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FEBRUARY 2018

Welders in Demand

Introducing Students to the Field

How Apprenticeships *Are Changing*

ITEEA Conference Preview— Building Bridges

technically speaking

Vanessa Revelli vanessa@techdirections.com

Education and business leaders agree that more needs to be done to encourage Michigan high school students to consider pursuing careers in skilled trades, they just can't agree on a solution.

Currently, lawmakers are discussing two bills that would require schools to provide students with more career information and help create a talent portfolio for every student. "There's a lot of opportunities that right now I think are not put forth in front of the students and parents as much as they should be," said Roger Curtis, director of the Michigan Department of Talent and Economic Development.

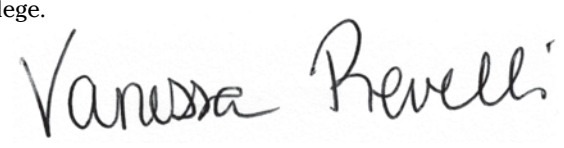
At a recent state Senate committee hearing, various business and industry trade groups expressed support for the legislation in hopes that it would address a growing problem in Michigan.

"This talent gap or talent shortage, or however you want to call it, it's become a primary barrier to economic growth in our state," says Delaney McKinley, senior director of government affairs with the Michigan Manufacturers Association. But to implement the legislation, Michigan schools will have to hire many more school counselors, and that comes with a huge price tag.

An Educational Development Plan, a document school counselors create, shows a student's education and career goals, and how to achieve them. The problem is that Michigan doesn't have enough counselors to help students properly. With the national average at twice the ratio recommended by The American School Counselor Association, at 491 to 1, Michigan has a long way to go. According to the Michigan Association of School Administrators (MASA), the state ranks near the bottom nationally for student to counselor ratios–roughly 729 students to just one counselor. The legislation would call for cutting that ratio by two-thirds. "Just to get our counselor ratio to … 250 to one … you're looking at a $316 million appropriation. That's a lot of money," says Chris Glass, West Michigan Talent Triangle, a group of 40 west Michigan school districts.

Peter Spadafore, the Associate Executive Director for Government Relations for MASA, says the goal of the two bills is "laudable." Nevertheless, Spadafore adds the association has "serious reservations" about the potential cost. "Without a major appropriation for counselors from the state, this legislation will be an unfunded mandate that will be inequitably implemented as inflation continues to outpace the states investment in K-12 education," says Spadafore.

Money is just one issue. Another is convincing students and parents that pursing a skilled trades career is not a lesser choice. "I think one of the big misconceptions about current technical education is we're just trying to push kids into jobs right away…. That's certainly not true," says Brian Sarvello, the career education director at the Marquette RESA. He says a majority of their students who complete a high school CTE program do go on to college.



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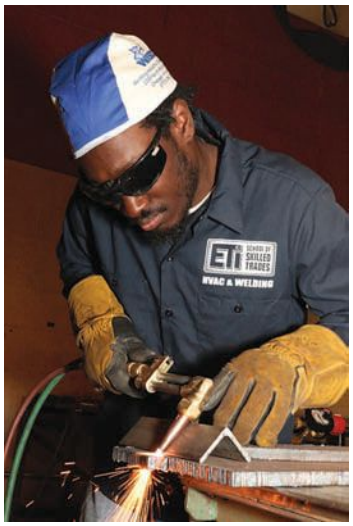

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About the cover: Student uses his offhand to brace the torch. Photo courtesy of ESAB Welding and Cutting Products. Cover design by Sharon K. Miller.

the news report

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Come Fly with Me

A high school sophomore has won Texas Instruments' (TI) #GenSTEM contest and a starring role in the latest edition of "STEM Behind Cool Careers," an entertaining series of calculator activities and videos that introduce middle and high school students to unexpected STEM careers. The national contest asked students and teachers to submit photos showing how STEM inspires them.

The winning photo is from Alex Livingston, a 15-year-old student at Tech Valley High School in Albany, NY, and a volunteer with the Civil Air Patrol Cadet Program, an auxiliary of the United States Air Force. Livingston is one of the youngest members of his local flying club to solo pilot a glider and has already logged nearly 25 hours of flight time.

As part of his prize, the aspiring commercial pilot traveled to Dallas where he visited with mathematicians and scientists at TI, got a behind-the-scenes tour of the McKinney National Airport, and sat in the cockpit of a flight simulator at Southwest Airlines' training facilities. "My trip to Dallas was an amazing way to see the different sides of flying and opened my eyes to the many career options that exist in the field of aviation," said Livingston. "It also helped me to connect what I need to learn in math and science class today to be successful in an aviation career in the future."

While in Dallas, Livingston met with Southwest Airlines veteran pilot, Captain Adam Schindall, who helped TI create the new aviation lesson, "STEM on the Fly." The fun, free activity puts students at the controls of an intercontinental airliner as they cruise through the math and science that explain how wings work. Designed for the TI-Nspire™ CX and TI-84 Plus CE graphing calculators, it shows students how a solid understanding of STEM subjects is vital for almost any career, and especially aviation.

"Like many students today, I used

Alex at McKinney National Airport

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

to struggle with the importance of learning things like how to solve for *x*, but now I know pilots solve for *x* all day, every day," said Capt. Schindall. "By connecting the things that students are already interested in, like flying, to the important concepts they need to learn, I hope this activity sets students up to soar in a future STEM career."

Get cleared for take-off here: https://education.ti.com/en/activities/stem/gen-stem/stem-on-the-fly

Nation's Only Merit Shop Floor Covering Apprenticeship Program

Jack Laurie Group (JLG), Indiana's largest commercial flooring and interiors contractor, has partnered with Associated Builders and Contractors, Inc., to offer the nation's only merit shop floor covering apprenticeship program. The program was created to boost the talent base of skilled floor covering installers and address the construction industry's staggering workforce shortage, which began during the Great Recession.

With guidance from the Flooring Contractors Association, JLG developed a four-year curriculum in floor covering installation that culminates with a graduate's certification as a trade journeyman. Participants are paid for on-the-job training, and a minimum rate of pay is guaranteed throughout the program. Participants also have an opportunity to earn an associate's degree from Vincennes University completely free of charge, thanks to a grant from the Indiana Department of Workforce Development.

The program has been certified by the U.S. Department of Labor (DOL) as an official apprenticeship. This is the first time the nation's labor department has approved an apprenticeship program in Indiana created by a private employer. Until now, all DOL-certified programs were offered by trade unions. Indiana is a Right-to-Work state, so nearly 80% of the construction work is completed by merit shop employees.

"This is a huge opportunity for the entire construction industry and the men and women who strive to make it their profession, and we are optimistic about the impact the program will have on the local economy," said Tom Postell, JLG vice president of operations and chief architect of the program.

Hardwood flooring installers make an average of $52,477 per year, according to Salary Expert. The average journeyman at JLG also makes north of $50,000 annually, and the minimum starting rate is $18 an hour.

The apprenticeship includes classroom, lab, and field training by JLG's own National Center for Construction Education & Research-certified instructors. More specifically, requirements include 8,000 on-the-job hours and 576 classroom and lab hours. The program is completely tuition free, but participants must have a high school diploma or GED. Participation in the Vincennes University associate's degree program is optional.

Interested candidates are asked to visit http://jacklauriegroup.com/careers/. Click on the 'register' tab and fill out the short contact form.

Alan Pierce
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Three-Dimensional Transformers

Origami is a traditional Japanese art form where artists create different three-dimensional shapes through the folding of a material. To develop a completely new three-dimensional object an artist must, to some degree, use trial and error. At the same time, I am sure that experienced origami artists have a tool box of folds they have used in the past that helps them create the object they envision.

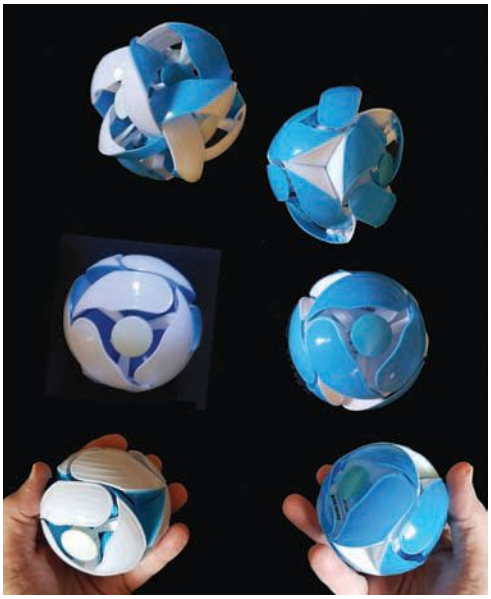


Photo 1—A simple toss into the air causes this ball to shape shift to change its color.

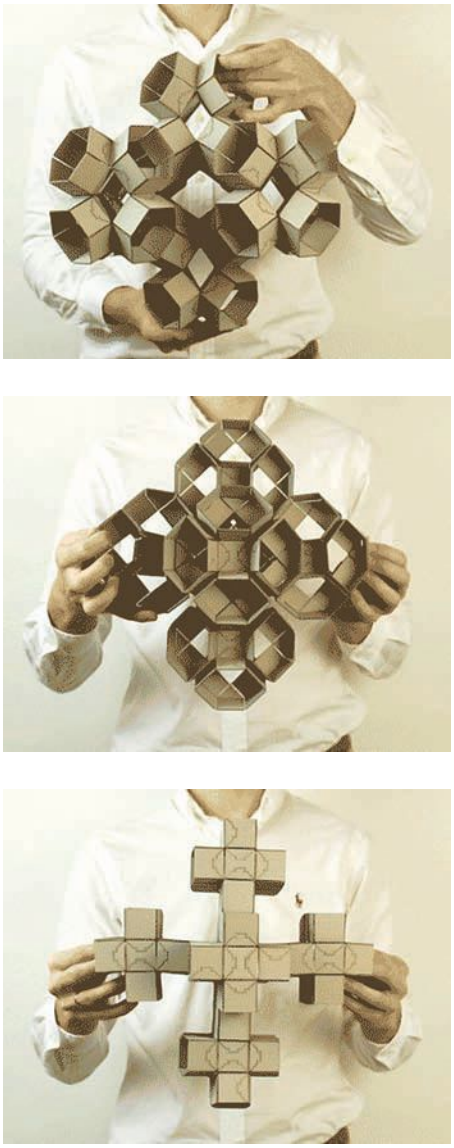
Using a modern process reminiscent of origami, the ball shown in Photo 1 will change its colors when it is tossed into the air. The acceleration created by a simple toss causes a slight air pressure differential on the top and bottom of the outer leaves of the ball. This causes its multiple thin plastic outer leaves to lift open and then switch their location with the inner leaves of the ball. To show you how this physical change takes place I captured a rapid series of snapshots which froze some of the physical movements of the ball during its metamorphosis from white to blue.

Professor Katia Bertoldi and her team of researchers at Harvard University's School of Engineering and Applied Science (SEAS) have recently developed a mathematical transformational technology that completely automates finding the best way to form a flat material into a form that can be shape shifted to perform many different functions. Using this technology, a designer or engineer would provide all the size and shape parameters that are needs to be achieved when the object transforms from one shape into another.

The computer algorithm that the Harvard researchers created applies a tool box of mathematical rules that it has at its disposal for creating all kinds of geometrical shapes. The program quickly finds all the possible solutions and then selects the solution that conforms to the parameters of size and shape that the researchers want as an output.

Photos 2-4 show an object that they created to show how multiple physical changes can be imbued into one object by their computer algorithm's knowledge of the mathematics of physical shapes. Hypothetically using this technology, you could create a habitat for astronauts that folds down flat to be transported on a flight to Mars. It can also be used to create a medical device that is so small it could be fed into the human body through veins, arteries, or the smallest of incisions. Once the medical device is in the correct position it can be opened to meet the medical needs of the patient. The next generation rescue robot could fold flat to sit in an emergency vehicle until needed; once opened, it can still shape shift to slip into an impossibly small opening to get to survivors.

It is truly amazing how their technology can alter the outer form of



Johannes Overvelde Harvard SEAS

Photos 2–4—These images all show the same object that can shape shift to change its form. By pre-designing the physical changes into an object, it can perform multiple functions or just change its size and shape.

Johannes Overvelde Harvard SEAS

Photo 5—The two metamaterial objects in this photo look different but they are the same object. They were created using the new Harvard technology so they can shape shift. By building in this ability this metamaterial can shift its functional properties.

large objects but that was not what they started out to accomplish. Their research goal was to develop the ability to change the outer form of a metamaterial (Photo 5). The physical shape of a metamaterial on a nano scale allows these materials to manipulate light and sound. Scientists have already shown with the right outer shape a metamaterial shrinks in size when it is heated and with a different outer form the metamaterial can actually cloak an object so light passes around it making the object invisible.

In the end, their transformational technology is equally successful at transforming the outer form of a material regardless of its size. Their technology breakthrough can be applied to everything from tiny nano-sized metamaterial structures, to structures as large as buildings and bridges. The breakthrough is very important because it will allow a design engineer to easily develop either full products or sub-assemblies that can be small for shipping and then open to full size once they are delivered to where they need to go. Watch this YouTube Harvard video for some further insight into this technology: https://youtu.be/7A_jPky3jRY.

Taking It a Step Further

1. In what way is the transformation of the ball in Photo 1 using the same principle that makes it possible for an airplane's wing to create lift?

2. Are Sir Isaac Newton's three laws of motion applicable when one analyzes the motion of the ball in Photo 1? Describe how they do or don't apply.

3. Metamaterials are barely covered in this column. They are the perfect subject for student research. They were actually discovered in the 1940s but research into their properties has recently exploded.

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

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Henry Dreyfuss and Industrial Design

Some people might think that a particular product looks better or is easier to use than a competing one. Those are characteristics of industrial design, the field in which Henry Dreyfuss excelled. His designs included such successes as Bell's standard desk telephone in 1937, Honeywell's round wall-mounted thermostat in 1953, and Polaroid's SX-70 camera in 1972.

Henry Dreyfuss, circa 1940

Dreyfuss was born in Brooklyn, NY, in 1904. His father supplied theatrical props and the family was not well off. Dreyfuss would have had little chance for a high school education except that a teacher recognized his artistic talent. He received a scholarship to a private high school and graduated in 1922, after which he apprenticed himself to a stage designer.

Over the next several years, Dreyfuss designed hundreds of movie and stage sets for New York's Strand Theater and other venues. His supervisor encouraged him to consider the emerging field of industrial design and Dreyfuss opened an office in 1929. An initial success was with Mason glass food jars that he redesigned to be square but with round lids. This allowed for stacking the jars more easily on shelves. He hired Doris Marks as his business manager and they married in 1930. They had three children and she remained active in the business.

In the 1930s, Dreyfuss received a contract from the Bell Telephone Company to redesign their standard desk telephone. He was an early advocate of "ergonomic" or "human factors" engineering. That meant he took into account how people would use a product. Dreyfuss insisted on working directly with company engineers and technologists. He convinced Bell to manufacture the comfortable and pleasant-looking black Model 300 handset telephone in 1937. His professional relationship with the company lasted 20 years as he continued to upgrade their designs.

Left, a Mercury locomotive in Chicago in 1936

Below, a Hudson locomotive

Dreyfuss then involved himself with the New York Central Railroad's Mercury and J3 Hudson locomotives. He streamlined the exteriors of ordinary steam locomotives to improve their appearance and thus increase ridership. The 1936 Mercury operated between Midwestern cities and his 1938 Hudson powered the company's elite Twentieth Century Limited passenger train between New York City and Chicago. Dreyfuss even designed the interiors, dinner service, and stationery used on the Hudson. The locomotives operated until the 1950s, when all 27 of the Dreyfuss Hudsons were scrapped.

1937 Bell Telephone desk phone

But most of Dreyfuss' work dealt with everyday items. The Hoover Vacuum Cleaner Company had a machine that he redesigned into an elegant upright unit in 1936. The first was the Model 150 and its basic appearance has remained unchanged. In 1939, he designed the Westclox Big Ben alarm clock, which has also retained its basic appearance.

Perhaps Dreyfuss's simplest and most elegant design was his round, wall-mounted T-86 thermostat for the Honeywell Company in 1953. Competitive units were rectangular and often appeared tilted on a wall. The Dreyfuss design did not have that problem. Commonly called the

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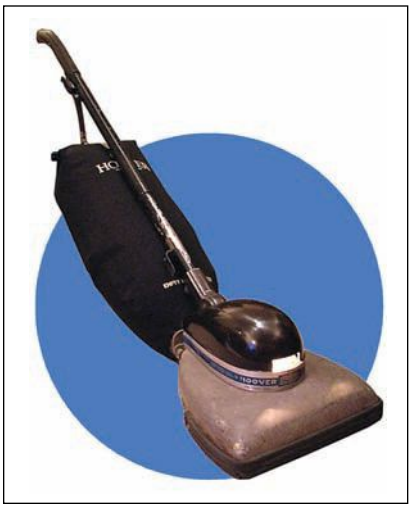
Dennis Karwatka is professor emeritus, Department of Applied Engineering and Technology, Morehead (KY) State University.



Hoover vacuum cleaner from the 1930s

Honeywell thermostat

Round, Honeywell has sold over 160 million of them. Dreyfuss's work also involved several of the Polaroid company's instant print cameras in the 1960s and 1970s. One author wrote that Dreyfuss redesigned "thousands of items" from kitchen utensils to locomotives and steamships.

Dreyfuss was a pleasant and witty man who liked the color brown. His office walls were brown, as were most of his business suits. In 1965, he helped organize the Industrial

Big Ben clock

Polaroid SX-70 camera

Designers Society of America and served as it first president. Dreyfuss and his wife died from carbon monoxide poisoning in 1972.

One of his more flamboyant projects was a 1947 flying car he named the Convaircar 118. It resembled the flying car in the 1974 James Bond motion picture *The Man With The Golden Gun*.

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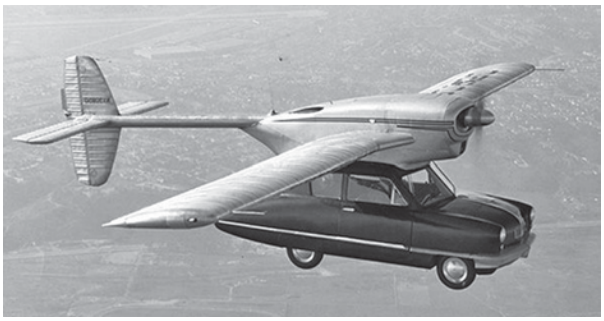

The Convaircar 118

Welders in Demand

It's a competitive world out there, but for those looking for a job that offers good wages and job security, welding could be the answer.

By Abbe Miller and John Henderson

DESPITE their young age, soon-to-be high school grads are confronted with potentially the biggest decision they'll ever have to make—what direction to take after they're handed their diploma. Thankfully, they have a lot of options. They can take the traditional route and head to a four-year college. Or, they can enlist in the military. Or, they can enroll in a trade school with careers that range from food service and auto repair to computer programming.

For some, the number of options can be daunting. However, the choice might be made easier by weighing a potential career's salary with the ease of landing a job.

According to PayScale, a company that uses special algorithms to assess the compensation for hundreds if not thousands of job titles, the average welder brings in more than $35,000 a year. Give that welder an AWS certification, though, and the income jumps to $45,000. Add that to the fact that welders are in high demand and you have a career that's not only lucrative, but also incredibly stable.

Solid Foundation

So how does one go about landing a welding job that offers a good wage and a solid sense of job security? The most sensible way is to find an accredited vocational school and enroll. In Illinois, there are only five that are accredited by both the American Welding Society (AWS) and the Accrediting Commission of Career Schools and Colleges, a nonprofit agency recognized by the U.S. Department of Education. One of them is the ETI School of Trades, located in Willobrook, IL, which offers courses in welding and HVAC/R.

Students typically graduate from ETI's program within 7-12 months, clocking in 265 hours in the classroom and 641 in a 12,000 sq. ft. hands-on lab. The program is broken into four levels that span the entire spectrum of welding fundamentals. Level one focuses on oxyfuel and plasma cutting, level two focuses on stick welding, and levels three and four focus on MIG and TIG, respectively.

Classroom hours include instruction in safety and procedural specifications, reading and understanding of welding drawings, and explanations of associated welding vocabulary and terminology. Lab hours include learning how to properly set up equipment and how to prepare material for welding and cutting. It also includes the techniques and methods behind the full gamut of welding processes.

"Students learn everything they'll need to be marketable in the workforce," says Michelle Scheldberg, director of admissions and marketing at ETI. "They learn all of the different welding positions they'll use in the field, and they get the chance to practice on a variety of materials, from aluminum to steel, and in various thicknesses."

In less than a year, graduates gain a well-rounded foundation—one that makes them incredibly desirable for employers. Scheldberg gets a smile on her face every time she's asked about ETI's program.

"Welding is a very rewarding career," she says. "Our graduates have worked on some pretty cool projects, like at McCormick Place and Cellular Field, but it goes beyond the Chicagoland area. One of our graduates sent us pictures of himself welding on the Golden Gate Bridge."

Preparing for the video shoot

The student demographics at ETI also go beyond the expected. Students come to ETI straight out of high school, but ETI's classrooms and labs are also full of adults looking to change careers, retired military men and women, and twenty-somethings frustrated with the tradi-

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Abbe Miller is editor-in-chief of Welding Productivity magazine, and John Henderson is product line manager, ESAB Welding & Cutting Products.

tional four-year college path they'd been on.

Camera Ready

During a recent visit to ETI's campus, instructors and students were producing a series of videos to illustrate some of the proper oxyfuel techniques taught at ETI. It was clear that the students were gaining valuable skills while also enjoying the experience of getting in front of a camera.

During the video shoot, ETI student Austin Morel, ETI oxyfuel instructor Aaron Styles, ESAB product line manager John Henderson and ETI student Dewaun Stephens laid out a few key tips for oxyfuel operations. Those tips, however, just scratch the surface of the learning opportunities available at ETI.

As exemplified in the following photo gallery, the range of information presented to students at ETI is wide and comprehensive. The day's taping included a nice sampling of what students can expect to learn during level one of the ETI four-part program: Introduction to Welding.

Life Is a Classroom

In 1977, the founders of the Chicagoland area's largest HVAC/R contracting company decided to take recruitment and training into their own hands. With a goal to produce more skilled technicians, they opened the doors to ETI. Several years later, the school expanded beyond HVAC/R training and launched its welding program. Shortly thereafter, the school received approval from the Illinois State Board of Education. Accreditation from the ACCSE and the AWS followed.

The founders knew that accreditation would be key for a variety of reasons, including the ability to offer Title Four funding, giving the school the ability to work with military students. They also quickly took into consideration the needs of their students, offering both day and night classes.

After graduating from ETI, students don't just walk off into the sunset. It's quite typical, in fact, for graduates to continue taking advantage of the school. Graduates can come back at any point in their careers to achieve additional certifications at a reduced cost. Currently, ETI offers testing for 38 certifications, and with a certified welding inspector on site, that number can easily grow if an alumni needs to be certified in a specific process.

"The biggest benefit for our students is that ETI is their forever classroom," Scheldberg says. "They can come back and refresh, retrain, or practice at any time they want."

The opportunities that are afforded through the ETI program are unparalleled. Not only can students land a good paying job, but they can also live the life that the American Dream promises.

"Our students want the white picket fence," Scheldberg says. "They want to be able to travel and have financial freedom. And these professions give them the ability to do that. They're making incredible money and they're moving forward in life. The skills that we're teaching them open so many doors and gives them career options that they didn't have before. Watching these students graduate with confidence in themselves is incredibly rewarding."

Proper Oxyfuel Techniques Photo Gallery

These photos illustrate just a few of the oxy-fuel techniques taught at ETI. For more details about their cutting, welding, and HVAC/R curriculum, visit eticampus.com. For more information on Victor gas equipment, its use, and safety, visit esab.com.

Always keep gas cylinders capped during storage and transportation, removing the cap only when you're ready to use the cylinder.

Visually inspect all threaded connections for signs of damage and contamination by grease, oil, or particles. Under high pressure and in the presence of oxygen, contaminants can easily combust.

Before installing the regulator, briefly crack open the cylinder valve to blow out particles that might have been missed during visual inspection. Stand to the side or behind the valve, keeping your body out of the high-pressure gas flow.

Continued on next page.

Use a wrench to tighten all metal-to-metal connections. This includes the regulator cylinder valve nut and hose connections. Hand-tighten connections involving an O-ring (such as between the torch handle and cutting attachment), as over-tightening could deform the O-ring.

Open the oxygen cylinder valve all the way, as it is designed to seat in the fully open position.

Open the acetylene cylinder valve 1/2 to 1 turn and no more. This permits quickly closing the valve in the event of an emergency.

After setting flow rates, spray connections with soapy water. If a soap bubble occurs (see inset), tighten the connection and re-adjust flow rates if necessary.

When setting gas flow rates, consult the manufacturer's tip chart. For the Victor 1-101 Series size #1 tip is used here, set oxygen flow at 30 to 35 CFH and acetylene flow at 3 to 5 CFH

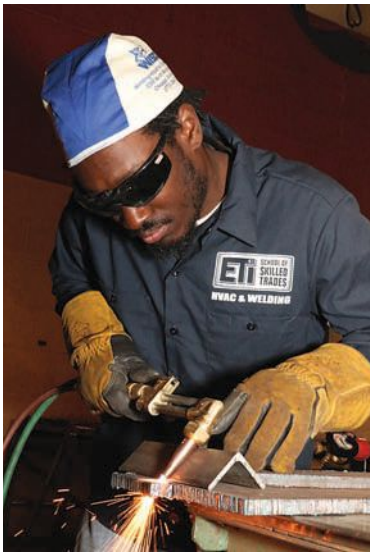
Open the oxygen valve on the torch handle all the way to ensure maximum flow to the cutting valve, open the acetylene valve 1/4-turn, and ignite the torch with a spark lighter, holding the lighter off to the side of the tip.

After lighting, the flame will generate a lot of soot and smoke. Continue opening the fuel valve until the smoke disappears.

After the soot disappears, transfer to the oxygen valve on the cutting attachment and slowly add oxygen until establishing a bright neutral pre-heat flame. Depress the oxygen cutting lever and release it; if necessary, re-adjust the oxygen level so that the flame shows both good pre-heat cones and a good cutting oxygen stream.

Hold the torch about 1/8 in. off the plate and at the edge of the plate until the steel reaches its kindling temperature, as indicated by a cherry red color.

To check if the metal has reached its kindling point, slowly depress the cutting oxygen lever. If the cutting oxygen does not quickly burn through the plate, back off—otherwise, the result will be the shower of sparks shown here.



To bevel an edge, the operator uses a piece of angle iron and keeps it in place with another plate.

Use your offhand to brace the torch. You can push or pull the torch depending on the situation, but in any event, tilt the head of the torch about 5° in the direction of travel.

Continued on next page.

The major equipment manufacturers design equipment so that it is inherently safe to use. For example, this premium torch features built-in check valves and flashback arrestors.

An oxy-fuel bevel cut—not bad for a student bevel cutting for the first time.

Some of the newer torches on the market help operators learn faster by providing visual cues, such as arrows for open and close directions.

Instructor Aaron Styles pre-heats the plate in preparation for a pierce.

When piercing, lift the torch up when depressing the cutting oxygen level. Doing so prevents molten metal from splashing on to the cutting tip and clogging the orifices or otherwise reducing tip life. Resume normal torch height after the flame pierces through the plate.

Instructor Aaron Styles says that attending a school such as ETI emphasizes proper safety practices to ensure that everyone gets to go home safely at the end of the day.

Finished videos:
https://www.youtube.com/watch?v=9Mye3DANlWA
https://www.youtube.com/watch?v=nrmlJiRRe9o

Dealing with Welding Fumes

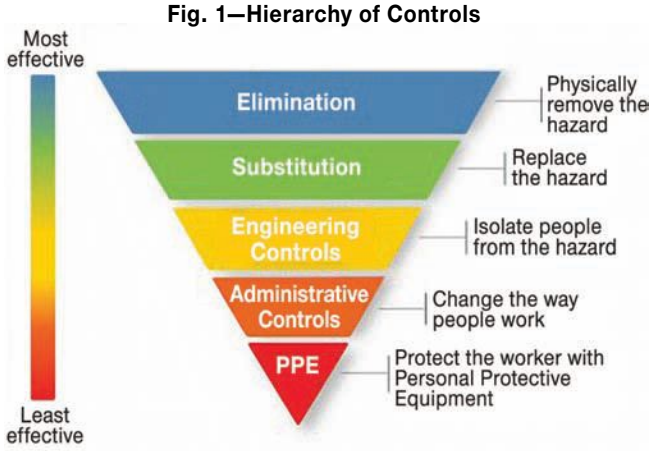
By Asra Jawaid

SIMPLY leaving the shop door open for ventilation isn't always enough to prevent the inhalation of dangerous welding fumes. This is particularly true when hardfacing, welding stainless steel, or doing projects that require high arc-on time.

Hardfacing also involves heavier flux-cored wire. "Hardfacing is an application that has higher fume-generation rates than just joining two pieces of metal together," says Allan Hilbert, product manager for Filtair equipment at Miller Electric. "When you're doing overlays and rebuilding surfaces on larger pieces of earthmoving equipment, there's a lot of welding at any given time. And during that time a worker could be overexposed very easily."

A welder's exposure can only be determined by taking a sample of the welder's breathing air during the workday, which is essential when hardfacing, working with stainless steel, or joining other materials that require special ventilation products. The two most common exposure limits are permissible exposure limits (PEL), which were established by the Occupational Safety and Health Administration (OSHA) and Threshold Limit Values (TLV), which were established by American Conference of Governmental Industrial Hygienists (ACGIH).

Fig. 1—Hierarchy of Controls



Hilbert believes the best way to prevent potential problems with welding fumes is to enact OSHA guidelines known as the **Hierarchy of Controls** (Fig. 1). The hierarchy includes elimination and substitution, engineering controls, administrative and work practice controls, and personal protective equipment (PPE).

Elimination and substitution remedies are designed to prevent potentially harmful exposure. For example, you might consider switching to shielded metal arc welding (SMAW), to gas metal arc welding (GMAW) with a solid or metal coated wire, or opt to use low-manganese filler metal. "This could mean changing consumables away from heavier wire," Hilbert says. "Take a close look at your process and what you're using; there may be another way to accomplish your goal with less fume generation."

Engineering controls involve physical changes to the workplace. These can include isolation, such as enclosing the welding process, or ventilation, which includes capturing material at the source (local exhaust ventilation), and/or ambient collection. "Ventilation is the most common precaution," Hilbert says. "There are a number of ways to achieve this." Depending on the application and the workspace, natural ventilation, mechanical ventilation, or local capture devices can be used to keep fumes and gases out of a welder's breathing zone.

Administrative and work practice controls are those that require the welder or employer to do something. For example, welders should reposition their head and/or the work to keep their head away from the fumes. They should also reposition their body so that the air flows from back to front, away from the breathing zone.

Employers can also introduce policies to ensure that welders are not overexposed to fumes and gases. "There are some companies that have gone to vision tests to

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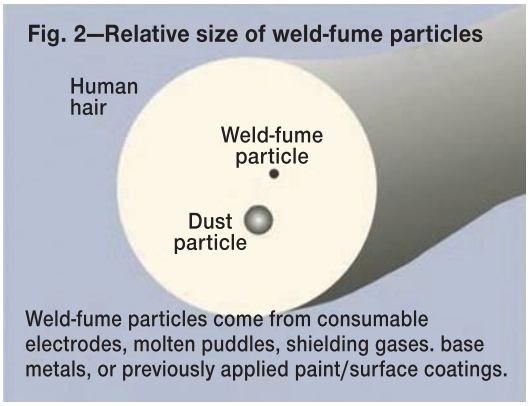
Asra Jawaid served as a contracted blog writer for the American Welding Society from 2016–2017. Article courtesy of American Welding Society, reprinted from their website, https://awo.aws.org/2017/05/welding-fumes-reclassified-as-group-1-carcinogen/.



make sure their welders could see well, because guys had their heads too close to the weld," Hilbert says. To learn more, see the AWS Ventilation for Welding and Cutting Safety and Health Fact Sheet and clause 5 of Z49.1 Safety in Welding, Cutting, and Allied Processes.

If OSHA mandated engineering and workplace controls cannot keep exposures below applicable limits, then welders must wear **personal protection equipment (PPE)** such as NIOSH-approved respirators. Each type of respirator is given an assigned protection factor (APF), which is the level of protection it will provide when used properly, together with a written respiratory protection program.

To maximize the benefits of respiratory protection, it's also important to ensure each employee has selected a respirator that provides a comfortable fit and doesn't negatively impact productivity. Respirator inspection is an important precaution that can help ensure that the welding operator is fully protected. To learn more, see the AWS Respiratory Protection Basics for Welding Operations Safety and Health Fact Sheet and clause 4.5 of Z49.1 Safety in Welding, Cutting, and Allied Processes.

What Are Welding Fumes and Gases?

Welding fumes are made of very small, and thus easily inhaled, solid particles, that come from welding consumables, base metals, and base metal coatings (Fig. 2). In addition to the shielding gases used to protect and enhance the properties of the weld, gases are sometimes the byproduct of the welding process itself. The amount and composition of these fumes and gases depend on filler metal and base material composition, welding process, current level, arc length, and other factors.

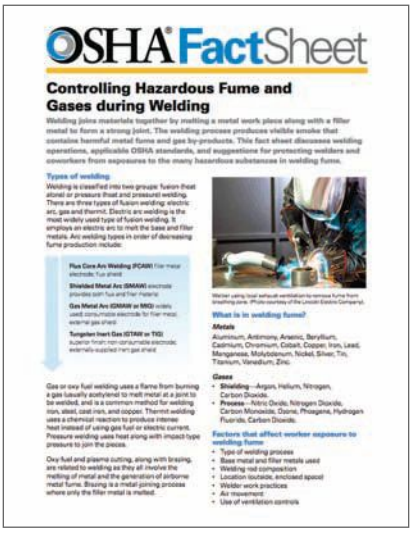
For example, the welding of mild steel produces fumes that commonly contain iron, manganese, and silicon, although the electrode or base metal may produce fumes with other compounds as well. Fumes generated from the use of stainless steel and hardfacing products are likely to contain chromium or nickel which have been reported to cause asthma as well as lung cancer in non-welding processes.

Above recommended levels of manganese can affect the central nervous system, resulting in irreversible coordination problems, difficulty speaking, and tremors in the arms and legs. Welding galvanized steel can potentially expose welders to dangerous levels of zinc. This can lead to "fume fever" which causes symptoms like those associated with the common flu.

The most common shielding gases used in arc welding include argon, helium, and carbon dioxide. While these gases usually do not pose a health risk, they can displace oxygen in the surrounding air. This, in turn, can causes dizziness, unconsciousness, and even death. Excessive levels of carbon monoxide can also be dangerous.

If a welder feels overexposed to the fumes, he or she should stop welding and go outdoors for some fresh air immediately. If the unease persists, consult a doctor. The supervisor and any co-workers back at the shop should be aware of the situation and how best to avoid the hazard. It's best to suspend welding until the situation is resolved.

For more information, refer to OSHA's Controlling Hazardous Welding Fume and Gas Fact Sheet.


OSHA FactSheet

Controlling Hazardous Fume and Gases during Welding

Online Resources

OSHA Permissible Exposure Limits—Annotated Tables
https://www.osha.gov/dsg/annotated-pels/

Threshold Limit Values http://www.acgih.org/tlv-bei-guidelines/policies-procedures-presentations/overview

AWS Ventilation for Welding and Cutting Safety and Health Fact Sheet
https://www.aws.org/library/doclib/fs36-201404.pdf?_ga=2.166017150.1758031131.1516047652-1308510120.1515096341

ANSI Z49.1 Safety in Welding, Cutting, and Allied Processes
https://app.aws.org/technical/AWS_Z49.pdf?_ga=2.196416492.1758031131.1516047652-1308510120.1515096341

AWS Respiratory Protection Basics for Welding Operations
https://www.aws.org/library/doclib/fs38-201309.pdf?_ga=2.196571372.1758031131.1516047652-1308510120.1515096341

OSHA's Controlling Hazardous Welding Fume and Gas Fact Sheet
https://awo.aws.org/wp-content/uploads/2017/05/OSHA_FS-3647_Welding-Fumes-and-Gases.pdf

From the best-selling *Technology's Past* books by Dennis Karwatka

Meet the Inventor of the Electric Welder

Elihu Thomson

Hall of History

MANY factories use electric welding to permanently fasten metal pieces together today, employing robots to do the job. Industrial robots use electricity to join metal in a manner almost identical to that first demonstrated by 23-year-old Elihu Thomson in the autumn of 1876.

Every auditorium seat was filled during the last of his five lectures at the Franklin Institute in Philadelphia. Thomson first charged a Leyden jar (capacitor) with a static voltage generator. He discharged the Leyden jar through the secondary wires of a transformer instead of the primary wires. The voltage in the secondary wires induced a large current flow through the primary windings. The high current produced an arc that melted and fused the barely touching primary leads. The leads had welded together.

Thomson was born in the industrial city of Manchester, England, where his father was a textile mill mechanic. An economic depression in 1857 forced the Thomson family to consider its alternatives. Thomson was five when his family moved to Philadelphia, the industrial center of America at the time. The older Thomson found steady employment as a maintenance engineer at a sugar machinery company.

Thomson's parents always encouraged his interest in reading and science. That encouragement was instrumental in his completing elementary school at the age of 11. Too young for high school, Thomson then spent two years conducting electrical and chemical experiments at home.

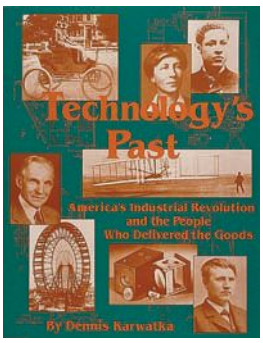
Thomson was an excellent student, and he graduated from Central High School in 1870. Six months later, the school offered the teenager a position teaching chemistry, physics, and electricity. Thomson became friends with fellow teacher Edwin Houston, who was only seven years older than Thomson.

The two men decided to work together on inventions. Their first successful one was a machine that separated cream from milk using centrifugal force. Their small income from royalties allowed them to buy and experiment with electrical devices. They specialized in dynamos, direct current (dc) generators. Dynamos produced electricity

Born:
March 29, 1853, in Manchester, England

Died:
March 13, 1937, in Swampscott, Massachusetts

This article is reprinted from Technology's Past—America's Industrial Reveloution and the People Who Delivered the Goods*, by Dennis Karwatka. To order your own copy, visit www.techdirections.com/bookshistory.html.*

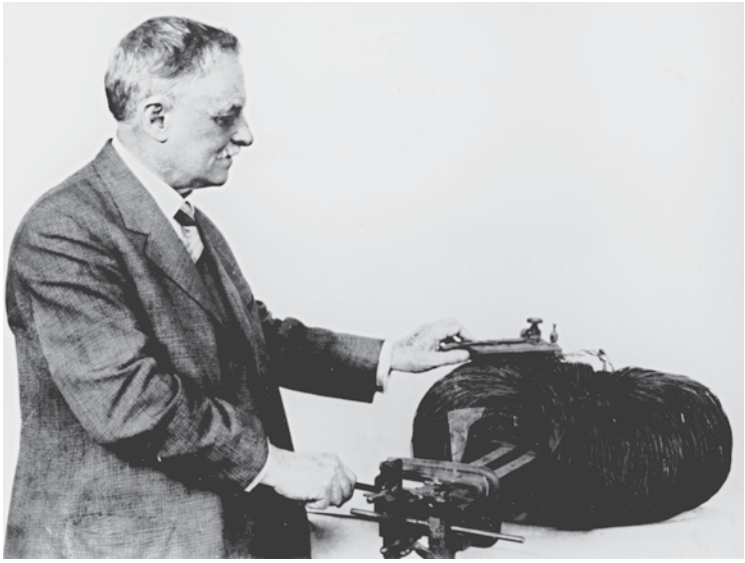


for arc lights used in factories and on public streets.

Thomson and Houston had some difficulty testing their designs because no indicating meters existed at that time. The two men had to make measurements with galvanometers and Wheatstone bridges in a variety of complex circuits. They eventually constructed several 500 V, 750 rpm dynamos for the 1,200 and 2,000 candlepower lamps used in street and factory lighting.

In 1879, by winding three overlapping armature coils, Thomson developed the world's first three-phase alternating current (ac) generator, or alternator. Through a simple change in connections, it could provide dc electricity through a commutator or ac electricity through slip rings. The more efficient alternators began to compete with dynamos. Production of ac required less mechanical power from steam engines than did production of dc.

Thomson and Houston sold their first three-phase alternator to a bakery in Lynn, Massachusetts. It was optionally wired as a dynamo and sold as part of a complete arc-lighting system. The sale led to other contracts and the two partners opened an electrical manufacturing



Hall of History

Elihu Thomson with his first electric welder

factory in Lynn. Thomson acted as the chief engineer of the Thomson-Houston Co.

The company gained great prominence and soon dominated the electrical manufacturing industry. By 1888, customers were using 358 Thomson-Houston dynamos and 44,417 arc lamps. The Thomson-Houston Co. employed 3,800 people in 20 buildings on a 23-acre site. Besides dynamos and alternators, Thomson-Houston also manufactured motors, electrical distribution systems, and equipment for electric railways.

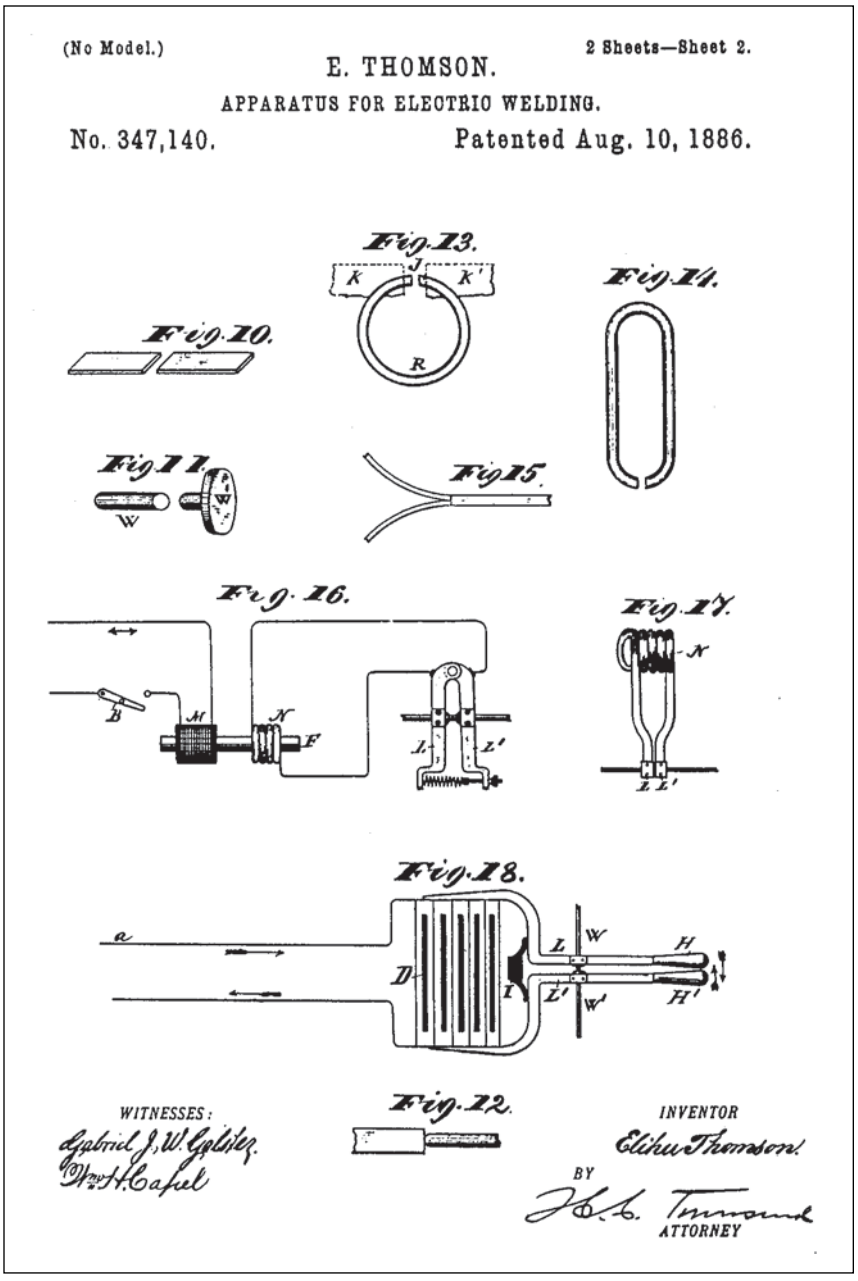
During the early 1880s, Thomson patented such inventions as shaded-pole electric motors for household appliances and automatic current regulators for transformers. He also patented air- and oil-cooled transformers and a wattmeter. Always interested in safety, he devised the grounded secondary of a transformer as a way to save lives. In 1883, Thomson conducted the world's first efficiency tests of a dynamo at the Franklin Institute.

The Thomson-Houston Co. merged with the Edison General Electric Co. in 1892 to form the General Electric Co. For the rest of his life, Thomson remained General Electric's consultant in technical matters and patent litigation.

Electric welding has been called Thomson's greatest contribution to industrial advancement. For many years, though, his numerous electrical interests and manufacturing responsibilities kept him from fully investigating electric welding.

In 1885, Thomson built a demonstration transformer and reversed the coils as he had done in his 1876 experiment. The secondary side consisted of a single ring of 1" × 4" copper bar with ends that protruded to serve as terminals. The primary side consisted of many windings of wire wrapped around a copper ring. The entire doughnut-shaped device was about 2' in diameter and weighed 1,000 pounds.

Thomson's welder combined pressure with heat, which came from the metal's resistance to the flow of current. The pressure came


(No Model.) 2 Sheets—Sheet 2.

E. THOMSON.

APPARATUS FOR ELECTRIC WELDING.

No. 347,140. Patented Aug. 10, 1886.

Fig. 13. Fig. 14. Fig. 10. Fig. 11. Fig. 15. Fig. 16. Fig. 17. Fig. 18. Fig. 12.

WITNESSES: Gabriel J. W. Galster. Wm. H. Capel.

INVENTOR Elihu Thomson.

BY ATTORNEY

Thompson's electric welding patent shows the transformer in Fig. 16

from clamps on the ends of the copper ring. Thomson's welder easily fused 1"-diameter steel rods in a few seconds.

Thomson took out a patent on his welder in 1886 and organized the Thomson Electric Welding Co. to manufacture it. Thomson welders resembled metal lathes. Roebling Iron Works in Trenton put his first commercial welder in operation in 1888. In describing the welder's functioning, a U.S. Ordnance Department report that year stated that current flows "sometimes reach 50,000 amperes." Thomson demonstrated his welding equipment at the 1889 Paris Exposition. The U.S. commissioners called it "one of the few recent developments of an important character in an entirely new direction." Thomson later exhibited 12 machines at the 1893 World's Columbian Exposition in Chicago. The largest had a 60 kilowatt capacity. However, Thomson usually demonstrated a smaller 300 Vac, 1,000 W unit. It easily welded 1/4"-diameter rod. The exhibit won a gold medal.

The International Electrical Con-

gress was held at the 1893 exposition. With delegates from 10 countries, the congress reached final agreement on the international units of the ohm, volt, ampere, coulomb, joule, watt, and henry. The congress chose Thomson, the best known of the six American delegates, to serve as its chairman. The group also selected Thomson's wattmeter as the exposition's standard reference.

An excellent and captivating speaker, Thomson was equally comfortable before groups of children or scientists. He was very active in a dozen professional societies, serving as an officer several times. He wrote many articles for scientific and technical journals.

His development of electrical welding was only one aspect of an extensive career that saw him gain world renown as an electrical expert. He accumulated a remarkable total of 696 U.S. patents—second only to Thomas Edison's 1,093. Thomson received 17 international awards and decorations, as well as honorary degrees from five colleges, including Harvard and Yale. He served as president of the Massachusetts Institute of Technology from 1920 to 1922.

Thomson was the foremost expert in the electrical manufacturing field, yet he had a pleasant manner, a trait often seen in people of high professional attainment. His hobbies included color photography and astronomy. He made the 10" lens for his own refracting telescope. He also enjoyed playing a pipe organ he had in his home at Swampscott, near Lynn.

Thomson and his first wife had four sons. His first wife died in 1916, and he remarried a few years later. Thomson had many significant technical accomplishments, his peers liked and regarded him highly, and he lived a long life. Still, Thomson's name is little known today, and it appears in few technical references.

References and Resources

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Modern Apprenticeships Offer Path to Career—and College

No longer an either-or proposition: Students plan apprenticeships then college on the way to the workforce.

By Tara García Mathewson

At least in word—if not always in deed—school districts across the United States have shifted from preparing students for college or careers, to preparing students for college and careers. District missions and visions have been re-written to reflect efforts to ready graduates for both paths, a signature goal of former President Barack Obama's Race to the Top education program.

But the difference between word and deed is an important one. And closing this gap is a major challenge for schools.

In Colorado, there's a nascent effort to use apprenticeships to give high schoolers work experience, and to do so in high-wage, high-demand career fields. At the end of the apprenticeships, which last three years, students have on-the-job experience, a useful credential in hand, and one year of college credit. They also earn about $30,000 in wages over the duration of the program.

Modern apprenticeship programs give young people a chance to train for future welding careers, among others.

The program, CareerWise Colorado, has placed 116 apprentices from four school districts with 40 employers this year, its first. Students split their time between a traditional classroom, the workplace, and a training center, where they receive technical instruction they'll need on the job. The program starts the summer before a student's junior year and ends one year after high school graduation.

Gretchen Morgan, president of CareerWise Colorado, a nonprofit intermediary that brings schools together with employers, said during a panel at the Global Learning Network conference last month in Boston that the program is designed to meet the needs of students and companies alike. That's what should make it sustainable.

For companies, there's fresh talent and a financial return on their investment in students. At the beginning of the apprenticeship, students are paid more than their productivity might warrant. But by year three, they're significantly more productive than their wages. In the Swiss model on which CareerWise is based, companies see an average return on investment of about 10%.

Students, of course, earn money, along with the credential, transfer credit to college and work experience that could lead to a full-time job. They also build a professional network, which Morgan said can go a long way toward alleviating inequality. ▶

Tara García Mathewson is a staff writer for 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.*

"People have the networks they are born into," she said. Children of white-collar parents often receive professional exposure early on that helps them make informed decisions about career pathways. For students who aren't born into these networks, school-based apprenticeships can help create or expand them.

CareerWise has made sure to limit barriers to entry for prospective apprentices. There is no GPA requirement to apply. Students just need to be able to graduate on time and have enough space in their schedules to accommodate the program. Morgan said Denver Public Schools has been particularly committed to supporting apprentices who need extra academic help. High-achieving students also tend to be drawn to the program as a way to make themselves more marketable for future jobs.

CareerWise did find it more difficult than expected to recruit students, however. School counselors and parents, especially, had to be convinced that this modern apprenticeship system wasn't a second-tier alternative to college, as traditional vocational education has sometimes been. CareerWise's leaders stressed to families that the companies partnering with their program are in high-growth fields—information technology, advanced manufacturing, business operations, healthcare, and financial services.

In Switzerland, 70% of young people choose to do apprenticeships through their schools.

Bob Schwartz, a professor emeritus at the Harvard Graduate School of Education and co-leader of the Pathways to Prosperity Network, said at the Boston conference that many career-focused programs in high schools around the country now emphasize partnerships with similar industries, in part to change the image of career education.

And Schwartz expects the popularity of career education would be very different if parents were removed from the equation, and young people themselves could choose between a traditional high school education and an opportunity to mix work and learning, earn money and a credential with labor-market value, and still leave open the option of post-secondary education.

"If we put that choice to young people, I'm sure they would vote with their feet," Schwartz said.

In Switzerland, which provided the inspiration for CareerWise, fully 70% of young people choose the apprenticeship route.

In Colorado, CareerWise hopes to expand over the next decade to serving 20,000 apprentices per year—10% of the state's juniors and seniors. And that's a start.

More Than Fun Answers

Computer Conundrum

1. Main frame
2. Back up
3. Fortran
4. Hard copy
5. BASIC
6. Download
7. Binary
8. Firewall
9. Laptop
10. Output
11. E-mail
12. Password

Edison's Inventions

They are all Mr. Edison's inventions!

Edison had 1,093 patents across a wide variety of technology areas. He is one of the most versatile and prolific inventors ever.

Hold the Anchovies Please!

The tax rate is 6.7% and the student discount is 15%.

They paid $12.96 plus 87¢ tax for lunch for two. Therefore, the tax rate is 87¢ ÷ 12.96 = .067 = 6.7%.

Since the total bill for the student was $5.88, the bill for her buffet and drink was $5.51.

Let x = charge for her buffet and drink.

Then $x + .067x = 5.88$.

So, $1.067x = 5.88$, and $x = 5.51$.

Since Mr. and Mrs. P each were charged $6.48 for a buffet and drink, the students got a discount of $6.48 – $5.51 = 97¢.

So, the discount rate for students is 97¢ ÷ $6.48 = 0.14969 = 15%.

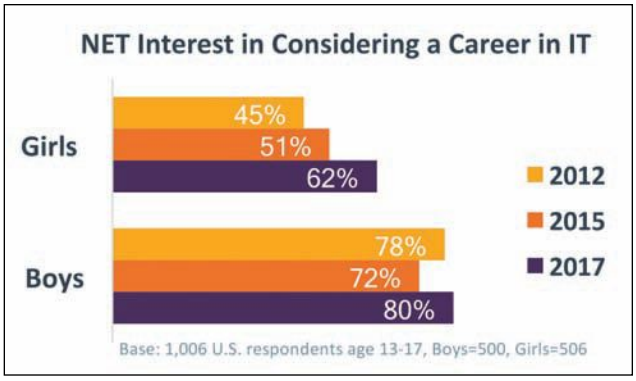
Stoking the Growing Interest in Tech Careers for Teenage Technologists

By Eric Larson

TO say technology is an integral part of the average American teenager's lifestyle is a slight understatement. Creating IT Futures' latest study, "Youth Opinions of Careers in Information Technology," reveals that about three quarters (74%) of boys and about two thirds (65%) of girls in the 13-17 age range go so far as to say they "love" technology. In fact, more than half the teens we surveyed late last year answered that friends and family usually turn to them for "tech support," such as answering questions and troubleshooting issues with computers, software, or mobile devices.

But does their high comfort level with tech mean these teens are suited for successful careers working with information technology?

Our research shows more and more young people are asking themselves this question. Seven in 10 teenagers



we polled reported they are open to the possibility of a career in the tech arena. That finding represents a 62% increase from the results of our last teen study of this kind two years ago.

The largest increase in tech interest comes from girls. In the latest survey, 62% of girls said they would consider a tech career, an increase of 11% from 2015. Among boys, 80% have considered technology as a career option to some degree, up from 72% in 2015.

Why the boost in positive perceptions? Our researchers found most teens see IT careers as lucrative and as offering the opportunity to do creative, innovative work. They also think that working in technology means the possibility to work in an appealing work environment with smart people and plentiful jobs.

The findings are welcome these days, as the need to attract a new generation of tech professionals is critical. The U.S. Bureau of Labor Statistics projects that through 2024 more than 1.2 million IT jobs will need to be filled due to industry growth and Baby Boomer retirements. Failing to address this looming tech talent gap has troubling implications for workers, employers, and the entire U.S. economy.

So, how do educators in the career-technical and STEM fields do their part to stoke this growing interest in tech careers?

First, we believe educators should view the mission as encouraging teens to become more than technicians. They should become technologists.

"Technologist" is not a term we hear often in education circles, but it should be. It is a label that applies not only to the day-to-day work of people in jobs of all shapes and sizes across the country, but also to a broad spectrum of industries beyond those that create software and build hardware.

Who is a technologist? Technologists have diverse interests and multifaceted personalities, but most share these five traits:

1. A Technologist Thinks Strategy First

The definition of "strategy" is a "plan of action or policy designed to achieve a major or overall aim." Technologists favor strategies before tactics – i.e., the actions and activities implemented to achieve an objective. Before they start working with technology or put technology to work, technologists step back and plan.

2. A Technologist Has a Passion for Solving Problems and a General Sense of Curiosity

Technologists don't see problems as obstacles to avoid. Rather, they consider problems to be opportunities for solutions. Their innate curiosity leads them to confront

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Eric Larson is senior director of Creating IT Futures' signature initiative, IT Futures Labs, which discovers and develops research, projects, programs, and best practices for charting new pathways to tech careers.

How Today's Teens View Tech Careers

	Age 13	Age 17
Positive Perceptions		
Pays well	58%	58%
Opportunity to be creative / work on new products, apps, etc.	60%	56%
Opportunity to use technology to make a difference	49%	57%
Lots of available jobs	33%	46%
Appealing work environment / work with fun, smart people	42%	43%
A job that's well respected	29%	40%
Negative Perceptions		
Working alone sitting in front of a computer all day	39%	45%
Difficult, complicated work	30%	40%
Jobs are mostly located in Silicon Valley and large cities	19%	21%
Boring work	16%	21%

challenges even when those solutions are not obvious.

3. A Technologist Sees Technology in a Constructive Context

Technologists appreciate that, in the broadest sense, technology is a tool with a value determined by its application for the benefit and assistance of people, whether in their personal or professional lives.

4. A Technologist Believes Tech Is About Humans, Not Hardware

Technologists see gadgetry as solutions that serve people. No gadget has value unless it helps a customer, colleague, citizen, patient, or any other type of person a technologist may encounter during their career.

5. A Technologist Values Respect, Cooperation, and Collaboration

Technologists maintain a positive, helpful disposition on the job and in relationships in or out of the workplace. They respect their employers' codes of conduct, appreciate the contributions of colleagues, and understand that going rogue isn't the best way to analyze a problem, execute a strategy, or implement a solution in a business context.

The best way to understand and appreciate the work of technologists is to see them in action. And this is where our research uncovered a challenge. Teens tend to look to people in their close circle, family or people who they know, that work in the industry as reliable sources of information. Trouble is fewer than 3 in 10 (33% of boys and 24% of girls) know someone who works for a technology company or has a job in technology.

Schools may be able to help bridge this gap by offering firsthand experience. More than half (54%) of the students in our study cited teachers and career counselors in schools as primary sources of career guidance. So, educators appear to be in prime position to steer teens to clubs, camps, and other programs that offer a slice of life as a technologist. And initiatives like NextUp, are primed to give schools a helping hand.

We created NextUp to introduce teens to the many possibilities of technology careers. Through curricula, projects, partnerships and mentorship, we aim to tap into their passion for technology, spark their curiosity and build a generation of technologists for tomorrow. Our volunteers augment the work of CTE educators by mentoring students in hands-on STEM projects, while sharing why they love their careers as technologists.

Here's how we work with partners in the education and business worlds to fuel IT enthusiasm:

FUSE, a Northwestern University program that's expanding and enriching STEAM (STEM plus Arts & Design) learning, with attention to IT concepts and skills for students in middle and high school.

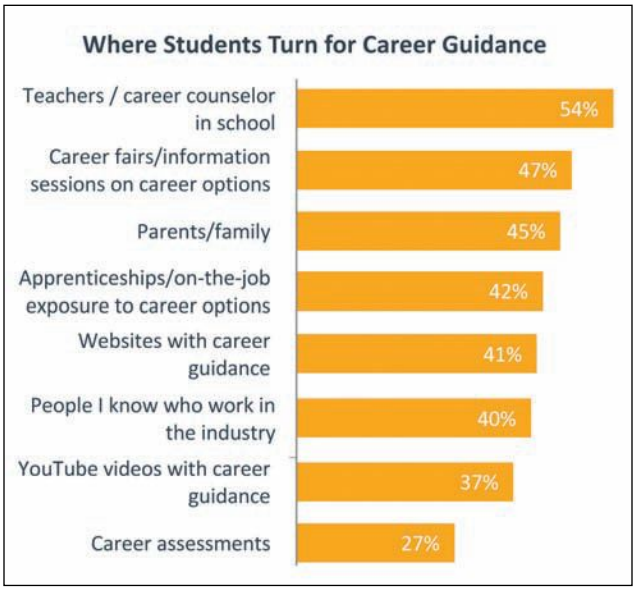
The New York Academy of Sciences, where CompTIA's network of IT professionals mentor students attending the academy's afterschool and summer programs.

TechGirlz, which offers fun and educational hands-on workshops, called TechShopz, and an annual Entrepreneur Summer Camp, all aimed at getting middle-school age girls interested in various kinds of technology.

The Technology Student Association (TSA), made up of 250,000 students in 38 states who go head-to-head each spring in several STEM team-based competitions.

In these programs, teenage students work with each other and work with working technologists. We feel it's the best way to counter the negative perceptions of tech careers our research uncovered, too. Nearly half of teenagers are concerned that careers in IT could be isolating, with long stretches of sitting alone in front of a computer all day. Girls more than boys have this perception.

Together, schools and organizations like Creating IT Futures can give teenage technologists a broad perspective beyond the classroom into their future in the working world—a pathway that enables them to translate their love of technology into a career they will love.



Be a Part of Building Bridges
within the STEM Community and Beyond!

ITEEA's 80th Anniversary Annual Conference in Atlanta

Gene Phillips, courtesy of ACVB and Atlanta Photos.com

BUILDING on the success of the Dallas conference, ITEEA continues planning for their 80th Anniversary Conference in Atlanta, GA, April 12-14, 2018. The theme is "Building Bridges within the STEM Community and Beyond." Making connections is a critical component of success for educators, and the 2018 ITEEA Conference will bring you up to speed on connecting with your colleagues, the broader STEM community, and with STEM decision makers.

With over 100 learning sessions, preconference workshops, the STEM Showcase, the latest products and services, dedicated Integrative Administrator and STEAM strands, competitions, and more, the 2018 Atlanta conference offers an unparalleled integrative STEM professional development opportunity.

New This Year— The ITEEA Action Annex!

Competitions! STEM Showcase! Ride-on car builds! Mini-Theater Presentations! It's all here for ITEEA conference registrants! Here's some of what you'll find in ITEEA's Action Annex:

The ITEEA STEM Showcase— *Highlighting Best Practices Through Integrative STEM Education!*

ITEEA's STEM Showcase is a unique and exciting event that features ideas, techniques, and best practices related to learning activities, marketing materials, career guidance, facility design, program design, assessment methods, equity, and classroom and laboratory management techniques. Showcasers illustrate a single element of technology or engineering teaching and learning that they feel they have exemplified. Attendees are invited to join ITEEA for our Celebration Reception immediately following the STEM Showcase.

Go Baby Go! Ride-on Car Build

Go Baby Go provides mobility (and play!) to very young children with special needs in the form of adapted toy ride-on cars. During the conference, faculty and students from Central Connecticut State University will be adapting several motorized ride-on cars near the exhibit floor.

Detailed information about the Go Baby Go! program and ways to get involved will be available, and all conference attendees are encouraged to stop by to see the program in action. On April 13th, the cars will be donated to children with special needs from the Atlanta area, who'll "test drive" their new rides before taking them home.

TEECA Student Competitions

ITEEA's Collegiate Association is well represented, with over 20 universities participating annually in a series of exciting competitions that require fast-paced ingenuity to solve problems and create solutions pertaining to robotics, manufacturing, and more. This year, teams competing

TEECA Collegiate Council students compete in challenges relating to transportation, manufacturing, communication, and more.

in the Transportation Challenge will work to model, design, and fabricate a new frame for an existing quadcopter that will allow it to pick up packages of varying shapes and sizes and deliver them to predetermined locations. You won't want to miss the finals!

ITEEA Mini Theaters

In Atlanta, ITEEA introduces Mini Theaters, providing a forum for action-oriented presentations on topics such as STEM Wars, BattleBots, Student Competitions, and AMPing up Your STEM Instruction!

World-Class Keynote Presentations

Cole Galloway

Neuroscientist and physical therapist Cole Galloway is most interested in rapidly prototyping novel technology (often DIY) to assist children and adults in maximizing their real-world exploration—specifically combining low tech and high tech into "Go Tech." His lab enjoys funding from NIH, NSF, the Department of Education, and the toy and assistive technology industry.

He was awarded multiple American Physical Therapy Association Awards. In 2014, he was included in Buzzfeed's "31 moments that restored our faith in humanity" and was named one of the "twenty people making a difference in healthcare." He is most proud of his association with the international Go Baby Go movement, whose mission is to help everyone co-create their world through mobility.

Watch Cole's work, which was featured in a TEDMED talk, at www.tedmed.com/talks/show?id=292991.

The recipe for growing (and regrowing) a human brain is simple: allow the human to actively interact within socially and physically enriched environments. In his fast-paced keynote address, Dr. Galloway will briefly introduce how the current model of rehabilitation for children and adults with brain injuries is failing. He will then describe how the 70-chapter Go Baby Go (GBG) "movement" is providing a community-based alternative that is more fun, functional, family friendly, and feasible. He will end with a practical roadmap of how ITEEA and GBG together can provide "brains-on/hands-on" education while saving the world!

Lonnie Johnson

Johnson is president and founder of Johnson Research and Development Co., Inc., a technology development company, and its spin off companies, Excellatron Solid State, LLC; Johnson Electro-Mechanical Systems, LLC; and Johnson Real Estate Investments, LLC.

Johnson worked as a research engineer at Oak Ridge National Laboratory, and then joined the U.S. Air Force, serving as Acting Chief of the Space Nuclear Power Safety Section at the Air Force Weapons Laboratory in Albuquerque, NM. In 1979, he left the Air Force to accept a position as Senior Systems Engineer at the NASA's Jet Propulsion Laboratory (JPL), where he worked on the Galileo mission to Jupiter.

Returning to the Air Force in 1982, he served as an Advanced Space Systems Requirements Officer at Strategic Air Command (SAC) headquarters, and as Chief of the Data Management Branch, SAC Test and Evaluation Squadron at Edwards Air Force Base. He was awarded the Air Force Achievement Medal and Commendation Medal on two different occasions.

In 1987, he returned to JPL where he worked on the Mars Observer project and was the fault protection engineer during the early stages of the Cassini (Saturn) project. He was responsible for ensuring that single point spacecraft failures would not result in loss of the mission. During his nine-year career with JPL, he received multiple achievement awards from NASA for his work in spacecraft system design.

In 1989, Johnson formed his own engineering firm and licensed his most famous invention, the Super Soaker® water gun, to Larami Corporation. Two years later, the Super Soaker generated over $200 million in retail sales and became the number one selling toy in America. Currently, Lonnie Johnson holds over 100 patents, with over 20 more pending, and is the author of several publications on spacecraft power systems.

Articles on Lonnie Johnson have appeared in numerous publications and he serves on the Board of Directors of the Georgia Alliance for Children, an organization that serves as an informed and influential voice to protect the rights and interests of Georgia's less fortunate children.

ITEEA Conference exhibitors share the latest technology and engineering products and services with attendees.

Celebrate ITEEA's 80th Anniversary Conference in Beautiful Atlanta, GA

While Atlanta is sprawling with towering buildings made of glass and steel, it is truly a city in the forest, dotted with expansive green spaces. Recently named to Lonely Planet's 2017 "Best in the U.S." list, this urban oasis is a multicultural haven for residents and visitors alike, yet exudes Southern hospitality. Individuals from all walks of life add to the city's charm and personality.

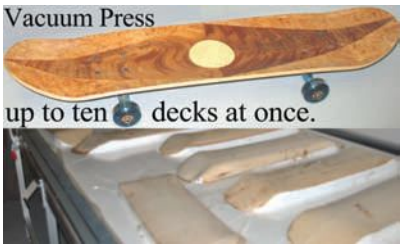
For full conference details, visit www.iteea.org/ITEEA_Conference_2018.aspx.

product spotlight

The newest and best for CTE and STEM classes

Skateboards/Vacuum Press: Free Two-Hour Instructional DVD

The best vacuum press you can buy! Teach a skill while having fun. Make skateboards and teach vacuum veneering. Let students be creative in their designs and shapes and increase their enthusiasm for woodworking. Large selection of highly reliable equipment with a pro system starting at $565. Schools receive a 10% discount.



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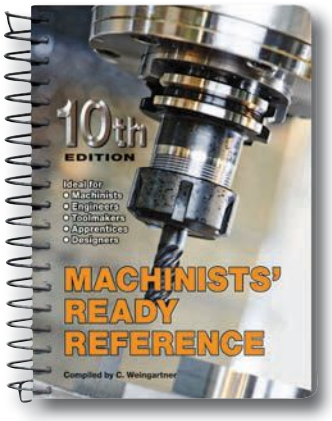

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Computer Conundrum

Can you figure out the familiar computer-related word or phrase represented by each arrangement of letters and/or symbols in the following puzzles?

1 MAIN MAIN MAIN MAIN	2 BACK	3 TRAN TRAN TRAN TRAN
4 HARD HARD	5 IC	6 L O A D
7 NARY NARY	8 F I R E	9 LAP
10	11 E	12 WORD

PUT

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

Edison's Inventions

Which of the following inventions can be attributed to America's greatest inventor, Thomas Edison?—**Harry Roman**, East Orange, NJ.

A. Recorded sound
B. Motion pictures
C. Light bulb
D. Electric light and power (utility) delivery system
E. Modern R&D laboratories
F. Office machines (dictation machines, typewriters and mimeographs)
G. Improved telephones (voice transmitter)
H. Advanced telegraphy
I. Electric vehicles
J. Storage batteries
K. Iron mining
L. Improved cement making
M. Concrete structures
N. Synthetic rubber
O. Fluoroscope
P. Basic discoveries leading directly to radio and vacuum tubes

Hold the Anchovies Please!

Mr. and Mrs. P ate at a new pizza place in town. The menu consisted of two items: (1) All you can eat pizza, pasta, salad, and dessert for $4.99, and (2) All you can drink beverage for $1.49. The bill for their lunch, 2 buffets and 2 drinks, was $13.83, which included tax. What is the tax rate in their town?

Mr. P noticed that most of the patrons were high school and college students and that they received a discount by showing their school ID. The total bill for the student in front of them was $5.88. What discount did the students get (what percent off did they receive)?

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

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.

See answers on page 24.

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