors are previous service technicians themselves and are also big proponents of the program. When students graduate, they're prepared to work for John Deere dealerships where job placement, excellent starting pay, benefits, and great working conditions are provided.

Students learn about the newest integrated technology found in today's smart machines, according to Shepheard. "This includes everything from installing and setting up guidance systems, to using remote diagnostic tools, to troubleshooting issues. They're not only sitting in a classroom and learning from a book. Students get their hands dirty, go to the field, and are able to work with customers and help setup new equipment," he said.

Students are rarely ever bored because they're constantly working on something new every day, according to Shepheard. Students like Dalton are typically assigned a mentor at the dealership who guides them while they participate. "One day they're talking with customers, resolving different issues and facing new challenges. The next day, the dealership may send them to the field in a fully-loaded service truck to work with customers and repair machinery," Shepheard said.

Whether it's rebuilding engines, servicing hydraulic pumps, or diagnosing electronic systems, dealership mentors play an important role and are there to help students apply what they have learned in the classroom. For more information about John Deere's technician training program visit JohnDeerePowerup.com.

Farm-Related Projects Bring Classroom Lessons to Life

The Milton Hershey School embeds agriculture and environmental education into all classes

By Tara García Mathewson

ALIZA Blackburn, an 18-year-old senior at the Milton Hershey School in Hershey, PA, has felt the inside of a live cow. She has made soap out of goat milk, collected dry corn husks to make fall decorations and harvested tomatoes, watermelon, and sweet corn to sell at a student-run market.

Blackburn grew up in small-town PA and saw farm fields before starting at the Milton Hershey School in fifth grade. But the school has made agriculture an integral part of her educational experience.

On more than 4,200 sprawling acres in southeastern PA, the school offers a tuition-free, residential education to about 2,000 kids. Founded in 1909 and run with the chocolatier's fortune ever since, the school uses its acreage as a core component of its curriculum. From K-12th grade, students learn lessons and tackle projects through the Agricultural and Environmental Education program.

In Aliza's case, the lessons are particularly relevant. She selected agriculture as her career pathway for high school and she plans to major in animal science in college next year, so all of the farm-related projects tie into career exploration.

"That definitely helped bring the classroom to life," Aliza said. And even beyond agriculture, she sees connections to her science and math curriculum in the projects, whether they are for a class or an extracurricular. "It could all connect in one way or another to my classes."

> **"Students are very savvy at knowing when they've been presented with an authentic opportunity versus a canned opportunity."**
>
> *Jaunine Fouché, director of the Agriculture and Environmental Education program, Milton Hershey School, Hershey, PA*

Jaunine Fouché, the director of the Agricultural and Environmental Education (AEE) program, dedicates her days to finding new ways to let students further explore the concepts they learn in their classes with projects that have real-world impact and relevance.

Giving students more control over their learning by letting them work on projects that interest them has become a common strategy in modern classrooms. Project-based learning, as it's called, is supposed to engage students and give them time to practice important skills for the 21st century workplace, including collaboration, problem-solving, creativity, and interdisciplinary thinking.

Fouché, a 2015 winner of the Presidential Award for Excellence in Mathematics and Science Teaching, said providing this kind of opportunity, while laudable, is difficult. Staff, she said, have to be highly trained and masters of their craft to support students as they pursue a range of possible answers to completely open-ended questions. This type of teaching is harder than simply lecturing at the front of the classroom.

But Fouché believes the harder work has its reward, particularly with the low-income student population that the Milton Hershey School serves.

"They don't have a lot of power in their lives, and I think it's incredibly important to empower them through their own education," Fouché said.

Sometimes students come up with the ideas for projects–like the time the high school marketing classes did market research about preferred ice cream flavors among their peers and then, through the

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Tara García Mathewson is a staff writer, The Hechinger Report. *This article was originally published on* The Hechinger Report *website, www.hechingerreport.org.* The Hechinger Report *is a nonprofit, independent news website focused on inequality and innovation in education.*

culinary arts department, developed recipes to actually make those flavors, taste-test them during lunches, and sell them through the AAE's Project Market, a student-run market open year-round to the school and the public.

Other times staff approach the students to help solve a problem–like the time staff members wanted to figure out a way to monitor the health of the bee colonies producing honey on campus and tapped students to do the problem-solving. (High schoolers in the computational technology classes programmed sensors and developed "buzz boxes" to monitor the hives.)

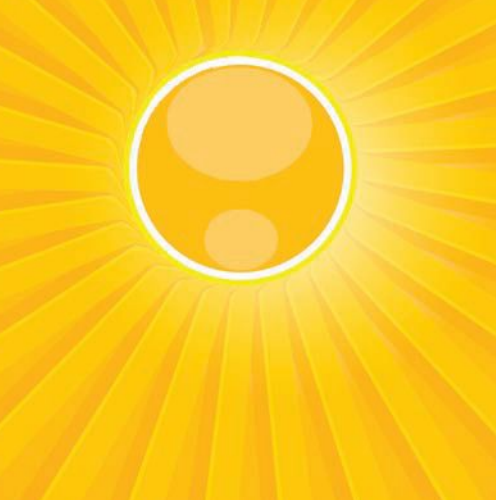
"Students are very savvy at knowing when they've been presented with an authentic opportunity versus a canned opportunity," Fouché said. "We are very good at providing them authentic ones."

Agriculture-related projects aren't the only ones Milton Hershey students work on. Project-based learning, particularly using science, technology, engineering, art, and math (STEAM), is woven throughout the student experience.

Aliza and a partner designed an experiment as part of her astronomy class that they submitted for a NASA competition that lets kids test out their ideas in space. She and her partner will send a small piece of canvas, a wooden bead, and a copper bead up to the astronauts on the International Space Station along with oil paint to see how the microgravity environment affects paint curing and adhesion to the three different surfaces. They'll conduct the same experiment on Earth and compare their data with the NASA astronauts' data for information to answer their research question.

Fouché oversees this program through the AEE program, too. Her department exists to bring learning out of the textbooks. Or, as she put it, "To provide the experiential context as an extension of what occurs in the classroom."

And Aliza can vouch for how engaging that can be.



How to Build a Solar Box Cooker

THE sun is a tremendous emitter of energy. Most of the energy is in the form of light and heat, which can be collected and used for generating electricity, as well as for heating, cooling, and lighting buildings.

Photovoltaic Conversion

Photovoltaic (solar) cells are large-area semiconductors that convert sunlight directly into electricity. Most of us have seen photographs of photovoltaics on roofs or on the ground near homes and buildings. Photovoltaics can meet virtually any electric power need and are used for numerous applications including watches, calculators, satellites, telecommunications, homes, schools, factories, and businesses.

Because of the cost, photovoltaic systems are not widely used, but advancements in efficiency and cost reduction should make photovoltaics economically competitive with traditional power sources by the end of the decade.

Solar Thermal Systems

Solar thermal systems convert the energy in sunlight to heat by using concentrators such as mirrors to focus sunlight onto a receiver. The receiver contains a fluid that absorbs the heat. The heat is then used to generate electricity or to warm buildings, dry agricultural products, or destroy harmful wastes.

Solar thermal systems use three different types of concentrators—central receivers, parabolic dishes, and parabolic troughs. Central receiver systems use heliostats (highly reflective mirrors) that track the sun and reflect it to a central receiver atop a tower. Parabolic dish systems use dish-shaped reflectors to concentrate and reflect sunlight onto a receiver mounted above the dish at its focal point. Parabolic trough systems use parabolic reflectors in a trough configuration and are the most mature solar thermal technology.

Solar Heating, Cooling, and Lighting

Energy from the sun is also used to heat, cool, and light buildings. Buildings are heated and cooled with active and passive systems.

Active systems rely on mechanical components to collect and deliver heat. For example, active solar water heaters use electrically powered pumps and valves to control the movement of warmed water. In contrast, passive systems use few mechanical components, relying instead on design features, gravity, and natural ventilation to heat and cool homes and buildings. Design features such as an atrium or high windows that allow more sunlight to reach the interior reduce the need for electric lighting.

Procedure

1. Glue foil on the cardboard. Dilute the water-based glue in a bowl, so that it will last a long time and you can brush-apply it. Glue foil

Materials

2 large corrugated cardboard boxes with flaps-one fitting inside the other with about 5 cm between them on all sides and bottoms (inner box should be at least 46 x 56 cm); a flat piece of cardboard about 20 cm longer and wider than the larger box

A light piece of glass or Plexiglas about 50 x 60 cm, a thin metal tray painted black about 42 x 52 cm

Dark cooking pots

Aluminum foil

Water-based glue

Lots of newspaper for insulation.

String (1' long)

A stick (about 1' in length)

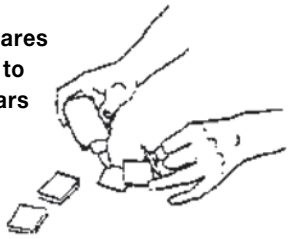
Article courtesy of the National Renewable Energy Laboratory. Reprinted from www.nrel.gov/docs/gen/fy01/30926.pdf.

completely over: (a) the inside and outside of the smaller box (cut off the flaps), (b) the inside of the larger box, (c)the inside and outside of the larger box's flaps, and (d) one side of the flat cardboard piece

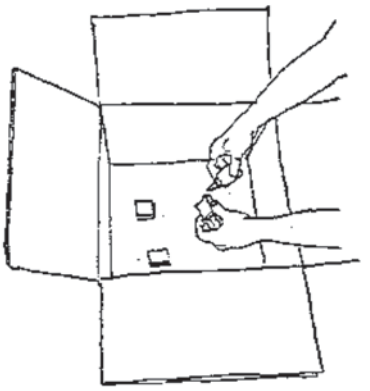
2. Add pillars and insulation. Using the discarded box flaps, cut out 4 cm squares. Glue them on top of each other to form eight 2-3 cm high pillars. Glue these pillars inside the bottom of the bigger box to support the inner box.

Tear up newspaper sheets in fourths and crumple each piece into a lemon-sized ball. Cover the bottom of the bigger box with these balls.

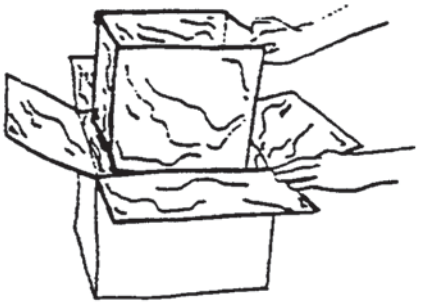
3. Add inner box and side insulation. Place smaller box inside the larger box. Stuff more newspaper



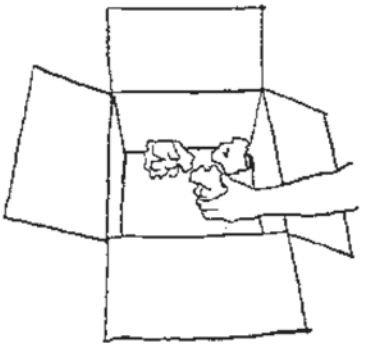
Glue squares together to form pillars



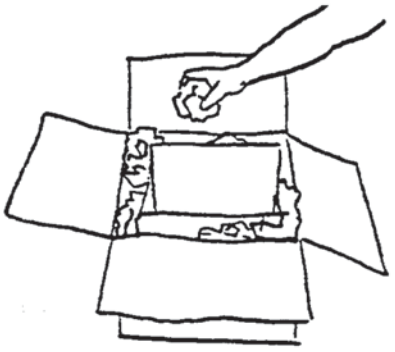
Glue pillars inside the bigger box.



Place the smaller box inside the larger box.



Cover the bottom of the bigger box with crumpled newspaper balls.



Stuff newspaper balls between the sides of the boxes.

More Than Fun Answers

Circular Reasoning

3	2	5	1	4
Number of circles with an odd number	Number of circles with an even number	Sum of the numbers in the first two circles	Difference of the numbers in the first two circles	Only number not used in the first four circles

Work It Out!

The answer is 14 more athletes.

Since the original 7 athletes can lose 20 pounds in 8 hours, those same 7 athletes can lose 10 pounds in 4 hours. That means that the additional athletes must lose 10 pounds in 4 hours.

Seven new athletes can lose 5 pounds in 4 hours (since they lose weight only half as fast as the original 7).

Therefore, you need 14 new athletes to lose 10 pounds in 4 hours.

Scramble Word Challenge

CROTH T O R C H

RASTUN S A T U R N

IDEOD D I O D E

CREWHN W R E N C H

When unscrambled, the letters in the squares should read:

A C C I D E N T

The name of the inventor? Accident. Mark Twain once quipped that more things were invented by accident than by design.

Father Of Answers

1 – H
2 – G
3 – E
4 – D
5 – A
6 – C
7 – B
8 – F

balls between sides of boxes.

4. Cut the flaps of the outer box so that they fit in the inner box. Cut them so that they can be folded over, covering the top space between the boxes as well as the inner wall of the inner box (see diagram). Fold the flaps over and glue them.

5. Put the black tray in the box. Paint it black if it isn't already. Use nontoxic paint.

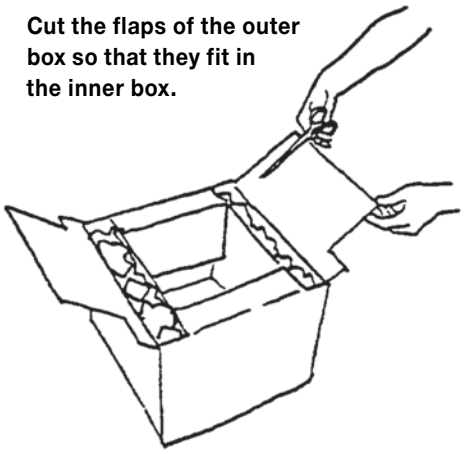
6. Make the lid. Take the flat cardboard piece and center it, foil facing down, on top of the box. Fold down what sticks over the edges of the large box. You need to make four cuts in the cardboard to do this. Then, glue the folded edges of the lid together (not to the box). Make sure the lid fits snugly on the box.

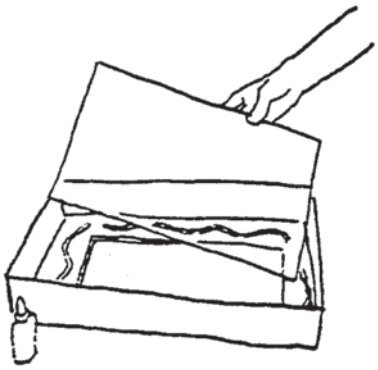
7. Glue the glass to the lid. Cut 3 sides of a rectangle in the lid. This rectangle should be slightly smaller than the glass. Turn the lid over and glue the glass, around its edges, to the inside of the lid. Press it flat until the glue dries. If you use plastic wrap, stretch it out around the rectangular opening and tape in around the sides.

8. Make a prop. Bend up the cut-out rectangle in the lid so that it can reflect sunlight into the cooker. Attach a stick with string to the corner of the reflector and the side of the lid. If it is windy, you may want a prop on both sides.

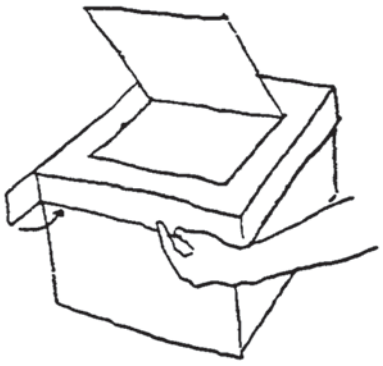
You are now finished with your solar box cooker and are ready to cook!

Cut the flaps of the outer box so that they fit in the inner box.

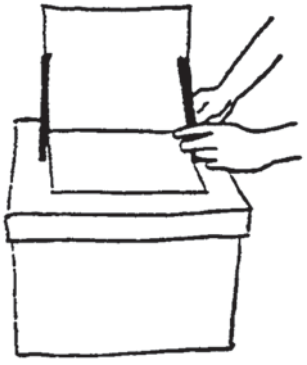




Glue the glass to the lid.



Fold down cardboard that sticks over the edges of the large box.



Prop the lid up so it can reflect sunlight into the cooker.

Ideas to Study

1. Investigate various kinds of insulation in your solar cooker.

2. Investigate the cooker at different times during the school year to determine when it takes the longest or shortest time to cook.

Guidelines for Cooking Food–Teacher Information

1. Put your food in covered black pots in the solar box cooker with the lid on.

2. Aim the box so the shiny side of the lid reflector faces where the sun will be in late morning (lunch) or early afternoon (supper). Tie the prop to hold the lid reflector where it shines the most sunlight into the box.

3. **Warning:** Temperatures inside the cooker can reach 275° F. Do not leave cooker unattended in a place where it could be disturbed by other students.

4. Food cooks better:

- On a warm, sunny day in late spring, summer, or early fall.
- If you put it towards the back of the box.
- If you adjust the cooker often so that its shadow lies directly behind it.
- If you divide the food up into small pots.

5. You need not stir the food while it is cooking. If you open the box during cooking, be careful of the high temperatures inside.

6. Most of all, put the food in early, and don't worry about overcooking-solar cookers seldom overcook.

Cooking times for recommended foods

1-2 hours:
rice, fruit, above-ground vegetables, pretzels

3-4 hours:
potatoes, root vegetables, some beans (including lentils), most bread

5-8 hours:
most dried beans

CNC Technology at Fresno City College

By Maryann Valentine

JORGE Perez is a part of the manufacturing program at Fresno City College and has been working with routers for quite some time now. After Fresno City College purchased a CNC router from Techno CNC Systems, Jorge was able to work hands on with the CNC and master his abilities.

Excelling in everything he does, with a creative twist to every project he completes, Jorge has become a true machinist in the past couple of months. His Instagram account, @ jorge_CNC, showcases a ton of the magnificent projects he's completed thus far.

Jorge believes that the manufacturing program at Fresno City College is an advanced program compared to others because the students are able to get a lot of hands on action with the machines. At the beginning of each class the students start by practicing using the CAD/CAM software, and by the end of each class their creativity is key. Fresno City College allows the students to make about five to six projects a semester, using different kinds of plastics. They then can move up to more advanced materials to make and engrave signs. The students are encouraged to think outside the box.

A sign made by Jorge Perez in a class at Fresno City College

Right, a six-pack holder designed by Jorge

"I find it so helpful that our instructors allow us to do our own programming, as well. At other schools, the instructors usually do the programming for you, or go over it with every single student individually. Instead, my instructor allows us to practice on our own. In our classroom we let other students teach each other, which is so awesome! It helps us all to learn the machines, as opposed to just following the directions on how to program. Our instructor believes that being able to teach one another is the key to becoming a true machinist."

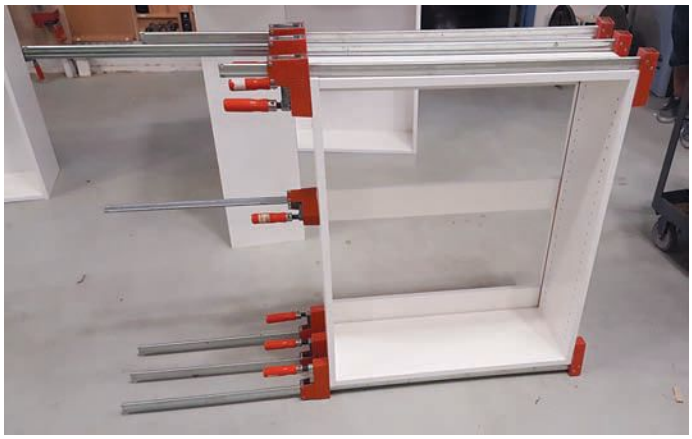
The class focuses on learning correctly, yet

Maryann Valentine is the marketing manager at Techno CNC Systems in Bohemia, NY.

Titan Series CNC router by Techno CNC Systems

putting a spin on every project with their own individuality and creativity. "One of the most recent projects we did was a six-pack holder. Our instructor gave us the blueprints where we designed everything in 3D first. After everyone created their sign, we were free to engrave. That's where the creativity really comes out!"

Perez spoke about the different levels of the class and how the class improves throughout the semester. They start with easier projects but then go on to more advanced classes where their projects become harder and their learning becomes clearer. "We recently used a 4x8 piece of melamine to create a cabinet of some type. It's tricky because we only have one piece to do the entire project correctly. That's the tricky part about manufacturing—everyone makes mistakes, so when we are tested on our knowledge of the machine/program itself, it is super nerve-racking to know that anything is possible."



A melamine cabinet in process

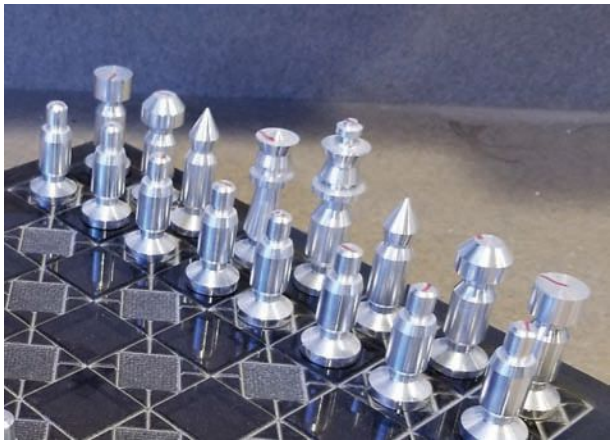
Perez shared a tip he recently learned from a personal experience using the Techno CNC in class. "I found it hard to know where my part was going to move on the table. I learned that the router is very forgiving. The machine will allow you to fix your mistake, which was one of the greatest tips I could have learned. I simply hit the pause button, reset the part to go back to 0, repositioned my part, and boom. I was able to save a lot of time and material by using this one simple trick time after time. You just have to slow down when you make a mistake, and the machine will fix itself for you."

One of the main goals of the program study is to become an instructor yourself. Perez's instructor has taught his students the importance of being able to teach someone else exactly what you are doing, and then, just then, you are a real machinist. The program focuses on making the students step outside of their comfort zone and allowing them to practice, learn, and study with the help of other students.

The program is focused around the machines, the software, and learning the correct way to do things, rather than following an instruction manual step by step. The students are also allowed to bring in their own material from home; they are not limited to what the school provides!

Perez went on to tell about his latest project and the most challenging part about completing his final: a complete chess set. "My final project for advanced class was to make a chess set. I couldn't figure out how to design it. I was determined to make mine unique and not look like the rest of the class.

"It was challenging. I cut out a lot of pieces but didn't have a board just yet. That is where the CNC router



Jorge routed each of the chess pieces for his final school project.

Routing out the chess board.

The final product is this one-of-a-kind chess board.

came into play. I used a 3/4" acrylic piece and routed the entire board using the CNC.

"The most challenging part was that I wanted to make a board that went with the geometry of my chess pieces themselves. I designed each piece from the ground up. I gave each piece extremely sharp corners and wanted the board to reflect upon that.

"With that goal in mind, I stared at the machine for a while to see how it engraved and to see what tool paths were available to program. It hit me finally, and I was able to figure out what speeds would cut the acrylic. I used the 4x8 router, which involved tool changes, as well. I had to do a 1/4" straight bit to cut it out plus an engraving bit to engrave on the board. It truly came out awesome, thanks to the Techno CNC."

From Frozen Foods to Four Wheels

How the Introduction of Microwave Technology to the Ignition System Could Significantly Impact Vehicle Performance

By Jeff Bogue

VEHICLES are not going anywhere for a while. We are still going to use them, and they will still cause gridlock during the morning commute in cities worldwide. However, the engine, electronics, and mechanics that are in your vehicle now might not be the same as vehicles in the future.

We have seen the implementation of advanced design, and the advances are getting further and further from what we would consider the norm. Mazda's HCCI (Homogenous Charge Compression Engine) is available in some 2019 models, Nikola's electric semi-truck will be available at the end of this year, and Freevalve's camless engine enhances timing events and decreases friction losses. These are all incremental steps in technology that have kept the transportation industry fresh.

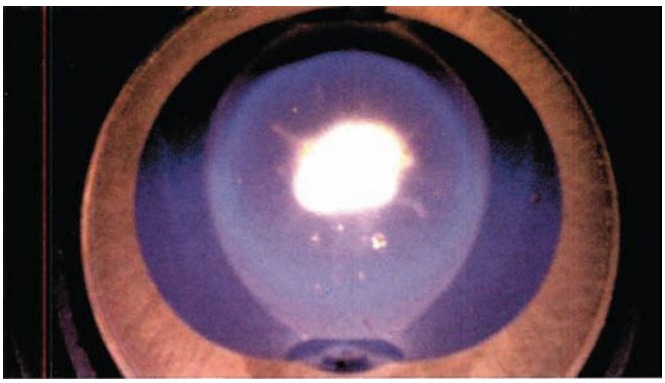
The Starter System was such a great leap in innovation when it was introduced in Cadillac models in 1912 it was considered revolutionary. ABS (Anti-Lock Braking System) was patented in 1928 but did not make it into a vehicle until the 1971 Chrysler Imperial. It too was a game changer, and now every vehicle not only has ABS, but TCS (Traction Control System), including some motorcycles. And then there is the automatic transmission. The modern version was developed in 1932 and sold to GM in 1940. Now, 80 years later, some manufacturers are dropping manual transmissions from their lineups completely.

Where do we go from here? OK, who doesn't have a microwave in their kitchen breathing life into day-old pizza? Well, it turns out that microwaves can do a lot of things not food related. This is way more interesting than leftovers and Hot Pockets.

Last year a new company, MWI (Micro Wave Ignition) in Germany, garnered a lot of attention with a completely new ignition system that utilizes microwaves to implement the combustion cycle. I was a little skeptical at first, but I am also not an automotive engineer. They have stirred the pot to the extent that former Porsche CEO Wendelin Wiedeking bought 20% of the company.

"MWI technology simplifies engine design. Expensive catalytic converters and/or bothersome AdBlue are no longer required," the company declared in an information sheet for investors, "Improving fuel economy by 30% and decreasing emissions by 80%". Wait. What? This is a bold statement, but it has claimed the attention of both Chinese and South Korean automotive manufacturers. Hyundai is in talks to buy into the company. The company also says that its technology meets EU regulations through 2030.

The kind of numbers MWI is promising from its technology are certainly enough to raise eyebrows. Cutting emissions by 80% would breathe new life into the traditional combustion engine, possibly even



Flame developing after microwave-assisted ignition in constant volume chamber.

http://firebrand.me.berkeley.edu/pages/mwassisted combustion.shtml

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Jeff Bogue is an electronics specialist focused on research and development. He works at ATech Training as a product representative and contributor to ATech Educator News. *This article is reprinted from the February 2019 issue of* ATech Educator News.

slowing down the push toward electrification. MWI also claims the tech can be integrated into existing engine architecture rather than requiring clean-sheet redesigns. While electric cars are certainly a great option for clean travel, EVs are still very expensive and not a viable option for some travelers. However, if every car could suddenly reduce its emissions by 80% just by replacing its spark plugs, that would be a huge win for both the environment and the consumer.

When we look at this technology a little deeper, it has been in the works for a while. In 2006, MWI was awarded second place in the Cyber One competition, thereby laying the cornerstone for technical development. In 2010, MWI built its first test stand to demonstrate that microwave ignition was technically viable.

In testing, the microwave-assisted plasma ignition system consisted of a 2.45 GHz magnetron (3 kW), a waveguide, a mixer, and a non-resistor spark plug. The first experiments were performed in a 1400 cc constant volume combustion chamber (CVCC) to clarify the mechanism of combustion enhancement by microwave ejection. The tests were performed using an acetylene-air compound in a closed tank with windows, so the events could be filmed. The acetylene-air blend provided a mixture that was more complete and offered a better view of the event cycle.

The microwave-assisted plasma ignition has a more advanced combustion phase than the conventional spark ignition showing larger initial flame kernel size and faster flame speed. The early stage of explosive flame generation inside the cylinder is called the flame kernel, think popcorn. The results of the testing in ignition and flame dynamics demonstrated the potential of a faster chemical reaction by applying microwave on combustion. The microwave-assisted plasma ignition had a higher spark intensity and larger covering area than the conventional spark plug.

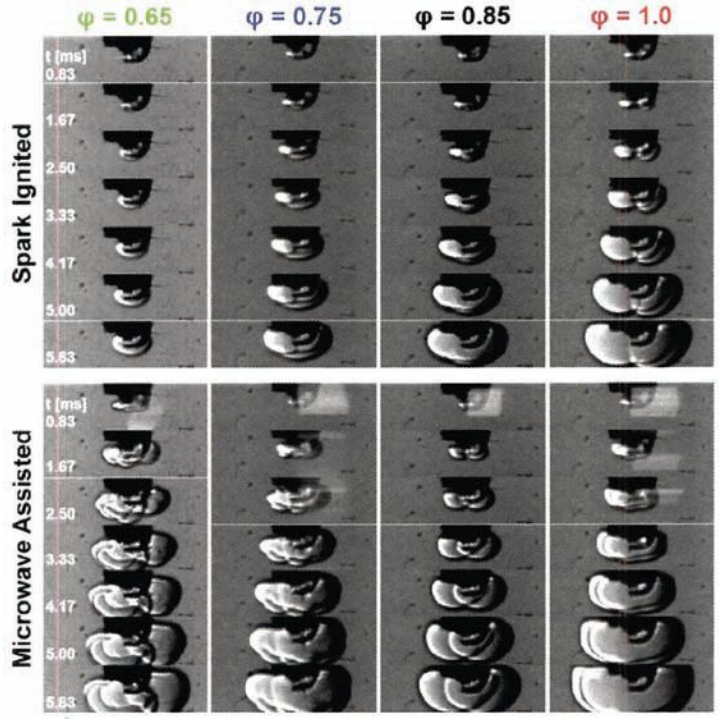
The distribution and intensity on the surface of the flame were also higher with microwave ejection. In terms of engine test, lean limit was extended, and the fuel efficiency was improved by 6% with microwave-assisted plasma ignition. The combustion phase was advanced, so the peak of in-cylinder pressure and heat release rate increased more than those of conventional spark ignition. Based on the faster combustion, the combustion stability was enhanced.

The microwave-assisted plasma ignition system proved itself to be advantageous from the start. The engine test results finally demonstrated that microwave ejection energy could improve all of an engine's performance and emission characteristics over conventional spark ignition systems.

With theory proven, MWI then started testing in engines. In 2017, MWI demonstrated that microwave ignition not only worked, but worked well. Pressure curves inside the cylinder had shown that microwave ignition releases significantly more effective output while injecting the same quantity of fuel per cylinder as compared to conventional spark injection.

The pressure increase is also steeper for microwave chamber combustion than for spark ignition. This means that the MWI combustion is faster and therefore more efficient. Maximum pressures inside the cylinder were also higher than regular spark ignition while remaining cooler. This not only increased fuel economy but garnered a significant power boost from the more complete burn at ignition and greater pressures on top of the lowered NOX emissions that come with the lower temperatures.

MWI has certainly started a buzz in the automotive industry, but only time will tell how far from real implementation we are. We wish them well and maybe one day we will be replacing spark plugs with tiny microwave emitters.



Schlieren images taken at 1200 fps for spark-ignited and microwave-assisted ignition modes.

http://firebrand.me.berkeley.edu/pages/mwassistedcombustion.shtml

Test Prep to Get into Vocational Education? Yup, It's a Thing

New Jersey's county-run career and technical high schools are helping to revive vocational education—but critics say some cherry-pick the best and the brightest

By Sarah Gonser

JALAL Abaza has a 3.9 GPA and loves fixing broken things. He's a senior at Passaic County Technical Institute, a public high school in New Jersey that offers work-based learning programs in fields ranging from business and applied technology to construction and cosmetology. Abaza spends mornings in a classroom, studying automotive tech, and afternoons at a local BMW dealership, repairing cars and earning $10 an hour.

Photos John O'Boyle for The Hechinger Report

Jalal Abaza, a senior at Passaic County Technical Institute, will graduate in June with a high GPA, valuable industry certifications, and a good job lined up.

Abaza—whose father, a bus driver, and mother, a department store manager, came to the United States from Syria in the 1990s—is on track to graduate from Passaic with two valuable automotive industry certifications, making him immediately hirable. He will have a year's worth of hands-on workplace experience—a rare commodity for a recent high school graduate and a big step in determining if a career in that field is a good fit. He will also have an established relationship with a dealership that is interested in bringing him on full time. Academically, he will be ahead of the game: While the minimum graduation requirement in New Jersey is 120 credits, Abaza and his classmates will graduate with a minimum of 167 credits, a requirement at his school.

"When I saw all the options at Passaic, I thought: Why not take advantage of all that?" Abaza said. "My parents really didn't think I'd go far with automotive, but now, they're very proud of me."

Vocational education programs like those offered at Passaic (known to students and staff as "Tech") are particularly well-positioned to prepare young adults for the labor market of the future, according to some workforce and education experts. In recent years, good jobs for people with only a high school diploma have dwindled, while positions that require both technical skills and an associate degree or some college education are multiplying. And there aren't enough trained people to fill them: New Jersey, like other states, is facing a looming shortage of skilled workers in fields including manufacturing, logistics and distribution, transportation and health care. If that employment picture doesn't change soon, some experts say, it could hamper economic growth.

As policymakers seek to help more young people get well-paying jobs that require specialized skills, they are increasingly turning to models like New Jersey's. Vocational education was once seen as a dumping ground for students who couldn't make the cut for college, but New Jersey's 66 county-run career and technical schools integrate work-based training with rigorous academic coursework to prepare students for both college and careers. The schools include large institutions like Tech that ready students for a variety of professional tracks, plus highly competitive "academies" that are built around a single field of study, such as medicine. Graduation rates at the schools top 97%—compared to about 91% statewide—and more than three-quarters of graduates continue on to college or other postsecondary education.

The model is also notable because

Sarah Gonser is a contributing writer, The Hechinger Report. *This article was originally published on* The Hechinger Report *website, www.hechingerreport.org.* The Hechinger Report *is a nonprofit, independent news website focused on inequality and innovation in education.*

Passaic County Technical Institute draws students from some of the state's poorest cities, including Paterson and Passaic. It is New Jersey's largest career and technical school and also the biggest high school in the state.

the schools are run by county governments, not school districts. This close relationship with county leadership gives schools a direct connection with local businesses, allowing them to be nimble and responsive to employers' needs. And they are popular: Of the almost 30,000 teenagers who applied for spots in New Jersey's vocational programs in 2017, only about 13,000 received seats.

But in an effort to create a variety of programs to attract a range of academic achievers, the county-run model's admissions process has produced a stratified system in which some of the elite vocational academies enroll a student body that's significantly less diverse than the population of the schools' home counties. This isn't the case at Tech, but it is occurring at some of the academies, which require an admissions test. It's a challenge that administrators of the programs are just beginning to grapple with, and it is emerging as New Jersey faces a legal battle over segregation in its traditional public schools, which are among the most racially divided in the nation.

If New Jersey can address the issue, education experts say, its approach to career education could be one that other places will want to emulate. In the past few years, Tech has hosted educators and school administrators—eager to observe the school's approach to career and technical education—from Ohio, Pennsylvania, New York, West Virginia, and Maryland.

"New Jersey's county vocational schools are the embodiment of this idea that if our current institutions aren't solving a problem, how can we create conditions so a different kind of solution can emerge?" said Andy Smarick, director of civil society, education, and work for the nonprofit R Street, a conservative think tank. In a 2017 report, Smarick said New Jersey's county vocational high schools hold lessons for other parts of the country, but he noted that the use of specialized tests as admissions criteria has generated criticism "for 'creaming' districts' best students and having student bodies that do not reflect their counties' demographics."

How Tech Connects Students to Careers

Tech is located on a sprawling 55-acre campus with tidy lawns and modern buildings in Wayne, New Jersey. It draws students from some of the state's poorest cities, including Paterson and Passaic, and it is not only New Jersey's largest career and technical school but, with 3,475 students on one site, it is also the biggest high school in the state. Because Tech answers only to its county, its administrators have a direct line to local industry leaders. These leaders keep the school in the loop on industry trends while, in return, Tech commits to turning out skilled graduates, prepared to fill the local job pipeline, either fresh out of high school or after further education.

Each of Tech's programs has an advisory board made of industry members and Tech teaching staff, who meet regularly. "They're discussing trends in the industry, how is the workforce evolving, what's on the horizon, what hasn't been developed yet, what's about to be outsourced." Ted Szczawinski, Tech's director of curriculum, said. "If you're in a silo here, you'll be training people for jobs of 10 years ago."

Mitchell Hidalgo, 17, a native of Paterson whose parents both work in factories, came to Tech seeking training for a well-paying, in-demand career. Today, when she pictures her future, she envisions an electrician's license and her own business. She works half days for a local electrical contractor through the School to Careers program in which Abaza also participates. In a few months, she'll graduate from Tech and work four years as an apprentice before earning her license. She knows the next few years will be tough because of the many skills and rules she'll be expected to master, but she also knows she has no interest in college, preferring to work with her hands and see the tangible results.

"I'm the only female at the company, and in class, it's just me and another girl among all the guys in the electrical shop. I try to use that as motivation to keep going and show others it's OK to do things that aren't expected of you," Hidalgo said. After she earns her license, she'll enter a heavily male-dominated trade: As of 2016, 97.9% of electricians are male.

Mitchell Hidalgo, age 17, is a native of Paterson whose parents both work in factories. She came to Tech with one intention: to train for a well-paying, in-demand career.

Tech does not have an entrance exam and evaluates students based on grades, standardized test scores,

attendance, and discipline records. The school accepts only about a third of the students who apply, and it is more diverse than its surrounding community. This school year, about 53% of students at Tech are Hispanic, 19% are white, and 10% are black; Passaic County is 42% Hispanic, 41% white, and 15% black.

An Elite Vocational Model

Just over an hour's drive from Tech, near the Jersey Shore, Monmouth County's Academy of Allied Health and Science is home to some of the state's highest-achieving high schoolers. It is a prestigious high school designed to prepare an elite group of students for higher education and careers in the medical sciences. Though it is a county vocational school just like Tech, it ranks among the state's top 10 high schools and, along with some of New Jersey's other elite vocational academies, has a student body that is significantly less diverse than parts of the county it is located in.

Like Tech, much of the academy's success lies in its close relationship with local industry leaders who open their doors to academy students, exposing them to on-the-job training.

These relationships are carefully nurtured by school staff—and aided by geography. The Academy of Allied Health and Science is next door to the Jersey Shore University Medical Center in Neptune, a teaching hospital that regularly hosts academy students through an intensive mentorship program.

For the academy, proximity to a major teaching hospital is key. "In any vocational program, you can never keep abreast of new developments in, say, medical science. No high school can," said Timothy McCorkell, superintendent of schools for Monmouth County Vocational School District. "But what you can do is partner with a cutting-edge teaching hospital where our students can get those experiences, get that exposure to the latest, greatest technology in the hospital, rather than trying to replicate that in the school."

Starting freshman year, long before her students enter the glass doors at Jersey Shore University Medical Center, Maureen Baldaccini drills her high schoolers on technical skills ranging from CPR and automated defibrillator use to infection control techniques. These are bundled with soft skills such as how to speak with adults, ask questions, and dress appropriately. This is how Baldaccini, a nurse and the academy's senior mentorship coordinator, ensures that the hospital will continue welcoming her students, allowing them workplace learning opportunities that will pave the way to competitive universities and, eventually, lucrative careers in the medical sciences. In the last four years, her graduates have been offered spots at schools including Harvard University, Yale University, and the Massachusetts Institute of Technology.

Bergen County is almost 20% Hispanic and 7% black, but the student body at the Bergen County Academies was just 1% black and 6% Hispanic last school year.

Even though the benefits of workplace learning—better-prepared workers and increased employee retention, for example—are clear, high schools rarely have the time and resources to create the relationships needed to sustain such opportunities. In a 2018 study exploring the lack of quality work-based learning for American high schoolers, Jobs for the Future, a nonprofit focused on education and workforce research, noted these programs are especially important to young people from low-income families who lack " the connections and formal support services to help them find the internships that will give them a leg up in the labor market."

An Opportunity That's Not Open to Everyone

New Jersey's first county academies were established in the early 1990s to attract high-achieving students who wanted to explore careers that differed from those offered by traditional vocational schools, in areas such as marine science and aerospace engineering, said Judy Savage, executive director of the New Jersey Council of County Vocational-Technical Schools, a nonprofit that represents the state's 21 county-run vocational districts. "The term 'academy' has gotten people to think in a different way about career and technical education, leaving behind some of those old ideas about vocational schools where you send the non-college-bound student so they can have some kind of skills or trade," she said.

But the academies' approach to admissions contributed to racial and socioeconomic disparities. In selecting students, academies rely on a special admissions test plus student standardized test scores. (Tech, by contrast, has no entrance exam.) In some cases, the academies have significantly smaller shares of black and brown students than their surrounding counties. While Bergen County is almost 20% Hispanic and 7% black, the student body at the Bergen County Academies was only 1% black and 6% Hispanic last school year.

Critics of the special admissions test say it can dissuade some students from applying and give a leg up to young people coming from well-resourced schools and those whose parents can pay for prep courses to boost their scores. Paul Tractenberg, founder of the nonprofit Center for Diversity and Equality in Education and author of a 2018 report exploring school integration in New Jersey, said that for the academies to become more equitable, admissions policies need to consider more than just test scores. Otherwise, he said, "they'll continue to be unrepresentative of the demographics of the county."

Administrators acknowledge that ensuring a diverse mix of students is a challenge. Some of the academies, including Monmouth, try to achieve some diversity by reserving one spot for the highest-scoring student from each of the school districts in

the county, so kids from low-income communities are assured seats along with those from affluent areas.

"It's something all of our schools are talking about: How can we recruit better and are there things we can do to help more students be prepared to enter these programs," said Savage. But so far, options like those being considered in nearby New York City—where the mayor proposed scrapping an exam that determines admission to the city's eight elite specialized high schools—aren't on the table. Meanwhile, school segregation is a problem statewide: Last May, civil rights groups and students filed a lawsuit calling for New Jersey to integrate the traditional public school system, which is sharply divided as a result of decades of discriminatory housing and zoning policies.

'I'll Always Be Able to Find Good Work'

For those who are able to secure a spot, four years of career and technical education in New Jersey's county system can illuminate a future path—or change a student's direction.

Nick Buttacavoli, 17, a Tech senior, enrolled dreaming of a career in the culinary arts. But four years spent learning the ropes in the school's kitchens yielded a realization: "I really want to go into law instead, maybe with a minor in business," he said. He's prepared for that as well, thanks to the school's dual focus on academics and careers.

"I'll always have culinary in my back pocket—it's not a skill that I'll ever lose," he said. "I'll always be able to find good work."

Buttacavoli works at Tech's in-house dining room, Chez Technique, which is staffed by students from Tech's culinary arts program, with a chef instructor overseeing things. Watching Buttacavoli chat with school administrators while refilling water glasses, one arm tucked formally behind his back, Szczawinski, the curriculum director, looked pleased.

"The skills he's learned here, they'll always be there for him, he'll never walk away from this experience, and from his first passion," he said. "And that's such a valuable asset to have."

Nick Buttacavoli, a senior at Passaic County Technical Institute, works at the school's in-house dining room, Chez Technique, which operates like a real restaurant, staffed by students, with a chef instructor overseeing things.

SkillsUSA Showcases the Nation's Best in CTE

THIS year SkillsUSA heads back to Louisville, KY, June 24-28, for the 55th annual National Leadership and Skills Conference (NLSC), a showcase of career and technical education students. More than 18,000 people—including students, teachers, and business partners—are expected to participate in the weeklong event.

The SkillsUSA Championships is a national competition for middle school, high school, and college/postsecondary students enrolled in public career and technical education programs. The SkillsUSA Championships, started in 1967, will be held on Tuesday, Wednesday, and Thursday. More than 6,500 outstanding career and technical education students—all state contest winners—will compete hands-on in 103 different trade, technical, and leadership fields.

Students work against the clock and each other, proving their expertise in occupations such as electronics, computer-aided drafting, precision machining, medical assisting, and culinary arts. Contests are run with the help of industry, trade associations, and labor organizations, and test competencies are set by industry. Leadership contestants will demonstrate skills including extemporaneous speaking and conducting meetings by parliamentary procedure.

The competitions will be open to the public and free of charge. On Tuesday, the Opening Ceremony is the first official conference event.

SkillsUSA organizes this event, which is considered the largest skill contest in the world and the single greatest day of industry volunteerism in America, annually at an estimated cost of more than $36 million. SkillsUSA adds contests to the SkillsUSA Championships each year to meet the demands of new and expanding occupations. SkillsUSA instructional programs represent 130 different occupational areas.

Prior to the official start, from June 22-24, students and advisors can experience Activate, Leverage, and Engage. Intense and rewarding, these three events cover individual, group, and interactive leadership training. Activate will help SkillsUSA members find their "start button" through hands-on, high-energy, and motivational programming. Activate is open to all SkillsUSA student leaders. Leverage is open to SkillsUSA's high school and college/postsecondary state officers. It provides state officers with high-energy leadership training that focuses on individual leadership skill development, building teams, and communicating effectively.

Engage, open to advisors, will show how to use SkillsUSA as an educational teaching strategy and an integral component of any career and technical education program. For more information, and to register, visit: skillsusa.org/events-training/national-leadership-and-skills-conference/registration-and-logistics/register/.

Delegate sessions for students are conducted by the national officers. The sessions provide a platform to conduct the organization's official business, elect student leaders, and recognize state association voting delegates.

SkillsUSA University is a program of educational seminars available to all participants Tuesday, Wednesday, and Thursday. SkillsUSA TECHSPO returns to the conference as a whole new experience and is now located on the competition floor. Look for products available to purchase from SkillsUSA's sponsors and vendors in both indoor and outdoor exhibits.

The week caps off with the Awards Ceremony, which takes place on Friday evening.

To help students who face a financial challenge in going to the national competition, the mikeroweWORKS Foundation has offered scholarships for the past eight years. In 2018 they contributed $50,000 to a scholarship fund for students.

The foundation focuses on students who are working primarily toward careers in manufacturing, construction, transportation, electronics, and other program areas where a skills gap exists. Since 2011, it has provided scholarships to nearly 500 SkillsUSA students, representing an investment of more than $400,000 in America's future skilled workforce.

"The skills gap is not only real, it's a reflection of what we value," said Mike Rowe. "To close the gap, we need to change the way the country feels about work. My foundation supports SkillsUSA because it celebrates the kind of skills that are actually in demand. Through excellence and competition, SkillsUSA encourages real-world training, and in the process, lays a foundation for thousands of careers in the skilled trades. SkillsUSA works."

To see the SkillsUSA 2018 Week in Review—National Leadership and Skills Conference, visit youtu.be/lhM0qL-poziY.

SkillsUSA is a vital solution to the growing U.S. skills gap. The nonprofit partnership of students, instructors, and industry ensures America has the skilled workforce it needs to stay competitive. Endorsed by the U.S. Department of Education, the association serves more than 335,000-member students and instructors each year in middle schools, high schools, and colleges.

This diverse talent pipeline covers 130 trade, technical, and skilled service occupations, the majority STEM-related. More than 600 corporations, trade associations, businesses, and labor unions actively support SkillsUSA at the national level.

SkillsUSA empowers its members to become world-class workers, leaders, and responsible American citizens as it improves the quality of our nation's future skilled workforce. SkillsUSA supports its student members through the development of SkillsUSA Framework skills that include personal, workplace, and technical skills grounded in academics.

Local, state, and national championships, designed and judged by industry, set relevant standards for career and technical education and provide recognition opportunities for students. SkillsUSA also offers technical skill assessments and workplace credentials through the SkillsUSA Career Essentials program, a cutting-edge solution that defines, implements, and measures career readiness skills for students.

SkillsUSA is organized into 18,000 chapters and 52 state and territorial associations. It has served more than 12.5 million annual members cumulatively since 1965.

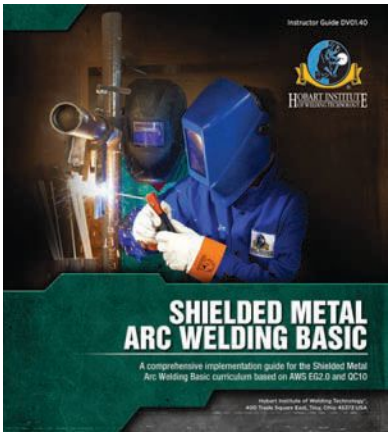
Index to Volume 78

The material listed in this index of Volume 78 (September 2018-May 2019) of **techdirections** is arranged alphabetically by subject.

product spotlight

The newest and best for CTE and STEM classes

Updated Welding Training Course



The Hobart Institute of Welding Technology is pleased to announce the release of our updated Shielded Metal Arc Welding Basic course featuring 38 video topics all filmed in high definition. The course includes a new course instructor guide, new quizzes, and new student workbook containing a mixture of technical welding topics and skill practice topics featuring new graphics and visual aids. Topics include: The 5 Essentials of SMAW, Electrode Selection, Distortion Control, Low Hydrogen Electrodes and Their Uses, Safety and Health of Welders, and much more.

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more than fun

Circular Reasoning

Place a number 1, 2, 3, 4, or 5 in each of the five circles so that the statement below each circle us true. Numbers can be used once, twice, or not at all.

Puzzle devised by David Pleacher, www.pleacher.com/mp/mpframe.html

Number of circles with an odd number	Number of circles with an even number	Sum of the numbers in the first two circles	Difference of the numbers in the first two circles	Only number not used in the first four circles

Work It Out!

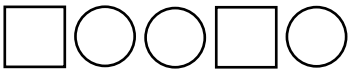
If 7 athletes altogether lose 20 pounds in 8 hours of workouts, how many more athletes would be needed to lose a total of 20 pounds in only 4 hours of workouts, providing the new athletes shed weight only half as fast as the original 7?

Puzzle devised by David Pleacher, www.pleacher.com/mp/mpframe.html

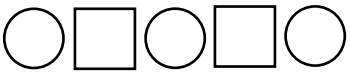
Scramble Word Challenge

The American author and humorist Mark Twain knew several scientific notables, including the great Nikola Tesla. Mark Twain also knew the obscure name of history's greatest inventor. To learn that name, first unscramble the four science-related words below. Write each answer in the line of squares and circles provided below each word. Then unscramble the letters in the squares to find the name of that elusive inventor.

CROTH



IDEOD



RASTUN

CREWHN

Father of. . .?

Although someone may be known as a father or mother of something, it does not always mean they invented, discovered or originated something. It does mean, however, that they are the person most closely associated with the "something."

Can you match the "fathers" to the respective industry they played a major role in creating?—**Harry Roman**, East Orange, NJ.

Father	Industry
1. Gail Borden	A. Air-conditioning industry
2. Carl Benz	B. Machine tool industry
3. Charles Hall	C. Paper industry
4. John McAdam	D. Modern roads
5. Willis Carrier	E. Aluminum industry
6. Nicholas-Louis Robert	F. American railroads
7. David Wilkerson	G. Automotive industry
8. John Stevens	H. Dairy industry

This is a good exercise that can easily be expanded upon. If students your don't know all the answers offhand, have them look up the "fathers" in an encyclopedia, the Internet or Dennis Karwatka's Technology's Past *books. Then, have students write a short biography on each "father." (For more information on the* Technology's Past *books, see page 27.)*

See answers on page 15.

We pay $25 for brain teasers and puzzles and $20 for cartoons used on this page. Preferable theme for all submissions is career-technical and STEM education. Send contributions to vanessa@techdirections.com or mail to "More Than Fun," PO Box 8623, Ann Arbor, MI 48107-8623.

even more fun

Cross-Sums

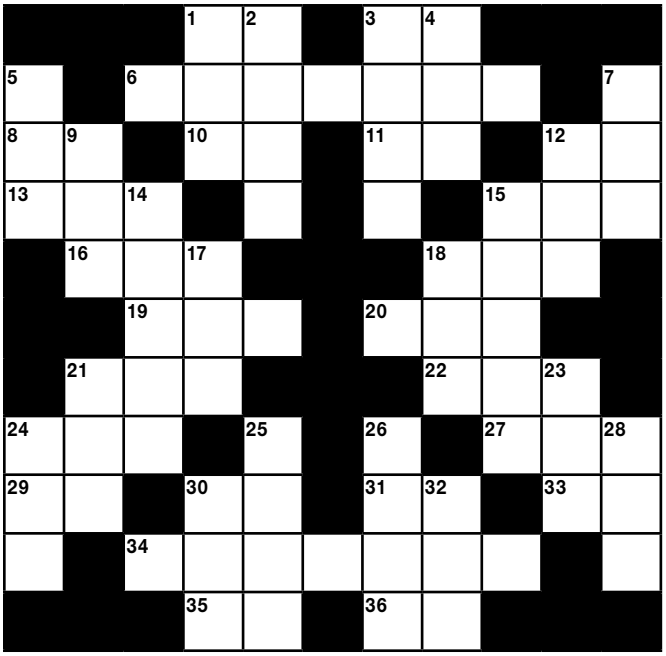
This puzzle is similar to a crossword puzzle, but it uses numbers instead of words. The clues are the sums of the digits in the answer. In the answers, there are no zeros, and no digit appears more than once in any answer.

Across

1 = 11
3 = 6
6 = 37
8 = 6
10 =9
11 = 8
12 = 13
13 = 13
15 = 10
16 = 12
18 = 16
19 = 17
20 = 16
21 = 14
22 = 12
24 = 14
27 = 16
29 = 13
30 = 4
31 = 13
33 = 10
34 = 36
35 = 6
36 = 9

Down

1 = 13
2 = 24
3 = 14
4 = 20
5 = 14
7 = 18
9 = 14
12 = 16
14 = 22
15 = 18
17 = 14
18 = 12
21 = 18
23 = 14
24 = 17
25 = 18
26 = 30
28 = 18
30 = 9
32 = 15



Machine Shop Search

This is a word search with a twist: Instead of providing you with a list of words to find, we've given you clues to those words. The words appear as they do in standard word search puzzles—horizontally, vertically, or diagonally, forward or backward. Check a box following each clue when you find an answer. For a list of words, see page 8.

H J D G T N A L O O C J L P V
M I L L I N G M A C H I N E T
E G Q K Y A C R E F M A H C D
D D K O D G W U A X I S K S V
O W C O O R D I N A T E S T K
C G C L H U I L E E T S L P E
G W E R C S L L A B D X F L H
M A C M A M S A L P Y B Q A T
Z C O P P E R F F P Q F C S A
J M R S J T V C A U R N P T L
A P C D O O W A M Y C E W I V
M C H U C K S D I G P X S C C
A N A M U I N A T I T V F S B
B R A S S A L U M I N U M L X

Nine machine shop terms ☐☐☐☐☐☐☐☐☐

Seven materials that can be machined ☐☐☐☐☐☐☐

Six 3-letter machining abbreviations ☐☐☐☐☐☐

Three types of machine tools ☐☐☐

See answers on page 8.

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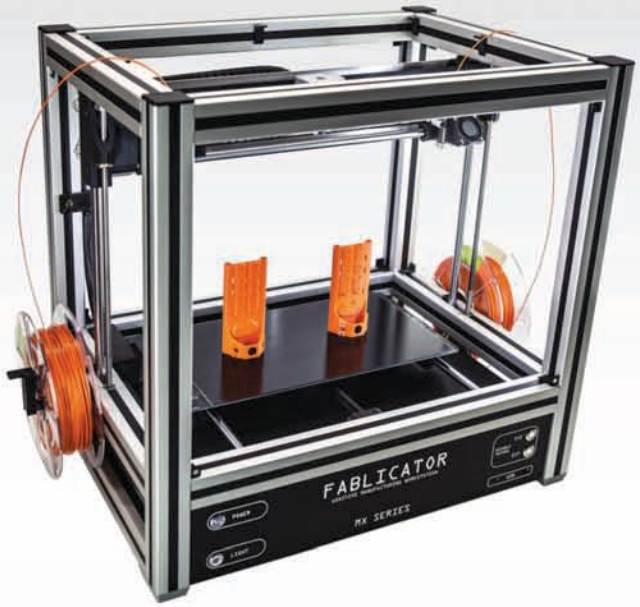

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