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Drawing Students to Building Trades

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Encouraging Student Innovation

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technically speaking

Vanessa Revelli vanessa@techdirections.com

I am constantly amazed with the advancements being made in biotechnology. When I heard the news story several weeks ago about a young engineer who developed a communication tool to help his niece, I was blown away!

Roy Allela (www.royallela.com), a 25-year old engineer and inventor from Kenya, created an amazing solution to bridging the communication barrier between deaf and hearing people. He has invented Sign-IO gloves that can translate signed hand movements to audible speech so deaf people can "talk" even to those who don't understand sign language.

The Sign-IO gloves feature sensors mounted on each of the five fingers to determine its movements, including how much a finger is bent. The gloves are connected via Bluetooth to an Android app that Allela also invented which uses a text-to-speech function to convert the gestures to vocal speech.

Image courtesy of www.blackbusiness.com

Allela was inspired to create the gloves because he and his family struggled to communicate with his 6-year-old niece who was born deaf. "My niece wears the gloves, pairs them to her phone or mine, then starts signing and I'm able to understand what she's saying. Like all sign language users, she's very good at lip reading, so she doesn't need me to sign back," he said in an interview with *The Guardian*.

The young inventor, who also works for Intel and teaches data science at Oxford University, first launched the gloves at a special needs school in rural Migori county, south-west Kenya. He aims for it to be available in every school for special needs children to assist as many deaf or hearing-impaired children as possible.

The Sign-IO gloves are currently still in the prototype phase of development, but they have already received awards and prize money which helped him further improve the invention. The invention has been the 2018 grand winner of the "Hardware Trailblazer Award" from the American Society of Mechanical Engineers global finals in New York and a second runner-up at the Royal Academy of Engineering Leaders in Innovation Fellowship in London.

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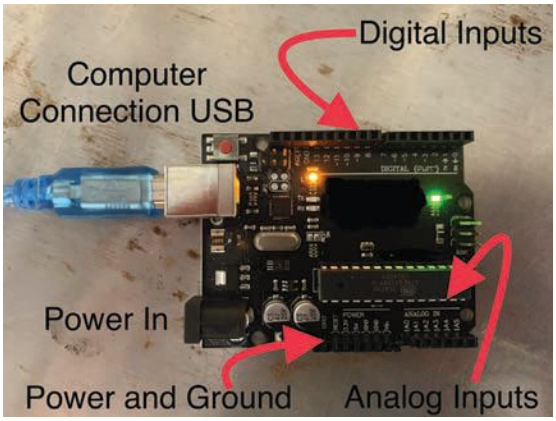

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About the cover: The ever-growing field of construction technology offers many different career paths. Cover design by Sharon K. Miller.

Vanessa Revelli
vanessa@techdirections.com

Autonomous Race Car Competition to Take Place at Indianapolis Motor Speedway in 2021

Indianapolis Motor Speedway (IMS) and Energy Systems Network (ESN) just announced a two-year $1 million prize competition that will culminate in a head-to-head, high-speed autonomous vehicle race Oct. 23, 2021, around the Speedway's famed 2.5-mile oval.

The Indy Autonomous Challenge is a competition among universities to create software that enables self-driving Indy Lights race cars to compete in a head-to-head race on the IMS track. The development of such software can help speed the commercialization of full autonomous vehicles and enhance existing advanced driver-assistance systems (ADAS) in people-driven cars. These technologies help drivers remain in control and avoid accidents by prompting awareness and improving accuracy.

Leveraging the Indianapolis Motor Speedway's Long History of Spurring Automotive Innovation

The Challenge builds upon the success and impact of the DARPA Grand Challenge—the 2004-05 defense research initiative that helped create the modern autonomous vehicle industry—as well as IMS's roots dating back to 1909 as a proving ground for the nascent automotive industry. More than a century later, IMS has contributed to countless breakthroughs in automotive performance and safety, including the first rear-view mirror.

"There's a fundamental connection between innovations on the racetrack and real-world improvements on the highway," IMS President J. Douglas Boles said. "With the launch of the Indy Autonomous Challenge, IMS continues to embrace its historic role as a catalyst for the next generation of vehicle technologies in motorsports competition and wider consumer platforms."

Five Round Structure Progressively Challenges University Students

The Challenge consists of five rounds. Teams submit a short white paper during the first round, and in the second round, teams must demonstrate vehicular automation by sharing a short video of an existing vehicle or by participating in Purdue University's self-driving go-kart competition at IMS. The Indy Autonomous Challenge's simulation sponsor ANSYS will supply its VRXPERIENCE Driving Simulator powered by SCANeR™ and its SCADE software development suite to teams for their use in developing autonomous vehicle software. ESN and ANSYS will co-host "hackathons" to familiarize teams with the simulator's full potential and ANSYS will award $150,000 in prizes to top finishers of a simulated race during the third round. The fourth round enables teams to test their actual vehicles at IMS in advance of the head-to-head race, which will award $1 million, $250,000, and $50,000 to the first, second, and third finishers.

"What we're asking universities to do is hard," said Matt Peak, director of mobility at Energy Systems Network. "Our hope is that by bringing together and offering up to participating teams the world's premier automotive proving ground, performance chassis manufacturer, engineering research center and simulation platform, as well as nearly $1.5 million in total cash awards, universities will see the Challenge as not just throwing down the gauntlet but also extending the helping hand to accelerate innovation and the arrival of new technologies."

A Global Platform for Collegiate Collaboration and Academic Advancements

Joining IMS and ESN for the announcement were race car manufacturer Dallara Automobili and the Clemson University International Center for Automotive Research. Through Clemson University's long-running vehicle prototype program Deep Orange, Clemson graduate automotive engineering students will collaborate with ESN and Dallara to engineer an autonomous-capable version of Dallara's 210 mph IL-15 Indy Lights chassis that can accommodate the competing university teams' driverless algorithms. Participating teams will be involved in the converted vehicle's design and specifications through monthly virtual design reviews and other feedback channels.

"Deep Orange is an educational framework that immerses students in industry-like environments to simulate real-world R&D challenges facing companies today," said Dr. Robert Prucka, Clemson University Kulwicki Endowed professor and Deep Orange 12 project leader. "Working with industry partners such as IMS, ESN, Dallara, and ANSYS gives students unparalleled opportunities to work with the latest technologies and collaborate with cross-functional teams in a way that will make them more innovative and capable engineering leaders after they graduate."

Five universities registered for the competition upon its opening: Korea Advanced Institute of Science & Technology (KAIST), Texas A&M Transportation Institute (TTI), University of Florida, University of Illinois, and the University of Virginia. Members of each of these early registered teams joined the organizers at the SEMA Show for the announcement.

"Nearly 15 years ago, the DARPA Grand Challenge helped prove the innovation-generating and industry-creating role of prize competitions, while recent years have seen the value of autonomous vehicle proving grounds—including Texas A&M RELLIS/TTI Proving Grounds Research Facility—on full display," said Ivan Damnjanovic, associate professor and director of engineering project management at Texas A&M University. "We're excited to be in on the

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

ground level of such a dynamic effort that leverages both of these tools while adding others that can excite and empower students, inspire classrooms and coursework, and altogether help transportation research institutions advance their programs."

Registration is open for accredited, tax-exempt colleges and universities (including foreign institutions of higher education) through Feb. 28, 2020. For more information and to register for the competition, visit www.indyautonomouschallenge.com.

Coding Dojo Launches Immersive Data Science Bootcamp

Coding Dojo, a leading coding education company, just announced the launch of the Data Science Immersive Bootcamp, a new program designed to teach and apply Data Science methodologies and tools so participants can solve real-world problems in business and academia. The 14-week course was developed to meet the growing employer demand for skilled Data Scientists, which rose by 31% since December 2018 and an astonishing 256% since December 2013, according to research by Indeed.com. The curriculum was designed by Isaac Faber Ph.D., the Chief Data Scientist for education and collaboration startup MatrixDS.

"Our mission is transforming lives through programming literacy and Data Science skills can lead to significant economic mobility in today's economy," said Richard Wang, CEO of Coding Dojo. "We will continue monitoring the evolution of the tech industry and creating educational programs to prepare the workforce for the careers of the future."

The new bootcamp will introduce core Data Science principles and develop students' skill sets to make them competitive in the workforce as Junior Data Scientists or Data Analysts. Participants will also develop Data Science solutions using the SQL, R, and Python programming languages, as well as build predictive models by leveraging statistical and machine learning processes.

"The thing that sets this program apart from other options is the diversity of, and approach to, learning," said Isaac Faber. "In 14 weeks, we'll cover in-depth topics that would typically require several years of classes in a traditional college-type setting. Students will be employable in the data workforce much faster than ever before."

Enrollment is now open for the first cohort that begins in March 2020. Basic Python knowledge is required, and preliminary Python training is included as pre-bootcamp work if students need extra help. Additionally, students must be 18 years old or older and have a high school diploma or GED. The course will initially be available at the Coding Dojo Bellevue, WA, campus; the company aims to roll the program out to additional campuses throughout 2020. The curriculum will be delivered via the industry-leading Coding Dojo Learning Management System and consists of lectures, videos, reading, assignments, and projects.

Visit codingdojo.com/data-science-bootcamp for further details.

Alan Pierce
pierceaj@techtoday.us; on Twitter @ TechToday_US

Alice the All-Electric Commercial Airplane

The carbon in the exhaust from a gas turbine jet engine combines with the oxygen in our atmosphere to form the global warming gas carbon dioxide. The United Nations Intergovernmental Panel on Climate Change (IPCC) indicates that this CO_2 plus the other global warming gases produced by commercial air travel is responsible for anywhere from 4-9% of the global warming that is directly caused by our industrial society. Every positive action that reduces the use of fossil fuels on the ground and in the air can reduce the catastrophic effects that global warming could cause in the near future.

Images courtesy Eviation Aircraft

Photo 1—The Alice aircraft is powered only by its lithium ion batteries.

Eviation is an Israeli-based company with a new all-electric regional airplane that can fly 621 nautical miles, at 240 knots, on a single electric charge, at the very low cost of $200 per hour of flight time. After an hour's flight this all-electric airplane, that Eviation named Alice, can recharge its lithium ion battery back to full capacity in a half hour.

To accomplish this flying time using cutting edge but still current technology, their airplane's battery pack weighs 7,800 pounds. By comparison the Tesla Model 3 long-range lithium ion battery holds one twelfth (1/12) as much electrical current as the Alice battery and it weighs 1,058 pounds.

Photo 1 shows Alice at this year's Paris Air Show. Its shape is as radically different from conventional airplanes as the power source that drives its engines. Its three engines are actually three very powerful electric motors. Each of these supersized motors has the same working parts as the motors you find in your home, a stator that creates the magnetic field that turns electrical energy into mechanical energy, and a rotor that spins the propeller (Photo 2).

Photo 2—The engines on this airplane are electric motors that function the same as motors you have in your home.

Part of its distinctive look is the location where the engines are mounted (Photo 1). Two engines are located at the end of each wing and one is located at the back of the plane. Since the propellers are mounted behind the wings surfaces and at the end of the plane these propellers push the plane through the air to create the air currents and velocity necessary for the plane to fly.

The aerodynamic design of this plane has the main pushing force performed by the propeller at the tail of the airplane; this leaves the wing pushers the job of reducing drag and providing redundancy if the tail motor should ever fail. Since these engines are electric motors, it is easy to control the individual spinning speed of each propeller. This can be done to control the flight characteristics of the airplane and cut the noise level created by wind turbulence that each propeller creates down to a whisper when flying low over residential areas.

Since the plane doesn't burn off a physical quantity of fuel, its weight (14,000 lbs) stays the same from takeoff to landing. This lack of weight change during the flight is just one flying characteristic that its advanced fly-by-wire technology doesn't need to process. The engineers that designed Alice's fly-by-wire system indicate that it is so advanced the pilot and co-pilot on board could literally sit back and relax and leave the flying to Alice's auto-pilot from takeoff to landing (Photo 3).

Eviation's Alice aircraft is now

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

ready to go through the US Federal Aviation Administration certification process so it can enter commercial use in the United States. It is expected to complete this process within the next two years. Cape Air is a regional airline that operates flights to places like Nantucket and Martha's Vineyard and they have already ordered a small fleet of this all-electric nine-passenger airplane (Photo 4). For further insight into the design and expected operation of this all-electric airplane, visit youtube.com/watch?v=W0DHhiwvatQ.

Taking it a Step Further

1. Is global warming related to human activity? Is it something that we need to be concerned about? Your teacher will provide you with the format you should follow while doing this research.

2. Build an electric motor.

Your teacher must approve all building plans before your group starts construction of its motor. All motors need to run on the power supplied by a single AA battery or battery power determined by your teacher.

When all the motors are completed it is time to see which motor will run for the longest time before its battery power is exhausted.

Photo 3—Alice has the newest fly-by-wire technology so its autopilot can handle a flight from takeoff to landing.

Photo 4—The interior of the airplane's cabin

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technology's past

Dennis Karwatka
dkarwatka@moreheadstate.edu

Enzo Ferrari and His Racing Cars

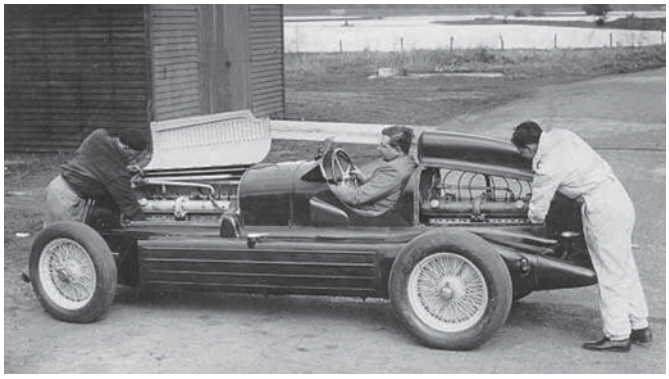
Over 4,000 different brands of automobiles have been offered for sale, and many used the name of the person who founded the company. One such example is the Ferrari. Named for Enzo Ferrari of Italy, who built his first two cars in 1940 for a Grand Prix road race.

Enzo Ferrari in 1920

Ferrari was born in 1898 in Modena, Italy, and raised with an older brother. His father operated a carpentry business out of his home. Ferrai was an indifferent student and received little formal education. When his father took him and his brother to a road race in 1903, Ferrari developed an interest in racing that remained with him his entire life. He saw service in World War I (1914-1918) with the Italian army. Both his father and brother died during the conflict. Ferrari married Laura Garello after leaving the army and they had one son.

Ferrari held various automotive-related jobs until he landed a position with the Alfa Romeo Company as a mechanic and test driver. He talked his way into driving one of the company's entries in an important 1920 race. He placed second, launching a driving career that saw him win 13 of 47 races. Ferrari was one of Italy's most respected race car drivers during the 1920s.

A 1930 Scuderia Ferrari race car. Since Ferrari was working for Alfa Romeo, these cars are often known as Alfas.



The Bimotor had two engines; its first race was in 1935.

One of the two original 1940 Model 815 race cars. Two Model 815s participated in the 1,000-mile Mille Miglia race 1940.

The 1947 Model 125s was Ferrari's first nameplate automobile, seen here in the 1947 Rome Grand Prix.

Alfa Romeo allowed him to lead the company's racing component, which they named Scuderia Ferrari (Team Ferrari) in 1929. His driving career was over, but Ferrari became responsible for developing engines and body designs. His team won eight victories in their first 22 competitions, and won two world championships.

One of their more unusual designs was the 1935 Bimotor, a racing car that had two engines. Both were in-line eight-cylinder engines rated at 270 hp. One powered the front wheels and the other the rear wheels. The car was a major race competitor but never performed as well as Ferrari had hoped.

Ferrari left Alfa Romeo in 1939 to establish an independent racing organization and built his first two cars in 1940. Called the 815, each had an eight-cylinder, 1.5 liter engine. Both raced in the 1940 Mille Miglia 1,000-mile road race. When Italy entered World War II (1939-1945), the government required Ferrari to manufacture engines for training aircraft and other items. His Modena plant was severely damaged in two air raids and Ferrari had significant challenges in retooling after the war.

Ferrari offered his first car for sale in 1947. His 140 employees manufactured the 125S, which was powered by a 118 hp, 1.5 liter, V-12 engine. It won the 1947 Rome Grand Prix race. Ferrari was reluctant to market his cars but needed the money to finance his racing team. He sold seven vehicles that year. They were single-door racing vehicles and unlike the sedans or convertibles seen on the roads of the time. The exact history of early Ferraris is difficult to trace. Serial numbers were often changed as the cars were raced, rebuilt, renamed, and then sold as new.

Ferrari's son, Dino, was instrumental in the company's engine development. The father-son team worked closely until Dino's 1956 death at age 24 from muscular dystrophy. Dino's death had such a troubling effect on Ferrari that he rarely left the Modena region for the rest of his life. He named a series of his 1968 to 1976 cars Dino.

Ferrari was intimidating and difficult to work for. He wrote in his biography, "I have yet to meet anyone quite so stubborn as myself." He remained as managing director of the company until retiring in 1971. At the time of his death in 1988, Ferrari's company manufactured about 1,300 cars a year and Ferrari race cars had accumulated over 4,000 victories.

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

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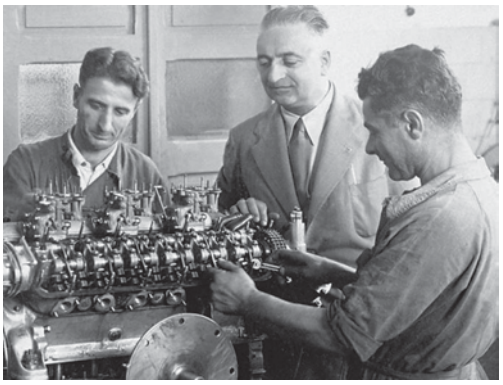

Enzo Ferrari, in the middle, with son Dino at left, inspecting an engine, circa 1952

A 1973 Dino, named to honor Ferrari's son who died in 1956

Flickr: Nan Palmero

Video Game-Like Tech Draws Younger, More Skeptical Workforce to Construction

By Jenn Goodman

MITTIE Cannon, founder of an Alabama nonprofit construction training program for girls, knows that a job in the trades offers many perks: good pay, job satisfaction, the ability to work as part of a team, and opportunities for advancement. But those incentives are not always enough to attract young women to the construction industry, which they see as dirty, tiring work that's more appropriate for men.

Interactive technology is helping to change their minds. Through support from local businesses and ABC chapters, Cannon's Power UP Loud program offers weekly workshops in middle schools focused on topics like plumbing, electrical, and site work. In addition to traditional training, the girls experience the industry via simulators and VR headsets that mimic some of today's most popular video games like Microsoft's Xbox gaming console and the Sony PlayStation.

Jenn Goodman is a Construction Dive Senior Reporter. Article originally appeared on constructiondive.com.

The young students—digital natives accustomed to using technology in nearly every facet of their lives—have a good time trying out simulators for activities like crane operation, excavation, and welding, Cannon said, but the experience is more than just fun and games. By seeing firsthand that construction work involves high-tech skill more than physical prowess, some girls begin to envision it as career.

"Technology gets the kids excited," Cannon told Construction Dive. "It's something in a child's mind that they can relate to."

Cannon is hoping that excitement will translate to future jobs for the girls, most of who are in the eighth grade. "We relate technology to how the students can do this and make a great living," Cannon said. "When you tie it to a career it's definitely a selling point."

An Eye-Opening Experience

Debbie Dickinson, CEO of Carrollton, Georgia-based Crane Industry Services, brings her firm's portable simulator machine to local college and career academies to help job seekers experience what it's like to be a heavy equipment operator. The Vortex unit from CM Labs in Montreal, Canada, can be programmed with load movements that mimic different real-world scenarios.

"It's so eye-opening to them," she told Construction Dive. "They're like 'Oh my gosh I had no idea this is what it's like to operate a crane.'"

Women especially are surprised to find that operating a huge piece of equipment doesn't require exceptional strength, and many users like the fact that the experience is similar to popular video games, with a joystick and foot pedals, Dickinson said. "People who are comfortable with video games are very comfortable with the simulation technology," she said.

Construction companies are using the technology to not only attract but also evaluate candidates, Dickinson added. Simulators are helpful for checking out potential hires without tying up expensive equipment or supervisor time.

"You can see how expensive it would be to screen someone on a piece of crane equipment that costs anywhere from $30,000 to several million dollars," she said. "You can't

let them loose by themselves without a certified operator, it would be too dangerous."

Her clients have used the Vortex to weed out unqualified applicants. "People show up who say 'I'm a certified operator with all this great experience,' but this helps to verify that somebody knows what they are talking about."

Justin Poland

A student tries out a VRTEX 360 electronic welding simulator at a Power UP Loud event.

A Recruitment Tool

Construction companies across the U.S. are scrambling to attract young workers, and the lure of using technology can be a big draw. In a recent USG+US Chamber of Commerce Commercial Construction Index of U.S. contractors, 32% cited the ability to work with advanced technology as a top way to attract new workers under 30.

Nevertheless, many job seekers don't associate the construction industry with the opportunity to work with technology, so forward-thinking firms are making it part of their recruiting and hiring process, said Chase Rozenberg, business manager of Philadelphia-based recruiting firm Washington Frank.

"As a recruiter for technology workers, we're seeing firsthand how the industry's increased adoption of digital solutions has helped draw new talent to the sector," he said. "More and more companies, in a huge range of verticals, are seeing the benefit that digital transformation brings, both in terms of productivity and recruitment."

Beyond the jobsite, technology is a selling point for white-collar job candidates as well, said Mike Lorenzo, director of emerging technologies with AECOM Building Construction. Construction firms known for being tech-driven often have a leg up when recruiting highly trained workers.

"It definitely helps by bridging the gap within the industry because 10 to 15 years ago someone with a mechanical engineering or similar degree wouldn't have looked at a construction-related job because the industry was known as being so archaic," he said. "They're now seeing that there are a lot of innovative things happening in the construction industry and it's a good career. They see that the skills they can bring here are actually going to be utilized and not tossed aside."

Crane Industry Services

A student tries out a simulator from Crane Industry Services.

Wendy Montgomery, senior talent manager at MEP provider Southland Industries, said industry leaders need to do more to promote the advantages of working in construction. While building construction may not be as "sexy" as the aviation or automotive industries, Montgomery said concepts like the importance of green technologies resonate with young job seekers.

"We have an opportunity to leverage their interest in tech by bringing up how our industry works to construct smart buildings," she said. "More and more, the skilled trades are requiring more complex, engineering-like skills so they can build better buildings with smaller environmental footprints."

At college recruiting fairs, students ask Southland representatives about the types of technology the company employs. They are especially interested in programs like Revit, Navisworks, and virtual reality tools, she said.

"Lots of students now are being exposed much earlier to the types of technologies available in the industry," she said.

With U.S. unemployment at a record low, companies also use tech tools to keep current employees happy and engaged. Because high-tech systems make work more efficient they can help with employee retention, Lorenzo told Industry Dive.

"For people like foremen and superintendents it's about finding ways to make their jobs easier even if it's just giving them an iPad or a new program," he said. "People are demanding that kind of technology as something they need to do their job."

New Products Hit the Market

Makers of construction and design software are tapping into the tech-based trend with products that borrow from top video game systems. For instance, Revizto's cloud-

Continued on page 15.

BY Program Creates Meaningful Connections and Careers

By Kelsey Zibell

THROUGH the Indiana Construction Roundtable Foundation, Chris Price has created a construction education and training program that works to provide adults in underserved communities with free education and opportunities.

The BY Program is a training and education course that offers NCCER Core and OSHA 10 lessons and certifications. It is a six-week program that teaches adults rudimentary skills that are needed to succeed in construction such as: basic safety, construction math, introduction to hand tools and power tools, introduction to blueprints, basic rigging, and soft skills training.

The best part of the program? It directly connects education to industry.

Throughout the program, students meet different employers and explore various markets as they work through the core curriculum. By the end of the program, students have met and interacted with many employers in several industries within construction.

The program is free for all who attend—thanks to partnerships with the state of Indiana and local communities. It is currently accepting adults over the age of 18 with or without a high school diploma. To enroll in the program, applicants must remain drug free throughout the program and complete a criminal background check.

Upon the completion of the course, a job fair is held where employers may speak with graduates and offer them a position with their company. According to Price, a graduate could walk away with 20 different job offers.

When these people go through the program, enter the industry, and begin making as much as $37 an hour, their lives are forever changed.

These job fairs have been highly successful for both students and employers in the long run. With high retention rates and employers continuing to return to the program to recruit, there has been an efficient pipeline of talent established in Indiana through this program.

Because of the high success rate, the BY Program asks industry partners to donate $500 if someone from the program is hired and retained for 90 days. This helps fund the program and ensures that the pipeline of talent continues to grow.

Currently, there are 500,000 adults without a high school diploma who are ready to enter the workforce in Indiana, according to Price. The BY Program hopes to recruit these adults in underserved communities and provide them with valuable career opportunities in construction.

Simply, the program aims to help adults who do not have many resources or assistance at their disposal. By connecting these adults to employers and career opportunities, they are giving them a chance to succeed and thrive in the construction industry.

Price shared that each class has been diverse with nearly 80% of students from a minority group and a growing number of women—the most recent class is half women. This is incredibly important as the industry tends to be predominately white and male. As these classes graduate and enter the field, the construction

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Kelsey Zibell is a marketing intern at NCCER in Alachua, FL. Currently, she is a student at the University of Florida pursuing a bachelor of science degree in public relations. Working with NCCER and the Build Your Future initiative, she is learning and writing about the skilled labor gap and how to recruit the next generation of craft professionals.

industry in Indiana is getting increasingly diverse, which is another win for the state.

Every month there are two to three classes taking place across the state with 20-30 students per class, and the BY Program is just getting started.

The program has continued to grow and gain popularity as word of mouth continues to spread about how this program has changed lives around Indiana. One man graduated from the class, found a job, and has since encouraged his entire family to go through the program. Another has recruited at least 50 people to go through the program and begin a career in construction since his graduation.

Price noticed that most of the people in the program come from challenging situations. Around 50% of them do not have formal homes. When these people go through the program, enter the industry, and begin making as much as $37 an hour, their lives are forever changed.

Each course is taught at local community centers across Indiana that offer additional benefits to attending adults. These benefits can include bus passes, financial assistance for tools, or employment and financial planning.

One of these centers, Southeast Community Services, helped transform the life of an adult struggling with homelessness.

The individual was homeless prior to the program and had no family support. After being forced to live in a tent city, they went to the community center to get their high school equivalency. Soon, they enrolled in the BY program. Upon graduating, they landed a job making $16 an hour with insurance and 401(k) benefits.

By connecting these adults to employers and career opportunities, they are giving them a chance to succeed and thrive in the construction industry.

At first, they were keeping their money all in cash and carrying it around, as they never had a bank account or the need for one. With the help of Southeast Community Services, they were able to open their first bank account, learn how to manage money, and find a place to live.

Currently, they are still working in construction, supporting themselves, and affording housing.

According to Peggy Frame, deputy director at the center, the BY Program has been a huge success for adults who have committed their time to it. When graduates are able to receive NCCER and OSHA credentials, industry connections, and employment and financial coaching, there is a high chance for success.

The center has completed three classes and Frame said that graduates have been placed in good jobs, retainment is high, and employers are continuing to come back to hire graduates.

The BY Program has been successful and it is still in its early stages. With hopes to expand across Indiana and eventually to other states, Price is paying attention to what is and isn't working.

Above all, he is working to put people above the things that commonly divide interests. As it all continues to come together, he hopes to keep recruiting, training, and bringing people together to enjoy a career in construction.

Continued from page 13.

based software employs powerful gaming technology that converts BIM models into collaborative 3D environments. Buildfore's new CtrlWiz, a Navisworks app, allows users to navigate a BIM model with an Xbox controller.

Stanley Tools

Stanley's remote control system

Developed in partnership with Humanistic Robotics Network, Stanley's wireless Remote Operated Control System for excavators emulates the design of an Xbox controller. Features include dual joysticks, ergonomic buttons, status display, and an emergency stop button.

Inspired by the 1990s 3D video game Doom, the ICE 3D application from DIRTT creates interactive interior environments in real time.

The programs are having a real-world impact. AECOM recently deployed Revizto on five major commercial high-rise projects in New York City, including 30 Hudson Yards, One Vanderbilt, and One Manhattan West, Lorenzo said. The company's internal Future of Construction initiative will keep the innovations coming.

"In terms of the technology we use, we're at a different place now than we were 10 or 15 years ago, when there were one or two folks on a job that were assigned to be the 'tech guys' but nobody else had to know about it," he said. "We're investing the time and resources to make company-wide leaps to new types of technology every year."

A Look at the Industry

5 Practical Benefits of Drones in Construction

By Kumar Wiratunga

PROJECT managers, job superintendents, and safety coordinators have more than enough on their hands when it comes to periodic inspections, jobsite progress monitoring, and keeping everyone safe on the job while focusing on delivering their projects on time and under budget. If a service or product could cost effectively eliminate or reduce the time devoted to daily, weekly, and monthly tasks to support these efforts and reduce rework and risk, you'd expect everyone to jump at the opportunity to be more efficient, right?

Although when commercial drones can track and inspect a site faster, better, and more accurately than a person ever could, surprisingly, many construction professionals inspect their sites the old-fashioned way.

Inspections are not the only benefit of drones in construction. To drive greater awareness of this proven technology in construction, we explore five benefits of drones in construction.

Benefits of Drones #1: More Accurate Mapping Measurements, Fewer Boots on the Ground

Between collecting and processing the data, traditional mapping (surveying) methods take time, and they require human labor. Beginning with high-res photo and video capture, a drone can do the job far more quickly at a much lower cost than traditional methods.

But, equipped with a LiDAR (Light Detection and Ranging) sensor, drones can do the same or better surveying a job in 60-70% less time. Moreover, if a construction site is dangerous or difficult to survey, drones can do the job, eliminating any risk to people.

Since LiDAR works by transmitting a laser beam and measuring the return reflection and it's situated on the drone—which is airborne—topography that would've been difficult to navigate on foot becomes a non-issue. Mapping (surveying) has been made much easier by making data collection simple and made available for 3D modeling and analysis.

Benefits of Drones #2: Reduce Safety Risks

The frequency and degree of cost overruns in the construction industry are well known. The industry has a serious issue with persistently low productivity, partly due to its slow adoption of new technology and lack of that technology being applied across all projects.

When managers are concerned with safety issues, the old way of doing things was to walk around the plant and take a look. It seems sensible, because a human pair of eyes and ears on the floor will be able to quickly recognize any problems with safety. But with the use of a drone and monitoring device, safety managers can see what is happening in real time, and which areas or issues need to be improved.

Construction managers are looking to prevent accidents and injuries with drones which will help reduce the risk of worker injury as the photographs and videos help everyone see what's going on at the site. Preventable issues like shallow excavations, unstable structures, equipment placements, or worker safety become that much easier to anticipate.

Seeking better ways to inspect job sites and identify potential hazards before they become dangerous, companies are increasingly turning to drones to improve efficiency and overall safety for workers. In the end, the result is a much safer construction site and less financial exposure to the project and the firm. ►

As Vice President of ARC Technology Solutions, Kumar Wiratunga drives technological innovation aimed at improving information management throughout the building lifecycle. *This article is copyrighted 2019 to ARC Document Solutions and originally appeared on the company's blog, https://www.e-arc.com/blog/5-practical-benefits-of-drones-in-construction/.*

Benefits of Drones #3: Superior and More Cost-Effective Construction Marketing

Photos and videos do the best job of showcasing projects, and many contractors opt for progress photos or aerial pictures shot from helicopters or planes to make the most impact. These have their own drawbacks, such as quality, expense, flexibility, time, and safety. Drones, however, are affordable imaging platforms that address all those concerns. In addition to their use as surveying tools, drones can also work wonders for construction marketing projects. For example, a developer who wants to visually demonstrate how a proposed project will be laid out can use the unique, overhead view only a drone can capture, as shown in Photo 1.

Photo 1— Drones provide affordable aerial photography, which can show many things such as job progress, or even potential job site hazards.

Pictures sell. Your marketing will improve dramatically if you can add aerial photos to your website, brochures, and social media accounts. Owners are thrilled to see progress photos of their projects. This is a fantastic way to cost effectively share weekly or monthly progress reports with all the stakeholders.

Benefits of Drones #4: A More Practical Method to Monitor Construction Progress

When new technology comes along, it's tempting to discount it as just another shiny new toy. But drone photography is a practical way to solve old problems, such as the challenge of monitoring construction progress.

It is challenging to capture the photos week after week with the same view, location, or altitude. Drones solve these problems with easy to repeat flights each week so that your progress photos and reports always look consistent and capture the key information you need. Eliminating variances in this process drives productivity and lowers costs.

By identifying any phase of the project that is getting delayed, and monitoring your job sites, you will have the project intelligence to proactively take steps that will reduce rework that will negatively impact cost and schedule. The more information you have at your fingertips, the more control you have over your project ultimately.

Benefits of Drones #5: Improved Communication

As anyone in the construction industry knows, communication is everything. With so many different types of contractors coming in and out, site condition changes, weather changes, and more, it becomes vital to keep an eye on the big picture. Drone photographs provide that big picture view.

The aerial view gives the team a different, valuable perspective. Supervisors can sit down with a high-resolution drone map and quickly catch or anticipate any site access issues, potential drainage problems, or threats to health and safety. Then they can more effectively communicate with their team about site issues and resolve them.

You should actively be considering drones and aerial imagery if you want to improve your project performance and keep the project cost and schedule on track. Drones can benefit every project site with tangible value from the very first flight onwards.

Want to Learn More about Drones in Construction?

To take an even deeper dive on the application of drones to any stage of a construction project, from pre-construction to project completion, you can watch the on-demand webcast, "Using Drones Across the Construction Lifecycle" at go.e-arc.com/webinar-drones-construction-lifecycle.

In this webcast, you'll hear about a full scope of practical use cases ranging from marketing, inspections, jobsite progress monitoring, site conditions, safety, environmental, and more.

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Getting Started with Arudino

By James Weinschreider
james.weinschreider@oswego.edu

TEACHING students how to implement a mechatronic system is a valuable component of a technology education. The Arduino is the ideal device to introduce students to programming and mechatronic components. It is a cost-effective solution using mass produced components and C++ which is a versatile foundational programming language.

Overview

An Arduino is an open-sourced programmable circuit board which has at its heart a microprocessor. Its principles are based on receiving inputs such as temperature, distance, and light level, and deciding to turn on or off outputs such as lights or motors. These decisions are based on a program called a sketch which is created by the user via an open-source Arduino programming software.

The system is extremely flexible and is highly customizable. Arduino control systems can to be used for any combination of inputs and outputs (e.g. lights, motors, pumps, LEDs). The product's ability to flex makes it an ideal educational resource as it can grow and change with every course or student idea.

Learning how to setup, program, and use an Arduino has many benefits to projects around the home—those blinds that need to be opened or closed based on the light level, the plants that need watering based on moisture level, or that fingerprint reader that opens a locked door. Providing students with exposure to this type of technology and programming will augment their education as well as provide real-life application.

James Weinschreider is assistant professor, Department of Technology, SUNY Oswego, NY.

Programming Language

The foundational programming language of an Arduino is C++, a language that is transferrable to many other programming applications. Free software known as the Arduino Integrated Development Environment (IDE) is used to create programs and transfer them to the Arduino via a USB connection.

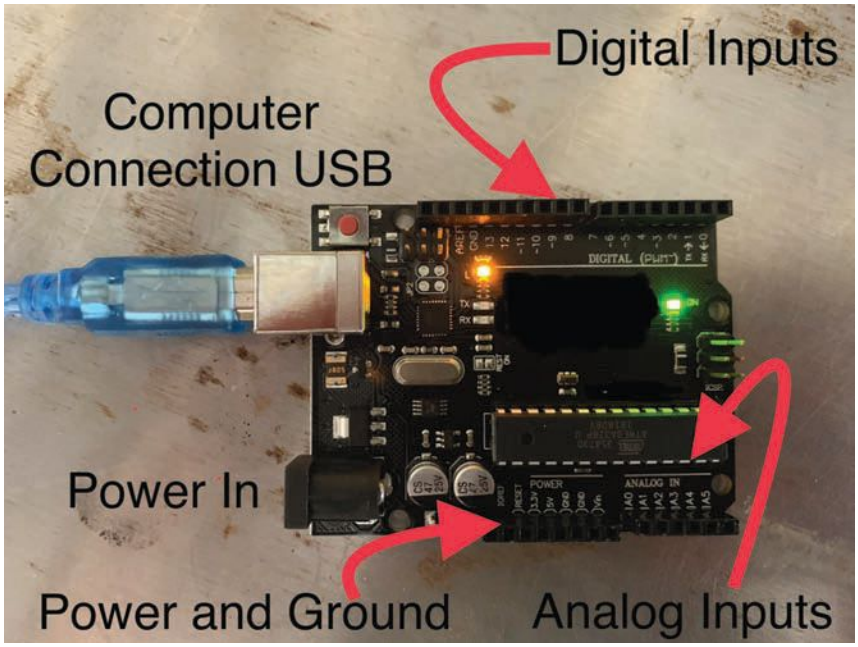


Photo 1—The Arduino

Cost

The Arduino has a great price point when compared to other platforms. The Arduino's low cost, open-source programming environment, and expandability stand out. The mass-produced nature of its components make the Arduino

extremely economical. It is an open-source controller resulting in many manufacturers creating their own "Arduino" board to the specs of the Arduino. The price of an Arduino UNO R3 equivalent board is around $10-$15 and a good starter kit can be purchased for only $40.

Table 1—Products Used to Teach Programming

Platform	Cost	Programming Language	Real World Application	Teaching Application
Arduino Starter Kit	$	C++ programming environment	Yes	Make any mechatronic system
Lego Mindstorm	$$$	Proprietary contained programming environment Robotic motion programming	No	Make simple robots that drive and do ancillary tasks Includes color, vision, and distance sensors
Sphero Family	$$	Proprietary contained programming environment Robotic motion programming	No	Program with JAVAscript, or from a tablet or smartphone to roll around desired
Raspberry Pi	$	Python Programming Environment	Yes	Make any mechatronic system

Programming Device Comparison

The four products commonly used to teach programming in education are: Lego Mindstorm, Sphero, Raspberry Pi, and Arduino. Each product has benefits and drawbacks regarding cost, programming language, teaching application, and application to the real-life setting (Table 1).

While the Mindstorm and Sphero's proprietary programming environments work well with teaching younger students to code and think logically, the products are not as versatile across multiple applications and do not foster creativity in older students that may be designing their own mechatronic application. Both the Arduino and Raspberry Pi devices offer a level of flexibility and usefulness not seen in Lego Mindstorm or Sphero and are an ideal choice for academic institutions.

Comparing the Arduino to the Raspberry Pi, there is a lot of overlap between these devices. Most of the components and sensors available on the market will function on either device. In general, the Arduino works great for simple tasks such as controlling the temperature, turning on a pump when the moisture gets too low, or reading an RFID tag. If a more complex task needs to be completed, like checking moisture levels, turning on a pump, stopping a motor when the limit is reached, or storing the data in a spreadsheet the Raspberry Pi may be the way to go.

There are only a few differences between the Arduino and the Raspberry Pi. The Arduino is microcontroller where the Raspberry Pi is a computer which runs on the Linux operating system. The Arduino uses C++ programming language and the Raspberry Pi uses Python.

Outfitting a classroom with kits for students can be expensive despite the low price point of the Arduino. An important step of curriculum development is to identify the main learning objectives and then to source the correct devices to support student learning. If students can work in teams, a smaller quantity of kits will need to be purchased. There are a variety of Arduino starter kits on the market. It is important to pick a starter kit that supports your learning objectives.

The Elegoo Super Starter Kit from Amazon is a nice entry-level kit. It can usually be purchased for around $35. It's a well-rounded kit that includes distance sensors, servo and stepper motors, temperature and humidity sensors, infrared remotes, and LEDs. It comes with some well laid out tutorials to get you started as well.

Arduino, Adafruit, and Sparkfun also offer starter kits. They are all well rounded kits but tend to not have as many features (Table 2).

Getting Started

Within the Arduino IDE software are a bevy of pre-written programs. A great program to start with is the Blink program. The Blink program can be used in conjunction with your starter kit, or you can use the tutorials that come with your starter kit to

Table 2—Sources of Starter Kits

Resource	Website
Arduino	**https://store.arduino.cc/usa/classroom-pack**
Sparkfun	**https://www.sparkfun.com/categories/393**
Adafruit	**https://www.adafruit.com/product/170**
Elegoo (From Amazon)	**https://www.amazon.com/ELEGOO-Project-Starter-Tutorial-Arduino/dp/B01D8KOZF4/ref=sr_1_3?crid=3AUEL5GH1I5QQ&keywords=elegoo+el-kit-003+uno+project+super+starter+kit&qid=1559236945&s=gateway&sprefix=elegoo%2Caps%2C205&sr=8-3**

learn the basics of C++ programming.

The Blink program starts out by teaching you how to blink the onboard LED that is wired to pin 13 on the Arduino board. This is a great simple program for understanding how sketches (programs) work and how to upload them to the Arduino. There is no wiring involved in this first activity. It serves a very nice purpose of having just a few lines of code that the students can edit to see what variables and outputs do. All the effects are seen in the rate of blinking of the LED.

One of the best books on the market to introduce C++ programming and how to use the Arduino is Programming Arduino: Getting Started with Sketches by Simon Monk (2011). He has a nice approach and really takes his time outlining the simpler exercises to build up your skills. As you progress in your programming ability the book expands on the capabilities of the Arduino and C++. It even goes beyond the level required for an introductory course.

Curriculum Application

The best approach to making sure students are growing their confidence and skill with C++ programming is to have them complete various stages of each exercise. While the students are moving through the stages of the exercises, it is important to provide oversight and verify that they've done each section correctly. This can be accomplished by watching each student or group of students run their programs.

By verifying that each piece of a program or concept is correct in real time, you can confirm the students are competent in each component of the programming sequence. This is important as each skill builds upon the other. Providing oversight at each step allows for coaching and brainstorming around problem areas. If patterns of problems begin to develop it is important to provide clarification to the group as a whole.

Another approach that is valuable is to add programming challenges to the code as students enter it into the software or having them alter the program or repurpose it in a new way. An important component of programming education is debugging. Changing variables and reusing code helps augment their understanding of program structure and function.

As programming skills are solidified and the student becomes more confident, multiple LEDs and pushbuttons can be wired on the breadboard to simulate scenarios (e.g. heating and cooling loops or motor controls). This is a great spot to introduce Ohms Law. Start using components such as motors or temperature devices individually, and then start combining different components together. This requires piecing together different sections of pre-written programs.

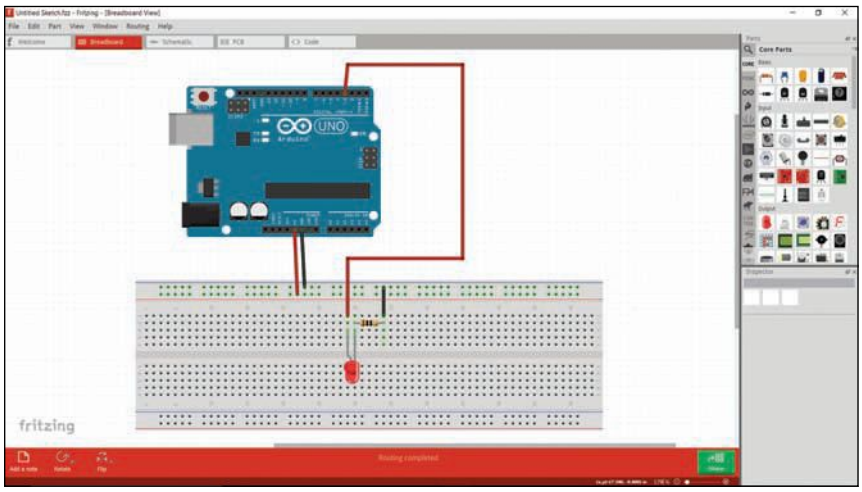


Photo 2—A simple LED layout using Fritzing.

Terminology

Arduino UNO R3: A microcontroller-based board that accepts inputs and outputs to devices

Shield: A specialized board that mounts into the pin terminals of an Arduino board and is used to control specialized devices such as motors or touch screens

Arduino IDE: The Arduino Integrated Development Environment. Open-source programming environment that uses C++ to create sketches to run on an Arduino.

Sketch: A program that runs on an Arduino

C++: A programming language used for creating an Arduino sketch

Supporting Open-Source Software

The Fritzing program works very well for creating wiring diagrams. Fritzing is a free, open-source software program that can be downloaded. It allows you to concisely and clearly display how to wire a circuit. It includes a library that has images of many of the standard components as well as the Arduino which allows for the construction of easy-to-read wiring diagrams and educational materials (Photo 2).

After the completion of six or seven tutorials, it is time to start piecing multiple programs together. Students should be a programming ninja. If someone were going to build a car, they would not first design rubber and then design a tire, they would select a tire that is premade.

The same goes with programming for each component of your design. If you are going to make new program, use code that has already been written for the components that make up the project. This is where the open source aspect of Arduino shines.

Code to control output and input devices wired to the Arduino are available online and free to use. For example, if you are using a thermistor to measure the temperature, you can go get the code for a thermistor and place it into your program. Then if the value is output to a digital display the code can be copied and placed into the same program as the thermistor. The programmer's job is to be able to weave the two parts together, taking the data from the thermistor and displaying it on the screen.

Resources

Many resources are available for questions that might arise when starting to use the C++ programming language. The site cplusplus.com has good descriptions of the operators used in programming. Arduino.cc/reference/en is also a great resource. This site is curated by Arduino and breaks the programming commands into concise searchable categories.

Many other open-source resources existfor project ideas such as create.arduino.cc/projecthub, howtomechatronics.com/tutorial/Arduino, and of course youtube.com. The scope of projects is endless.

Adding Project Complexity

A more advanced project may use a shield. Shields fit into the pins of the Arduinio and contain specialized electrical components for doing specific tasks such as running a larger motor or a touch screen.

Inexpensive relays can be purchased that can be controlled directly by the Arduino. So, if a designed system has different voltages the relay is controlled by the Arduino's 5-1/2 V and the other side of the relay can be 120 V to control a motor or 24 V to control a pneumatic valve bank to control air cylinders.

Turning Ideas into Innovations

This California Architecture & Product Design instructor teaches students how to imagine innovative products for the future. "The skills, experience, and wisdom will come in time," he says.

By Karen N. Kitzel

PETER Wachtel is that wacky, wonderful teacher you'll always remember. Engaging and fun, he allows imaginations to run wild in class.

The industrial technology instructor helps students use the tools, computers, and machines that enable them to experience the process of translating a rough idea into a finished product. Nearly 170 of them take his classes in product innovation and design, computer-aided drafting (CAD), or architecture.

Wachtel started at Camarillo (CA) High School in August 2016, but he's no stranger to the classroom. For over 20 years, he's taught at prestigious institutions: Pratt Institute, Parsons School of Design, Otis College of Art and Design, Art Center College of Design, The Art Institutes, and Massachusetts Institute of Technology. His goal? Bringing college-level education to high school.

As the inventor of many products and holder of multiple patents, he is able to share what it's like to invent, design, and produce real-world products.

Wachtel and his students are relatively new to SkillsUSA but excited to expand their knowledge and test their skills. "This is our first year," he explains. "We implement different parts of the SkillsUSA curriculum into our classes so that all students are involved and participate."

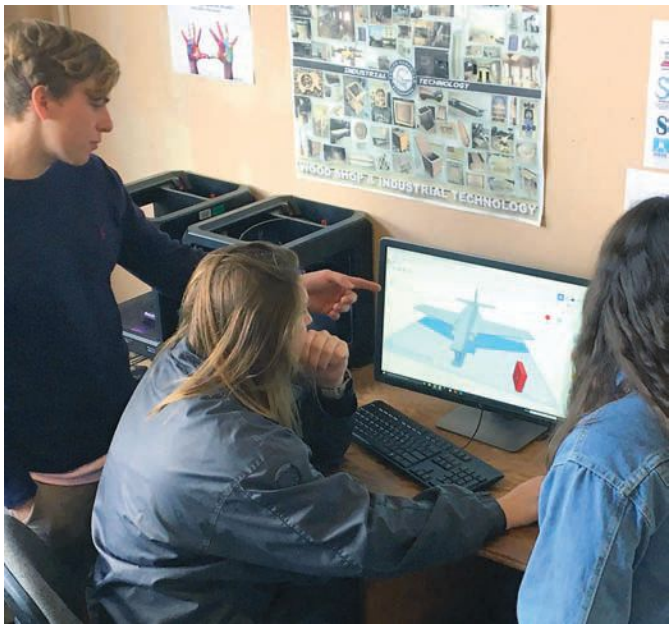
Students who enter his program may have an interest in design and invention, but most have not thought

Photos courtesy Peter Wachtel

2019 Harbor Freight award recipient Peter Wachtel (left) teaches classes designed to help students innovate on a variety of real-world projects including souvenir cups, restaurant ware, and treehouses.

Wachtel with two product design students showing off student-designed and -built working guitars (acoustic and electric)

Karen Kitzel is Associate Director, public relations/communications, SkillsUSA. Reprinted from SkillsUSA Champions *magazine by permission of SkillsUSA Inc.*



Wachtel's students work on a range of designs, including one pitched to Universal Studios

about a future in industrial design. Through projectbased learning, they're introduced to a variety of possible career paths: industrial designer, toy designer, entertainment designer for theme parks, set designer, architect, prop designer, manufacturer, drafter, or model maker. These paths tie to postsecondary programs and offer good starting salaries. All of Wachtel's classes are articulated for three credits at any U.S. college or university.

Imagination and Innovation

Wachtel makes class more exciting by bringing many real-world projects inside the classroom. The students built logo breadboards for The Cave, a restaurant at a local winery. They designed Harry Potter souvenir cups for Universal Studios, a project that included a research outing to the theme park. And, they've mentored younger students on product design, including the Girl Scouts.

To help fund some of their activities, students sell products out of their school workshop. The teacher proudly shares student projects on Twitter.

Wachtel's own love of designing started when he was a child.

"I always loved to design and figure things out creatively," he says. "I built a go-cart out of a lawn mower when I was 9, and my dad's still mad at me. Since then, I've designed over 500 toys and products and worked with the best companies in the world."

One of Wachtel's products is the World- Famous Grill Wrangler, a three-in-one tool he launched through an innovation collaboration platform called Quirky. The combination spatula, tongs, and fork has been demonstrated on NBC's "The Tonight Show" and the "Today" show.

The innovative instructor cites one important reason for his program's success. "My teaching technique focuses on imagination. I tell students that everything around you is worthy of exploration. The desire and love for what you do—make it part of your life. The skills, experience and wisdom will come in time."

Collaboration is key, Wachtel says, as his students teach one another as much as he leads class. "It's great for students to learn from each other's strengths," he adds.

He teaches students to love learning. As for himself, "I love teaching students how to solve problems and think creatively, to discover something new. Their eyes light up when they discover talents and skills they never thought they had."

Wachtel showing a product design student the details that go into designing and making a custom skateboard using the router. Students custom-make products for sale to the public as part of the program.

ON THE WEB

→ Read about careers in industrial design at: https://tinyurl.com/koql857

→ Watch a video about Camarillo High School's product design program at: https://www.youtube.com/watch?v=RYNAAc7PaOk&t=4s

→ Follow Peter Wachtel and his students on Twitter at: https://twitter.com/KidToyology

How Do Schools Train for a Workplace That Doesn't Exist Yet?

By Caroline Preston

WE'VE all heard the dire predictions about the coming robot apocalypse. Automation threatens 47% of jobs. As many as 800 million people worldwide could be displaced and need to find new jobs by 2030. Middle-class families will be hit the hardest.

Chris Burns has heard these sorts of predictions, too. He's also seen just how fast changes are happening in his own industry, information technology. Burns works for a business near Cincinnati that sells cloud computing and other technology services, and he says there is a big shortage of skilled IT employees both nationally and in his metro area. His company has started working with local high schools to introduce students and teachers to tech tools and career paths, but he wonders whether it's enough and what sorts of approaches he ought to be taking given the uncertainty around what jobs will look like in the future.

I asked Anthony Carnevale, director of the Georgetown University Center on Education and the Workforce, for his thoughts on this question. Carnevale told me that, first of all, the story of robots creating mass unemployment has been overhyped. To the extent that automation alters people's work lives, it'll affect the tasks they do, but few occupations will be completely wiped out. We still need people training to be computer programmers, and nurses, and engineers—some of those individuals may just have different specialties within their fields in a decade or two.

Burns' industry, though, is one that'll experience some of the biggest whiplash. "He's sitting pretty close to the sun," Carnevale says.

Schools just aren't going to be able to keep up with every tech development—companies can't always keep up—so a lot of the learning will have to take place on the job. Carnevale says that internships are a great way for companies to offer students a chance to get both a taste of a career and pick up new skills. Older workers will also need employers to step in and help them train on new tools.

For his part, Burns told me he suspects that "soft skills"—things like critical thinking, problem solving, and communication—are going to be key and that those abilities will serve young people no matter how their jobs evolve with new technologies. The growing importance of soft skills is a topic we've written about here at Hechinger. And Carnevale says he shares this perspective.

"In the old days," says Carnevale, "you took orders from the person above you and had a very fixed job." Managers were the only people who needed to know how to write memos, organize people into teams, or give instructions clearly. But as the economy has shifted from a manufacturing to a service economy, he says, "all those skills are necessary all the time."

For educators, the big challenge is figuring out how best to teach students not just to receive knowledge but to apply it. Some states have begun mandating that schools teach soft skills. Educators are also experimenting with approaches like "project-based" and "student-centered" learning, that encourage collaboration and solving complex problems that have applications for the real world.

And schools are welcoming business leaders like Burns into their classrooms. In the Cincinnati area, Burns and his colleagues are taking mini computers into schools, introducing students and teachers to the power of information technology, and working with one school to develop an IT-focused career track. The precise contours of the IT workplace of the future aren't yet known, but this seems clear: the industry still seems like a pretty safe bet for employment well into the future.

Sarah Gonser for The Hechinger Report

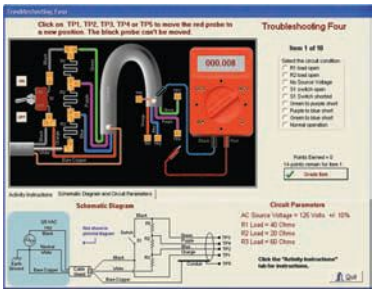
Jobs in information technology are growing quickly and employers are trying to find ways to get kids excited about careers in the field.

Caroline Preston is a senior editor, 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.*

product spotlight

The newest and best for CTE and STEM classes

Teach Electrical Troubleshooting



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More than Fun Answers

Stewart's Birthday Cake

The width of the yellow icing must be 1.5".

Let x = width of the yellow icing

Then $9 - 2x$ and $12 - 2x$ would represent the dimensions of the chocolate icing. See diagram below.

Set up expressions for the area of the chocolate icing and the yellow icing and set them equal to each other.

Yellow: $A = 12x + 12x + (9 - 2x)\,x + (9 - 2x)\,x$

Chocolate: $A = (9 - 2x)(12 - 2x)$

Now set these two expressions equal to each other and solve.

$12x + 12x + (9 - 2x)\,x + (9 - 2x)\,x = (9 - 2x)(12 - 2x)$

$24x + 9x - 2x^2 + 9x - 2x^2 = 108 - 24x - 18x + 4x^2$

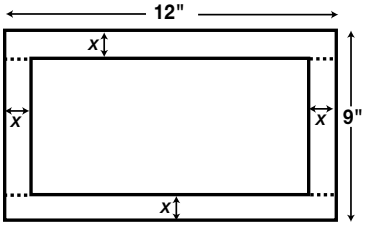
$42x + 42x = 108 + 8x^2$

$8x^2 - 84x + 108 = 0$

$2x^2 - 21x + 27 = 0$

$(2x - 3)(x - 9) = 0$

$x = 3/2$ or 1.5



Think Outside the Box

Box 1 = x, Box 2 = y, Box 3 = z

x = 10 lbs.

$x + y = z$

$y = 10 + \frac{1}{2}z$

$y = 10 + \frac{1}{2}(x + y)$

$x + y = z$

$10 + 10 + \frac{1}{2}(x + y) = x + y$

$20 + \frac{1}{2}x + \frac{1}{2}y = x + y$

$40 + x + y = 2x + 2y$

$40 = x + y$

$40 = z$

Total $x + y + z$ = 80 lbs.

Pizza! Pizza!

Mrs. P should should eat 7/20 of Mr. P's pizza.

Use the area formula for a circle to determine the areas of each pizza:

Eleven inch pizza: $A = 3.14 \times (5.5)^2 = 95.03$ sq. in.

Six inch pizza: $A = 3.14 \times (3)^2 = 28.27$ sq. in.

The total area of the two pizzas is 123.30 sq. in., so each person should receive 61.65 sq. in. of pizza. Since Mrs. P ate 28.27 sq. in., she should get 33.38 sq. in. of Mr. P's pizza.

So, the fractional part of Mr. P's pizza would be 33.38 / 95.03 ≈ .3512 ≈ 7/20.

The Games People Play

They played 39 games.

Since Jackson won exactly 15 games, then James lost exactly 15 games, which would give him negative 15 points. Since James had a final score of 33 points, he must have received 48 points from winning, so he won 24 games. Therefore, they played 24 + 15 = 39 games.

Jackson was 15 - 24 with 6 points, and James was 24 - 15 with 33 points.

Supplier Directory

Whatever your classroom or lab needs, you'll find manufacturers and vendors here that can help you. The fields each company serves appear in bold type.

When you contact a company, please let them know you saw their listing in **techdirections**!

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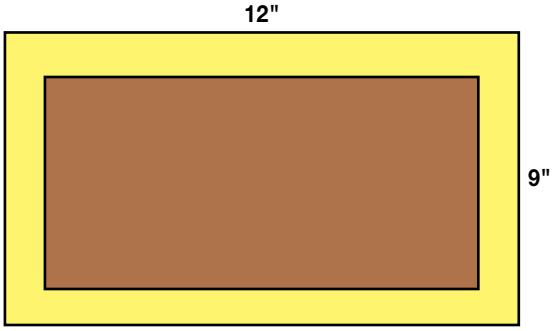
more than fun

Stewart's Birthday Cake

Stewart's birthday is in December and he wants a 9" by 12" rectangular birthday cake with chocolate icing and yellow icing as shown in the diagram below. There is no icing on the sides.



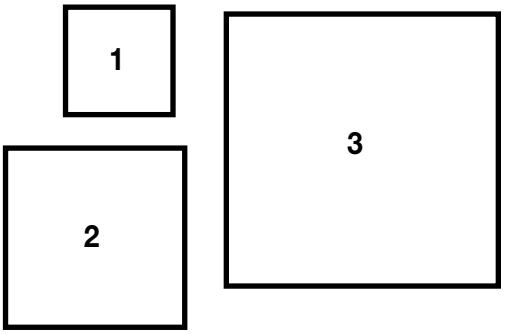
The yellow icing must be a constant width all around the cake, and the amount of chocolate icing must equal the amount of yellow icing.

Determine the width of the yellow icing.

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

Think outside the Box

Box number one weighs 10 pounds. Box number two weighs as much as number one plus one half of box number three. Box one and box two together weigh as much as box three. What is the combined weight of the three boxes?



Pizza! Pizza!

When Mr. and Mrs. P go out for pizza, Mr. P orders an 11" diameter pizza and Mrs. P orders the 6" pizza.

They decide to share the pizzas equally, but Mrs. P eats all of her pizza. What fractional part of Mr. P's pizza should she get so that they each have the same number of square inches of pizza?

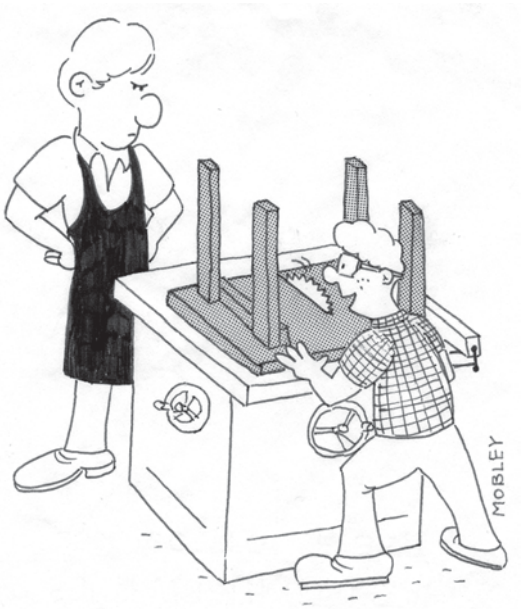
Puzzle devised by David Pleacher, www.pleacher.com/mp/mpframe.html

The Games People Play

Jackson and James play a two person game in which the winner gains 2 points and the other player loses 1 point.

If Jackson won exactly 15 games, and James had a final score of 33 points, how many games did they play?

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



"But, you said it was a table saw."

See answers on page 25.

We pay $25 for brainteasers 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.

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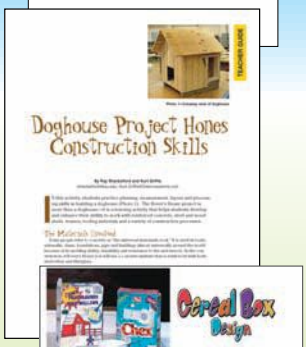

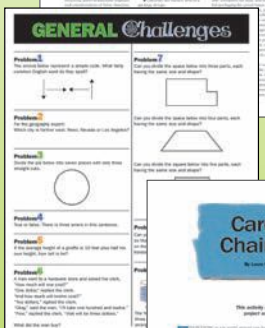

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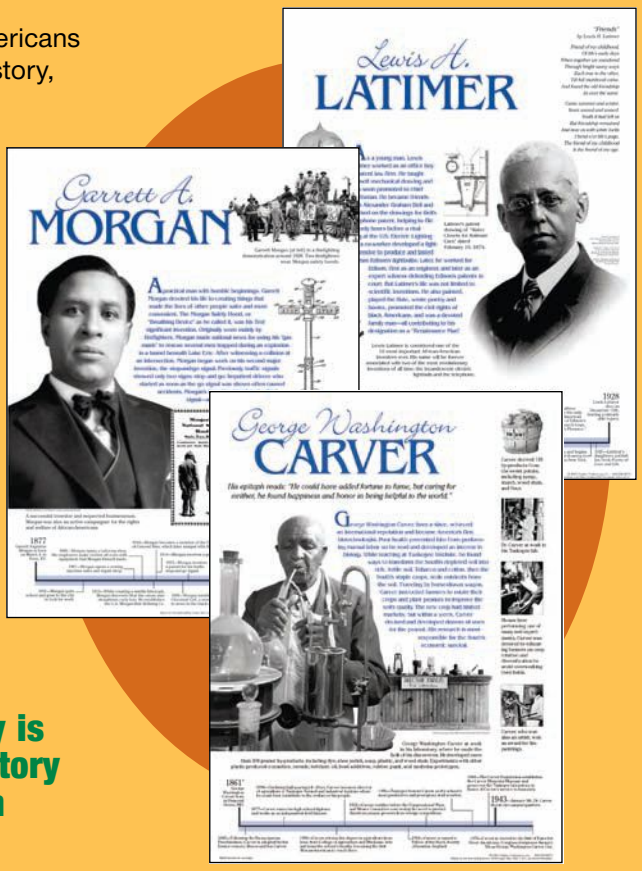
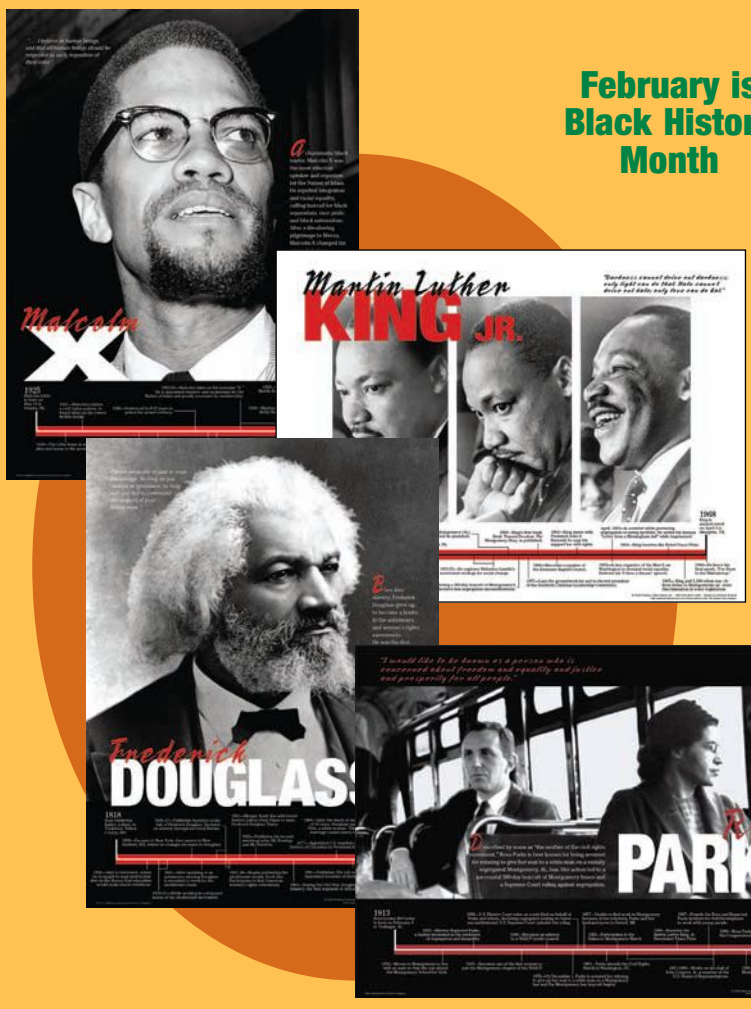


February is Black History Month



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