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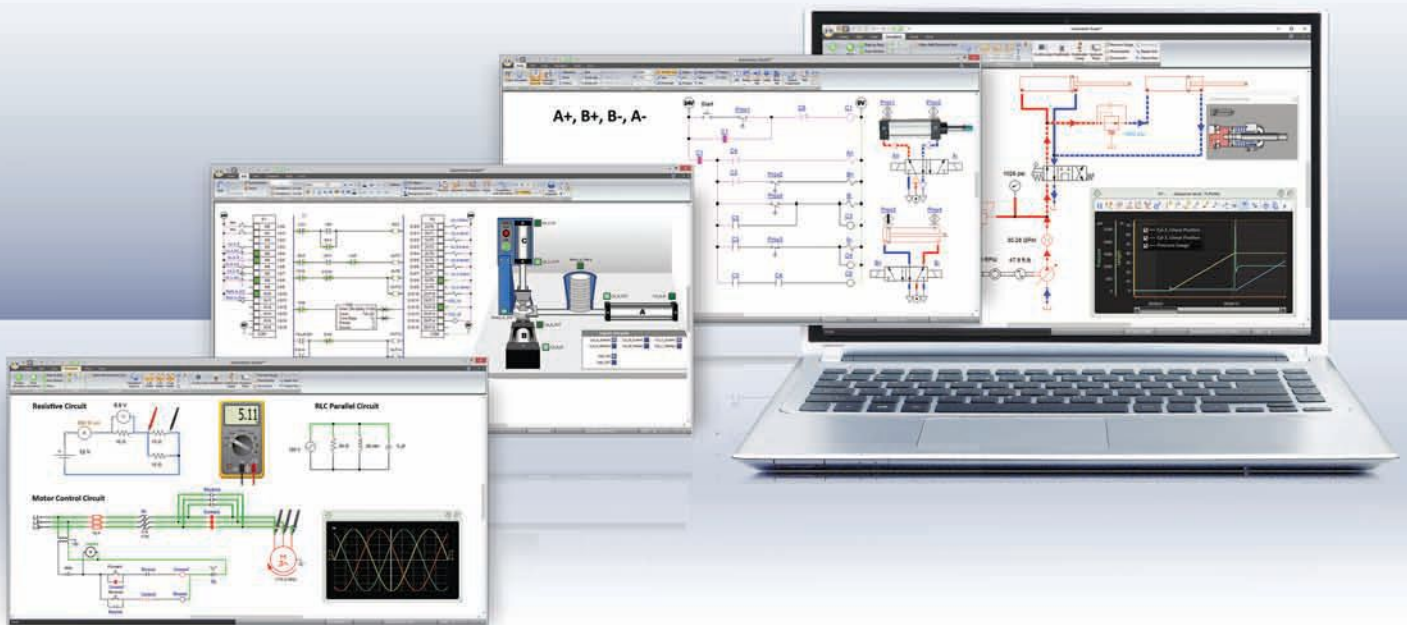
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Vanessa Revelli vanessa@techdirections.com

I receive lots of press releases every day. Many of them just get tossed in the trash, but when this came in I knew I had to share it with you.

Onshape, the leading 3D cloud CAD system, is partnering with Magic Leap on a new 3D product design app for its spatial computing universe. The new CAD app will be developed for the Magic Leap One Creator Edition, a lightweight, wearable computer that allows digital content to step out of the screen and into the real world.

When wearing Magic Leap's Lightwear headset, which allows users to see contextually aware digital objects in the real world, engineers will be able to bring life-size 3D CAD models into their physical surroundings and collaborate on design changes.

"We're excited to bring the many benefits of modern CAD to engineers in the Magicverse," says Onshape CEO Jon Hirschtick. "For more than a half-century, CAD users were confined to working on a flat screen. The Magic Leap One will push product design into a whole new stratosphere."

"Imagine your engineering team is reviewing the latest design for a race car. With the ML One, they will be able to put that car right on the conference table, go under the hood and examine the engine block. They can then levitate the car above their heads and check out the exhaust system," he says.

"The spatial computing universe has the potential to transform every industry," says Magic Leap CEO Rony Abovitz. "Along with our other development partners, Onshape is helping us discover new applications and

markets for Magic Leap One. I look forward to helping them continue to shake up the world of design and manufacturing."

"The new Onshape app will support live 3D editing of CAD models, with design changes updated in real time through the Magic Leap device," notes Hirschtick. "This is far more powerful and impactful than being able to merely view static, already-completed designs. And using our modern CAD system's real-time collaboration tools, even team members based in different parts of the world will instantly see each other's updates."

"Offering Onshape's cloud CAD system through the rich, immersive view of Magic Leap will one day seem as natural as designing on laptops, phones, and tablets," he adds. "We're proud to be ahead of the curve by giving engineers access to the latest tools they can't find anywhere else, tools that will help them push their creative limits, and ultimately design better products."

To see Magic Leap's keynote addresses at the L.E.A.P. Conference, visit <http://www.magicleap.com/LEAPcon>.

After reading about Magic Leap, I hope you want to play with it as much as I do!

Vanessa Revelli

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. 3.

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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.

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About the cover: Gary Mitchel, left, works with a student at the job site, building a pole barn for a client. See article on page 22. Photo courtesy of Erika Konowalow. Cover design by Sharon K. Miller.

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Vanessa Revelli

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High School Students Create Websites in 48-Hour Experience

In October TAG Education Collaborative (TAG-Ed) worked with non-profit 48in48 to host a 48-hour Student Digital Immersion experience. TAG-Ed helps generate enthusiasm for STEM throughout the state of Georgia among students in grades K-12 while facilitating public and private partnerships between Georgia's educators and the tech business community.

The goal of a digital immersion experience is to provide high school students with the opportunity to develop their technical skills and build project portfolios while working alongside technology experts. The students gain marketable skills while giving back to the communities in which they live.

48in48 is an event where volunteers create 48 websites for 48 non-profits in the community. Forty students are screened, selected, and paired with 100+ skilled marketing professionals, developers, and web designers.

"48in48 is a catalyst for marketing and technology volunteerism and social entrepreneurship," said Carole Williams, executive director, 48in48. "This hands-on experience introduces students to the digital marketing industry and its incredible culture of professionals. It also gives these students the chance to learn how they can make an important impact by using their unique talents to give back to their community."

According to code.org, the state of Georgia currently has over 19,000 open computing jobs or 3.8 times the average demand rate for open jobs in Georgia. This number also represents a 4:1 ratio in terms of the number of open jobs relative to the number of student candidates graduating with the appropriate skill set for those jobs.

"To help close the gap, we know that many K-12 schools and postsecondary institutions have adopted different forms of project-based, experiential, and cross-disciplinary learning models that have not reached scale," said Errika Moore, executive director, TAG-Ed. "Therefore we value the support and investment of organizations like LexisNexis Risk Solutions that creates and enables valuable experiences for students in non-traditional environments."

LexisNexis Risk Solutions will provide \$10,000 in grants and sponsorships to TAG-Ed and 48in48 to help launch and manage the 48-hour digital immersion experience for students.

"We are thrilled to once again partner with TAG-Ed and 48in48 for this innovative event," said Kara Grady, VP, Corporate and Brand Communications, LexisNexis Risk Solutions. "As a global technology company, we understand the importance and impact of coding instruction and technology education at an early age. The wonderful thing about this project is that it provides an opportunity to build coding knowledge and skills while supporting non-profits in the process and lets students be a part of real-world solution for organizations in need."

To learn more, visit www.tagedonline.org/programs/digital-student-immersion-experience.

FusEd Contests Earn School's Money

The FusEd Network (FusEd), a division of Cadez Media, Inc., has launched a unique student community to identify and showcase talented teens to the media industry. These unique opportunities are content-based production assignments that connect major advertisers and large media companies (i.e. Gannett, NBC Universal, and Tronc) to specific talents of the FusEd community.

FusEd creators and teams (ages 13-18) get hands-on experience while FusEd partners are introduced to fresh and unique concepts that resonate with the high school audience. FusEd was created by media entrepreneur Tom Cadez, who has a significant history of creating and developing start-up media entities. FusEd is a student-driven content network developed to enhance digital skills while raising funds for students and high school media and athletic departments.

"To create successful community-based, digitally-enhanced infusion programs, we needed to design, identify, and showcase talented student content creators without economic barriers being a concern. Since most students have cell phones and are familiar with video production, this opportunity to empower and highlight young talent became much clearer and easier to implement," said Cadez. "We work with major national brands who will provide cause-related funds to film and journalism students for real-life, industry-related learning experiences. We have also forged partnerships with major studios and media companies to connect our student creators to our network partners, providing specific career-enhancing opportunities. Individual or team-based content producers generate fresh, real, and relevant content that resonates with their peers, teachers, and parents, as well as their friends and neighbors."

One of FusEd's initial contests features Powerade, offering school sports departments approximately \$800,000 in prize money for a variety of athletic program costs. Powerade, a division of Coca-Cola, has developed a content assignment that challenges students' storytelling abilities by asking the contestants to share why their school's athletic program deserves \$10,000. The Powerade "Power Your School" Video/Essay assignment is offered to students (13-18 years of age) and offers 50 \$10,000 grand prizes and 150 \$2,000 in first place prizes. To enter, go to fus-ed.co.

Vanessa Revelli is managing editor of techdirections.

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JD.com's Totally Automated Warehouse in Shanghai

Is your career choice or current career going to be eliminated soon by automation and/or the artificial

company in China and have over 300 million customers. They use automation wherever possible to deliver

the same individual items into a JD.com storage box, and then send the container to its proper place for temporary storage at the facility until it will be pulled by a robot to fulfill a customer's order.

Scanners that are a part of the artificial intelligent logistics system orchestrate a robotic dance that includes robotic arms, conveyor belts, and automated trolleys that move along the floor of the facility without bumping into each other. The robotic arms use visual systems to see what they need to pickup and AI to instruct them how to best handle differently shaped objects.

The individual items that customers order are in storage throughout the facility. A complex system of roaming robots and conveyor systems, AI logistically controlled, bring all the items together at amazing speed so the automated packager can pack them and send them on to shipping.

It has taken so many words to describe a system, at this facility, that can handle 200 thousand orders each day. Seeing is believing—this YouTube video shows cutting edge AI automation at work: https://www.youtube.com/watch?time_continue=1&v=RFV8IkY52iY.



Photo courtesy JD.com

Photo 1— This giant facility employs only four people and 1,000 robots.

intelligence (AI) revolution? I raise this question not to scare you but to warn you that your career choice should include insight into how your selection will be affected by smart computer algorithms or artificial intelligent robotic systems in the foreseeable future.

We are still a long way from the type of “almost human” robots often depicted in science fiction movies. However, the loss of jobs to robots that still look like machines is picking up speed. The 1,000 robots in this JD.com automated warehouse in Shanghai, China, (Photo 1) are AI-controlled to pick, package, and then ship thousands of orders each day.

The robots are now doing the jobs that would normally be done by 180 workers. One hundred and eighty workers did not lose their jobs—this product fulfillment warehouse, the size of seven football fields, was designed and built to only need four human workers.

JD.com is a Chinese company that most of us in the U.S. have never heard of. They are the largest retail

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

products within 48 hours from the time they were ordered. To accomplish this task, they are building totally automated warehouses and are now even using drones to get the products to their final destination (Photos 2 and 3).

The products from different companies arrive by truck at the receiving loading dock. These resupply trucks are unloaded by automated forklift trucks and scanned to make certain that the order manifest matches the delivery.

As soon as the boxes are brought inside they are turned over to a robotic system that can unload the individual boxes, scan each item from the large shipping box, place



Photos 2 & 3—The company uses drones and self-driving delivery robotic trucks to make same day deliveries.



Photos 4 and 5—An AI logistics system controls robotic arms, conveyor belts, and automated trolleys throughout this fulfillment warehouse.



Taking It a Step Further

1. JD.com has launched a world-wide robotics challenge that is open to university teams. You will find all the details online at: <https://jdcorporateblog.com/jd-com-launches-global-robotics-challenge>.
2. Select three careers that you are thinking about pursuing. Research each career to see if automa-

tion technologies are already, or in the near future, impacting the chances of your employability in this career by the time you graduate school. ©

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technology's past

Dennis Karwatka
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The Studebaker Brothers— The World's Largest 19th-Century Wagon Manufacturer

Successful partnerships among siblings are a bit uncommon in American technical history, but there have been a few. The twin Stanley brothers established the Stanley Motor Carriage Company in 1899.

They manufactured Stanley Steamers as well as other motor cars. William Harley teamed up with three Davidson brothers to form the Harley-Davidson Motorcycle Company in 1903. Their company still makes motorcycles

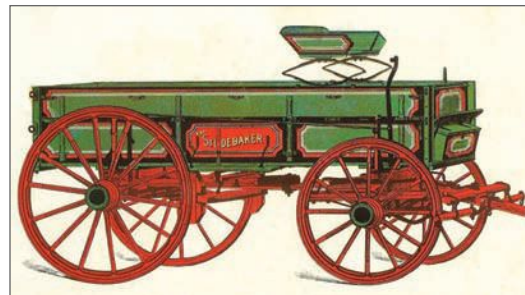


A painting of the Studebaker brothers: from left, Henry, Clement, Jacob, Peter, and John

brothers is certainly worth noting. It began with the two oldest: Henry (1826-1895) and Clement (1831-1901). They organized a company in South

Bend, IN, that became the world's largest horse-drawn wagon manufacturer in the 1890s.

Most of the brothers were born in Ashland, OH, where their parents worked at farming and blacksmithing. They were generally good students



Above, drawing from a Studebaker wagon ad

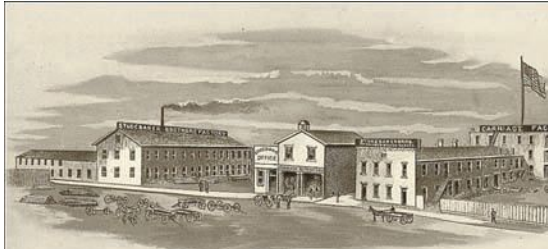
Right, 1900 Studebaker wagon, restored by Budweiser



in Milwaukee, WI. But a partnership that includes four, of five, Studebaker

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

but attended school only sporadically. Clement worked in the family's blacksmith shop, learning skills in wagon repair. He moved to South Bend in 1850 to work at a threshing machine company. The rest of the family joined him the following year.



The Studebaker factory in 1868 (left) and in 1890

Clement and Henry pooled their savings in 1852 to open their own business. They built two wagons that year. The brothers were as interested in quality as income and produced the best horse-drawn wagons in the region. They made about 12 wagons the next year and gradually prospered as their reputation grew.

The H & C Studebaker Company received a large government order in 1857 for 100 wagons that provided a welcome financial foundation. Brother John (1833-1917) had returned from the California Gold Rush region with \$8,000 he had earned making wheel barrows. He used it to purchase Henry's share of the business, and Henry retired to farming.



Above, a 1908 Studebaker carriage

Right, a 1902 Studebaker electric car

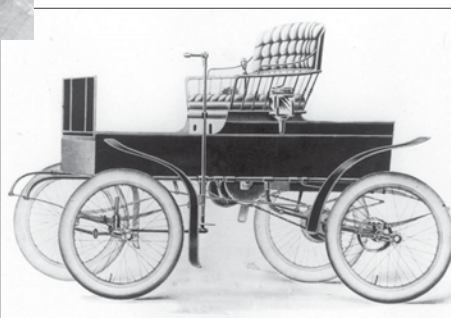
Below, a 1904 Model B gas-powered Studebaker



The company soon became the leading wagon manufacturer for pioneers heading west. Studebaker built half of their covered wagons. The Civil War provided still another period of growth. The company's expanded factory covered four acres, employed 140 workers, and had a spur line to the Lake Shore and Michigan Railroad. The last two brothers—Peter (1836-1897) and Jacob (1844-1887)—joined the company about this time.

The company experienced two major fires in the 1870s but demand for their wagons was so great that they easily rebuilt. A typical Studebaker farm wagon of the period cost around \$160. But the company also built 22 different models of fancier carriages. One was their expensive enclosed glass-fronted coach, lined in leather, complete with horses, for \$3,000. The company's total production in 1874 was 11,050 vehicles.

During the 1890s, the Studebak-



er Brothers Manufacturing Company claimed to be the world's largest producer of horse-drawn wagons, with a capacity of 75,000 vehicles per year. Its new four-story factory was a block long and located on 20 acres. Five rail lines entered company property. Studebaker had branch offices in six major Ameri-

can cities and four foreign countries.

Of the brothers, only John remained active with the company during the 1890s and he was against expanding into motorized transport. But the younger generation prevailed and Studebaker sold its first electric car in 1902. Only 20 were sold that year.



A 1953 Studebaker Commander

Company leaders soon realized that gasoline engines would be preferred in the future. Studebaker merged with other manufacturers and sold its first gasoline-powered automobile in 1904. Within three years, wagon and automobile sales were nearly equal. By 1914, Studebaker produced over 35,000 cars and continued to be highly profitable. John Studebaker, the last surviving brother, retired that year and died in 1917.

The company stopped making horse-drawn vehicles in 1919, but its innovative automobiles remained in production at South Bend until 1964. Its classic 1953 Commander model was designed by famed industrial designer Raymond Loewy (1893-1986). ©

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Newton High School Students Have a UNEEK Opportunity

By James Hofmann & Brian Bennington

jhofmann@newtonnj.org; bbennington@newtonnj.org

NEWTON High School technology teachers Jim Hofmann and Brian Bennington recently offered their students a UNEEK opportunity, a chance to see Oscar, the UNEEK robot, at work. Jim, who is also the school's FIRST varsity robotics coach, started following the Keen company two years ago when he saw they were an American manufacturing shoe company. "I had read about the development of these collaborative robots being used to create, weave these shoes."

"I had an email come to my inbox from Keen. I told Brian, also our school's varsity la-

Jim Hofmann and Brian Bennington are technology teachers at Newton (NJ) High School. Jim coaches the school's First LEGO League and FIRST Robotics Competition robotics teams and is known for his work with the school's STEM program. Brian is also the technology building coordinator and a TSA advisor.

crosse coach, that in time someone will even develop a robot to lace lacrosse stick heads." I asked him if he would support the idea of inviting in Keen for a day and he said, "that would be amazing, let's do it." "So,

They closed the application window shortly after that, having gotten such a large response. "We're super happy to be here."

This UNEEK opportunity was not limited to only Technology Student

Oscar, the UNEEKBOT, open for business. Notice the excited students in the reflection.



Photo by Paige Strangeway

I responded back with an invitation to Keen when I saw they were planning an East Coast tour." The rest is history now.

"Jim's was the first request," Scott Owen, Innovation Manager said.

Association (TSA) and FIRST varsity robotics team members. A steady stream of classes visited the mobile lab all day including computer science, art, marketing, photography, and graphic design students.

All staff and students had a different perspective on what they were observing. Some wanted to know more about the history of the company, the products, and the name of the robot. Many wanted to know the cost of the shoes, if they could order a pair online, and the procedure for proper fitting.

Oscar, the UNEEKBOT, is comprised of two robotic arms and is named for the then 17-year-old, Oscar Williamson, who wrote the code to have the robots create the shoes. He worked for House of Design in Nampa, ID, the only company that would take on the project. It took him 18 months to create the code that weaves shoes.

KEEN is taking the “World’s Smallest Shoe Factory” on the road, hitting design, engineering, and business schools around the country. They’re inspiring the next generation of innovators to push boundaries and experiment with new concepts. With two robotic arms that can create made-to-order UNEEK sandals right on the spot, UNEEKBOT is a programming wonder and it all started with a typical question among innovators: “What if?”

“UNEK is this puzzle that we wanted to figure out,” says Rory Fuerst, Jr., Director of Innovation at KEEN. “It’s been seven years of my 33-year-old life. I’ve spent tens of thousands of hours doing this thing that people said was impossible and was never going to work.”

On its own, his design of a shoe with two cords and a sole revolutionized the shoemaking process. As Rory says laughing, “We got kicked out of factories,” because the sandal’s cord-based, upper-making process was so different. Creating that shoe with a robot only added to the perceived impossibility of it. But Rory says that was the goal from the beginning.

“We said, ‘If we had to do this with a robot, how would we do it?’ And if you look at UNEEK, all it is is a repeatable pattern,” he says. “It’s two loops stacked on top of each other, repeated 37 times in a size 9.”

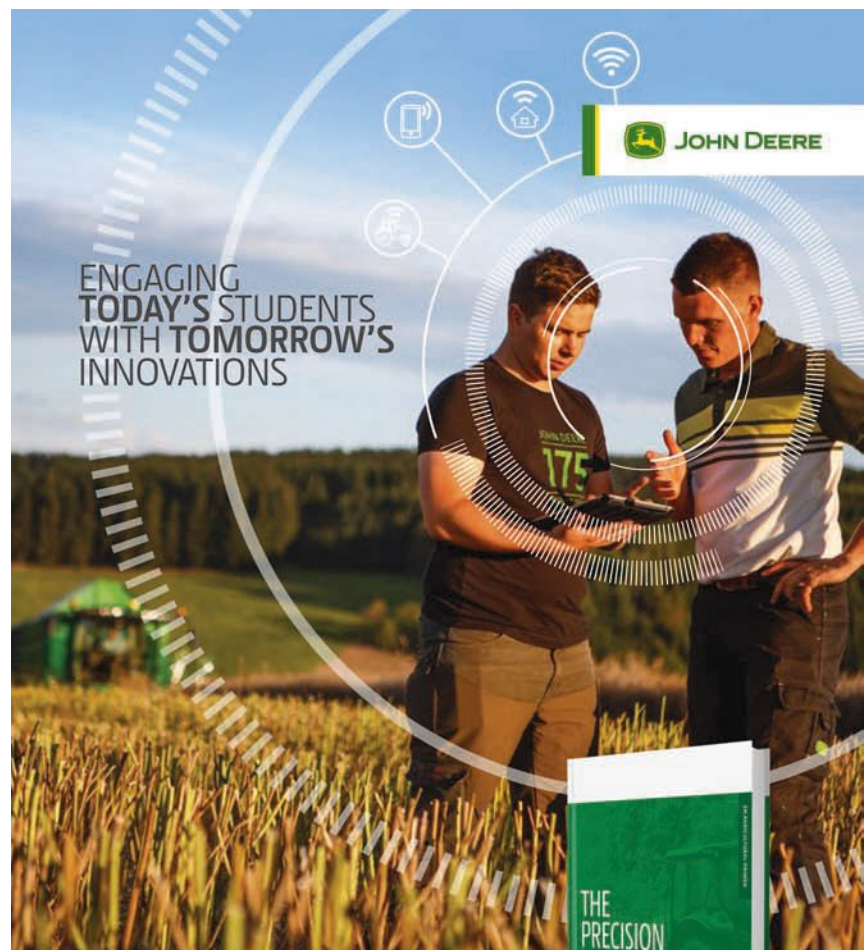
That repeatability made it a

great candidate for robotics. Still, when KEEN took the idea to different engineering companies, they said it was too hard for robots to do. House of Design Robotics was eager to take on the challenge, and worked with Rory and team to make it happen.

“It’s all math at the end of the day,” he says. “Everything is just points in space. So that’s how UNEEK works. The code dictates where those points in space are, and that’s what sets the loop lengths in UN-

EEK’s cord design. Tweak the points to change the fit or accommodate a new material, and the loop length changes. The key is understanding how the code applies to real life and the interconnectedness of the cords. If you’re adding loops, you have to know what you’re taking out somewhere else.”

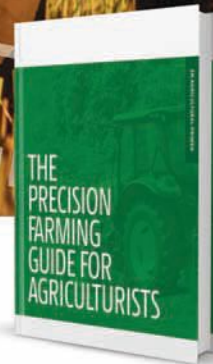
At one-point UNEEKBOT had 576 points to do the bottom half of the shoe (through re-engineering, it’s closer to 100 now). In comparison, Rory says that most industrial robot



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Freshly made UNEEK shoes after the human finishing touches

UNEK sandal, my goal is for you to come in, order your UNEEK, order a coffee, drink your coffee, and walk out with your shoes.” Rory says, laughing, “And we are talking about a nice, hot coffee; we still need a bit of time.”

As Rory’s UNEKBOT journey continues, his passion is just the kind of never-give-up, innovative spirit that the KEEN Innovation Team hopes to inspire and connect with while meeting with the next generation of innovators.

“I cannot stress enough that if you really want to do something different, you have to be really, really different. And you have to be OK

systems often will have less than 10 points. That’s how intense the coding and, more specifically, translating the coding is. Plus, each shoe size, gender, and right and left shoe needs to have its own slightly different code.

“Trying to manipulate soft materials and control them is the hardest thing in the world,” he explains, adding that cord elasticity also factors into the complexity. “Even a slight variance in stretch as little as 2% could lead to a robot crash.”

UNEKBOT has been fully operational since the summer of 2017, when it first launched in Tokyo. Yet the team is continually tweaking the code to make adjustments, and the process is constantly evolving to try to make it go faster. But by and large they’ve got it down to a science: it can take as little as 25 minutes to build an original UNEEK sandal, and closer to 20 minutes for the UNEEK slide. The UNEKBOT itself does the bulk of the work, weaving the up-

per of the UNEEK slide in under six minutes, and then the bot’s human counterparts do the finishing work.



Technology students invited up on the demo stage.

“To make a shoe in 25 minutes in an urban area, in this kind of setting with a shoe this complex, is absolutely unheard of. For the original

with that. I think that’s something that people who are studying and preparing to get into this need to understand,” Rory says. “It starts with you being you. And, frankly, that’s what the UNEEK sandal is all about.”

Both technology teachers, Brian Bennington and Jim Hofmann, shuttled their technology classes in and out all day to support Innovation Manager Scott Owen, Robotics Engineer Ben Kolligs, Marketing Coordinator, and Shoe Maker Nani Tomas. The Newton High School STEM lab was moved out to the senior parking lot in a flexible format all day long.

More than 250 students and staff enjoyed the UNEEK opportunity. The real hero however was our



Keen Innovation Manager Scott Owen addresses interested students.

own Newton High School principal Jeffrey Waldron. Waldron helped us scramble to create the needed paperwork and normal request process within the time constraints of public school's approval. Waldron said, "Let's make this happen." He's been completely supportive of our program. What a super cool day. ©



Anna Maniago (center), Newton's ESL teacher introduces her students to potential STEM careers.

A UNEEK Shoe Company

THE designers, engineers, and big thinkers in our KEEN Innovation Lab love to push boundaries and experiment with new concepts. They utilize insight, creativity, exhaustive testing, state-of-the-art tools, and long nights of hard work to defy convention, solve problems, and bring great ideas to life.

Tucked into the hills of Portland, KEEN Inc. is quietly rewriting the rules for the entire footwear industry. In the process, it may have found a recipe to bring manufacturing back to the U.S.A.

Rory Fuerst Jr. was fresh off a long, exhausting mission to reinvent the very concept of shoes. The final product of this effort, the UNEEK, is a sandal made almost entirely out of meticulously knotted cord. It's a project, he says, that started at the local hardware store and eventually expanded to pull in robotics experts from Idaho to Japan to develop a system capable of creating this bizarre deconstruction of footwear, and swallowing six years of his life in the process.

"Every night, I would go to bed thinking, 'this isn't going to work,'"

he recalls. "But it was such a fun process. By changing the cookbook, we weren't held captive to the same rules that most shoe developers were; we were creating a new path."

And the result is strong. Totally unique, totally weird, and as I can personally attest after stomping around in a sample, almost unnaturally comfortable. They feel like no other shoe; they feel like nothing at all, in fact. Unnervingly comfortable. The customers, Rory says, are already eating them up.

When Portland, OR-based Keen Footwear introduced its UNEEK sandal back in 2015, the outdoor industry sat up and took notice. The entire shoe is held together by a single cord that weaves its way through both the sole and a lightweight upper. It looks as unique as its offbeat construction.

So, when the company searched for ways to push the UNEEK brand in new directions, it knew it had to come with something as original as the shoe itself. It found exactly what it was looking for in the form of the UNEEBOT, a specially developed

robot capable of building custom versions of the sandal, anytime or anywhere.

Developed in conjunction with a company called The House of Design (thehouseofdesign.com), which specializes in making one-of-a-kind automation solutions, the UNEEBOT has been dubbed "the world's smallest shoe factory." The system consists of two robotic arms, several custom fixtures, and a tablet which serves as the robot's controller.

When activated, the two arms work together to create a custom pair of UNEEK sandals, automatically selecting the proper colored cord before seamlessly weaving it through the shoe's other components. In fact, on its fastest setting, the robot completes its task in just six minutes, which is roughly half the time it takes someone to accomplish the same work by hand. The shoe is then handed off to an actual human, who checks the UNEEBOT's work for quality control and finishes the last few steps of its construction.

"The UNEEBOT's hardware consists of off-the-shelf products that can be purchased online, but it's the software created by House of Design that makes it special," said Rory, Keen's director of innovation, to Digital Trends. "Everyone else told me it wasn't possible to create a robot that could do what we wanted but the team at House of Design simply went to work developing the code to make it happen."

To see Oscar the UNEEBOT in action, visit <https://www.keenfootwear.com/uneebot-tour.html>. ©



READY TO WORK

As the housing industry struggles to find skilled workers, pre-apprenticeship programs are helping women train for high-paying nontraditional jobs

By Pat Curry

MISTY M. was working at temp agencies, making just enough to get by. “I felt lost not knowing where I was going in life,” she said. Then she learned about Apprenticeship and Non-Traditional Employment for Women, or ANEW, in Renton, Washington, the oldest, continuously running pre-apprenticeship in the country.

Once signing up for ANEW’s training program, Misty was exposed to many different trades and figured out the one that interested her. She also met other women who were ready to make a change in their lives, like Christina B., who had decided to make a career change after 20 years in the restaurant business.

After graduating from ANEW’s training, both Misty and Christina were accepted into apprenticeship programs and are on their way to

Pat Curry is managing editor of Building Women. Article courtesy of NAHB and Building Women.

careers in construction, “making a good living, not just scraping by,” Misty said.

“I love every minute of it!” Christina said. “I couldn’t have done it without the ANEW program.”

Over the course of her lifetime, a woman working as an electrician will make more than \$1 million more than a woman working in a traditional “female” job, such as a childcare worker or service worker.

The construction industry continues to struggle to fill positions throughout the trades, yet women are a largely untapped source of highly capable and motivated workers. But since women traditionally have not been encouraged, much

less trained, to pursue construction jobs, pre-apprenticeship programs such as the ones offered at ANEW are helping them gain the skills they need to be successful as an entry-level employee.

ANEW’s 11-week pre-apprenticeship training program gives participants the technical skills they need to be competitive for an apprenticeship. The training includes such critical skills as basic hand and power tool use, trades math, reading blueprints, job site safety, first aid, interviewing and resume preparation, and even fitness and nutrition for the trades.

Efforts Underway to Expand Access to Apprenticeships

The Department of Labor is working to expand apprenticeship opportunities around the country, with an emphasis on reaching women, people of color, and other underrepresented populations. In 2017, DOL announced the launch of the National Center for Women’s Equity in Apprenticeship and Employment,

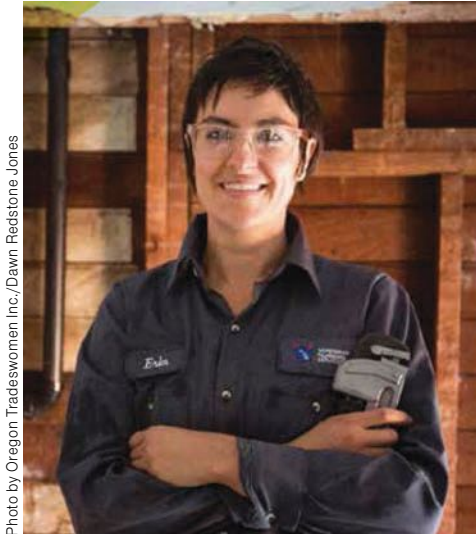


Photo by Oregon Tradeswomen Inc./Dawn Redstone Jones



Coast to coast, organizations are helping women prepare to apply for apprenticeships in construction jobs that pay much better than traditional “female” jobs.

a consortium of organizations representing nearly every staffed tradeswomen’s organization in the country, including ANEW.

In announcing the initiative, DOL cited a recent study from the Institute for Women’s Policy Research (IWPR), which found that female-dominated jobs share many of the same skills with male-dominated jobs facing skills shortages. While the study focused on jobs in advanced manufacturing, IT, and transportation, distribution, and logistics, the issues faced by those industries are consistent with those seen in construction. The opportunities are similar as well; many of these jobs pay well and don’t require a college education.

The Bureau of Labor Statistics reports that in 2016, the year for the most recent data available, women accounted for more than half of all workers within several industry sectors, including education and health services (75%), financial activities (52%), and leisure and hospitality (51%). Women accounted for less than half in several industry sectors, including manufacturing (29%), agriculture (25%), transportation and utilities (24%), mining (13%), and construction (9%). Women account for less than 10% of individuals enrolled in apprenticeship programs.

According to the national Tradeswomen Taskforce, women represent

almost 70% of all low-wage workers, yet represent only 3% in high-wage, nontraditional occupations such as construction.

This disparity in occupational segregation means the difference in a woman and her family’s economic well-being. Over the course of her lifetime, a woman working as an electrician will make more than \$1 million more than a woman working in a traditional “female” job, such as a childcare worker or service worker.

With additional training, especially through apprenticeships, women can successfully fill higher-paying job openings and build a lifelong career that can improve economic security for their families.

“Half of American families with children have a breadwinner mother, and women of color are especially likely to be raising families on their own,” said Ariane Hegewisch, National Center advisor and IWPR Program Director on Employment and Earnings. “Investing in improved access to apprenticeships and good jobs not only improves the earning power of women and ensures greater economic security for American families, but helps tackle key skill shortages.”

Women Leading the Charge

The collaboration is being led by Oregon Tradeswomen, a group long supported by PWB councils, and

Chicago Women in Trade (CWIT). The goal is to scale and promote adoption of strategies that increase access to and retention in apprenticeships among women, especially women of color.

“Apprenticeship means on-the-job training combined with classroom study, offering new workers a ‘learn while you earn’ opportunity that also provides good benefits and portable credentials,” said Jayne Vellinga, executive director of CWIT. “Apprenticeships in the construction, manufacturing, and transportation sector open doors to high-wage, high-skilled jobs and career pathways that offer pay equity and economic security for women.”

The need for expanded access to apprenticeship programs for women has been recognized by the federal government for more than 25 years. Congress passed the Women in Apprenticeship and Nontraditional Occupations (WANTO) Act in 1992 to provide technical assistance to employers and labor unions to encourage employment of women in apprentice-able occupations and nontraditional occupations.

WANTO support is given through federal grants to organizations across the country to support innovative projects that improve the recruitment, hiring, training, employment, and retention of women in apprenticeships in industries, such as

advanced manufacturing, transportation, and construction. Administered by the Department of Labor, WANTO this year will award at least \$994,000 to up to six communitybased organizations to encourage women's employment in underrepresented occupations and pre-apprenticeship and apprenticeship programs. In 2017, DOL awarded nearly \$1.5 million in grants to support the recruitment, training, and retention of women in skilled occupations.

The persistently small percentage of women in apprenticeship programs and in construction jobs—despite the ongoing efforts and the opportunity for good wages—shows how difficult it is to attract women to the field.

It is not unreasonable to assume that part of the reluctance comes from fear of being harassed on job sites. Organizations such as ANEW are working hard to educate employers about the importance of having a work environment where everyone

The persistently small percentage of women in apprenticeship programs and in construction jobs—despite the ongoing efforts and the opportunity for good wages—shows how difficult it is to attract women to the field.

feels safe and respected. ANEW has partnered with the city of Seattle and Sound Transit on a respectful workplace campaign called RISE Up: Respect, Inclusion, Safety and Equity in the Construction Trades.

“With the increased number of racial and gender incidents happening on construction sites, we are trying to draw attention to what behavior is not acceptable, ways to intervene for yourself or others, and how to report incidents,” ANEW Executive Director Karen Dove said.

Coast-to-Coast Training Opportunities

With so few women working in construction, it might be surprising to know that the efforts to draw women into the field are significant and some pre-apprenticeship programs have been in existence for decades. New York City's Nontraditional Employment for Women (NEW) was founded in 1978, the same year affirmative action guidelines were first applied to employing women in the construction trades and doors to highway, trades careers were cracked open for women. NEW strives to prepare women for careers in the construction, transportation, energy, and facilities maintenance industries.

The number of women construction workers in New York City has grown substantially as a result of a coordinated effort between NEW, labor unions, contractors, and government. With a commitment by these partners to place women in 10% of all new apprenticeship slots, more than 1,300 NEW graduates have found work as electricians, carpenters, plumbers, painters, ironworkers, operating engineers, and sheet metal workers since 2005. An additional 1,000 women have found careers in the energy, transportation, and facilities maintenance industries.

Tradeswomen Inc. (TWI) in California was founded in 1979 as one of the state's first organizations for women in the trades. It continues to be one of the most active and effective organizations in the nation focused exclusively on the needs of women in the skilled trades. Its mission is to recruit more women into construction and related trades, promote the retention of women in the trades, and develop their capacity for leadership and career growth.

Among its many programs, TWI conducts monthly general Entry to Apprenticeship for Women work-



Photo courtesy of Moore Community House Women in Construction

Basic use of power tools is one of the critical skills taught to women in pre-apprenticeship training programs. The Moore Community House Women in Construction program in Biloxi, Mississippi, places more than 70% of its graduates.

shops. It also works with the Center for Domestic Peace to inform and prepare victims of domestic violence for opportunities in the trades.

Founded by tradeswomen in 1981, Chicago Women in Trades (CWIT) developed a Pre-Apprenticeship Tutorial Workshop, now Technical Opportunities Program, to increase the number of women prepared to enter the trades. CWIT offers three sessions of this 12-week course, serving an average of 75 women annually. It also offers the Women in Welding Program, primarily geared toward preparing students for entry-level manufacturing jobs. Successful graduates receive fork lift driving and OSHA 10 certification, as well as American Welding Society credentials.

CWIT also seeks to improve opportunity and working conditions for women in construction and other male-dominated occupations by developing and promoting policies and practices that support women's careers. Plus, it is designated by the Department of Labor's Office of Apprenticeship as the Technical Assistance Center for the Midwest Region. Under this initiative, CWIT provides training, technical assistance, and resource materials to registered



Graduates of the Moore Community House Women in Construction program gather for a class photo. A grant from the Department of Labor has helped the program expand its classes and offer free child care.

apprenticeship, pre-apprenticeship, and other training and workforce development providers working with women.

Solving the Child Care Issue

Pre-apprenticeship programs aren't just located in major metropolitan areas. The Moore Community House Women in Construction pre-apprenticeship job training program in Biloxi, Mississippi, has trained more than 400 women since it first started offering courses in 2008; it currently has a placement rate above 70%. The eight-week, full-time course helps train women for careers in apprenticeship and nontraditional occupations, work that typically offers higher pay and more opportunity for advancement than the minimum-wage jobs held by many low-income women in Mississippi.

In 2016, Moore Community House's Women in Construction program was awarded a \$3.5 million, four-year grant by the Department of Labor to expand its services. The

The grant allowed Women in Construction to address the biggest obstacle for women entering into job training and employment: child care.

grant allowed the program to triple its number of graduates annually, as well as offer new types of classes, such as the program's first evening class.

The grant allowed it to address

the biggest obstacle for women entering into job training and employment: child care.

"During the past nine years, we have seen that child care can be a barrier for many students," said Julie Kuklinski, Women in Construction's program director. "Through this initiative, we can now provide child care stipends, along with other supportive services, to our students. These stipends are also available during the job search process, meaning students can study and look for work with the comfort that their child care needs will be met."

Not having to worry about child care made all the difference for Women in Construction students such as Caitlyn David, who hopes to start her own company in the real estate industry one day. She was "just finding myself thrown into the world on my own with a 1-year-old little boy" when she saw an ad for the class.

"It listed that (the class) was free, and they offered child care and transportation assistance," David said. "I was amazed how all my current setbacks were relieved by this one program."

Taking the course gave her more confidence and increased the level of independence she could achieve in real estate. She loved being able to work with her hands and create something from nothing. After completing the course, she was asked about her hopes for the future.

"I hope to be an inspiration to other women stuck in dead-end jobs," she said, "to step out of their comfort zone and realize their full potential." ©

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SkillsUSA Carpentry

Cassandra Puletapuai

CASSANDRA Puletapuai feels a certain kinship with wrestler-turned-actor Dwayne Johnson, otherwise known as The Rock. And with rocks in general.

As Puletapuai (pronounced POOH-lay-TAH-pooH-WHY) says of her Sa-

she realized, the only path to progress was a lot more time in school taking classes.

“It wasn’t where I wanted to be,” she says. “It’s not where I wanted to grow.”

Talking with a couple of her friends who were welders, “I noticed,

lived in Illinois, Texas, and Virginia before settling in Leawood, KS.

“My favorite TV show when I was little was ‘Home Improvement,’ like Bob Villa, and I loved Heidi,” she remembers, referring to the comedy’s “Tool Girl” character. “It’s so funny how that ended up. I was like, ‘Hey, wake up! I need to be them.’”

After coming across Kansas City Kansas Community College, “I started looking around at what I wanted to do, and I was just drawn to carpentry,” Puletapuai says. After seeing what the program offered—building a house—she knew “that’s what I definitely want to do.”

Like a metamorphic rock, Puletapuai admits she was “a little rough” at first. “I’d never picked up a hammer; I’d never sawed anything.” But after becoming more polished, her creative nature drew her to design and the perfectionism it requires. “For women, we have that natural attention to detail, which is what carpentry is all about and geared to,” she explains.

A Rock-Solid Platform

In the carpentry program, Puletapuai says she was “motivated by not only the mechanics of what’s offered on the technical side but definitely the personal and the professional skills that are offered.” As a SkillsUSA member, she was elected to state office and competed nationally in Extemporaneous Speaking.

“The networking is immense,” she describes the most recent SkillsUSA conference in Louisville, Ky. “Just by being at this conference, I’ve met

Continued on page 24.



After seeing what the program offered—building a house—she knew “that’s what I definitely want to do.”

—Cassandra Puletapuai

moan heritage, “We don’t have many role models, if you will.” By pursuing success as a carpenter, “I’m hoping to show my Polynesian brothers and sisters, ‘Hey, this one is for us. This is possible,’” she adds. “Because we just have The Rock.”

Coincidentally, she’s a former geologist. After getting a bachelor’s degree from the University of Missouri – Kansas City, Puletapuai worked on prestigious projects for engineering and hydrogeology firms nationwide. But in that profession,

“Hey, wait a minute, you guys are surpassing me in your income. You have no student debt, and you’re able to sit at the table with me.”

“I did kind of one of those steps back, analyzed my life, and that’s when I realized, ‘Wow, you guys have all this advancement, upward mobility, the opportunity to be an entrepreneur and start your own business.’ That’s when I started scouting technical training.”

A self-described Army brat, Puletapuai was born in Germany and had

Success Stories

Edvan Slick

TWO weeks before Edvan Slick's state championships, his father died. "The only thing that came to my mind was, 'Why should I stop? I'm still young, and I've got quite a lot more years to learn. There's no reason that I should just stop and not compete,'" says Slick, whose Navajo heritage—plus a love of carpentry and woodworking—helped him stay focused and determined.

"In all the years that I have been in teaching, I've had some great students come through my classes," says his former instructor, Robert Nash of Monument Valley High School in Kayenta, AZ. "Edvan was one of those students who wanted to learn, be a good student and be a good role model for others.

"When he came in as a freshmen, he didn't know too much about carpentry or construction," Nash adds. "His father worked as a construction worker most of the time, and his job took him away from home a lot."

A resident of the Navajo Nation Reservation in Shonto, a 45-minute drive away, Slick often stayed after school to work on his carpentry skills. He also was on the football team, meaning he often wouldn't get home until after 8 p.m. to take care of chores like chopping wood and checking on livestock. Then he'd have to get up around 4 in the morning to catch a bus back to school.

Having graduated in 2016, Slick now says SkillsUSA helped him with "learning other ways to do certain things and expanding my mind and experience, like learning from mis-

takes. It changed my life by giving me that confidence that I can learn if I fully apply myself."

His instructor remembers Slick as being positive and motivated to do better. "He was also focused on what he wanted to do in school and in life," Nash says.

"When Edvan's father passed away, he dealt with it through his own traditional way of life. He knew he was now one of the persons his mom and siblings would depend on. I talked to him about life and what it means after someone close dies.

The person who no longer is with

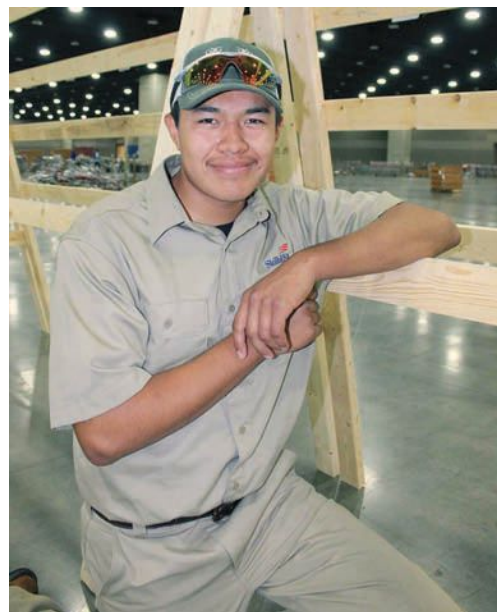
specialist at the Arizona Department of Education. "Watching him in the contest, he was focused and determined, and he had a high-quality product at the end," she says.

To maintain that kind of focus, Slick points out, a contestant "can't come in with an 'I'm going to win' mentality.

"I came to the competition knowing that this is a good learning experience. I'm still learning, and I've still got quite a few more years to go and learn. So, the mentality when I first came to this competition was, 'Just do what I know; do what I do best.'" Still,

"It changed my life by giving me that confidence that I can learn if I fully apply myself."

—Edvan Slick



us expects everyone to move on. I think he understood that well."

Soon afterward, Slick was competing in Carpentry at his state SkillsUSA event, where he caught the attention of Cindy Gutierrez, a program

he won the gold medal and qualified for the national championships.

Homing in on his future

Slick planned to join the U.S. Marine Corps once he turned 18 in

Continued on page 24.

Building Pole Barns Raises Student Success

By Erika Konowalow
erika@pickawayross.com

POLE barns dot the landscape throughout the Logan Elm Local School District, which covers a 200-square-mile area in Ohio's Pickaway, Ross, and Hocking counties.

which introduces them to carpentry and electrical. It is a satellite program of Pickaway-Ross Career & Technology Center in Chillicothe, and serves as a pipeline to the career center's programs for juniors and seniors.

"I would encourage that at the home schools to give younger students more hands-on experience earlier," Kornack said.

Through Pickaway-Ross' partnership with Logan Elm, Mitchel's students complete a pole barn each semester. The structures have ranged in size from 24' x 24' to 36' x 40'.

Each semester, the students spend the first two to three weeks learning safety rules for working on the site and earn an OSHA CareerSafe credential. During that time, Mitchel also shares with them a blueprint of what they're going to build.

"Gary likes to give them a big picture so they can think about the next step," said bus driver Tom Van-



Students in Gary Mitchel's Industrial Maintenance class work on constructing a 56' x 48' pole barn. The Logan Elm High School class is a satellite program of Pickaway-Ross Career & Technology Center in Chillicothe, OH.

Farming remains an integral part of this rural district, whose main campus is about 30 miles south of Columbus, the state capital, so the prevalence of pole barns is not uncommon.

Since 2009, more than 15 pole barns have been built by district high school students working roughly 90 minutes a day at a different site each semester.

The students are in Gary Mitchel's Construction Technology class,

Erika Konowalow is the public relations and marketing coordinator, Pickaway-Ross Career & Technology Center, Chillicothe, OH.

Mitchel has taught at Logan Elm for 33 years, the last eight as a Pickaway-Ross satellite instructor.

"This is a rare thing in the state," Mitchel said of his trades classes: Manufacturing (Metals I), Welding Technology, Machining Tools, Engineering, and Career Skills. "Logan Elm and Pickaway-Ross have been very supportive of industrial technology classes. Most schools do not offer this."

Robert Kornack, education program specialist in construction and transportation with the Ohio Department of Education, said that the program is a great opportunity for home school students.



A student cuts a piece of lumber for the pole barn.

Dette, who has been helping on site for about six years. “By him doing that, it helps so they don’t do one step and then stand around.”

And then, by week 3, Mitchel, VanDette, and eight to 12 students

Mitchel estimates that since he started teaching the electives for Pickaway-Ross, perhaps 15 to 20 students each year have gone to the career center for their junior and senior years of high school.

part of growing up,” Mitchel said of VanCuren.

Last spring, upon completion of the Leists’ 24’ x 24’ pole barn, Mitchel heaped praise on the eight-member crew during the project’s dedication.

“This group fell into place really well. We had some excellent framers; we had a boy who ran a shovel and a rake for a month, did a tremendous job. Guys find their niches,” he said.

Bill Leist said he was impressed with the students’ work.

“When the bus pulled up, the doors opened and it was boots on the ground and ready to work,” he said.

Nate Smith, principal at Logan Elm, said the class allows students to solve real-life

problems that they could encounter on a job site.

“These problems are difficult to replicate in the classroom and Mr. Mitchel’s program gives our students amazing opportunities.”

New Year, New Opportunity

Students started on this semester’s project after Labor Day and



Gary Mitchel, left, works with a student at the job site. Each semester, Mitchel’s students build a pole barn for a client.

are on site and ready to build a pole barn for their client. But Mitchel emphasizes that learning the trade is secondary to other skills he wants his students to acquire.

“They need to be prepared, safety-wise and weather-wise,” Mitchel said, adding that as they have a very narrow window to work, they are on the site in rain and snow.

“They learn how to work together, work independently, and take instruction.

“All I ask is that every day they get a little better,” Mitchel said.

Tough Love, Life Lessons

Mitchel comes across like a drill sergeant, shouting out orders on the site as he works alongside the students. But it’s obvious that he and the kids have much affection for each other.

“I bark. I have to be loud so they hear me,” Mitchel said.

But his bark lacks the bite to deter students from choosing to take Mitchel’s many courses.

Tucker Stulley took Mitchel’s Manufacturing and Machining Tool classes his freshman and sophomore years, respectively.

“I discovered I really liked machining,” said Stulley, now a senior in Pickaway-Ross’ Machining & Manufacturing program.

Dennis Franks, superintendent at Pickaway-Ross, said the class provides a great opportunity to introduce students to this career path early in their high school careers.

“With the current focus on early adoption of CTE, this program and many others we have at the middle school level expose kids to the benefit of a career-technical education and the value CTE brings to their success in high school as well as the workplace,” he said.

Franks said this and similar programs are what local employers say they need: skills that help develop work ethic and let employers build on to make their workforce more productive and competitive.

Hayden VanCuren, a senior, started taking Mitchel’s classes as a freshman.

“He’s a leader,” VanDette said of VanCuren.

Mitchel agreed, praising VanCuren for showing initiative on the project for Bill and Kathy Leist by arranging for a family friend to drill postholes at the site.

“Hayden took ownership; that’s



Gary Mitchel, right, shows a student how to cut siding for use on a pole barn the class built last spring.

homeowner Denny Compton said he is already thrilled with what’s taking shape.

“I come home every evening and I see amazing progress on what these young men are doing,” he said of what will be a 56’ x 48’ barn. ▶

Compton learned about Mitchel's class from the local paper, the *Cirleville Herald*, which has published



Students ensure that the siding is level at their 2018 project site in March. The group built a 24' x24' pole barn.

photos of the finished projects over the years.

Community members can call Mitchel at school to request his students build a barn. Prospective clients must live within a short radius of the high school so the crew has time to get to and from the site and have time to work.

Clients provide the materials, a snack for the students on Fridays, and a pizza party at the high school after the barn is dedicated. The students, of course, provide the labor.

"It has to cut the cost in half," mused Angie Saxton, an English teacher at Pickaway-Ross who had a 32' x 40' horse barn with a 10' overhang built during the 2016-17 school year.

One of the larger projects to date, it took Mitchel and his students the whole year to build the horse barn.

Saxton said the tradeoff for the savings is that the homeowner must be patient, as the project is going to take longer because stu-

dents are building it. Some potential clients don't commit to the project because of the time element, but Saxton said there are benefits that outweigh expediency.

"As an educator, I like seeing the progression and that they're learning something," Saxton said. "I like that it's a learning experience."

VanDette likened the project to 4-H, where kids learn about farming, business, and trades disciplines through hands-on activities.

"The students grow every day," he said. "This program is a treasure."

Mitchel refers to his job as "the best decision I never made," explaining that his parents forced him to attend college.

A graduate of Ohio Northern University, Mitchel studied industrial technology with a minor in education, knowing that he wanted to teach.

"I loved high school shop classes and working with my hands," he said. "Now I'm blessed to have a career I love and seeing the lights turn on with my students." ©

Skills—Cassandra, from page 20.

other carpenters, other teachers, who are willing to share their knowledge with me. They're like, 'How are you doing? Do you know how to do this?' or 'Hey, look me up.' I love that, because at a university I felt it was very 'sink or float' and very closed off, like, 'I know more than you.' I didn't like that." Now, she adds, "I feel the connections I've made are very genuine."

Being a SkillsUSA leader has given her a platform to encourage more women to go into carpentry. "I became an advocate as I got further and further into my education," she says. At her school's career day, her words have resonated with female visitors. Others are listening, too, from state legislators to middle-school girls.

As for future plans, "I will continue to be an advocate for SkillsUSA, volunteer," she adds. "I also want to start my own busi-

ness and be an entrepreneur.

"I'm already ready to go and build buildings," the student asserts. "No, I'm realistic with my goals, but slowly but surely, I know I would probably start with remodeling, slowly start there and then probably get into new construction."

To help her neighbors attain the American Dream, Puletapuai wants to offer quality homes at an affordable price. She also dreams of a faraway place and lifting its residents out of poverty—something even The Rock can't do.

"I made this promise: If I am successful, I will definitely go back to American Samoa and teach my own Polynesian brothers and sisters how to do a trade in carpentry, so they can get off the island, or make a living there," she says.

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Skills—Edvan, from page 21.

August, having qualified for its construction and engineering option. "I actually got denied because of a food allergy," he laughs at the unexpected turn of events. So, Slick shifted his focus to a short distance from his family home.

"After graduating, I started to build my own house, learning the how-to's and getting the hands-on," he says. The work has been done "mostly by myself with my brother, and sometimes the help of some others for the hard labor. I actually laid the house out and framed everything."

Once his house is finished, Slick adds, "I want to continue doing residential construction, because I love woodworking, and I still want to go to school, maybe for construction management."

This love of learning carries over into his advice for the next round of SkillsUSA Championships competitors: "Expand your mind and consider this a good learning experience. Even if you don't win or if you place, you're still at the national level, and you can still learn more."

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Builder's Word Search

Try to find the 42 construction terms hidden in this puzzle. Any builder worth his salt should be able to recognize them. After you've found the words, see if you can define them for an added challenge!

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

ARCHED
 BALCONY
 BASE
 BENCH
 BIDET
 BOSS
 COILS
 COPPER
 DOME
 DOWELS
 DRAGLINE
 DYNAMITE
 FREESTANDING
 GABLE
 GATEHOUSE
 LADDER
 LEAKS
 LEVERS
 LIFTS
 LINTEL
 LOTS
 LUMBER
 MANSION
 MARBLE
 NEWELS
 NICHE
 NOSING
 OUTLET
 REPARIAN
 ROCKS
 RUNNERS
 SAFES
 SEMI
 SEWER
 SILLS
 SLATE
 SYSTEMS
 TILES
 TINS
 TRAY
 TREADS
 UTILITIES

Answer on page 29.

More than Fun Answers

Crossnumber

A	1	B	8	C	9		D	6	E	7	F	5
G	7		0	5			H	1		0		0
		I	2	5	J	1		0		0		
K	2		5			2			L	5		0
		M	8	N	9	5	O	3		0		
P	6		3	9			Q	1		1	R	7
S	3		7	9			T	3		9		5

What Is the Football Team Doing on Our Field?

The smallest number is 25.
 The least common multiple of 2, 3, and 4 is 12. Add 1. The sequence is 13, 25, 37, 49, ...

The Long and Winding Road

Mr. P and his wife averaged 66.1 mph. Subtract 1 hour 50 minutes from 20 hours to get 18 hours 10 minutes. Divide 1,200 by 18 hours 10 minutes (or 18.1666... hours) to get 66.055 mph.

A Sale that Is on Sale?

The item was already reduced by 50%.
 If you took 50% off the original price, and then you took 50% of what was left, you would have reductions of 50% and 25% off the original for 75%.

Using algebra,
 let x = original price
 let $R \times x$ = reduced price
 The final price is $0.25x$
 Hence, $0.5R \times x = 0.25x$
 so, $R = 0.5$ or 50%, and the amount of discount is $100 - 50 = 50\%$.

Word Scramble Challenge

S P A R K F I L T E R
 T R I A C S O C K E T

When unscrambled, the letters in the squares should read: SCI-FI. The name of the genre is SCI-FI, as in Science Fiction.

Published several years after his death, Johannes Kepler's novel Somnium ("Dream") told of a voyage to the Moon made by means of a sailing ship levitated through a magic spell. Somnium is considered the world's first science-fiction story.

Doodling's Evolution and Drafting in the 21st Century

By Anna Gudde

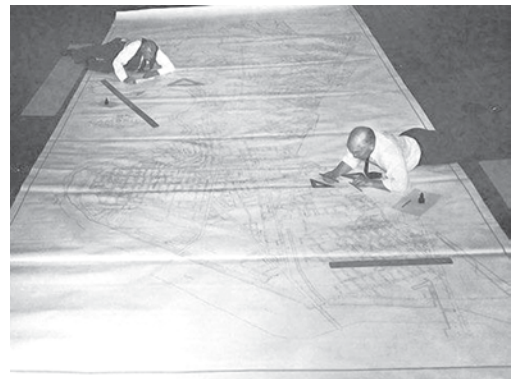
ARE you a doodler? Perhaps you fill the margins of your notebook with sketches and drawings. Or maybe you draw on napkins or scrap paper to pass the time. At some point, we're probably all doodlers.

Ever wonder if your sketches could come to life? With a few added dimensions and a dash of technology, they could.

Doodling, or drawing, has been around a long time. From early cave drawings to design software such as AutoCAD and SolidWorks, we can safely assume that since we've had

part of the process to a highly developed skill set.

- **Early drafting tools**—Before computers and computer-aided design (CAD) programs, architects, draftspeople, and engineers used pencils, paper, rulers, bow compasses, and the like to sketch out their ideas. Nowadays, most "sketching" is done on the computer. But these early tools are far from obsolete. While there are definite benefits to using CAD programs, knowing how to draw to scale and how to



Engineers designing aircraft wings on huge sheets of paper.



Teaching students to use traditional drafting tools such as these can help them communicate their ideas.

an instrument in our hands, we've been sketching plans and technical drawings, and doodling ideas.

The History of Drafting

Let's take a closer look at drafting and its rise from an under-the-radar

write neatly in specs are still valuable skills in the drafting world.

- **1960s**—Sketchpad, created by Ivan Sutherland in 1963, was the first CAD-type program. It ran on the Lincoln TX-2 and enabled users to create drawings on the computer.

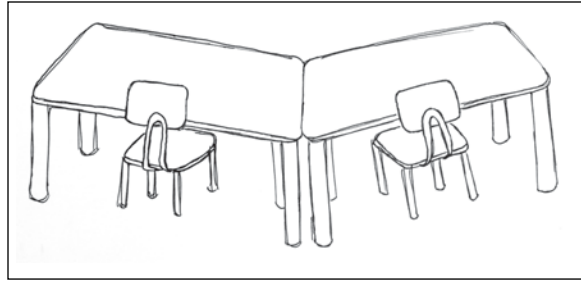
Sketchpad ushered in the modern age of engineering and made way for the various CAD programs in use today.

- **1970s**—Initially, aerospace and manufacturing companies were the only users of Sutherland's program. Eventually, though, CAD programs that worked on smaller computers were introduced to the industry. After design engineers tackled the learning curve of using CAD, their efficiency and productivity went through the roof. Over time, CAD software became affordable and more user-friendly, and its popularity grew.

- **1980s-1990s**—AutoCAD—still widely used today—was introduced in 1982. CAD software was then developed further to include 3-D features, and suddenly the technical drawings of the past became increasingly lifelike and easy to engineer.

Anna Gudde is marketing projects coordinator, Pitsco Education.

● Present—The evolution of drafting has brought us to the present day, where using 3-D models is the norm and the trend to create full virtual prototypes is hot. Soon, we might not notice the difference between a virtual 3-D object and a real object—crazy, isn't it? Who would have thought the evolution of drafting was so high-tech?



Before computers and CAD programs, architects, draftspeople, and engineers used pencils, and paper to sketch out their ideas.

Drafting and Design in Today's Classroom

Thanks to the ideas, designs, and brilliance of past artists and inventors, today's drafting and design students can use previous and modern technology to become anything from architects, carpenters, and general contractors to materials engineers, planners/designers, roofers, and much more.

So, what does that mean for today's drafting or engineering classroom? What can teachers do to pre-

Today, 3-D models are the norm and the trend is to create full virtual prototypes.



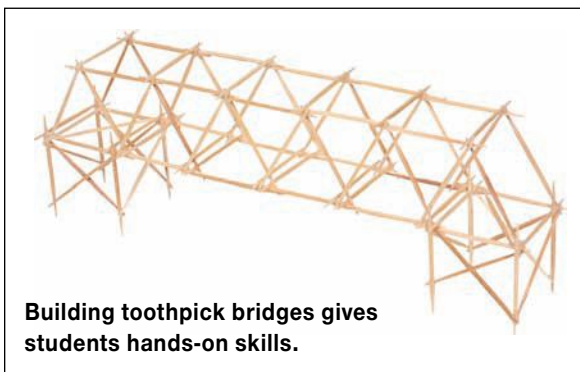
ing, 'This needs to move over,' and 'Drill this hole. . . .'"

There are several ways to give students the necessary hands-on skills. Introducing them to T squares, bow compasses, and other drafting tools is one. Actual hands-on building is another. Instructors can teach a class on bridges and bridge building and have students use toothpicks and glue to build toothpick bridges. Or give the class balsa wood and challenge stu-

work together to build a doghouse or even a storage shed.

Beyond hands-on skills, students need to have an awareness of the career opportunities available and the skills, both technical and soft skills, necessary to be successful in their chosen field. Having students explore O*NET OnLine is a great way to introduce them to the various drafting and design careers. An assignment to research a sample career and write a report on the skills and training required, what type of salary to expect, and whether the student thinks this career would be a good fit will help students gain a fuller understanding of what the drafting and design workforce entails.

The world of drafting has come a long way in a relatively short span of time. But today's students have a wealth of opportunities available to them. It's exciting to think about what's on the horizon. ©



Building toothpick bridges gives students hands-on skills.

pare students for the high-tech world of drafting and design?

For starters, instructors can go back to the basics. Because while the majority of universities and careers are using CAD, students still need to demonstrate an ability to draw to spec, to measure and scale drawings up or down as needed, and to communicate their ideas on the fly, especially if they're working as contractors or contracting supervisors. As Pittsburg State University's Dr. Andrew Klenke, associate professor of technology and engineering education, explains, "When you get on the job floor, you aren't able to say, 'Well, where's my computer?' No, they grab a piece of paper towel or whatever and they start sketching it out, say-

dents to create the strongest trusses possible. Kits such as Pitsco's True Scale House Framing Kit make the building easy and fun for both the teacher and the students. Older or more advanced students could

Further your drafting exploration with these sources:

Examining the History of Engineering Drafting and Design

<http://blogs.autodesk.com/inventor/2016/12/20/examining-the-history-of-engineering-drafting-and-design>

Sketchpad of Ivan Sutherland

<http://history-computer.com/ModernComputer/Software/Sketchpad.html>

Computer-Aided Drafting & Design History

<https://www.techwalla.com/articles/computer-aided-drafting-design-history>

O*NET OnLine

<https://www.onetonline.org>

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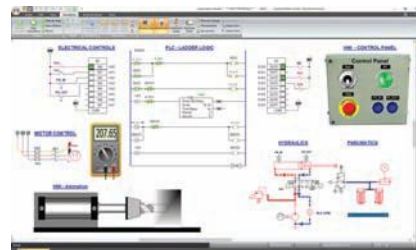
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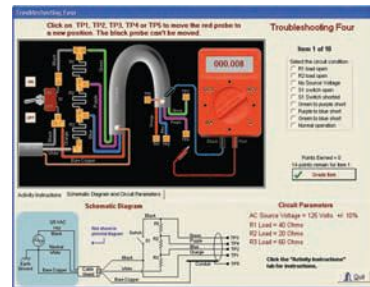
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Builder's Word Search Answers

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

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Crossnumber

Find the solutions to the following problems and place the answers in the correct spaces of the puzzle. Only one digit per square. Numbers must read from left to right and from top to bottom. Look for the key starting problem. All other problems are based on the solution to that one.

A	B	C		D	E	F
G				H		
	I		J			
K					L	
	M	N		O		
P				Q		R
S				T		

Across

- A. P down \times 3
- D. R down \times 9
- G. D across + 30
- H. 10^2
- I. H across \times 251
- K. $1/2$ of L across
- L. $1/2$ of H across
- M. I across + 64,430
- P. C down - 316
- Q. J down - 8
- S. O down + 66
- T. H across + 295

Down

- A. K across - 8
- B. M across \times 100 - 927,163
- C. H across \times 10 + 45
- D. D across - 65
- E. I across \times 300 - 524,981
- F. K across \times 2
- J. K across \times 5
- N. D down + 389
- O. C down - 642
- P. R down - 32
- R. H across - K across

A Sale that Is on Sale?

Last summer, I saw this confusing sales sign in Macy's:

**75% off original prices
when you take an extra 50% off
already reduced prices**

What was the percent of the first reduction?

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

What Is the Football Team Doing on our Field?



When you arrange the members of a marching band in rows of 2, 3, or 4, there is always 1 person left over. However, when you arrange them in rows of 5, the rows are all even. What is the minimum number of people in the marching band?

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

The Long and Winding Road

A roundtrip from Fort Collins, CO, to Lubbock, TX, and back to Fort Collins is 1,200 miles. It took Mr. P and his wife 20 hours for the roundtrip but those 20 hours included their pit stops. If they stopped for a total of 1 hour 50 minutes, how fast did they average over the whole trip (in mph to the nearest tenth)?

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

Word Scramble Challenge

Johannes Kepler, (1571-1630), a strong supporter of Copernicus, is famous for his three Laws of Planetary Motion. But here's a lesser-known fact. In his later years, Kepler also invented a whole new genre of fiction. To find out what that

genre is, 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 learn the answer.

PARKS

○ ○ ○ ○ ○

ACTIR

○ ○ ○ ○

FERTIL

○ ○ ○ ○ ○

ESTOCK

○ ○ ○ ○ ○ ○

See answers on page 25.

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.

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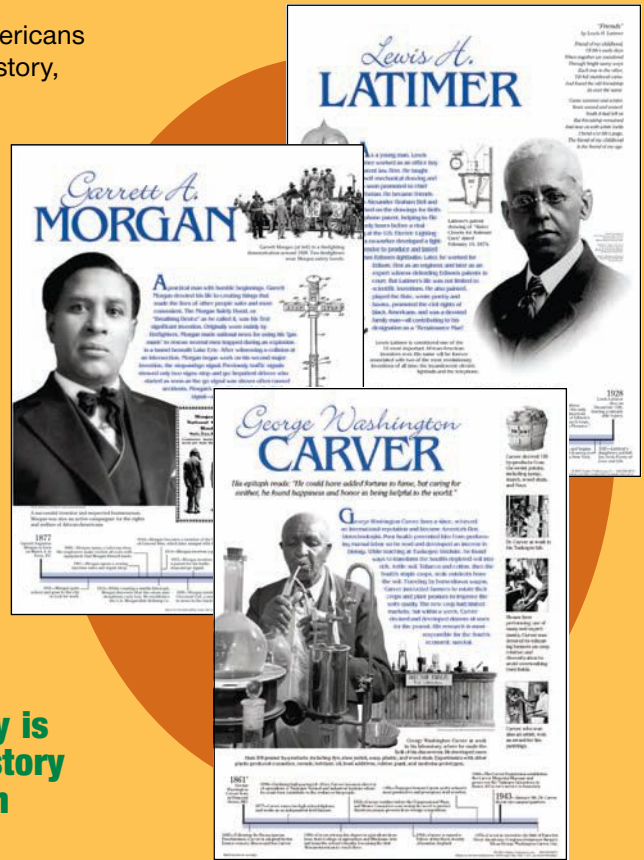
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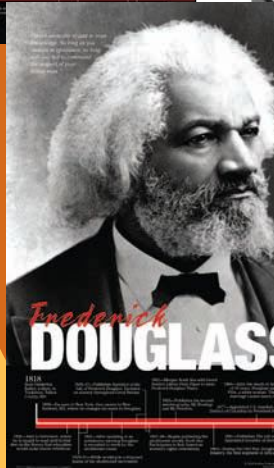
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(Portraits)
Martin Luther King, Jr. (March)
Thurgood Marshall
Rosa Parks
Sojourner Truth
Harriet Tubman
Booker T. Washington
Malcolm X
The Buffalo Soldiers (Plains)
The Buffalo Soldiers (Uniform)
Montgomery Bus Boycott
The Tuskegee Airmen

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