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MARCH 2019

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**Attracting Women**  
**to Cybersecurity Jobs**



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



I have been fascinated with autonomous vehicle technology for a long time. Well before it was a reality. This fall I was fortunate to experience it in person when I attended the International Manufacturing Technology Show (IMTS) in Chicago, IL. This mega-convention takes over McCormick Place every two years, and the 2018 show broke new records for booths and exhibiting companies, as well as the most exhibit space ever reported in the show's 91-year history with 2,123 booths representing 2,563 exhibiting companies spanning 1,424,232 sq. ft. of expo space.

There were many amazing exhibits, but my favorite was Olli, a 3D printed autonomous shuttle created by Local Motors (LM) and IBM. Not only did I get to see Olli in action, I got to take a ride! It was very interesting to see how Olli navigated other vehicles, pedestrians, and roadways in general. When riding Olli, seatbelts were a must as it is quick to stop, leaving riders with a jerky experience on occasion.

LM is taking this technology to the next level by doing real-world testing with its Olli fleet challenges. The winning entries for the first challenge (2018), were Phoenix, AZ, and Sacramento, CA.

The first-of-its-kind global fleet challenge invites municipalities, campuses, and designated districts to propose a short-term, local use for Olli, the world's first co-created, self-driving, electric shuttle. Entries are evaluated by a panel of esteemed judges before an Olli fleet is deployed to a series of select locations.

EVTI, Arizona's first joint technical education district, earned the bid for the Phoenix-area Olli deployment, after being evaluated among several entrants. Sacramento (CA) State University earned the bid for the Sacramento-area Olli

deployment. These fleets will be deployed in early 2019 once the areas have been mapped by Olli officials.

"Olli is already transforming the way we think about transportation and it is showing us, from its deployment in Adelaide to its deployment at the University at Buffalo, that autonomous vehicles can be safe, sustainable, and practical," Rogers said. "It's exciting to know that with each new challenge a new audience will be exposed to self-driving technology. And, we look forward to the insights that will come from each deployment as the ever-changing industry of autonomous vehicles continues to evolve."

California Congresswoman Doris Matsui, who served as a judge on the panel evaluating the Sacramento entries, said she is pleased that Sacramento State will get the chance to integrate Olli, and its innovative technology, into its campus.

"The Olli AV shuttle represents the direction our transportation is going in the near future," Matsui said. "The nature of the landscape and route chosen by Sacramento State ensure that safety is of the utmost importance during this test period. I am eager to see students and faculty alike utilize this technology and make it a part of their daily lives. Exposure to this type of technology is an important first step."

To meet Olli, visit: [youtu.be/K564rXrlZbc](https://youtu.be/K564rXrlZbc).

*Vanessa Revelli*

## techdirections

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**About the cover:** Students use squeegee tools to smoothly install the adhesive graphic film on a car hood. Photo courtesy of Roland DGA. Cover design by Sharon K. Miller.

**Vanessa Revelli**

vanessa@techdirections.com

## New One-Year General Automotive Service Certification

Beginning in winter semester 2019, Kalamazoo (MI) Valley Community College is offering a one-year certificate program in General Automotive Service (GAS). Full implementation of the new program starts in fall 2019.

"This was driven by our local employers and advisory committee that are desperate for technicians at any skill level," said Kalamazoo Valley's Automotive Department Chair Doug Martin. "It has led to a few agreements of understanding with employers that want to see their

*Vanessa Revelli is managing editor of techdirections.*

technicians progress and become more skilled. Employers are looking at sending new hires or prospective employees through the one-year certificate so they do not have to do the training in-house. This will benefit the program, the student, and the industry."

Martin explained that the certificate program is designed to provide a rapid path to entry-level technician skills. Students may enroll in the program independently, or employers may choose to send their technicians for training.

The program teaches some of the foundational skills that area employers require of their technicians who are starting in the repair industry. If students are successful, they can earn state certifications in brakes,

steering and suspension, electrical, and air conditioning. It will also provide the students with the ability to test for their MACS (Mobile Air Conditioning Society), Refrigerant Handling Certification (EPA 609).

"We have employers considering using this option for training service writers, clerical, management, and other positions," Martin said. "This industry is just changing so fast. We will strive to use the resources we have to do everything we can to keep up with employer demand."

For more information about the General Automotive Certificate, go to <https://bit.ly/2BAoSbj>.

## Girls in Tech Announces New Coding Bootcamp

Girls in Tech, a non-profit organization focused on the empowerment, education, and entrepreneurship of women in technology, has just launched CODE G: Level II. This new intermediate coding program is designed to teach web development using Python and help more women obtain tech jobs.



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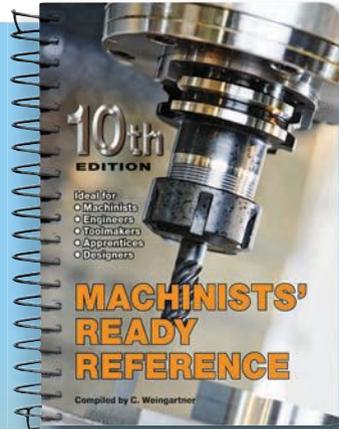
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CODE G's pilot bootcamp took place last month in San Francisco, CA, and more will take place throughout the year.

"CODE G: Level II is a great way to learn and grow Python skills," says Girls in Tech Founder and CEO Adriana Gascoigne. "We're excited about this new iteration of the CODE G program and all the opportunities it offers participants."

According to the National Science Foundation, women are underrepresented in the science and engineering workforce, although the gap is shortening. Women make up half of the total U.S. college-educated workforce, however they only make up 29% of America's science and engineering workforce.

Female scientists and engineers are concentrated in different occupations than males; women comprise 62% of social scientists and 48% of scientists working in life sciences, but only 15% of engineers; of those 25% are in computer and mathematical sciences. Education and exposure to new, job market-ready skills is one big way to reduce that gap.

The CODE G: Level II bootcamp consists of immersive 40-hour, five-day courses conducted in person for face-to-face mentorship with instructors. These courses are a mix of instruction, coding, experimentation, and deployment of original creations.

Each CODE G: Level II bootcamp hosts approximately 20 participants broken up into four to five smaller groups.

At the most recent CODE G: Level II bootcamp, participants worked on Python essentials, web development inside Flask, using Git for version control and interfacing Python sites with SQL databases, creating databases inside SQLAlchemy, and deploying Python code in cloud environments.

Finished projects included a tech company employee satisfaction visualization tool leveraging Kaggle data, a Twitter search term visualization tool, and a dynamic web app for browsing California water quality data.

CODE G was developed to help intermediate-level coders build and improve their skills. After conversations with Girls in Tech's partners who are committed to diversity, they understood that one of the tech industry's needs is to help talent with strong technical foundations bolster their skills in order to pass technical tests with day-to-day, hands-on skills that are critical for working as a web developer.

Education and confidence building are two of the most important fac-

tors needed to end gender inequality in the tech industry. Bootcamps such as CODE G are critical for closing that loop from both a technical, skill-building perspective and a practical, confidence perspective.

Working in conjunction with tech companies hiring talent every day, Girls in Tech believes that education and new initiatives such as these can make a major difference for workers entering the industry.

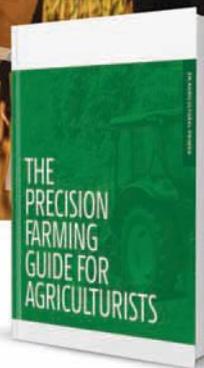
Visit <https://girlsintech.org/programs/code-git/> to learn more. 



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## David Gestetner and His Office Printing System

In the 19th century, before the use of typewriters and Xerox machines, the only way to make a few copies of a document was to hand write each one. That was time consuming and required checking each copy for errors. David Gestetner from Hungary made things much easier in 1881 with his unique patented pen and wax paper stencil. It was the first piece of office equipment that allowed production of numerous copies quickly and inexpensively.

Gestetner was born in 1854, about 80 miles west of Budapest. He had three siblings and both of his parents were involved with a restaurant business. Gestetner left school at 13 to work for an uncle who made sausages. Four years later, he apprenticed himself to another uncle in Vienna who was a stock broker.

Part of his job was to hand write



An 1887 Cyclostyle flat-bed duplicator

copies of the daily stock results—there was no other way to generate several copies of the same document. Gestetner soon tired of the

---

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

job and traveled to Chicago where he made a living selling kites. The kites used a sturdy lacquered paper called Japanese paper that had



David Gestetner in 1893

long, strong fibers. Gestetner moved to London in 1879 where he found employment with a printing company. He lived in that city for the rest of his life.

Gestetner began thinking of ways to make multiple copies in smaller runs of about 10 to 50 copies. His first innovation came just two years later. It was a hand-held pen with a small sharp-toothed rotating wheel at its tip. A user would write normally on wax-coated

Japanese paper. That created lines of text that consisted of many tiny holes—about 140 per inch—in the stencil.

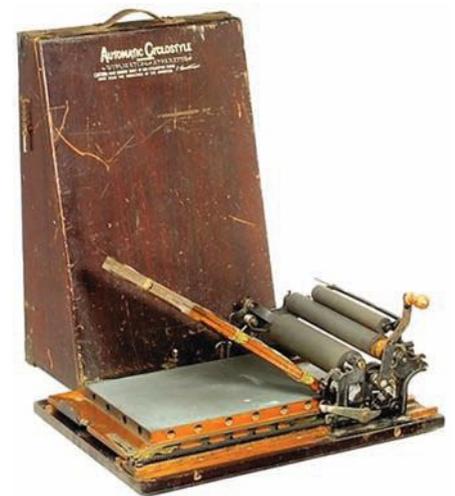
Gestetner then laid a sheet of ordinary paper on a flat plate and placed the stencil on top. Rolling ink over the stencil transferred the written words onto the paper. The

method worked well from the very beginning and Gestetner readily found financing to open his Cyclostyle Company. About 100 employees at his London factory were soon making the duplicators.

He called his special pen a Cyclostyle for "cycle" (rotating wheel at pen tip) and "style" (from stylus, the Latin word for pen). Many of Gestetner's later products used a modification of that word. The early 1887 cyclostyle system sold for about \$12.50. Gestetner eventually held at least 24 patents as he continually improved the pen, stencil material, and other equipment.

The popularization of the office typewriter a few years later provided an ideal environment for his hand-cranked rotating-drum Neo-Cyclostyle duplicator. A stencil was neatly cut on a typewriter and then wrapped around a drum. Ink inside the drum was driven through the stencil by centrifugal force and printed a clean image on a sheet of paper as it was fed through.

The Gestetner Cyclostyle duplicator was in such demand that Gestetner established several international branch offices. A related copying method called the mimeograph process was controlled by Thomas Edison and Albert Dick in America. To avoid legal conflicts, Gestetner agreed to sell his equipment only in Europe.



1897 Cyclostyle flat-bed duplicator, improved with rollers



**1922-29 Cyclostyle hand-cranked drum duplicator**

Called D. G. by most people, Gestetner married Sophie Lazarus in 1885 and they had seven children. He had few interests beyond his business and his family. His company grew to 6,000 employees in 1939 and Gestetner hired many of his family



**Cyclostyle pen tips**

members. He never retired and died in 1939 while on a vacation in France.

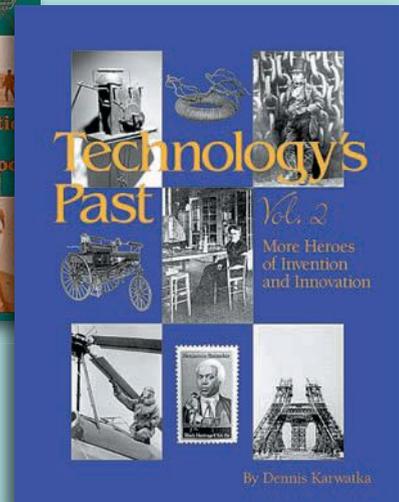
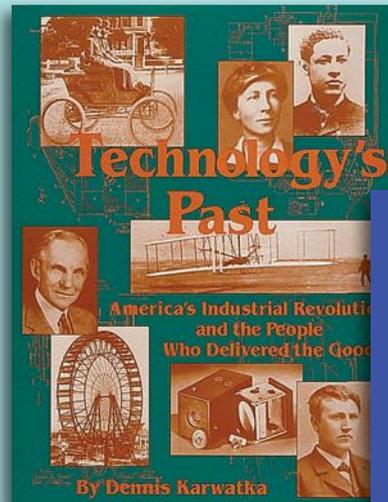
A modern-day tourist walking the streets of London might notice blue plaques on buildings that honor individuals who once lived there. A plaque was unveiled on Gestetner's former home in 2011 during a dedication ceremony attended by his grandson, two great grandchildren, and other relatives. Gestetner products are still supported by Ricoh Company, Ltd. ©

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Proudfoot, W. B. (1972). *The origin of stencil duplicating*. Hutchinson & Co. Publishers.

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## Scientists Are Now Tapping Our Brain Waves

The human body is controlled by the most amazing biological computer found in our natural world. One can argue that ours is not the largest brain found in nature, but it is the only one that can turn conscious thoughts into complex technologies.

Recognizing the power of our brains is nothing new but trying to tap into our thoughts to create cyborg human enhancements is no longer science fiction.

One of Elon Musk's newest technology initiatives is the creation of a company named Neuralink.

The goal he set for its scientists and engineers is the development of hardware that can allow the human brain to automatically interface its thoughts with artificial intelligence programs on the person's computer or smartphone. Neuralink is now hiring; if you feel you have what

Elon Musk is looking for, you should complete the application process at [www.neuralink.com](http://www.neuralink.com)

Musk's Neuralink initiative appears to be looking to create their symbiotic bio-hacking cyborg connection using devices implanted inside peoples' brains. I am sure Musk will have no problem getting volunteers for their implants when

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

Neuralink's technology is ready and approved for human testing.

At CES 2019 I found BrainCo. Founded in 2015, it has already made



BrainCo

**Photo 1 (above)—The Focus1 BMI captures brainwaves from its contact points on a person's skull**

major strides in tapping human brain waves without the need for brain surgery. The BrainCo technology was developed by scientists, engineers, and PhD students from Harvard University.

The Focus1 headband that

they created (Photo 1), is an electroencephalogram (EEG) interface that detects the electrical activity of a person's brain through contact with several points on a person's skull. The significant difference between the BrainCo brain-machine interface (BMI) and a medical EEG is the number of contact points that are detecting a person's brainwaves. You can see in Photo 2 that the BrainCo BMI only makes contact with a limited number of points on a person's skull.

At the Harvard University Center

for Brain Science the researchers and PhD students developed and tested the headband brain wave detection system. They also developed and tested the algorithms that would allow this technology to eventually become useful products after BrainCo became an independent company from Harvard.

To interpret the brainwaves that their headband interface picks up, the scientists developed algorithms that convert the brain's electrical signals into digital code that their computer programs can use to measure a wearer's concentration and focus. Their algorithms allow the researchers to measure concentration. Their system includes programs and games that are designed to help a wearer improve the attributes that the researchers or educators are going to measure.

The neurofeedback that a wearer receives, as they complete tasks in the different computer programs, are designed to help them improve their attention and focus during different types of learning activities. Photo 3 shows me wearing the BrainCo BMI at CES 2019 and working with their software. My goal was to relax my body and mind and focus my



BrainCo

**Photo 2—The BrainCo BMI uses electroencephalogram (EEG) technology, but with much fewer contact points on a person's skull than a medical EEG.**



**Photo 3—My testing of their BMI headband and software at CES made it clear to me that their 5,000 student study results could become an education game changer.**

**Photo 4—The BrainCo brainwave research study can selectively look at individual students. Its researchers and school administrators can, on the fly, measure their attention to what is going on in the classroom.**



BrainCo

games, exercises, and activities that are designed to help students relax and improve their attention and focus. When the 5,000-student brainwave study is completed the researchers will have documentation that hopefully proves that their technology can, at a statistically significant level, improve a person’s ability to concentrate and focus on different learning tasks. A successful research outcome will show that their system can determine and measure each student’s learning style, and at the same time improve the overall performance of all the students in the classroom.

The goal of FocusFIT is to use the BMI neurofeedback, algorithms, and appropriate computer games and activities to help athletes reach their

thoughts to control, only with my mind, a car on the computer screen. They have now developed proprietary algorithms and neurofeedback programs and products for education (FocusEDU), fitness (FocusFIT) and wellness (FocusNOW).

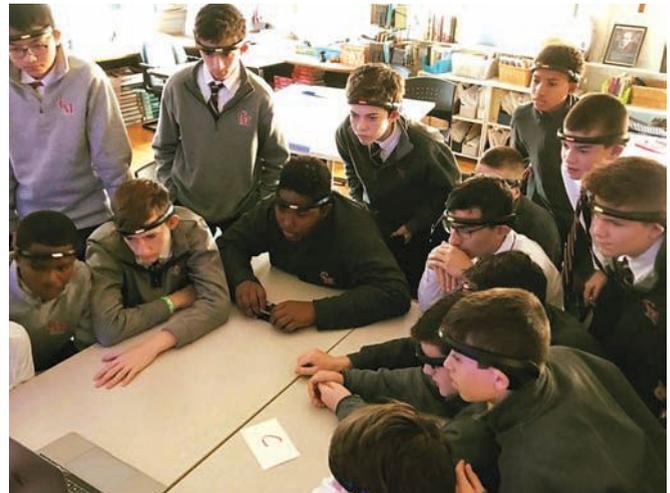
FocusEDU started out as a joint project between PhD students from the Harvard Center for Brain Science and the Harvard Graduate School of Education. Together they created the FocusEDU program. BrainCo has signed up 5,000 students in what they indicate is the “world’s largest student brainwave study.”

Through the use of the headband brain interface and the proprietary software, FocusEDU is studying the effectiveness of the headband’s ability to measure and increase student attention and focus during different types of learning activities. Figure 1 shows how the brain study research-

ers and educators can view individual students and measure their attention levels on the fly during classroom activities when the Focus1 hardware is being used (Photos 4 and 5).

The training programs include

**Photo 5— Students don’t have to be sitting at a computer for their brainwaves to be measured and documented.**



BrainCo



best performance and fastest recovery times. The wellness program FocusNOW has its own algorithms and software designed to help adults and seniors reduce stress and improve their focus and concentration.

### Taking It a Step Further

1. If, in the near future, an implant or BMI headband could give you a cyborg link with your smartphone, how do you feel this would change our education system?

2. As a class assignment, compete to see which group can identify:

- The number of animals that have larger brains than us.
- The number of animals besides us that use tools. Describe how these tools are used or made. ©

**Fig. 1—The algorithms chart the variability of student concentration and can provide insight into the individual learning styles of each student.**

# Tool and Equipment Funding

By Mark McKinney

**D**OES your program have old, worn out equipment? Do you wish to purchase additional tools for instruction? Are you repeatedly informed by your administration they do not have money for any of these? Whether you are an instructor new to automotive education or a veteran, here are some

would appear to be programs with little funding, especially when it comes to higher priced items on the “want or needs list.”

Here are some tips and ideas to acquire additional monies for your program. These may help you secure additional funding to purchase tools and/or equipment, keep your program both compliant with ASE, and

to maintain a high level of excellence in instruction. However, these ideas come with a price! You must be

willing to do some additional work to make most, if not all of these suggestions become a reality.

## Advisory Council/Committee

First and foremost, you need to have the support of your program’s advisory committee. Utilizing your advisory committee to its fullest will provide documented support for your program’s needs. Instructors will likely share their program needs with your advisory committee. Therefore, it is imperative to properly document that sharing. This begins and ends with advisory meeting minutes. If you are asking the administration for

money, requesting a donation, or applying for a grant, properly formatted and detailed advisory meeting minutes may significantly increase your chances of receiving needed funding.

## Meeting Minutes:

- List all members in attendance. Include names and areas of representation, i.e. John Doe—xyz Ford, or Jane Smith—xyz Auto Parts.
- State location, date, and time of meeting. Include time of when the meeting adjourned.
- List all members who were absent for this meeting (this quietly alerts absent members they were missed when you send them copies of the minutes).
- Detail a review of previous committee’s recommendations and their current status. Repeatedly listing in your meeting minutes that a previously recommended (anything?) has not been purchased by the district as of the date of this meeting, can eventually garner additional attention.
- Include an overview of any discussion concerning program needs,



methods which may provide some insight for acquiring additional funding.

Through the years of networking with schools, instructors, and education professionals, difficulties in funding for tools, equipment, and training aids, particularly in Automotive Training, appear common. Maybe it should be re-phrased, the “lack of funding” for these items.

Many of us have interacted with a school that seemingly has endless amounts of cash to fund programs. Even though these were few and far between, I must admit, I always experienced envy during those encounters. The far more common situation

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*Mark McKinney is an ATech instructor. This article is reprinted from the January 2019 issue of ATech Educator News.*



direction, and recommendations by your committee.

- Include significant, quotable remarks by members if and when appropriate.
- Make sure to email or snail mail a copy of these minutes to each advisory member, even those not in attendance.



- Be patient. It may take several attempts to persuade the school's administration to acquire equipment. Don't give up if it does not happen quickly.

## Funding Sources

Most career-technical schools have at least some access to Perkins funding. The Carl D. Perkins Career and Technical Education Act of 2006 (Perkins IV) is a principal source of federal funding to states and discretionary grantees for the improvement of secondary and postsecondary career and technical education programs across the nation. The purpose of the Act is to develop more fully the academic, career, and technical skills of secondary and postsecondary students who elect to enroll in career and technical education programs. For more information on the Act, visit the Perkins Collaborative Resource Network at <https://cte.ed.gov/legislation/about-perkins-iv>.

## Matching Funds

Some schools may have an opportunity to utilize a piece of Perkins funding referred to as "matching funds" which essentially means they can apply for Perkins monies that will pay 50% of the needs cost. This results in the school being required

to only pay the other 50% of the needs cost. It is recommend that you check with your school's treasurer for additional information on this.

## Grants

Don't be afraid to apply for grant monies. Often times, there may be grant money available to automotive repair programs. It is easy to say things like "I don't know how to write a grant proposal", "I do not know where to search for grants", or the inevitable "I don't have time to apply for a grant."

All grants are not created equal! Yes, some grant proposals will require significant research, documentation, and properly formatted details. If there is a grant available which requires this kind of work, seek out the help from one of your school's English teachers. They can be great help in this area.

However, many grants will require only a moderate amount of work. You will need to complete their application which will likely require you to write a story detailing your program's needs—why you need this, how will you utilize this during your instruction, how often will it be used, and how you believe it will increase student achievement. Write short, hard hitting sentences. Long winded statements will likely lose the reader.

## Grant Writing Help

Don't be afraid to seek out assistance when applying for a grant. Ask your advisory committee for help in preparing a grant application. There may be someone on your committee who has grant writing experience. Know a college student? Ask them to review your work. Research—look at successfully written grants. Obviously, there is a lot of information available on the internet and at your local library. If you are applying for a government grant, you can request copies of previously awarded grants through the Freedom

of Information Act.

Apply for multiple grants. The general application information will be similar on all grants, i.e. school info, program details, name, place, etc. The primary body of the proposal will require the most work. However, once you have the body of one written, many times all you have to do is slightly modify it for a different proposal.

Here are some automotive-related grants which may help you achieve your goal:

### RPM Foundation Grants

<https://rpm.foundation/apply-for-grant/>

### US Department of Education

<https://ed.gov/about/offices/list/ovae/pi/grntprgm.html>

### DENSO

<http://www.densofoundation.org/grants/educational-grants/>

### The College Grants

<https://www.collegegrant.net/trade-school-grants/>

### Grants for Automotive Repair Programs

[http://www.afterschoolalliance.org/afterschoolSnack/Grants-for-automotive-repair-programs\\_12-10-2018.cfm](http://www.afterschoolalliance.org/afterschoolSnack/Grants-for-automotive-repair-programs_12-10-2018.cfm)

Our profession has seen a large influx of new instructors in both



the secondary and postsecondary education levels. For many, the lack of knowledge in this area appears widespread. Ideas and suggestions for acquiring funding are always welcome. ©

# The Electrification of the Truck

By Jeff Bogue

**I**T'S coming. We have all seen the signs and it seems to be around the corner. The electrification of the truck is coming. From the Tesla all electric, the Nikola hydrogen fuel cell truck, and now even Cummins seems on the verge of jumping in with both feet. The electric truck is coming, but are we ready?

UPS and GreenBiz Group funded a study last year on the electrification of the truck and found that the upfront cost of acquiring electric trucks is the single biggest obstacle to ownership. They also found that the two main drivers of switching to electrification are the image boost and environmental benefits achieved by fielding zero and near-zero emission trucks. Respondents also said that the savings those same trucks can bring to a fleet over their operating lifetime is the second biggest advantage.

Those benefits were the top reason for electrifying, according to 83% of the respondents. With the cost of the kilowatt-hour capacity falling with each passing year, the upfront costs are expected to fall to around \$100 per kWh by 2023. That is a significant boost in initial investment costs, but the infrastructure may fall short where long haul vehicles are concerned. Trucks that make short

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*Jeff Bogue is an electronics specialist focused on research and development. He works at ATech Training as a product representative and contributor to ATech Educator News. This article is reprinted from the November 2018 issue of ATech Educator News.*

intra-city loops and then return to a central garage overnight for charging might be the first units that grab a market share. Or as Cummins is hoping, the Hybrid Diesel will fill that void.

Motor carriers and shippers around the world have placed 15,325 confirmed orders for electrified commercial trucks and buses worldwide for delivery between now and 2021, with many in the trucking industry speculating that the tipping point for truck electrification has arrived. Most of the volume is accounted for in non-binding orders reported by hydrogen fuel cell

hybrid and fully electric commercial vehicles for the next five years," he said.

China has grabbed a lot of attention lately for its aggressive electric vehicle plans, but almost 60% of all



Above, the Volvo FE



Left, Cummins Power Drive

electric truck maker Nikola Motor Co. and by customers of battery-electric vehicle builder Tesla.

Alastair Hayfield of Interact Analysis told Trucks.com "There are multiple billions of dollars being invested in battery development and production, and there are heavy electric truck and bus subsidy programs in China, Europe, and parts of the U.S." Costs are coming down and it all adds up to "significant growth in

commercial electric vehicle orders placed are in the U.S., with China receiving almost 24% of confirmed orders. South Korea has also announced plans to replace all 26,000 of its natural gas-powered buses with fuel cell buses by 2030. And the orders keep coming in.

Nikola has already received pre-orders from U.S. Express and Anheuser Busch, and Tesla has pre-orders from UPS, Pepsi-Co, Sysco, and

Anheuser Busch. The bulk of electric truck deliveries through 2021 will be heavy-duty models, but the medium-duty electric and hybrid models offered by Volvo, Ford, Mercedes-Benz, and Cummins will be an ever-growing market that seems on the verge of jumping ahead.

Volvo has several models of its FL electric medium-duty truck that it will start offering next year. The base electric FL produces up to 248 hp and 313 lb.-ft. of torque. It has a gross vehicle weight of 35,274 pounds. It takes about 1.5 hours to fully charge the batteries with DC fast charging.

Where rivals such as Freightliner and Tesla are placing motors at the wheels of their electric trucks, Volvo has taken a different approach. The FL has a single powertrain with one electric motor and has a range up to 186 miles depending on its configuration.

It has enough battery capacity that its cost of operation is on par with a diesel counterpart when used for refuse collection. The initial sales will be in Europe, but the company is in talks with the California Air Resources Board and others to introduce the electric versions of the FL and its larger FE electric truck in the U.S.

Cummins has introduced its take on the hybrid with its Cummins PowerDrive. The PowerDrive offers both parallel and series operation going between two hybrid and two pure electric modes of operation. The system has completed more than six million miles of combined operation in both the U.S. and China, and work is underway to introduce it to the European market. The flexibility and economy of the system has resulted in a reduction of emissions of up to 80% compared to conventional diesel-driven service vehicles.

The Tesla all-electric semi has four independent motors powering the behemoth, has a fully loaded (80,000 pounds) acceleration of 0-60 in about 20 seconds, and has rated ranges of 300 to 500 miles per charge (depending on battery configuration and load-out). As of yet Tesla has not

released any horsepower specs for their semi.

The Tesla is like all things Tesla, a little over the top, but with a 0.36 drag coefficient design it only uses approximately 2 kWh of electricity every mile. The truck recently traveled unescorted for a week from the

of torque. This is said to allow the vehicle to maintain a speed of 65 mph fully loaded (80,000 lbs) up a 6% grade. Impressive to say the least.

What makes these trucks so special is that they use hydrogen fuel cells to generate their electricity, have an estimated range of



**Tesla Semi**



**Nikola Truck**

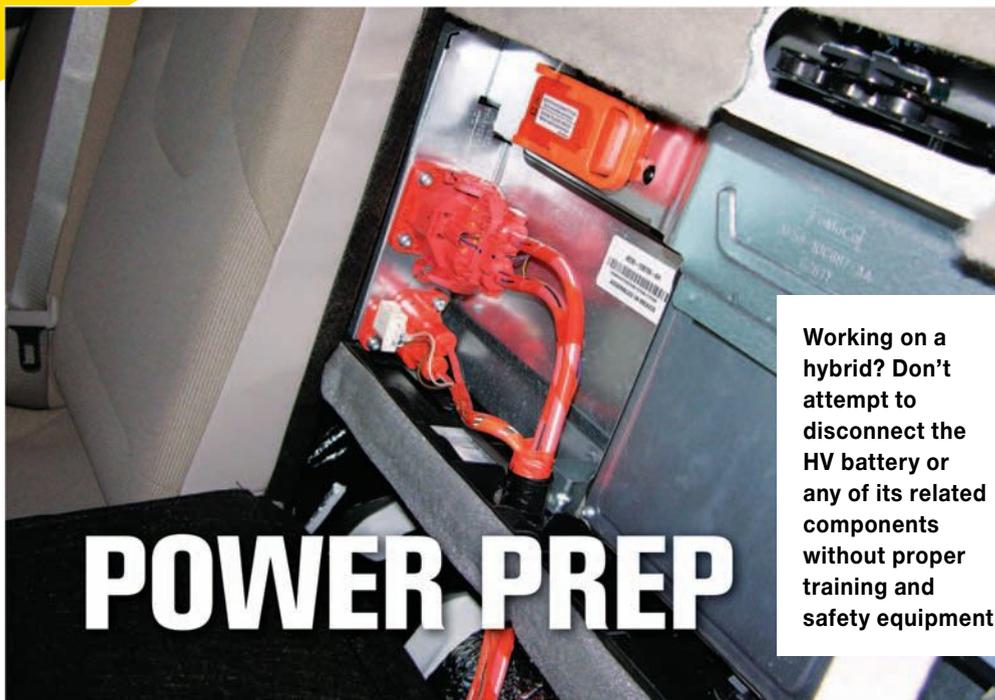
factory to the J.B. Hunt Trucking headquarters in Arkansas. The unveiling of the prototype was in 2017 and they are expected to start making deliveries sometime in early 2020. According to Tesla, they have around 2,000 pre-orders at this time.

The last big rigs in line are the Nikola One and the Nikola Two, the Nikola One being a Sleeper Cab and the Nikola Two being a Day Cab. These are fully electric hydrogen-powered semi-trucks. The trucks use a 320 kWh EV battery supplying six motors with a combined output of around 1,000 hp and 2,000 lb.-ft.

1,200 miles per fill up, and release zero emissions. The Nikola One and Two are expected to start shipping in early 2020; Nikola has stated that they have already received over 8 billion in pre-orders. They have also stated that pre-orders can be made with no deposit. That is confidence.

Trucking worldwide is changing and the electric truck is here. These vehicles won't be showing up in shops anytime soon, but the fleet technicians could be working on these in the next few years and for a long time to come. ☺

Comparison of Electric Trucks			
	Powertrain	Range(miles)	HP
Volvo	1	186	248
Cummins	Parallel/Single	Varies	Varies
Tesla	4	300-500	1,000
Nikola	6	1,200	1,000



Working on a hybrid? Don't attempt to disconnect the HV battery or any of its related components without proper training and safety equipment.

## The Importance of Properly Disconnecting Vehicle Batteries for Collision Repairs

By Sean Guthrie

**B**ATTERY disconnecting is an operation that occurs—or at least should occur—on nearly every car that is repaired. Welding discharges substantial energy in order to generate heat to melt metal. It's easy to understand the amount of heat required to melt metal; now realize that during welding the metal is reaching that temperature instantly.

For this instant melting of metal, a focused and intense amount of energy is needed. Car computer systems operate on 12 V DC current, with some sensors using a 5 V reference. Welders operate on no less than 110 V AC current and when grounded to the vehicle body, represent a real risk to every ECU on the vehicle. Even a stud gun or a dent puller sends en-

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*Sean Guthrie is a contributing editor for ABRN and the director of operations for Car Crafters Collision Centers in Albuquerque, NM. This article is reprinted from the January 2019 issue of ABRN.*

ergy into the metal to weld the tip of the machine to the panel. Those, too, are 110 V current, and again they, too, take an intense energy.

When the vehicle's battery is connected, a path to all of its electrical systems potentially exists. The energy from the welders can therefore over-energize and thus damage the electrical components. Any time a welder or dent puller is used, the battery should be disconnected.

There is one more area that always requires the battery to be disconnected prior to repair, and that is when working on SRS components. In addition to disconnecting the battery, most OEMs specify a period of time that you must wait prior to disconnecting any of these system components to avoid accidental deployment.

Vehicles are now often equipped with two batteries: a primary battery and an auxiliary battery. With the large array of computer systems, vehicles today are having to share responsibilities across multiple batteries.

The primary battery takes care of the standard vehicle operations, the starter, engine control, and other basic features. The auxiliary battery will handle things like navigation, advanced air conditioning systems, lighting, and other high-power-using accessories.

It is critical to know if the vehicle being worked on has just one battery or multiple batteries. Disconnecting only the primary battery will not suffice in proper electronic protection during welding, SRS repair, or other repairs that require the primary battery to be disconnected. The auxiliary battery may not be located near the primary battery or even within eyesight. It is critical to pull repair procedures to discover if a vehicle has additional batteries and if so where they are.

The high voltage batteries used in hybrids is a story all by itself. These vehicles have an auxiliary 12 V battery in addition to the HV battery. Don't attempt to disconnect any HV battery or HV system component

without proper training and safety equipment.

With a little bit of research and some general understanding, everyone can agree that it is necessary to disconnect the vehicle's battery during most repairs. The hurdle instead is how it should be done and the dangers if it is not done correctly.

The best comparison is with computers. The proper way to shut down a computer is to follow the shutdown steps through the operating system. We've all pushed the button and forced a computer off—or worse yet unplugged them. The reboot after that is time-consuming and at times nerve-racking. The computer goes through and performs self-checks, asks if it should open in safe mode, and then finally opens up.

Cars today are computers with wheels, and they don't want to have their power plug pulled. If this happens, there are going to be some repercussions or at least some steps to reboot them correctly.

The short list in Fig. 1 covers needed recalibrations or initializa-

Fig. 1—Recalibrations or Initializations

- Honda states the importance of an occupant detection system reset after a battery disconnect, and a steering angle sensor relearn may even be required after disconnecting the battery.
- Volkswagen says you must cycle the key and then perform a guided fault code finding by using a diagnostic tester.
- General Motors says you may have to program the volatile memory, and for cars with stop/start, it may not function until the car sits for 3 hours after programming.
- Toyota states that utilizing their Techstream to memorize steering angle sensors may be required, and without doing so, systems like lane departure, parking guidance, and precollision system will not operate. Power door locking systems may, too, need to be reinitialized.
- Nissan states you must reset electronic systems by utilizing a scan tool.
- Ford has in repair procedures for some of their vehicles that a battery monitoring system reset after installing a battery is required.
- BMW requires a battery registration process.
- Porsche requires fault codes be reset after a battery disconnect/reconnect.
- Chrysler states you must check the PCM for any stored battery disconnect trouble codes and clear if required.

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tions that may be required when reconnecting a battery for the majority of vehicles being produced today. It is possible to make the same statement for every vehicle

**Disconnecting the vehicle's battery is not a simple matter of removing the cable anymore. Be sure to follow the OEM procedures prior to disconnection and be aware of any needed recalibrations or initializations that may be required when reconnecting.**

Pete Meier



manufacturer that is producing cars today. Of course, that list would be even longer. The point of the list is to show that it is quite possible that just disconnecting a battery will require some sort of calibration or code clearing.

In addition to the scanning, it may be necessary to perform other acts to bring the vehicle to pre-disconnect condition. The simplest of these is to recalibrate the windows auto function. Manufacturers that require that reset include Honda, Acura, Subaru, Nissan, Infiniti, Toyota, Lexus, Volkswagen, Audi, and GM. This list of course isn't all-inclusive, as there may be some that have been missed and others may require it on their new models.

The point is that from recalibrating steering angle sensors to resetting auto window functions, disconnecting and reconnecting is not as simple as it once was. The only way to know what may be required is to consult the repair procedures, perform a scan, and ultimately a test drive and function test to ensure all features work correctly.

When working with vehicles it is always possible that a battery gets drained. Shops do not typically drive vehicles or leave them running for long periods of time, so batteries never get an opportunity to get charged. Just like battery discon-

necting/reconnecting, jump starting has gotten a bit more temperamental.

Reconnecting a battery from a dead system wakes up the comput-

ers, and the computers have a process to deal with it. A system with some charge is neither awake nor asleep. Hitting that system with more than 12 V instantly can cause serious damage.

A quick example is a Porsche that required a \$3,200 repair from a jump start that was performed incorrectly. The proper procedure states utilizing anything other than another vehicle to start a flat battery will cause damage to the computer systems.

When using a jump box, the small batteries inside may not be capable of handling the current draw from a starter, dropping below 12 V and thus creating a spike of voltage when first connected and subsequent drop when the car is trying to start. The smaller jump boxes are utilizing lithium batteries which may have a fully charged voltage of upwards of 15 V.

Similar voltage is produced by a charger placed in start mode. In order to reduce the amperage load from the starter, charger, and jump box, manufacturers increase the output voltage. This allows the starter to rely on voltage to accomplish its necessary wattage output instead of amps, thus having less drain on the jump box or charger. The problem with this is that the computer systems may not be equipped to handle the increased voltage. Most alterna-

tors are specifically regulated to no more than 13.5 V; thus, the computers are not designed to handle any more voltage.

Since the person who jump-started the Porsche failed to follow the proper procedure, it created a hefty repair bill, delayed the completion of the vehicle, and created a CSI issue and lack of trust in the repairs. High-end luxury automobile makers are not the only ones that have these requirements.

Remember that most auto manufacturers do not produce their own computer systems. There are a limited number of companies who produce modules, computers, and sensors for all the auto manufacturers. This means that the same company producing electronics in a high-end super car can be producing—and likely are producing—electronics in the cars that you see in your shop every day.

Proper safe repairs are critical. Shops and techs cannot afford the



Scott Manna

**This is the electrical connection for a BMW Safety Battery Terminal, a pyrotechnic device that is designed to disconnect the battery in the event of an accident.**

liability of performing improper repairs. Ensuring that proper repair procedures are followed is critical, whether it is with something as in-depth as structural sectioning or with something as seemingly simple as a battery disconnect/jump start. The only way to ensure the vehicle will leave the shop in as good of condition as it was in before the accident is to follow OEM repair procedures and guidelines! ☺

*Examples and data shared by Jake Rodenroth from asTech.*

# Freevalve and Camcon: *The Race to Camless Engines*

By Jeff Bogue

I have been watching this race for a few years now and it looks like something is going to hit the fan pretty soon. I keep muttering “What took so long, haven’t we been talking about this for a while?”

I remember discussing the possibility of a camless engine a few years back and it just seemed like some impossible musings around a torn down engine in someone’s garage with a refrigerator full of, uh, adult beverages. Now I can honestly say “About time!”

It seems a simple enough concept. Remove the cam and control each valve individually, electronically, in real time, giving the engine exactly what it needs when it needs it.

When I was in the military we used solenoids to open and close all kinds of things. Electro-mechanics was my specialty. When I saw the Freevalve concept several years ago I called an old Navy buddy and said “Tadaaa” almost like I had stuffed the camless engine in the car myself.

Needless to say, I am not nearly the car guy these engineering gurus are. To be honest, saying these gentlemen are car guys is like saying Pythagoras was a math guy.

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*Jeff Bogue is an electronics specialist focused on research and development. He works at ATech Training as a product representative and contributor to ATech Educator News. This article is reprinted from the December 2018 issue of ATech Educator News.*

The internal combustion engine is an air pump. It breathes in fresh air and expels exhaust gases. This might seem over simplified, but that is what it is and does. As the pistons move up and down, the intake and exhaust valves open and close to facilitate the breathing process.

Something has to tell the valves when to open, how far to open, and finally when to close. That is the job of the camshaft. The camshaft is physically turned by the crankshaft via a pulley system that operates by a rubber timing belt or a metal timing chain.

It sounds complicated and it is. Not only has this basic design been the operating system since the beginning, it is inefficient and complicated, performance being limited to either horsepower and torque, or fuel efficiency.

Automotive manufacturers have been trying to engineer their way around this compromise for years. The best attempts came back in the late '80s and early '90s with the VVT (variable valve timing) systems. These systems would physically shift the camshaft either forward or back to change the timing events of the valves, thus giving the engine both a performance boost and a fuel-efficient mode when needed.

VVT was and is a great improvement over the regular performance or fuel economy camshaft options of vehicles before, but it does have its drawbacks. The engine keeps firing while the cam is repositioning itself, thus giving less than optimal performance between the two modes of operation. Being a sys-



tem that offers both performance and fuel economy, there is still no middle ground.

Regarding the Camless Engine there are two schools of thought. A British company called Camcon and a Swedish company called Freevalve (a sister company of Koenigsegg, the car manufacturer) have taken different approaches to answer the same questions.

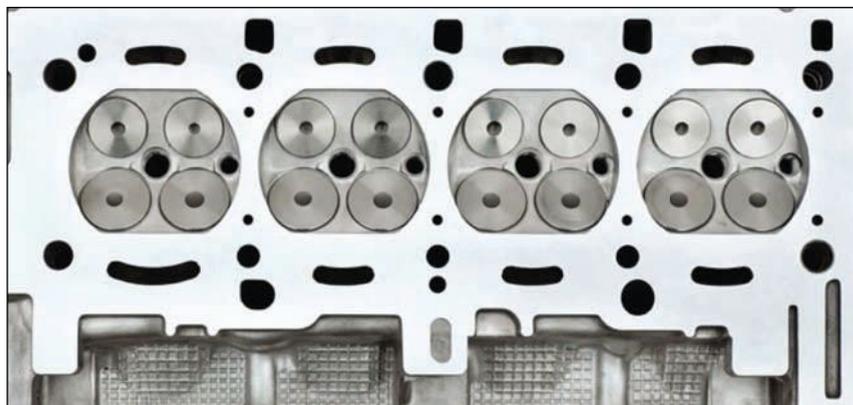
With Camcon’s IVA (Intelligent Valve Actuation), electromechanical actuators are housed on top of the engine, each controlling a short camshaft that manages a single valve or valve pair. As the system allows complete flexibility, benefits include

more sophisticated cylinder deactivation, more low-down torque, and more high-speed power as situations demand. The system can reposition the lobes of the small electrically driven cams as quickly as the engine requests it.

Mark Gostick of Camcon stated “We can effectively change the camshaft every time the engine turns over.” Autocar says Jaguar Land

rover is showing interest and offering technical help to Camcon, and both indoor and road testing is in the cards. Camcon says the setup could be only two-three years from production if adopted by a major automotive supplier.

inder arrangement. It can be retrofitted to an existing engine that wasn't designed for it. You'd have to modify or delete the timing drive and redesign the cylinder head to remove the conventional valvetrain and insert the electrical actuators. Their engineers say it's not difficult to do. The block, the bulk of what comprises an engine, could be left “more or less” unchanged.



The IVA system has two interesting things to its advantage.

1. The IVA system is a desmodromic system. This means that not only do the electronically controlled cams control how and when the valves open, they also physically control how and when they close. This removes the reliance on valve springs to push the valve back closed after their timing event.

The desmodromic system opening and closing the valves removes any bounce or “floating” of the valves at high RPM ratings. Both Indy cars and Ducati motorcycles use desmodromic systems to get their incredibly high RPM ratings (over 11,000 RPMs each).

2. The IVA System is backwards compatible. IVA works on any kind of piston-driven internal combustion engine, naturally aspirated or forced induction, gasoline or diesel, large or small displacement, inline- or V-cyl-

The next engine on the list is the QamFree engine from FreeValve. This is an entirely new engine design, of which Koenigsegg is not unfamiliar with, having built some of the most innovative engines in the world and jamming them into cars.

The QamFree engines use electronic actuators with pneumatic and hydraulic controls to open and close the valves. When a camshaft opens and closes a valve, the cam profile doesn't allow the valve to completely open and close all at once. As the cam rotates, the lobe of the cam gradually opens the valve until it is completely open and then gradually closes.

In the FreeValve engine, the valve completely opens and closes almost instantaneously. This makes the fuel-air mixing a more complete process

causing a more complete burn in the cylinder.

FreeValve engines offer several benefits over conventional engines other than the controlling of the individual valves.

1. The camless engine has fewer moving parts. As a result there is less horsepower-robbing friction.

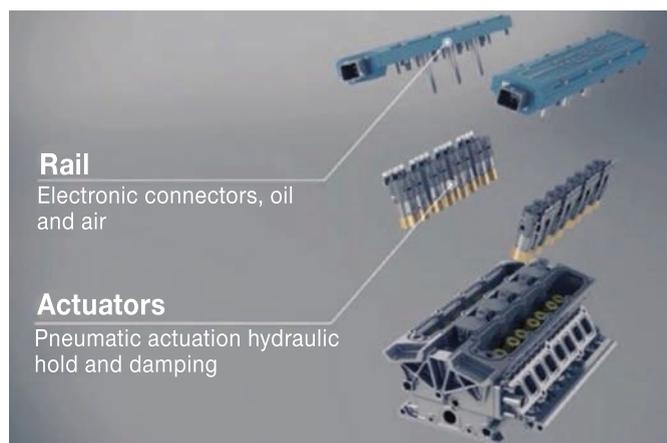
2. The camless engine design allows the engine to be smaller and lighter than a conventional engine. The 1.6-liter turbocharged engine is 44 lbs. lighter than conventional engines.

3. The camless engine is more efficient. The 1.6-liter turbocharged engine offered a 47% increase in horse power (230 hp), a 45% increase in torque (236 lb.-ft.), and a 15% increase in fuel efficiency.

4. The engine uses port injection instead of direct injection. This would save money as less-expensive fuel pumps and regulators can be used because of the lower pressures at the fuel rail.

5. As all four valves per cylinder are controlled individually, exhaust pressures can be controlled more accurately. This eliminates the need for the wastegate and associated controls for the turbocharger.

Both engines showcase different designs on the engine. Innovation is taking place with new technology and experimentation of application.



Neither engine is market ready, but both companies are racing to get them in the hands of the consumer. The FreeValve engine has already been showcased in test vehicles in China. ©



# Starting a Wraps Class from Scratch

By Mark Podolak

**M**ARK Podolak never knew where his love of cars would lead him. A graphic design and graphic communications instructor at Saddleback Community College in Mission Viejo, CA, Mark was tapped by his department in 2017 to lead a new vehicle wraps class—two weeks before it started.

## Educating the Educator

“I was asked to be the replacement instructor,” said Podolak. “The only problem was, I had never designed, produced, or installed a wrap.” To prepare him for his new role, Saddleback sent Podolak to Roland’s Born-to-Wrap workshop, held at Roland DGA headquarters in Irvine, CA. The class was led by experts from Louisville, KY-based Digital EFX Wraps, renowned for their vehicle wrap installation and business management instruction.

*Mark Podolak is a graphic design and communications instructor, Saddleback Community College, Mission Viejo, CA*

Podolak described the comprehensive, two-day experience: “The Born-to-Wrap workshop taught me all the basics. I just kept raising my hand, and Matt [Matt Richart, of Digital EFX Wraps] answered every question. He was very encouraging,” said Podolak. In the workshop, Podolak learned each step in designing, printing, and installing a vehicle wrap.

To assist Podolak with the class, Saddleback print technician Will Baldwin was also sent for training, attending a Born-to-Wrap workshop held on the campus of famed NASCAR team Richard Childress Racing in Welcome, NC.

Fortunately, Saddleback’s vehicle graphics shop already had top-of-the-line printing technology in place. Outfitted with a 64” Roland VersaEXPRESS RF-640 large-

format inkjet printer, a 30” Roland VersaCMM SP-300i printer/cutter, and a Roland GX-400 large-format cutter, the shop’s production environment was ready to go.

“The Rolands produce consistent, quality prints and are easy to use, which makes teaching my class that much easier,” noted Podolak.

Podolak’s one-credit vehicle wrap class is called Introduction to Vehicle



Saddleback College’s 64” Roland VersaEXPRESS RF-640 large-format inkjet printer prints colorful graphics for installation on vehicles.

Wrap Design and Application. His first class had just seven students, but one year later, the enrollment had grown to 27 and has stayed strong since. The class spans two weekends and packs in 40 hours of learning activities.

## Tools of the Trade

The first day of class, every stu-



**Students practice removing excess vinyl from lettering before installation.**

dent takes a mandatory shop safety test (S/P2). Podolak also acquaints them with the tools needed to produce and install vehicle graphics. He demonstrates the printers producing vehicle graphics, and the vinyl cutter contour-cutting letters and graphics.

During the class, all three of the machines are kept busy. "Keeping print production flowing throughout the day is important to ensure we can teach all aspects of the vehicle wrap process. Fortunately, our Roland devices are really robust. We've had zero repairs, and the image quality, print speeds, and cutting accuracy are great," said Podolak.

Podolak also introduces students to the other tools used for vehicle graphic installation, including magnets, masking tape, squeegees, and a heat gun.

During the course, students get very familiar with the vehicle graphics squeegee, a small hand-

held instrument about 4" wide. The squeegee is gripped with a thumb on one side and all four fingers on the other, and is held at an angle, with the finger knuckles actually touching the material as it's being squeegeed. Richart tells his students, "we're not using the squeegee like a snow shovel. We're making overlapping strokes, so only about 1" to 1-1/2" of the squeegee blade is pressing down on the film with each stroke."

Squeegeeing is a painstaking job which, if done right, lets the air escape and results in a smooth, glass-like wrap surface. In his Born-to-Wrap classes, Richart emphasizes the importance of applying the correct amount of pressure on the squeegee. "Too little pressure, and your material will not adhere. Applying too much pressure won't damage the film, but it can create wrinkles," he said.

Students are also introduced to a heat gun which has two important functions in vehicle wrap installation. The first is to help stretch and loosen the material around complex areas with lots of curves and angles, such as bumpers, mirrors, and door handles. "With heat, the material becomes more malleable, and any wrinkles or imperfections can be drastically

vehicle. For post-heating, the students practice using a circular motion with the heat gun, holding it a few inches away from the material and heating each section for a total of 5-10 seconds. Richart points out that different films require different post-heating temperatures, generally ranging from 160-220°. Today's heat guns come with temperature sensors, so installers can verify when the material has been heated to the desired temperature.

## Hands-on Learning

Podolak deliberately designed his Saddleback Community College Wrap Class curriculum to be hands-on. The very first day he teaches his students the Hinge Method over seams. "We destroy some vinyl. Then we use a heat gun to restore the vinyl to its original glass-like finish, and they reapply it," he said. "You can see that they are excited to get their hands on the material."

Richart further explains the Hinge Method: "The Hinge Method is a technique for taking a large piece of vehicle graphics film and laying it on a surface with minimal distortion or wrinkling," said Richart. "It's especially helpful if you are working by yourself, and can be used when working on both flat and gently curved surfaces."

**Saddleback's hands-on vehicle wraps class has students applying vinyl on the very first day.**



decreased or eliminated," notes Richart.

The second use for a heat gun is the important final step of post-heating, which allows the material to closely adhere to the shape of a

For the Hinge Method, students first lay the graphic material on the surface to be wrapped, using masking tape or magnets to hold it in place. They then use additional masking tape or magnets to divide

the graphic in half. This “hinge” created by the magnets or tape effectively divides the surface into left and right halves.

Students then flip up one side of the material and peel the backing paper away from the adhesive film, all the way up to the hinge. They cut away the backing paper along the line where it meets the hinge. Then, starting from the hinge side, students slowly begin squeegeeing the material to the surface of the vehicle. They then repeat the process on the other side. According to Richart, the second side is easier to squeegee flat since the first side provides a tacked-down base to gently pull against, allowing students to lay the material down with few wrinkles or distortions.

“While new vinyl materials have some give built into the material, installers should not rely on creating more than an inch or two of stretch,” said Richart. “Any more than that and you risk having distortions.” He also noted that newer materials can actually float or slide a bit over the surface of a vehicle after the backing is removed, so they can be accurately positioned before being tacked down with a squeegee and adhered with a heat gun.

After Podolak’s students have mastered the Hinge Method, the class starts working with larger, 3’ x 3’ squares of vinyl. “By the end of the first weekend, I demonstrate the Triangle Method,” said Podolak. “Students can then begin applying partial door and hood graphics.”

The Triangle Method is another professional technique used during vehicle wrap installation. Richart compares the Triangle Method to making a bed. “When you lay a sheet on the bed, you match the corners to the actual corners of the bed, smooth over the surface to remove any large wrinkles, and tuck in the sheet on diagonal corners,” he said. “It’s a similar process when you are working with a large piece of adhesive vinyl, such as a graphic for a hood or door.”

To begin the Triangle Method, students are taught to lay the material smoothly over the area to be covered. They then peel back the



Left, students practice using a heat gun to warm the material and reduce wrinkling.

adhesive film backing on a corner of the graphic, readjust the position of the graphic and tack down the exposed corner of material to the vehicle. This becomes a pivot point. Then they remove the remainder of the film’s backing, move to the opposite corner of the graphic and surface (e.g., top right to bottom left), and tug on the material to create a bit of tension and smooth any wrinkles. The remaining two corners are handled in the same manner, tugging and tacking opposite corners. “Just like a bedsheet, you want to tug on and tack down the material in that triangle shape to create a smooth surface,” added Richart.

When Podolak’s students become a little more advanced with their skills, he teaches them how to wrap the more complex areas of the vehicle, such as door handles, side-view mirrors, and bumpers.

Throughout the class, Podolak emphasizes careful work and good technique. “Techniques like the Hinge Method and the Triangle Method can help students save time on installations in the future, while guaranteeing a smooth, durable wrap for their customers,” he said.



Below, students use specially designed squeegee tools to smoothly install the adhesive graphic film.

## Designing Their Future

Later in the course, the students learn to design stickers, using Adobe Illustrator to create their designs and VersaWorks RIP software to send them to the Roland machines for printing and cutting. “The VersaWorks RIP software is intuitive and easy for the students to learn,” said Podolak. “We approach the work systematically, and the students pick it up very quickly.”

To keep the students focused on their future, Podolak brings in guest speakers from local sign shops to talk about careers in signmaking as well as vehicle graphics design and installation.

Although most of Podolak’s vehicle graphics students are 18-22-year-olds, there are always a few older students in the class. Every student has his or her own reason for taking the course. “Some students just want to wrap their own cars, some want to

Continued on page 27.

# Jobs in Cybersecurity Are Exploding: Why Are Women Locked Out?

*How high schools are trying to attract girls to this lucrative tech field*

By Sarah Gonser

**T**HE four members of Team Throckmorton, playing junior agents for a cybersecurity firm, are up against a wily gang of hackers. To detect and ultimately thwart the cyber criminals, who are masquerading as legitimate business owners, the ThrockAt himortons must solve a series of increasingly difficult challenges beginning with figuring out

Gathered around a large wooden table in the computer room at Red Bank Regional High School, the girls, working on school-issued black Dell laptops, snack on lunch from brown paper bags and occasionally help themselves to Oreo cookies from a communal pack. Erin O’Kane, a 10th grader, fills an index card with numbers as she decodes a classified message online. Seated across from her, Hannah Gazdus, a junior and a member of The Team That Must Not Be Named, is using her lunch period to scan a block of Python code for green-highlighted text, which indicates the presence of suspicious commands.

If the creators of the girls-only online cybersecurity competition Girls Go CyberStart are successful, some of these high schoolers will get hooked on the quickly expanding and well-paying field of cybersecurity and, in the process, help offset one of technology’s deepest gender gaps: Just 11% of cybersecurity professionals today are women.

Employers in the United States, and countries worldwide, face a critical shortage of professionals trained in protecting corporate and government computer networks and systems from cyberattack. As these attacks grow more frequent and sophisticated, jobs in information security are expected to skyrocket. The Bureau of Labor Statistics predicts that jobs for cybersecurity analysts in the U.S. will grow 28% by 2026. Currently, there are 285,681 unfilled

jobs available in cybersecurity, according to CyberSeek, a website that tracks the cybersecurity job market. Globally, research indicates there will

**The Bureau of Labor Statistics predicts that jobs for cybersecurity analysts in the U.S. will grow 28% by 2026.**

be a shortage of 1.8 million cybersecurity professionals by 2022.

Attracting and retaining qualified workers to the field—especially women—has become a critical issue across sectors, from banking to health care, aviation, and government. “Can we staff up fast enough to be able to protect the power systems of the United States, the weapons systems, the financial systems? Because, right now, we do not have anywhere near enough people to do any of that,” said Alan Paller, director of research for the SANS Institute, a cybersecurity training company that created the Girls Go Cyberstart challenge. And yet, said Paller, the on-ramp for women into cybersecurity remains obstructed. “If we block entry for women, we’re blocking 50-70% of the talent,” he said. “When I walk into a high school Cisco Networking class, I’ll see 30 boys and one girl. Girls are being told loudly: ‘You are not invited.’”

With a median wage of \$92,600, cybersecurity jobs pay enough to

Photos: Sarah Gonser for The Hechinger Report



**Hannah Gazdus, a junior at Red Bank Regional High School, and a member of The Team That Must Not Be Named, plans to study science or engineering in college. The Girls Go challenge appeals to her because she likes solving puzzles.**

how to log into one of the gang member’s social media accounts by cracking a password reset form.

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

vault workers into the upper-middle class and beyond. Cybersecurity work typically requires a bachelor's degree in computer science or programming, a few years of experience in a related field such as networking, software development, or systems engineering, and in some cases, an information security certification.

At Red Bank Regional, 40 girls, divided into 14 teams, signed up to play Girls Go CyberStart. The push to get girls into computer science is newly backed by a statewide mandate that requires all New Jersey high schools to offer computer science by next school year, and that makes the course mandatory for graduation beginning in 2022.

During the 2015-16 school year, just 39% of New Jersey high schools with Advanced Placement programs offered an AP computer science class, mirroring the limited availability of such classes in high schools nationwide. Of New Jersey's 1,111

teacher at Red Bank Regional High School whose classes focus on systems, networking, cybersecurity, and forensics. The lead organizer of the school's Girls Go challenge, she credits nonprofit organizations like Girls Who Code and code.org for impressing upon schools the importance of teaching digital skills and competence.

"In my experience at the high school level, it's not that girls are being shut out of technology exactly, a bigger issue is that they're not self-identifying," Galante said. "I'm seeing boys realize in high school, 'I can do this,' so they're getting to the right college so they can take courses in this field. They're just way ahead of the game."

In an effort to reach more girls for the Girls Go game at Red Bank, for example, Galante recruited girls from non-tech classes, including a dozen from

Especially once girls reach middle and high school.

"The elephant in the room is that girls 'can't do math good,'"



**In an effort to get more girls at Red Bank to participate in the cybersecurity challenge, teacher Mandy Galante, center, recruited girls from nontech classes, including a dozen from a creative writing class. "We want to get the girls who never even thought of doing this," she said.**

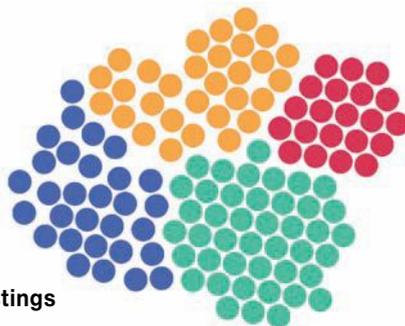
said Smith. "But when you look at standardized tests and SAT scores, girls are scoring just as well as boys in math and science. In some cases, they are actually doing better. The question isn't about competence, it's an issue of decision-making about what to pursue. When a preponderance of women are making decisions that will affect their lifelong earnings potential, we need to ask why, and what is it about our culture that is telling women: 'This is where you belong'?"

In a report she recently co-wrote on the gender wage gap, Smith found that although women are now graduating from college in greater numbers than men, and are pursuing STEM degrees more than ever before, they still earn 81¢ for every dollar earned by men when wages are averaged across job sectors. She also found that when women choose majors in well-paying sectors, they tend to then select the least lucrative submajors. For example, 54% of women majoring in STEM fields concentrate in biological and life sciences, which are among the majors with the lowest-paying career prospects, but only 17% select majors in the more lucrative field of engineering. ▶

### Tech-Enabled Earners

Middle-skill positions made up nearly 50% of U.S. job postings in 2016, according to Burning Glass. Even basic digital skills, such as experience with spreadsheets, offered more opportunities for these job seekers.

- Non-Digital
- Basic Digital Skills Only
- Advanced Digital Skills
- Occupation-Specific Skills



Each ● represents 100,000 job postings

Source: Burning Glass

computer science graduates in 2016, only 15 percent were women.

### Tech-Enabled Earners

Middle-skill positions made up nearly 50% of U.S. job postings in 2016, according to Burning Glass. Even basic digital skills, such as experience with spreadsheets, offered more opportunities for these job seekers.

"We've made tremendous inroads in just the last few years," said Mandy Galante, a technology

a creative writing class. "We want to get the girls who never even thought of doing this," she said.

For women, barriers to entry into cybersecurity, and the tech field in general, begin long before high school, said Nicole Smith, a research professor and chief economist at the Georgetown University Center on Education and the Workforce. "Our parents make decisions early on about what boys and girls should be doing," she said. "The social conditioning starts really early."

The Girls Go challenge is an effort to equalize the cybersecurity playing field, or at least to plant a seed of interest in cybersecurity at the high school level. This past winter, in its first year, 6,654 girls across 16 states and the territory of American Samoa

**“At a high school level, cybersecurity doesn’t need to build on coding—you could be an arts major and get into cybersecurity ... Though once [girls] get to college, they’ll definitely need to learn some coding.”**

*Mandy Galante, a technology teacher at Red Bank Regional High School in New Jersey*

participated in the game. In order for schools to access the game, the SANS Institute asked governors’ offices nationwide to partner in its promotion. Winners each receive a \$100 gift certificate and an all-expense-paid trip to a conference in Chicago for women in cybersecurity. The winning team’s host school receives a \$1,000 award.

Melissa Vuong, 15, is a sophomore at Red Bank and a member of team Throckmorton. With zero coding experience, she was primarily drawn to the opportunity to collaborate with her team. “It’s super fun working together,” she said. “And it’s my first time playing a game like this, so it’s a challenge, but I like it.”

Girls Go is not the first online challenge designed to attract young people to cybersecurity, though it is the only game specifically for girls. The Air Force Association’s CyberPatriot online competition and Gen-Cyber camp, funded by the National Security Agency and the National Science Foundation, are aimed at attracting high schoolers to the cybersecurity field, though they do tend to appeal primarily to boys. While some girls do participate, Galante

noted, they rarely make it to the leaderboards and thus fail to garner attention and awards, which among competitors creates a deeper interest and connection to the field.

“We’ve learned over the years that winning shiny stuff, and having people make a big deal out of you, helps young people believe in themselves and be attracted to something,” said Galante. “But even though girls were participating—in small numbers—in challenges like CyberPatriot, this recognition wasn’t happening for them. The boys, who have so much more experience in gaming, were the ones being recognized.”

In spite of increasing numbers of women pursuing STEM degrees, only 26% of computing jobs in the U.S. are filled by women. Like cybersecurity, the broader field of jobs related to computing faces a labor shortage with 1.1 million job openings projected by 2024.

When women do opt to major in STEM fields such as cybersecurity, they frequently leave the field after a brief tenure, according to a 2011 report by the Georgetown University Center on Education and the Workforce. “Even when women do well and excel in college in technology, they divert into teaching math or science, or into fields like biology or pharmaceuticals—fields that are predominantly female and pay lower wages,” said Smith, the Georgetown economist. This may be due in part to priorities. When considering a new job, men value salary above other factors, the Georgetown report found. Women, on the other hand, prioritized proximity to home; working environment, and workplace communication; and prospects for upward mobility.

Workplace environment is clearly a factor, especially in cybersecurity where teams tend to be small and therefore perhaps more intense. Marian Merritt, the industry engagement lead for the National Initiative for Cybersecurity Education, points to the hyper-competitive, noncollaborative, war-terminology-oriented nature of cybersecurity as a major concern for women. The initiative, a unit within the U.S. Department of Commerce,

aims to alleviate the cybersecurity workforce shortage.

“Anecdotally, we know that there’s an emphasis in cybersecurity on being self-taught, self-driven, and adversarial,” said Merritt. “I think it’s time to figure out if this is just growing pains within a relatively new field—cybersecurity is maybe 10 years old as a subspecialty—because there are a lot of things happening in cybersecurity that are of big concern.”

When the Girl Scouts Research Institute, a unit connected to the Girl Scouts, surveyed its membership for its own STEM study, it found that 74% of the girls expressed interest in science, technology, engineering, and math—yet only 13% said those fields would be their first choice for a career. Fifty-seven percent said that if they did enter a STEM field, they would have to work harder than a man just to be taken seriously.

At Red Bank Regional, after the weeklong Girls Go challenge, neither Team Throckmorton nor The Team That Must Not Be Named scored sufficient points to win at the national or state level. On the final scoreboard for New Jersey, Team Throckmorton placed 73rd out of 168

**Just 11% of cybersecurity professionals today are women.**

teams in the state, while The Team That Must Not Be Named placed 97th. Still, after playing Girls Go this winter, 70% of the players nationwide said they are now interested in a cybersecurity career, compared with 36% prior to playing the game, according to a survey by the SANS Institute.

One of those newly cyber-enthused students was Brigid Clanton-Calnan, a junior at Red Bank. “Right now, I’d say I’ve gone from pretty much zero interest in cyber security to really being pulled in that direction,” she says. “And I’d love to play the game again, if it happens again next year.” ☺

# Teacher Training Opportunities

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## Additional Opportunities

**Roland** offers Basics and Beyond, a 2-Day Hands-On Born to Wrap Workshop. Upcoming workshops will be held at Louisville, KY, Benicia, CA, and Welcome, NC. Visit [www.rolanddga.com](http://www.rolanddga.com) for details.

**Shopbot** offers 2.5-day Digital Fabrication for Educators Training at their Durham, NC, headquarters. Upcoming classes: June 13 - 15, July 18 - 20, and August 8 - 10, 2019. Call 888-680-4466.

**Technology Education Concepts, Inc. (TEC)** offers personalized one-on-one training in Concord, NH. Email [techsupport@TECedu.com](mailto:techsupport@TECedu.com) or call 1-800-338-2238.

### Wrap, from page 23.

make it a hobby, and others are here to build a career," Podolak said. "We get a wide variety."

### Wrapping Up the Semester

In the fall of 2018, Podolak's class took on a very special final project. They produced and installed a partial wrap of a 7' x 14' trailer for Boy Scout Troop 872. The wrap was designed by Gloria Turnbull, a current Saddleback student who had taken Podolak's very first wrap class, and whose son was in Troop 872. "It was the coolest vinyl wrap I've ever been involved with, because my former student designed it, and current and former students all turned out to help," recalled Podolak.

"It's important that our students are familiar with the industry-standard equipment and techniques as they head out into the world," Podolak said. "The deeper your knowledge goes, the more valuable you are to employers." ©



A student carefully installs a partial trailer wrap installation for Boy Scout Troop 872 along a seam in the trailer.

**Instructor Mark Podolak stands next to the completed wrap for Boy Scout Troop 872, which was designed, produced, and installed by his current and former students.**



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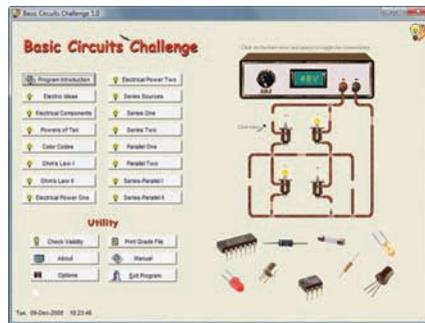


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## More Than Fun Answers

### Math in the Water

17.05 cm  
Let  $x$  = depth of water  
Using the Pythagorean Theorem,  
 $(x + 10)^2 = x^2 + 21^2$   
 $x^2 + 20x + 100 = x^2 + 441$   
 $20x = 341$   
 $x = 17.05$

### Watch the Speed Limit!

It is not possible to average 60 mph no matter how fast you come back. If the distance from New York to Chicago is 900 miles, then it would take 30 hours to get there at 30 mph. To average 60 mph over the whole trip of 1,800 miles, you would have to make the trip in 30 hours, but you already used 30 hours going there, so you would have to make the return trip in zero hours.

### Electro-mechanical Analogies

1—D A battery stores electrical energy in its chemical components. A water tower stores water with the potential energy it has due to its height.

2—A A fuse has the lowest current capacity of any component in an electrical circuit and will fail first like the weakest link in a chain.

3—B A rectifier permits the flow of electricity in one direction but offers a high resistance in the opposite direction. The pawl on a ratchet permits the rotation of its shaft in one direction, but engages the ratchet to stop rotation in the opposite direction.

4—E A rheostat is an adjustable resistor used to change the amount of current in an electrical circuit. A faucet can change the amount of water flowing from a pipe.

5—C A transformer can step up or step down the voltage from its primary to secondary windings. A belt and pulley system can speed up or slow down the rotation of shafts by using pulleys having different diameters.

### Always Problems!

The student must get 104 questions correct with 16 wrong answers.  
 $104 - 1/4(16) = 100$

## Share your teaching experiences with your peers!

### Want to get published?

We are looking for articles about what is going on in the career-technical and STEM education fields!

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Submissions should be emailed to [vanessa@techdirections.com](mailto:vanessa@techdirections.com). Please put "Article Submission" in the subject line. Please also include photos and drawings, if appropriate.

If you have an idea you want to pitch to make sure it would be a good fit, send Vanessa an email, [vanessa@techdirections.com](mailto:vanessa@techdirections.com).

### Want your students on the cover?

We are also looking for high-quality vertical photos for cover use. Photos should show students engaged in education activities. Send your photos to [vanessa@techdirections.com](mailto:vanessa@techdirections.com).



## Math in the Water

Henry Wadsworth Longfellow introduced the following in his novel *Kavanaugh*:

When the stem of a water lily is vertical, the blossom is 10 centimeters above the surface of a lake. If you pull the lily to one side, keeping the stem straight, the blossom touches the water at a spot 21 centimeters from where the stem formerly cut the surface. How deep is the water?

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



## Watch the Speed Limit!

An automobile went from New York to Chicago at an average rate of 30 mph. How fast would it have to come back to make the average speed for the round trip 60 mph?

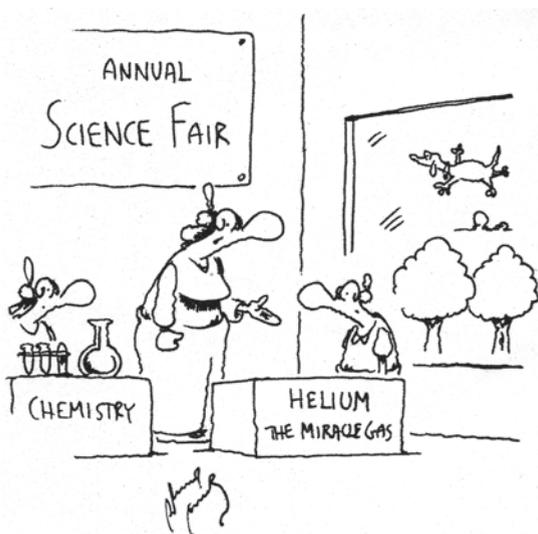
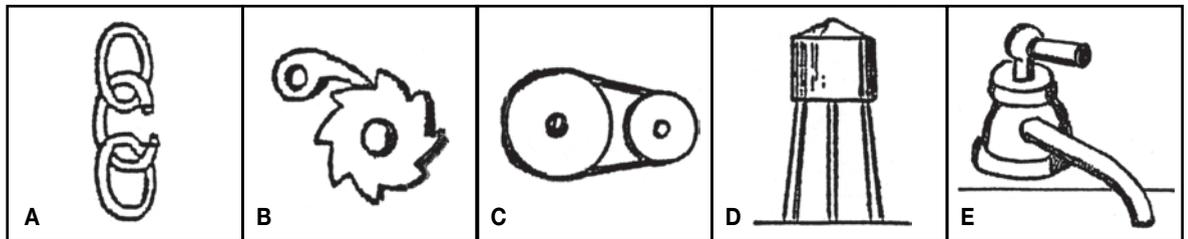
Puzzle devised by David Pleacher, [www.pleacher.com/mp/mpframe.html](http://www.pleacher.com/mp/mpframe.html)

## Electro-mechanical Analogies

Some common electrical components function the same way common mechanical devices do. If you can see an analogy between them, you have an understanding of their operating principles.

See if you can match the electrical components (1-5) with the mechanical devices (A-E) that operate similarly. —**Robert Balin**, Cypress, CA.

1. Battery    2. Fuse    3. Rectifier    4. Rheostat    5. Transformer



"Well, Billy, I suppose you have some lame excuse for not having your assignment today."

## Always Problems!

How many problems must a student get right to score 100 on a 120 question test if the teacher gives one point for each correct answer but subtracts 1/4 point for each wrong answer?

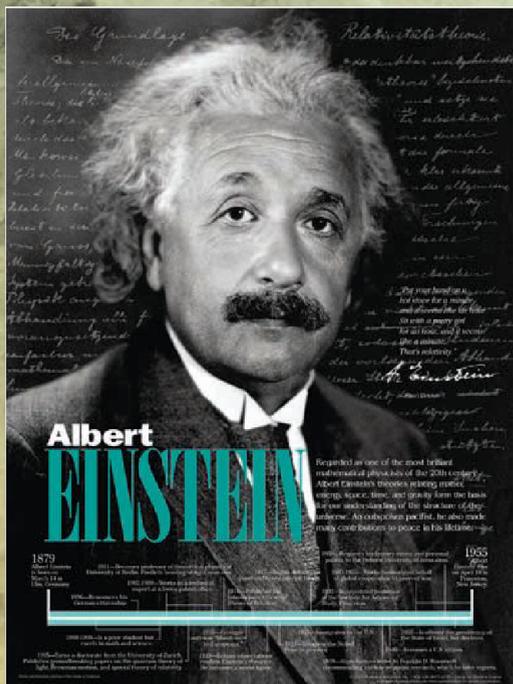
Puzzle devised by David Pleacher, [www.pleacher.com/mp/mpframe.html](http://www.pleacher.com/mp/mpframe.html)

See answers on page 29.

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](mailto:vanessa@techdirections.com) or mail to "More Than Fun," PO Box 8623, Ann Arbor, MI 48107-8623.

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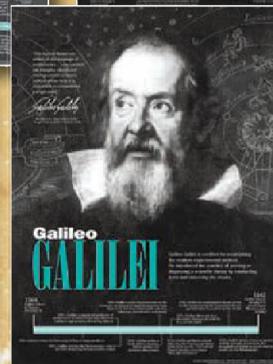
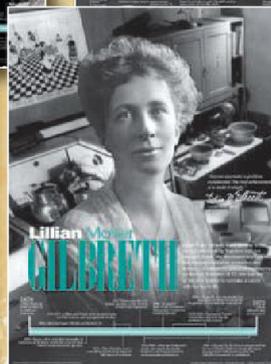
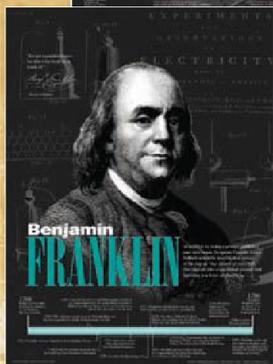
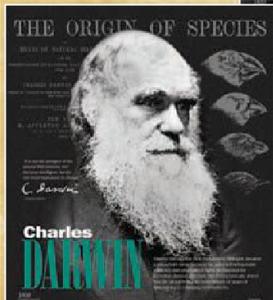
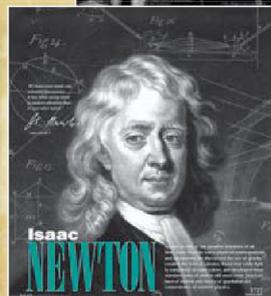
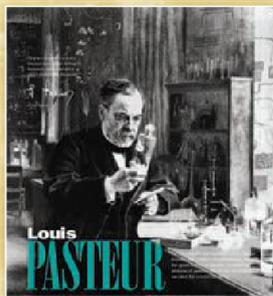
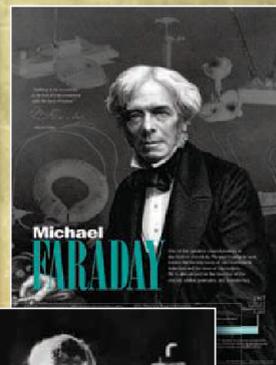


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