www.techdirections.com

techdirections

linking education to careers

OCTOBER 2017

Battery Technology
Charges into the Future

FERPA Part 2
How Does It Affect You?

Special
Pull-Out Product Guide
Inside

technically speaking

Vanessa Revelli vanessa@techdirections.com

Happy October! I hope the transition back to school was an easy one for you all. On page 26 there is a success story about students who are learning at the Volkswagen Chattanooga factory. I wanted to give you some more information about what Volkswagen is doing in Hamilton County, Tennessee, to educate students.

In a press release from September 5th, Volkswagen Chattanooga announced that eight of its 16 eLabs are now fully operational in Hamilton County schools. The schools were selected by representatives from Volkswagen Chattanooga, Tennessee Department of Education, Tennessee Department of Economic and Community Development, Hamilton County Department of Education, and Public Education Foundation.

"At Volkswagen Chattanooga we hold a deep, active, and ongoing belief that education, whether at university, a middle school lab, or an apprenticeship on the shop floor, is crucial to a successful career," said Ulrich Heimann, Executive Vice President of Finance & ITP Volkswagen Chattanooga. "These Volkswagen eLabs will teach hands-on, engineering-based learning, and we are excited that eight labs around the county are opening this school term to engage and inspire the imagination of children throughout the community."

Volkswagen eLabs, which are the result of a $1 million donation by Volkswagen Chattanooga and the State of Tennessee, will provide approximately 8,000 Hamilton County students access to science labs featuring rapid prototyping technologies, including renewable energy components, laser cutters, CNC routers, 3D printers, robotics, microcomputers, and vinyl cutters.

The schools are also each responsible for raising $5,000 annually in cash or contributed materials to ensure that the lab is continually refreshed and materials are replaced.

Each Volkswagen eLab is staffed with a Volkswagen eLabs Innovation Team to ensure utilization to the maximum capacity. The teams are made up of highly trained teachers with specialized skills in facilitating learning through digital fabrication, according to the release.

Gov. Bill Haslam said "Through the eLabs, Hamilton County middle and high school students will have access to innovative programs that will equip them with skills they need to be successful in the future."

HCDE Superintendent Dr. Bryan Johnson expressed his excitement to see how students respond to the eLabs. "We all know STEM is one of the most important learning tracks for twenty-first century students as there will be 42,000 STEM jobs in the state of Tennessee alone within the next few years. Our amazing partnership with Volkswagen means our students will get the hands-on learning they need to truly be career and postsecondary ready."

I am so impressed with these program, and look forward to following their continued success.

techdirections
A Prakken Publications Magazine

Digital Tech Directions (ISSN 1940-3100) is published monthly, except June, July, and August, by Prakken Publications, Inc., 251 Jackson Plaza, Suite A, Ann Arbor, MI 48103-1955. Executive, editorial, and advertising offices are at PO Box 8623, Ann Arbor, MI 48107-8623, telephone 734-975-2800; fax 734-975-2787. Vol. 77, No. 2.

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

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

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

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

October 2017

techdirections

This issue of **techdirections** is brought to you **free** by these leading companies. Let them know you saw their advertisements or listings in **techdirections**.

Company	Page	Web Address	Phone
3 Rocks Technology	17	www.3rockstech.com	909-297-5173
All Electronics Corp.	29	www.allelectronics.com	800-826-5432
Electronix Express	6	www.elexp.com	800-972-2225
ETCAI Products	16, 29	www.etcai.com	800-308-0154
Hobart Institute of Welding Technology	19	www.welding.org	937-332-9500
Industrial Press	20	www.industrialpress.com	212-889-6330
John Deere Publishing	7	www.johndeere.com/publications	800-522-7448
Kelvin	14, 18, 19, 29	www.kelvin.com	800-535-8469
Lucifer Furnaces, Inc.	16	www.luciferfurnaces.com	800-378-0095
Mastercam	14, 32	www.mastercam.com	800-ASK-MCAM
Quality VAKuum Products, Inc.	19	www.qualityvak.com	800-547-5484
Roland DGA	9	www.rolanddga.com/edu	800-542-2307
ShopBot Tools, Inc.	15	www.ShopBotTools.com	888-680-4466
SoftPlan	14	www.softplan.com	800-248-0164
Tech Directions	4	www.techdirections.com	800-530-9673
Tech Directions Books & Media	16, 17, 18, 22, 29, 31	www.techdirections.com/products.html	800-530-9673
Techno Education Division	15, 27	www.techedcnc.com	631-648-7481
Test Equipment Depot	11	www.TestEquipmentDepot.com	800-517-8431

techdirections is a magazine for career/technical and STEM educators. Designed for the involved educator, techdirections brings to life today's technology and provides a wealth of engaging student activities. To receive a free subscription at your school address, please visit us online at techdirections.com/subscribe.html or use the form below.

Subscribe to techdirections for FREE!

techdirections is free to educators at their school address.

Use this form or visit www.techdirections.com/sub.html

Your type of school (check only one):

- (A) ☐ Fed./State/School District Headquarters
- (D) ☐ College/University
- (E) ☐ Community/Jr. College
- (F) ☐ Vocational/Technical School
- (J) ☐ Sr. H.S. (9-12)
- (K) ☐ Jr. Sr. H.S. (7-12, K-12)

Check all subjects you teach or supervise:

- (Y) ☐ 3D Printing
- (X) ☐ Aeronautics/Aviation
- (A) ☐ Agricultural Tech
- (5) ☐ Appliance Repair
- (I) ☐ Applied Math/English
- (B) ☐ Automotive (incl. Auto Body)
- (C) ☐ Bldg. Trades/Construction Tech (incl. HVAC&R)
- (F) ☐ CAD/Drafting/Design
- (V) ☐ Careers/Technical (incl. Vo-Ed, School-to-Work)
- (7) ☐ CNC/CAM/CIM/FMS
- (S) ☐ Communications
- (3) ☐ Computer Tech
- (G) ☐ Electricity
- (H) ☐ Electronics
- (1) ☐ Engineering/Pre-Engineering
- (K) ☐ Forge/Foundry
- (Z) ☐ Green Technology
- (J) ☐ Hydraulics/Pneumatics
- (E) ☐ Information Technology
- (M) ☐ Machine Shop
- (N) ☐ Manufacturing/Production
- (P) ☐ Metals
- (Q) ☐ Plastics
- (R) ☐ Power/Energy (incl. Diesel)
- (6) ☐ Robotics
- (8) ☐ Safety
- (D) ☐ Science/Appl. Sci.
- (2) ☐ Small Engines
- (L) ☐ STEM
- (W) ☐ Technology Ed
- (4) ☐ Tech Prep
- (9) ☐ Transportation
- (T) ☐ Welding
- (U) ☐ Woodworking

Please print

Name ______________________________

Title ______________________________

School ______________________________

School Address ______________________________

City ____________________ State __________ Zip ______________

E-mail ______________________________

E-mail address information is for in-house use only and will not be shared or sold!

Subscribe online:
www.techdirections.com/sub.html

FAX: 734-975-2787

Mail: Tech Directions Requests
P.O. Box 8623
Ann Arbor, MI 48107-8623

contents

October 2017
Vol. 77, No. 2

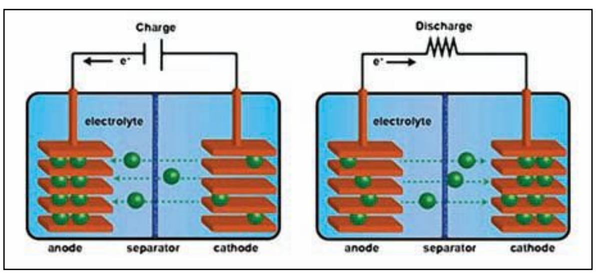
page 13

SPECIAL FEATURE

ELECTRICITY/ELECTRONICS

CTE

PROFESSIONAL DEVELOPMENT



page 18

COLUMNS

About the cover: Student using a soldering iron to work on an electronic board. Cover design by Sharon K. Miller.

the news report

Vanessa Revelli
vanessa@techdirections.com

Ultimaker Game Challenges Students to Think Outside the Box!

For the 2017 back-to-school season, the Ultimaker North American Community Team has constructed a game that puts the power of design back in your hands. The Ultimaker Design Engine Starter Pack is a game created to provoke, inspire, and entertain students, educators, 3D designers, artists, and engineers of all experience levels!

The Starter Pack can be used to generate scores of new projects, fueling a deeper exploration into the use of desktop 3D printers. For educators, students, and 3D designers of all backgrounds, the Starter Pack is both a handy icebreaker and a challenging activity that sparks creativity.

In the recommended "Starter Round" that introduces the game to first-time users, participants receive one Challenge Card and two Parameter Cards.

The Challenge Card sets the stage for all the activity that follows. The participant studies this card to identify the problem(s) to solve. The two Parameter Cards provide additional considerations the participant must address in the design. By the end of just three minutes, you must generate a name for your creation, an elevator pitch (no more than one minute) that would clearly communicate your idea to a stranger, and any quick sketches you need to help you to describe your project.

A challenge for 3D printing? No problem! The later rounds of the Starter Pack are great opportunities to introduce design-for-manufacturing related concepts, but for the

---

Vanessa Revelli is managing editor of Tech Directions.

More Than Fun Answers

Rack 'Em Up
Here are six solutions for each rack, listed in order A through F using this pattern:

A
B C
D E F

Rack 10:

A	B	C	D	E	F
1	4	6	5	2	3
1	6	4	3	2	5
3	2	6	5	4	1
3	6	2	1	4	5
5	2	4	3	6	1
5	4	2	1	6	3

Rack 16:

A	B	C	D	E	F
3	6	8	7	4	5
3	8	6	5	4	7
5	4	8	7	6	3
5	8	4	3	6	7
7	4	6	5	8	3
7	6	4	3	8	5

Rack 13:

A	B	C	D	E	F
2	5	7	6	3	4
2	7	5	4	3	6
4	3	7	6	5	2
4	7	3	2	5	6
6	3	5	4	7	2
6	5	3	2	7	4

Rack 21:

A	B	C	D	E	F
7	5	6	9	4	8
7	6	5	8	4	9
8	4	6	9	5	7
8	6	4	7	5	9
9	4	5	8	6	7
9	5	4	7	6	8

Checkmate!
They didn't play each other.

Driving Me Crazy

1. P	5. R	9. A	13. E	17. L	21. F
2. J	6. O	10. Q	14. C	18. D	22. M
3. I	7. B	11. S	15. G	19. V	23. T
4. N	8. U	12. H	16. W	20. X	24. K

Scientist's Word Scramble
ELECTRICITY, MAGNETISM, FARAD, VALENCE, BENZENE
Famous scientist: Michael Faraday

starter round, set your imagination free to focus on finding a solution to the problem first, and think materials and methods second.

Lizabeth Arum and Matt Griffin of the Ultimaker NA Community team devised this card game specifically to address requests from educators for tools to help students to create new works from their imaginations to help motivate them through the process of mastering desktop 3D printing.

Often, after a few initial projects that introduce students to 3D printing—like making key fobs, nametags, or by downloading pre-existing files to print or modify—educators are at a loss for what comes next. How can they help their students take advantage of the promise of desktop 3D printing—a general purpose tool they can use to create original designs?

That's where the Ultimaker Design Engine Starter Pack comes in. The game can be used either as a class, or by individual students. Use the cards with the Starter Round rules to promote a quick brainstorming activity or use the cards as a starting point for a long-term project that includes research, prototyping, and documentation. With over 50 challenges, 60 parameters, 20 modeling modifiers, and an expansion pack, students will never be prompted to design the same thing twice.

In the spirit of physics and engineering class egg drop challenges, 48 hr. hackathons, and design/art school exercises, the Starter Pack aims to activate participants to create wild, spur-of-the-moment projects. And educators find that these adhoc exercises strike a nice balance between easy-to-complete, school day projects and ambitious, semester-long student projects.

While the Starter Pack includes instructions for several common approaches for how to use the cards in an educational context, Ultimaker anticipates that the uses and "flavors of play" will vary greatly depending on the specific aims of the participants.

The aim with the Starter Pack is to offer a flexible-enough set of rules to suit a range of styles of play, numbers of players, and levels of experience. Players are expected to discover new and powerful approaches to style of play over time, and share them with Ultimaker!

One way to share is to participate in Ultimaker's Design Engine Challenge which goes until October 31st. For eight weeks, the North American community team will pose weekly challenges by drawing cards from the Design Engine Starter Pack. If you submit at least four solutions, you will have the chance to win an Ultimaker 2 Extended+! To get complete details, visit: https://ultimaker.com/en/education. td

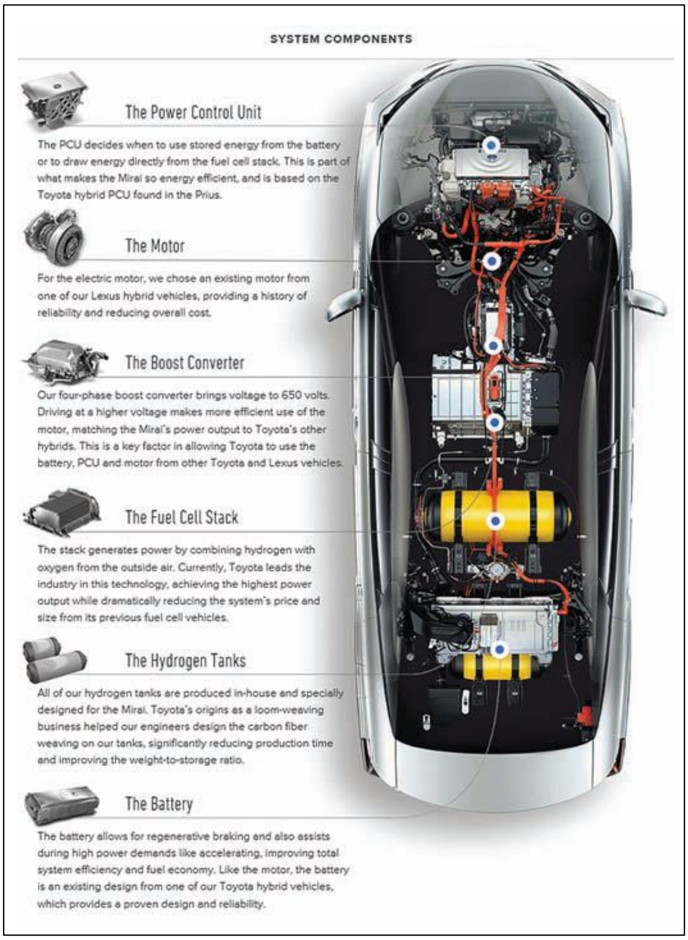
technology **today**

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

The Home Hydrogen Car Refueling Station

The fuel cell vehicle has long been considered the Holy Grail in automobile research. These cars are powered by the chemical reaction of hydrogen and air and they don't produce any of the environmentally dangerous biproducts produced by today's fossil-fueled vehicles. The only thing that spews from a hydrogen-powered vehicle's tailpipe is clean water vapor.

Toyota engineers have been developing hydrogen-powered vehicles for a quarter of a century; they started selling them in the U.S. in 2015. Their new Mirai can go 312 miles on a tank of hydrogen and has the acceleration of a gasoline-powered muscle car. The engineering that goes into their hydrogen-powered cars is amazing! You can better understand this by looking at the distribution of components in the car (Photo 1).



Toyota

Photo 1—From the outside, a hydrogen car looks like any other car. When you look at the layout and purpose of each of the components, you can really appreciate the engineering behind the fuel cell automobile.

Today, Toyota has plenty of competition, but even with good mileage per fill-up, Toyota and its competitors can't ramp up production to drive down the cost per vehicle until someone comes up with a plan to flood the landscape with hydrogen fueling stations.

If you have ever heard the phrase, "which came first, the chicken or the egg?" you might realize it is the perfect description of why there are limited hydrogen cars on the road today. Fueling station owners indicate they can't invest in thousands of hydrogen fueling stations before the vehicles are on the road, and the car manufacturers know people won't purchase their cars until they have lots of places to fill their fuel tanks.

In a January 19, 2017, joint announcement, the Fuel Cell Technologies Office (FCTO) of the U.S. Department of Energy (DOE) and the Hydrogen Education Foundation (HEF) announced SimpleFuel and Ivys the winner of their $1 million H2 Refueling H-Prize Competition. The DOE H-Prize was designed to challenge corporate, private, or university engineering teams to create a new hydrogen generating appliance which would safely generate hydrogen from water or natural gas, store it in its own storage tanks, and safely and quickly fuel hydrogen vehicles in much the same way people now purchase a tank of gasoline at their local gas station. The winner of the challenge needed to produce a final appliance that could be safely installed in homes, gasoline stations, car dealerships, community centers, and any other locations that would be convenient for people to go to refill their hydrogen vehicles' fuel tanks.

The SimpleFuel appliance (Photos 2 and 3) uses electric current to split water into hydrogen and oxygen. It then compresses the hydrogen for storage in its storage tank. Their appliance has a 700 bar dispensing pressure. The higher the compression that one achieves with hydrogen, the more gas you can store in a storage tank. A tank that can store 700 bar compressed hydrogen needs to be able to handle the 10,000 psi pressure of the compressed gas.

The SimpleFuel appliance is also designed to be scaled from a unit with the capacity to meet the needs of a single family to one that can supply a constant flow of cars at a local gasoline station. Refilling time per car is about 5 to 15 minutes. The home unit will be able to fully refill the tanks on a homeowner's vehicles every day.

The nozzle on their appliance creates a positive sealed link between the refueling storage tank and the vehicle's onboard storage tank. It prevents outside air or hydrogen from entering each other's

---

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

SimpleFuel

Photos 2 and 3—The SimpleFuel appliance recently won the $1 million H-Prize from the DOE. When they go into full production, they might make hydrogen-powered cars very popular.

domain. The connection is also supposed to be child proof. Before refueling begins, the nozzle grounds the car to bleed off any static electricity. It is my understanding that the fuel door on these cars, when opened, shuts off the vehicle's electric motor so the car can't be accidentally driven while it is being refueled. The system actually makes it safer to refuel a hydrogen-powered vehicle than a gasoline-powered vehicle. For more information and to stay up to date on further developments, go to: ivysinc.com/simplefuel-main-page. You can also download the SimpleFuel presentation from the hydrogen prize organization website: hydrogenprize.org/materials-from-h2-refuel-h-prize-webinar-with-winner-simplefuel-available/.

Taking it a Step Further

Tech Challenge: Your mission, if your teacher assigns it, is to build alternative-powered vehicles. Specific design elements, size restraints, construction materials, and method to determine the fastest vehicle will all be determined by your teacher. td

technology's past

Dennis Karwatka
dkarwatka@moreheadstate.edu

Hans Geiger and His Geiger Counter

The measurement of quantities that we can visualize has rarely been a problem. The ancient Egyptians, for example, evaluated weights, distances, and time with little difficulty. But measuring unseen characteristics like temperature, electricity, and atomic radiation was more challenging. The first person to make a numerical measurement of atomic activity was Hans Geiger of Germany in 1908. He went on to invent the Geiger counter a few years later.

Geiger was born in 1882 in Neustadt, about 80 miles south of Frankfurt. He was the oldest of five children and raised in Erlangen, where his father was a philosophy professor. Geiger was an enthusiastic physics student at the University of Erlangen, where he earned his doctorate degree in 1906. His specialty dealt with electrical flow through gases. Geiger accepted a research position at the University of Manchester in England and worked with Ernest Rutherford (1871-1937). Rutherford won the Nobel Prize in chemistry in 1908.

One of Geiger's responsibilities was to develop a method to measure the strength of low-energy radioactive emissions. He designed a system that aimed the emissions at a piece of gold foil and then onto a reflective screen. That resulted in tiny flashes of light, which Geiger had to count. The measurement was only approximate because there were thousands of light impulses each minute. The task was difficult, so Geiger developed a better method in 1908. He used a thin wire inside a sealed tube containing an inert gas at low pressure. The wire connected to the positive side of a battery and the metal tube to the negative side. A radiation stream directed at the tube caused an avalanching ionization effect that resulted in a voltage increase in the wire. A sensitive galvanometer measured the voltage and the system became the prototype for the Geiger counter.

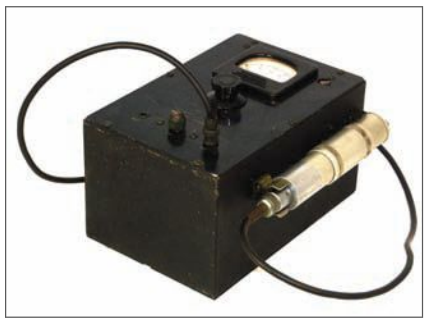
Hans Geiger in the 1930s

Geiger developed an international reputation and in 1912 took a position as director of Germany's first radiation laboratory in Berlin. He served as an artillery officer in the German Army during World War I (1914-1918). Long periods spent in the defensive wartime trenches left him with painful bouts of rheumatism for the rest of his life. After the war, Geiger married Elisabeth Heffter and they had three sons.

He returned to his position in Berlin and remained there until 1925 when he went to the University of Kiel in northern Germany. There, Geiger worked to improve his radiation counter. He teamed up with Walther Müller (1905-1979), Geiger's first doctoral student. They developed a measuring device with improved sensitivity and durability. They also added a circuit to provide an audible click. Their design became available in 1928. Modern users often call them "Geiger Müller" or "GM" counters.

Geiger researched other aspects of atomic radiation such as cosmic rays, nuclear fission, and x-ray scat-

A 1932 Geiger counter

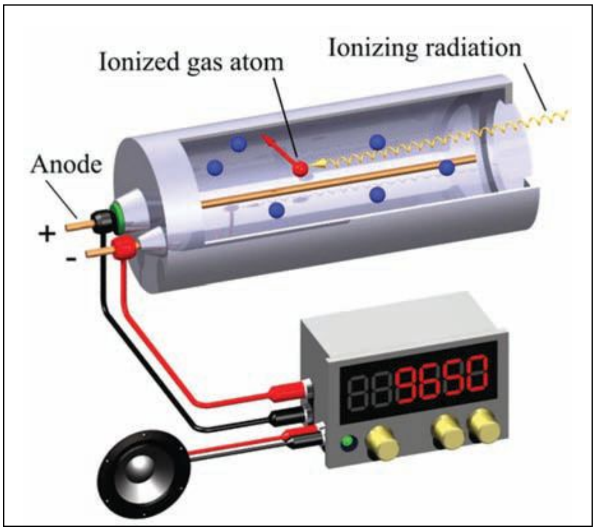


Geiger counter built at Harvard University in the 1940s

1950s era CD V-700 Series Geiger counter

Modern digital-readout Geiger counter

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



Operating principles of a Geiger-Muller tube

https://commons.wikimedia.org/wiki/File:Geiger-Muller-counter-en.png

tering. He often used his counter to obtain the necessary data. Geiger was also editor of the German scientific publication Journal of Physics. He was a talented instructor who was popular with students and co-workers. Geiger's rheumatism became so painful during World War II (1939-1945) that he was often confined to his bed. His last lecture, on cosmic rays, was in 1942. Geiger died in 1945.

Bright yellow Geiger counters featuring model numbers with CD-V prefixes were sold in America during the 1950s and '60s. That stood for Civil Defense Victoreen. John Victoreen (1902-1986) was the first manufacturer of radiation-measuring equipment. The introduction of nuclear energy encouraged some people to use Geiger counters to search for uranium as a fuel for power plants. Modern Geiger counters are now available from internet suppliers for $200 or less. td

References

Asimov, Isaac. (1964). *Asimov's biographical encyclopedia of science and technology.* Doubleday and Co. Publishers.

Gillispie, Charles Coulston. (1972). *Dictionary of scientific biography.* Charles Scribner's Sons Publishers.


Uranium prospecting, circa 1955

The Future of Portable Power

By Steven Keeping

LITHIUM-ion technology is the best power source yet devised for today's consumer electronics. But contemporary batteries have their limitations and superior solutions are under development in labs around the world.

Smartphones represent the peak of portable electronic design. These powerful cellular- and Internet-enabled devices boast computing power and memory capacity that matches the spec of desktop PCs and Macs from only a few years ago. An Apple iPhone 6S, for example, sports a dual-core, 1.8-GHz, 64-bit processor, plus 2 GB RAM and 128 GB Flash.

But today's smartphones have an Achilles Heel; their batteries. Lithium-ion (Li-ion) batteries have struggled to maintain an energy density (Wh/kg) improvement of around 7% per year.

For example, the original iPhone weighed in with a 620 MHz 32-bit processor with 128 MB RAM, 16 GB Flash and a 5.18 Wh battery, while today's iPhone 6S sports a 6.55 Wh cell. The electronics of the latest Apple smartphone represent a dramatic leap in performance compared with the first model while the battery energy density has improved by only around 26% in eight years.

According to Apple's specifications, the Li-ion battery in the iPhone 6S has a capacity of 1715 mAh and is capable of around 11 hours of Internet browsing or high definition video playback. It's an impressive level of performance, but still not sufficient to stop travelers, for example, diving for the charger at the first sight of an airport terminal mains socket in order to top up.

Is the big leap in Li-ion battery technology just around the corner or does the technology represent only a waypoint on the journey to a power source offering weeks or even months of service between recharges?

Developing the Li-ion Battery

It's taken over 40 years to develop the Li-ion technology that powers today's portable products. Lithium-based batteries are successful because they combine high capacity with low weight, resulting in more energy per kilogram than any other metal.

During charging, lithium ions are energized and move from the $LiCoO_2$ to the carbon. When the battery is in use, the ions move back the other way causing liberated electrons to travel in the opposite direction round the circuit to power the load (Fig. 1).

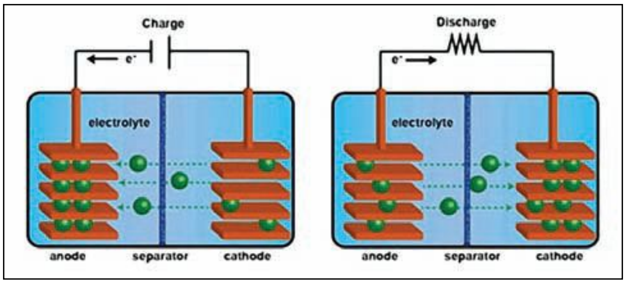


Fig. 1—In a conventional Li-ion battery, lithium ions (green) move between the electrodes while liberated electrons power the load. Charging moves the ions back to the negative electrode.

However, a key weakness of Li-ion batteries is their fragility. Each time ions are shifted, some react with the electrodes and remain forever embedded in the material. Eventually the supply of free ions is depleted and the battery fails. Each charging cycle also causes some volumetric expansion of the electrodes which stresses the structure and causes microscopic damage, diminishing its ability to store ions. Consequently, Li-ion batteries can only be recharged a limited number of times. Moreover, overcharging can force so many ions into the electrode that disintegration of the material can occur. It's important to properly manage the charging and discharge rate of Li-Ion batteries in portable devices using a power management IC such as the bq40Z50-R1 Li-Ion Battery Pack Manager from Texas Instruments.

Early versions of Li-ion batteries employed a liquid electrolyte to separate the electrodes, later using a porous separator soaked in an elec-

Continued on page 21.

Steven Keeping is a contributing writer for Mouser Electronics and gained a BEng (Hons.) degree at Brighton University, U.K., before working in the electronics divisions of Eurotherm and BOC for seven years. He then joined Electronic Production magazine and subsequently spent 13 years in senior editorial and publishing roles. In 2006, Steven became a freelance journalist specializing in electronics. He is based in Sydney. Article courtesy www.mouser.com.

techdirections

Pull Out and Save!

Fall Product Guide

KELVIN EDUCATIONAL

Techno CNC Systems Educational

Industrial Press

ShopBot
888-680-4466 • ShopBotTools.com

Mastercam

SOFTPLAN
ARCHITECTURAL DESIGN SOFTWARE

3 ROCKS TECH.

HOBART INSTITUTE OF WELDING TECHNOLOGY

ETCAI Products

LUCIFER FURNACES

Q.V.P.

Aeronautics/ Aviation

Wright Brothers Design Challenge™ with PowerPole™

Using KELVIN®'s Wright Brothers Design Challenge with PowerPole (#851507), students turn a foam tray, toy motor, and propeller into a model airplane! Students in middle school and up can learn about aeronautics and problem solving with KELVIN®'s unique PowerPole™ Challenge. Compete to build the lightest and the most innovative planes! See our website for our full line of plastic supplies and equipment.

KELVIN®
www.kelvin.com

Architectural Design

SoftPlan, The #1 Choice of Design Professionals, Is Also a Powerful Teaching Tool

With 30 years of development, SoftPlan offers an industry-leading solution for residential design. SoftPlan is a professional program with great educational pricing, giving students the flexibility to create complex, custom drawings with speed, accuracy, and ease. SoftPlan's BIM capabilities also allow students to build 3D project models of their work.

SoftPlan meets your budget, and is used by businesses and schools everywhere in North America. In fact, students using SoftPlan won the SkillsUSA National Architectural Design Championship in two of the last three years of competition. SoftPlan's free curriculum and our *Learning SoftPlan* books allow both teachers and students to learn the software in a matter of a few weeks.

Prepare your students with the tools they will use after graduation. Call or email to get pricing for your classroom.

SOFTPLAN
ARCHITECTURAL DESIGN SOFTWARE

Softplan
800-248-0164
sales@softplan.com
• www.softplan.com

CAD/CAM

Validate Students' Skills with Mastercam Certification™

Mastercam Certification™ is a quick and easy way to validate a person's skills, benefiting both employers seeking qualified recruits, and individuals seeking to advance their careers. Enabling students to achieve a certification in the world's most widely used CAM software helps to ensure their success once they leave the program. Certifying students in Mastercam not only validates their skills but also your program.

Mastercam®

Mastercam
800-ASK-MCAM • www.mastercam.com

CNC

ShopBot Desktop MAX Prepares Students for the Future

The ShopBot Desktop MAX is the newest member of ShopBot's line of CNC tools. With a tool bed measuring 36" × 24", and the stability and precision of a dual-motor gantry, the ShopBot Desktop MAX cuts, carves, machines, and mills a variety of materials including wood, MDF, plastics, foams, vinyl, and aluminum.

The Desktop MAX has two options for beds. Choose from the versatile easy-to-remove aluminum tool deck, enabling a variety of end-machining processes, or the universal vacuum hold down deck kit for hold down of larger sheet goods. Add-ons and accessories, like the ShopBot Rotary Indexer, extend the capabilities of the tool and expand learning opportunities for your students. Each new ShopBot comes bundled with two powerful software programs to create CNC projects and includes a quick start setup guide.

ShopBot tools are at work in hundreds of STEM and career education programs around the U.S.—helping teachers provide their students with knowledge of CNC tools and software currently being used in the workplace. ShopBot Tools' support for educators goes beyond providing quality CNC tools by offering free ready-to-cut classroom project files on the ShopBot website (shopbottools.com) and an active user community in our ShopBot forum. Technical support is always free.

Founded in 1996 and headquartered in Durham, NC, ShopBot Tools focuses on making digital fabrication technology affordable and accessible, with a wide range of tool sizes from the Handibot® Smart Power Tool to the ShopBot Desktop to full-sized shop tools.

ShopBot®
888-680-4466 • ShopBotTools.com

ShopBot Tools, Inc.
www.ShopBotTools.com
919.680.4800 • 888.680.4466 • Fax: 919.680.4900
Sales: sales@shopbottools.com
Support: support@shopbottools.com

CNC

Industrial Skills Training Solutions

Techno CNC Systems Educational Sector (www.techedcnc.com) offers high-speed, affordable industrial-quality CNC routers, plasmas, and laser machines in a wide range of sizes with work areas available from 12" × 12" to 5' × 10'. All Techno machines are perfect for classrooms and offer endless STEM opportunities.

Techno CNC Systems Educational

Techno CNC's routers, plasmas cutters, and laser equipment make it easy and exciting for educators to prepare students for the technical manufacturing jobs of tomorrow. Students meet modern manufacturing challenges face to face, turning design concepts into reality on Techno's latest industrial equipment.

Our webpage "Success in Schools" features a photo of President Barack Obama visiting a school showcasing multiple Techno CNC routers in a Fab Lab. A fine example of how Techno CNC equipment is leading the way in educational training! Check out Techno's educational website, which showcases 30 years of educational success stories in many areas of interest: (www.techedcnc.com/schools.htm)

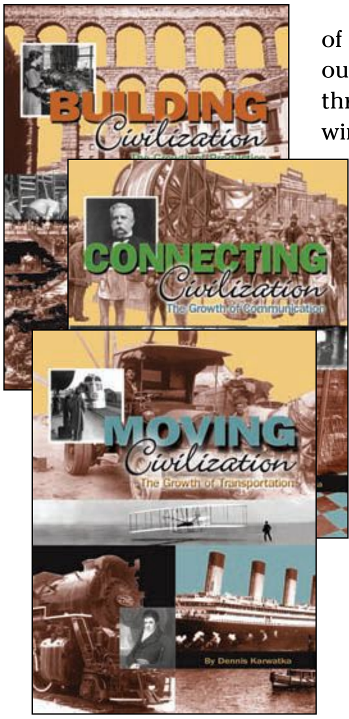
- Fab Lab
- STEM
- Maker Space
- Pre-Engineering
- CO2 Car Curriculum
- Design/Rapid Prototyping
- Manufacturing
- Architectural Design

Every Techno CNC machine is installed and supported by local Techno representatives to ensure a successful startup. Techno CNC Systems provides superior technical support FREE for the life of our equipment. Call today to get your CNC machining program off to the right start!

Techno CNC Systems, LLC • Educational Sector
631-648-7481
www.techedcnc.com • technosales@technocnc.com

CTE

Technology and Civilization Books

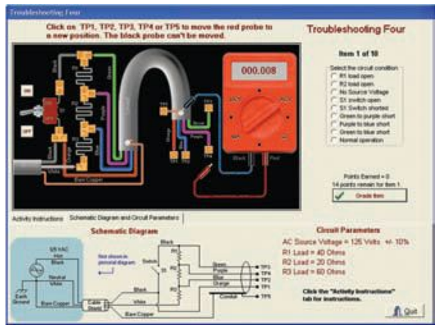


Read the fascinating story of how technology has shaped our world in this handsome three-book series by award-winning author Dennis Karwatka! These books bring to life the fields of production, communication, and transportation. Each presents a comprehensive overview of the technology's evolution, plus a selection of biographies of its key innovators. They offer an upbeat view of humanity's technological history; clear, easy-to-follow descriptions of inventions that make technology interesting and understandable to all readers; and a discussion of the effects of technical advances on the lives of everyday people, giving readers a fascinating glimpse of the day-to-day lives of past generations. Beautifully illustrated with vintage photos and drawings. Only $19.95 each, get the whole set for only $49.95!

Tech Directions Books & Media
800-530-9673 x300
www.techdirections.com/bookshistory.html

Electricity/ Electronics

Electronics Learning Activities



Do you teach electronics, electricity, HVAC, or automotive technology? Still using old methods to teach modern technology? Interactive software makes learning exciting. Topics from Ohm's law to op amps and digital troubleshooting are covered. Use your current textbooks and curriculum. Activities provide immediate feedback and grading. Learning activities are constructed using random variables to assure varied experiences. Use on computers/networks on campus or students can use it at home. $229 for unlimited site licenses! Funding often available through Carl Perkins, your media center, or library. Software is excellent for retention, individualization, and remediation. Download trial software programs from our website.

ETCAI Products
800-308-0154 • Fax: 901-861-0233
info@etcai.com • www.etcai.com

Engineering

Fun Engineering Software

Time Engineers teaches middle or high school students science, technology, engineering, and math without leaving the fun of gaming behind. Students travel in a time machine to three different time periods and encounter typical engineering problems to solve in order to build pyramids, irrigate farmland, command a WWII submarine, raise and lower medieval drawbridges, and more. Only $19.95.

Distributed by
Tech Directions Books & Media
800-530-9673 x300
www.techdirections.com/time-engineers.html

Heat Treating

Dual Chamber Furnaces

Lucifer Furnaces' Red Devil units—an excellent, economical introduction to metallurgy. Complete heat treating: hardening furnace (2200° F) over tempering oven with recirculating fan for uniform heat reaching 1200° F. Featuring easy-to-replace heating elements, digital controllers, energy-efficient insulation, hearth plates protecting floor brick, and safety switches on horizontal swing doors. Prewired—easy installation—shipped ready to connect to main power supply. A great choice for schools.

Lucifer Furnaces, Inc.
www.luciferfurnaces.com • info@luciferfurnaces.com
800-378-0095

Machining

Master Machinist DVD Series

DVD series provides excellent individualized or classroom instruction and skills review. The series is produced by a journeyman toolmaker and emphasizes safe procedures throughout. Content has been reviewed by machine trades instructors. Individual DVDs cover the *Milling Machine*, *Engine Lathe,* and *Inspection Tools*. Individual DVDs are $59.95 each; save on the series, only $169.95.

Tech Directions Books & Media
800-530-9673 x300
www.techdirections.com/machvideo.html

Mechatronics

Entry-Level Mechatronics Training System

Mini Mechatronics Training System, MMT-95519 is an ideal tool for entry-level users to be familiar with PLC programming and industrial maintenance. Students learn skills to troubleshoot, maintain, and program automation systems.

Features:

1. The most compact industrial-grade mechatronics training system.
2. Fits any lab; the comprehensive mechatronics training curriculums are included.
3. A flexible learning system for students to practice not only basic PLC programming but also advanced automation logic control concepts.
4. Six basic labs for students to be familiar with the system components.
5. Six advanced labs for students to practice logics, sorting, and automation programming.
6. Most affordable and innovative mechatronics system for high school CTE programs.
7. Training contents include DC motor control, sensor applications, pneumatic cylinder control, screw mechanism control, and troubleshooting.
8. Fundamental Allen Bradley PLC instructions practice curriculums included.

3 ROCKS TECH.

3 Rocks Technology
888-351-3989 • Fax: 909-532-5780
www.3rockstech.com
info@3rockstech.com

techdirections
linking education to careers

Dear Tech Directions Readers,

Tech Directions Needs Your Help—Share your knowledge with your fellow teachers.

We are looking for articles about what is going on in the career-technical and STEM education field, ideas teachers can use in the classroom, and anything that can help prepare students for a career. Articles should be approximately 1,000-2,000 words in length and should be accompanied by photos and/or drawings, when appropriate. Also, we are looking for quality photos for cover use. They should be high resolution and of a vertical orientation.

I would love to share what you are doing in your classroom/school with your peers. Looking forward to hearing from you,

Vanessa Revelli

Vanessa Revelli, Managing Editor, Tech Directions Magazine
vanessa@techdirections.com • 734-975-2800 x306

Plastics

Plastics Manufacturing Equipment

KELVIN® has a complete line of Plastics Manufacturing equipment for your classroom. The EZee™ Plastic Vacuum Former (#841970) is a fun way to create student-designed vehicles and more! The Hot Line Acrylic Bender (#841999) warms acrylic strips so they can be shaped on the Angle Jig (#841998). See our website for our full line of plastic supplies and equipment.

KELVIN® • www.kelvin.com

Projects

Save Money with Bulk Packs!

Kelvin® Bulk Packs are a great way to save money in the classroom! They include consumable materials and instructions for a wide variety of popular Kelvin® projects. The Solar Racer™ Wood Base, #841415, is shown at right. Visit our website for a list of all our Bulk Packs.

KELVIN®
www.kelvin.com

Robotics

KELVIN® Kre8® Red Robot

KELVIN®'s Kre8® Red Robot (#283707) is an easy to make and easy to customize autonomous robot that can be controlled with the Genie PCB418 Board (#842211, kit or #842210, assembled). Comes with free software Genie download. Covers steering, balance, speed, friction, circuit wiring, movement, gears, and motors. Visit our website for our full line of Kre8® easy-to-make projects!

KELVIN®
www.kelvin.com

STEM

Educational Catalog

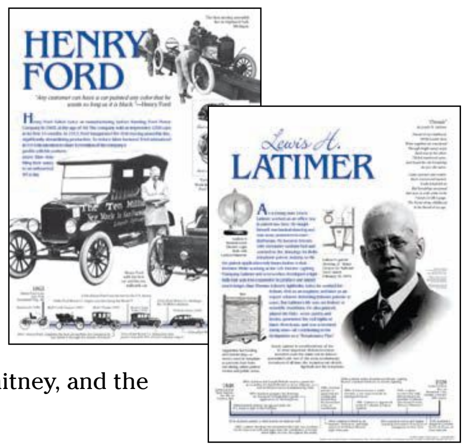
Our latest catalog for Science, Technology, Engineering, and Mathematics as well as Electronics is available online. Visit our website for more information.

KELVIN®
www.kelvin.com

STEM

Technology's Past Posters

Stunning posters depict the people and inventions that changed our lives forever. Series documents the hard work and persistence of creative dreamers who overcame hardship and skepticism to produce marvelous innovations that have changed our world. Each poster features a brief biographical description and a timeline of key life events. Series includes Alexander Graham Bell, George Washington Carver, George Eastman, Thomas Edison, Henry Ford, Charles Goodyear, Lewis Latimer, Garrett Morgan, Nikola Tesla, George Westinghouse, Eli Whitney, and the Wright Brothers. Posters measure 18" × 24".



Tech Directions Books & Media
800-530-9673 x300 • www.techdirections.com/posterstech.html

Transportation

Dragster Blanks with Pre-Drilled Axle AND Power Input Holes

NEW & EXCLUSIVE! No CO2 Dragster Blanks pre-drilled with both axle and air input holes (#970386, 10" L, 50/pkg., $105) or CO2 Dragster Blanks pre-drilled with both axle and CO2 input holes (#970387, 12" L, 50/pkg., $130). Bulk pack dragster kits also available. For more information, visit our website.

KELVIN® • www.kelvin.com

Welding

Welding Training Curriculum

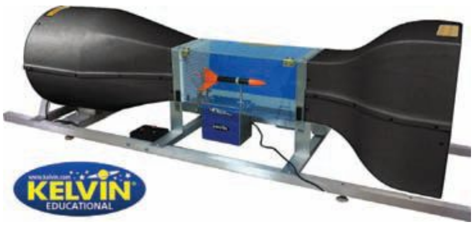
HIWT offers world-class curriculum materials on all major processes based on AWS® Entry Level SENSE criteria (QC10 and EG 2.0). Our complete training programs include DVDs, instructor guides, and student workbooks. Designed with input from instructors, video modules present core information and model proper technique so students can work independently with the aid of their workbooks and coaching from their instructor. Visit our website to see a complete line of offerings.

HOBART INSTITUTE OF WELDING TECHNOLOGY

Hobart Institute of Welding Technology
937-332-9500 • www.welding.org

Wind Tunnels

Wind Tunnel II™



The sleek design of KELVIN®'s Wind Tunnel II™ (#840614) features smooth laminar air flow, variable speed, and variable angle of attack. Students can measure lift and drag to accurately evaluate their designs of wing sections, rockets, cars, and dragsters. Also use it to test mini wind turbines. View results on your computer screen. See our website for more information.

KELVIN® • www.kelvin.com

Woodworking

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.

Quality VAKuum Products, Inc. 800-547-5484
qvp@qualityvak.com
www.qualityvak.com

Continued from page 12.
trolytic gel. This allowed the batteries to have a sandwich construction leading to the thin designs common to today's mobile handsets. Further development led to Lithium polymer (Li-Pol) cells that used a solid polymer as the separator. One downside of Li-Pol batteries is that the ions travel more slowly through the solid polymer than liquid electrolyte, so charging takes longer.

Building a Better Battery

Millions of research dollars continue to be spent to improve Li-ion batteries. Scientists focus their efforts on enhancing characteristics such as energy density, self-discharge rate, peak demand and pulse performance, charging time, and tolerance to deep discharge, together with improving device safety.

Developments have primarily targeted two areas: alternative materials for positive electrodes, negative electrodes, and electrolytes–with a view to packing more lithium ions into the electrodes, making it easier for the ions to move in and out, and easing the passage of the ions through the electrolyte–and overcoming the technology's inherent safety challenges.

Positive electrode materials nearing commercialization include lithium nickel manganese cobalt oxide ($LiNi_xMn_yCo_zO_2$), which has an energy density about 20% greater than $LiCoO_2$ but at higher cost, and lithium nickel cobalt aluminum oxide ($LiNi_xCo_yAl_zO_2$), which has an energy density about 35% greater than $LiCoO_2$. Experimental negative electrode materials include lithium titanate ($Li_4Ti_5O_{12}$) (which has low energy density but higher recharge cycles), hard carbon (greater storage capacity), tin/cobalt (energy density), and silicon/carbon or pure silicon (energy density).

There are also several interesting initiatives for improving the mobility of the ions. One example comes from the University of Illinois at Chicago (UIC) and replaces the thin, almost two-dimensional, positive- and graphite negative-electrodes of a conventional Li-ion battery with three-dimensional porous nickel structures.

Pohang University

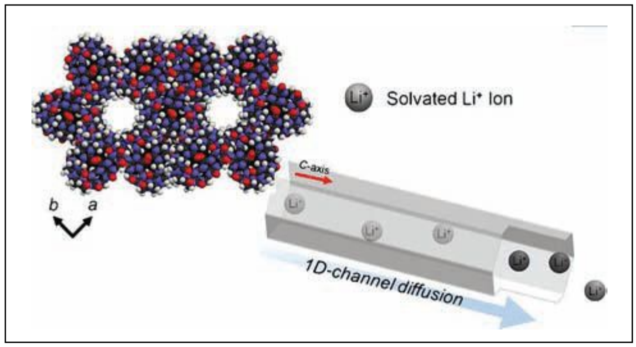


Fig. 2—South Korea's Pohang University's electrolyte enables lithium ions to diffuse far more freely than a conventional electrolyte.

$LiMnO_2$ and nickel tin (NiSn) are plated onto the structures to form the positive- and negative-electrodes, respectively. The result is electrodes that can hold many more lithium ions than a conventional device with greater freedom of movement. The university claims this battery would be 30 times smaller than a device of the same capacity and could be charged 1,000 times quicker.

UIC is also doing some pioneering work replacing lithium ions (which carry a +1 charge) with magnesium ions (which have a +2 charge). The result could be a battery with a considerably higher energy density than Li-ion cells and can withstand many more recharging cycles.

Researchers have also concentrated their efforts on employing nanoscale (10^{-9} m or nm) materials to improve the mobility of lithium ions through electrodes and electrolytes. For example, scientists at South Korea's Pohang University have built a prototype battery from pumpkin-shaped molecules organized in a honeycomb-like structure which can be used as a solid electrolyte. The molecules have a thin channel (measuring 75 nm in diameter) running through them which enables lithium ions to diffuse far more freely than in a conventional electrolyte (Fig. 2). In tests, the porous electrolyte demonstrated lithium ion conductivity of around three times that of conventional commercial solid electrolytes.

Another example of nanomaterials at work to improve Li-ion batteries comes from Massachusetts Institute of Technology (MIT). Researchers Byoungwoo Kang and Gerbrand Ceder at the institute claimed that by using nanoball electrodes, batteries could be charged about 100 times as fast as normal Li-ion batteries, resulting in a smartphone that could charge in 10 seconds. The 50-nm balls of lithium iron phosphate dramatically improved ion mobility and the MIT researchers further accelerated the process by coating the balls with a thin layer of lithium phosphate.

Carbon nanotubes might already be at work inside smartphone batteries. The exact composition of most positive- and negative-electrodes are currently held as trade secrets, but the level of commercial production of carbon nanotubes hints that Li-ion batteries are already taking advantage of their properties. Carbon nanotubes exhibit greater surface area, higher conductivity, and better mechanical stability than bulk carbon.

Other developments include eliminating the carbon altogether and replacing it with silicon or germanium nanowires to further increase the surface area of the negative electrode. This again boosts the mobility of the lithium ions and allows more to be absorbed during charging without volumetrically stressing the material (enabling more recharge cycles).

Nanostructuring generally increases the surface area-to-volume ratio, which improves both energy- and power-density due to an increase in electrochemically active surface area and a reduction in ion transport lengths. The downside is an increase in side reactions between the electrode and the electrolyte, causing higher self-discharge, fewer recharging cycles, and shorter shelf life.

Prototype batteries using nanomaterials exhibit much higher energy densities than today's commercial batteries. But at present materials are expensive and the manufacturing process is difficult to scale to industrial levels.

The Next Generation of Lithium Battery

One development that brings together all the strands of current Li-ion battery development is the Lithium-sulfur (Li-S) battery. This device takes advantage of developments in materials, three-dimensional electrodes, and nanomaterials to improve on today's Li-ion products. Current developments target electric vehicles, but the hope is the technology can be shrunk such that the battery is suitable for portable products like smartphones.

The negative electrode is a thin sliver of lithium while the cathode is lithium oxide (Li_2O_2) in contact with active sulfur. The reason for such keen interest in the technology is the predicted maximum energy density. The best contemporary Li-ion batteries produce about 200 Wh/kg and the technology has a theoretical limit of around 320 Wh/kg. The theoretical limit for Li-S is around 500 Wh/kg. The key advantage for these types is that the sulfur can host two lithium ions compared to the 0.5 to 0.7 for conventional intercalation materials—resulting in the superior energy density.

Beyond the Battery

Other power sources for portable power include supercapacitors and fuel cells. A supercapacitor is a high-capacity capacitor that bridges the gap between electrolytic capacitors and rechargeable batteries, such as the EDLC 5.5V EDLC Supercapacitor from TDK. Supercapacitors offer higher energy storage and power density than conventional capacitors, making them excellent for burst or pulse load applications like an LED flash, power amplifiers, or certain audio circuits. Supercapacitors can also provide power for devices that draw very little current over a long time, such as the Real-Time Clock (RTC) and Watchdog FRAM Supervisory ICs from Cypress Semiconductor.

Although very promising, supercapacitors have two main disadvantages over batteries. First is a voltage range of 2.5 to 2.7 V (compared to 3.5 to 3.7 V for Li-ion batteries). To achieve higher voltages, several supercapacitors are connected in series which increases complexity by demanding careful voltage balancing. Moreover, the voltage of a supercapacitor decreases on a linear scale from full to zero which results in some stored energy remaining in the device once the voltage drops below a usable threshold. The second drawback is the supercapacitor's low energy density. Compared with the Li-ion battery's 200 Wh/kg, even the best supercapacitors struggle to exceed 10 Wh/kg. That means that a bank of supercapacitors will take up much more space than an equivalent Li-ion battery.

Fuel cells represent perhaps the most esoteric attempt to steer portable power sources away from conventional batteries. Invented in 1838 and cemented into popular perception during the Apollo 13 crisis, fuel cells have long been used as a method of converting the chemical energy of fuel into electricity, and are considered a good option for electric vehicles. However, due to their size, portable fuel cells are inappropriate for mobile electronic products at this time.

Li-ion batteries are a rapidly maturing technology that lie at the heart of the most capable portable consumer electronic devices. But while providing satisfactory service, consumers crave longer life from batteries. That's stimulating ongoing research to develop and refine the chemistry and physics to ensure that Li-ion technology continues to evolve. Some of that research promises to yield lithium-based batteries with double the run time of existing cells in like-for-like applications. However, even that might not be enough to satisfy the demands of future consumer electronic products, so expect to see alternative technologies like supercapacitors, fuel cells, energy harvesting, and yet-to-be-invented power storage devices enter the fray. td

Part 2

How Does FERPA Affect You?: 2017

By Thomas V. Toglia
Thomas.Toglia@lr.edu

FAMILY Educational Rights and Privacy Act (FERPA), also known as the Buckley Amendment, was enacted in 1974 to oversee the privacy, discharge, and accuracy of educational records. Many administrators and instructors that manage CTE and STEM programs are uncertain how FERPA applies to their secondary and postsecondary students. Moreover, because today nearly all student records are digitized and communicated electronically, CTE and STEM instructors have an even greater responsibility to protect students' privacy to avoid discrimination, identity theft, and unauthorized disclosure (U.S. Department of Education, n.d.).

Digital Communications and Social Media

At this time, there is limited official guidance regarding FERPA and various forms of digital communications. Nonetheless, CTE and STEM educators must fully comprehend their obligation to protect student privacy when communicating through the use of technology. As such, any email, text, tweet, or social media post that contains personally identifiable information regarding a student and is "maintained" by the institution should be considered an "education record" and thus afforded all FERPA protections, unless they fall within one of the aforementioned FERPA exceptions (e.g., a health or safety emergency). Given this, and the limited guidance available, education attorney Brian Crowley (2013) suggests that institutions avoid using school email accounts to communicate personally identifiable information about students. School personnel are further advised "not to use their personal phones, email accounts, Twitter,…social media accounts, and other personal technology to communicate with other staff, students, parents, or teachers about students (Crowley, 2013, paras. 13 & 14).

CTE and STEM educators must fully comprehend their obligation to protect student privacy when communicating through the use of technology.

Finally, another form of media with FERPA implications involves the use of security cameras. Specifically, as more schools and colleges install video surveillance cameras in buildings, hallways, parking lots, and on school buses to deter student misconduct and violence, the question arises as to whether the video is an "education record" and if it protected by FERPA. This issue was recently settled in a Third District Court decision (see Bryner v. Canyons School District, 2015). In this case, a parent wanted the school district to provide him a copy of a video surveillance recording that included his child who was involved in an altercation with another student. The school refused to accommodate his request indicating that the video contained images of other students and therefore could not be released to the parent unless all the other parents consented. The school district did offer the parent a redacted copy, but he would have to pay $120.00 for the redaction. The court agreed with the school district and concluded that "the video was an education record subject to FERPA." The court also affirmed that the parent must pay the cost of producing a redacted version. Interestingly, when surveillance video is maintained solely by campus law enforcement its release is not subject to FERPA regulations. However, even in this situation caution should be exercised as some law enforcement records are also maintained in a student's file, and therefore are considered education records as well and thus subject to FERPA.

Requests for Public Records

Due to an increased demand for

Part 1 appeared in the September 2017 issue of **techdirections**. *You can read it online at www.omagdigital.com/publication/?i=433290&ver=html5&p=20*

Thomas V. Toglia is an adjunct professor of education law and ethics, Lenoir-Rhyne University, Asheville, North Carolina.

accountability and transparency, institutions are seeing more requests for records related to disciplinary incidents and campus crimes, including sexual misconduct under Title IX. While the Clery Act requires schools to report crime statistics, it does not permit the disclosure of personal information that would identify the student or students involved in the incident. Nonetheless, news organizations have sought to obtain very specific information, including names, which they feel should be available under a state's Public Information or Open Records Act. State public records laws are similar to the federal Freedom of Information Act (FOIA) and require schools to provide information when requested. However, public records laws have an exception that bars disclosure if the information is protected by another law such as FERPA. In these situations courts have generally concluded if the information requested is considered to be an "education record" as defined by FERPA or if it cannot be reasonably redacted to protect personally identifiable information then the institution may deny the request for disclosure (Kaplin & Lee, 2014).

Enforcement of FERPA Provisions

Currently, the Office of the Chief Privacy Officer (OCPO) (formerly named the Family Policy Compliance Office) of the Department of Education is the entity charged with enforcing FERPA and responding to complaints regarding suspected violations. The OCPO also requires school districts to notify parents and eligible students of their rights to file a complaint and information detailing how to do so. Essentially, if a parent or eligible students feel that their privacy rights have been violated under FERPA, they may file a written complaint with the OCPO. The complaint must contain specific allegations of fact that show reasonable cause that a violation has occurred. The OCPO will then notify the involved school and ask for a written response. Following an investigation, if the school district is found in violation, the OCPO will furnish a statement detailing what is required for compliance and provide a timeline during which the school may comply voluntarily. Sanctions for noncompliance include temporarily withholding payments of federal assistance until a resolution can be reached and may lead to the termination of all eligibility to receive federal funds (U.S. Department of Education, 2017). It is also worthy of mention that FERPA does not currently allow parents or eligible students to sue schools under the federal law. However, a legal right does exist in most states for those who have been harmed by the unauthorized release of private educational records to seek compensation (Kaplin & Lee, 2014).

Compliance Guidelines for CTE and STEM Educators

In the classroom, educators must ensure that students' privacy is maintained. For example, the following practices should be avoided:

- Posting student grades publicly (e.g., office door or class website by name or social security number, including the last four digits of the social security number).
- Discussing a student's academic performance, or attendance, with someone other than the student or an official with a legitimate educational interest.
- Displaying students' projects that reveal names and grades (the student's name may be disclosed if the parent, guardian, or eligible student provides written consent).
- Posting progress charts in the laboratory that track a student's completion of activities or assignments that will ultimately lead to a grade.
- Placing graded exams or report cards on a table to be picked up which requires students to sort through all papers.
- Disclosing grades or progress to the parents of adult students without the student's consent.

Interestingly, in a case that found its way to the Supreme Court, Owasso Independent School District v. Falvo, 2002, it was ruled that peer grading, the practice of having students exchange papers to grade, is not a violation of FERPA. The Supreme Court, in a decision on February 19, 2002 declared that peer graders are not acting as agents for the educational institution nor are they "maintaining" the grade.

In fact, the Court held that "correcting a classmate's work can be as much a part of the assignment as taking the test itself. It is a way to teach material again in a new context, and it helps show students how to assist and respect fellow pupils" (Hall & Marsh, 2003, p. 304). Similarly, in the spirit of Owasso, the U.S. Department of Education has determined that group grading of team assignments within the classroom is also an acceptable practice and does not violate FERPA. Still, students retain the right to opt-out of such practices.

While the Owasso case is often quoted regarding permission to use peer-graders, the courts are less clear when it comes to student-workers and parent volunteers that have access to grades and records. In these situations, it is recommended that confidentially agreements that affirm they will protect the privacy of students be completed by the student aides or parent volunteers. Even so, most legal experts suggest that when in doubt, instructors should always err on the side of caution and not disclose a student's educational information without first consulting enrollment management personnel,

Sanctions for noncompliance include temporarily withholding payments of federal assistance until a resolution can be reached.

or the institution's legal counsel.

Additional situations where CTE and STEM educators need to be concerned regarding student privacy and FERPA directives relates to their interaction with employers of students participating in work-based learning initiatives, and when writing letters of recommendation. Work-based learning, such as internships, job-shadowing, and cooperative work experience, is common in CTE and STEM education. Hence, it is important for instructors and work-based education coordinators to fully understand how FERPA applies to their work with potential and current employers of students.

As instructors and coordinators seek to place students in productive training sites, it becomes necessary to communicate information regarding students' qualifications to prospective employers. In order to make an informed decision, employers usually request information pertaining to students' grades, courses, and performance. Although employers are participating in the work-based learning experience, they are not deemed "school officials" with a "legitimate educational interest" (Hall & Marsh, 2003). As such, in accordance with FERPA, instructors and coordinators are not able to disclose information considered part of the students' educational records without the written consent of the parent or eligible student. To remain in compliance with FERPA, many institutions include a statement in the work-based training agreement authorizing the school to release pertinent educational records to actual and prospective employers that must be signed by both the parent and the student. Likewise, schools must obtain written permission to disclose personally identifiable information to certain organizations that work with STEM students, such as those completing National Science Foundation (NSF) STEM internships (Family Education Rights, n.d.).

A situation like interacting with employers of work-based learning students is writing recommendation letters. CTE and STEM instructors are regularly asked by students to write letters of reference for employment, scholarships, and enrollment in other institutions. Under FERPA, facts often addressed in letters of recommendations (e.g., GPA, course grades, performance, and other non-directory information) are part of the students' educational records. Consequently, instructors must obtain a signed release from the parent or student specifying the records to be disclosed, the purpose, and to whom the disclosure will be made. Also, if a letter of recommendation is kept on file, the student retains the right to read and inspect it, unless this right has been specifically waived. An exception to obtaining a release when writing a letter of reference occurs when the recommendation is based solely upon personal association/observation with the student and the letter does not contain any information acquired from educational records (University of Utah, n.d.).

Clearly, FERPA has far-reaching implications for those that teach and administer programs in CTE and STEM education. Moreover, as history has shown, FERPA and its associated guidelines will continue to be challenged and redefined as circumstances merit. In fact, currently there are several pending bills in Congress that seek to "modernize" FERPA for a digital world and to clarify the "school official" exception, especially as it relates to third parties. As such, CTE and STEM educators should resolve to stay informed regarding new policies and practices, and when in doubt always seek advice regarding the privacy and disclosure of students' educational records.

References

American Association of Collegiate Registrars and Admissions Officers (AACRAO). (2006). AACRAO FERPA Guide.

Bryner v. Canyons School District. (2015). Retrieved from https://cdn-files.nsba.org/s3fs-public/reports/Bryner%20v%20%20Canyons %20 School%20District.pdf?MkArNe7KjCN1YAK.OnlSGFFYMvfGap4D

Crowley, B. (2013, February 20). Are Emails, Texts, Tweets, and Other Digital Communications Student Records Under FERPA and State Law? [Blog post]. Retrieved from http://edlawinsights.com/2013/02/20/are-emails-texts-tweets-and-other-digital-communications-student-records-under-ferpa-and-state-law/

Family Education Rights & Privacy Act (FERPA) Release and Statement of Informed Consent (n.d.) Retrieved from http://depts.gpc.edu/~enlistem /ENLISTEM.Release.pdf

Family Policy Compliance Office (FPCO). (2012, March). Transcript: Intersection of FERPA & Part B of IDEA Confidentially Provisions [Webinar]. Retrieved from http://ptac.ed.gov/sites/default/files/transcript-to-ferpa-idea-webinar-march2012.pdf

Feder, J. (2013, November). *The Family Educational Rights and Privacy Act (FERPA): A legal overview.* Washington DC: Congressional Research Service.

Garcia-Kaplan, O. (2015, June 10). What is PARA? Another Student Privacy Law. [Blog post]. Retrieved from http://blog.ferpasherpa.org/?p=221

Hall, B. H., & Marsh, R. J. (2003). *Legal issues in career and technical education.* Homewood, IL: American Technical Publishers, Inc.

Helfrich, B. (2013). Title IX v. FERPA: Which Law Trumps Following a Sexual Harassment Investigation. [Blog post]. Retrieved from http://www .mickesotoole.com/articles/title-ix-v-ferpa-which-law-trumps-following-a-sexual-harassment-investigation-by-betsey-helfrich/

Joint Guidance on Data Matching to Facilitate WIOA Performance Reporting and Evaluation (2016, August). Retrieved from https://www2.ed.gov/policy/gen /guid /fpco/pdf/final-ferpa-tegl-report.pdf

Kaplin, W. A., & Lee, B. A. (2014). *The law of higher education* (5th ed.), (Student Version). San Francisco: Jossey-Bass.

Meyers, T. E. (2016, April). 2016 FERPA Update Back to the Basics (Or Back to the Future?). Presented at the 2016 School Law Seminar, April 7-9, Boston, MA.

National Forum on Education Statistics. (2006). Forum Guide to the Privacy of Student Information: A Resource for Schools (NFES 2006–805). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

National School Boards Association (NSBA). (2017). Annual notices. Alexandria, VA: Author.

Rinehart-Thompson, L. A. (2009). Amendments to FERPA Regulations: New Changes Attempt to Balance Safety and Privacy in Student Records. Retrieved from http://library.ahima.org/doc?oid=91935#.WSdR8pLyv3g

Teeter, D. T. (2017, May 5). Top 5 Common HIPAA "Myths" That Arise in Higher Education. [Blog post]. Retrieved from http://www.higheredu-cationlegal insights.com/2017/05/common-hipaa-myths-that-arise-in-higher-education/

University of Utah (n.d.). Family Educational Rights and Privacy Act (FERPA): Online tutorial for faculty and staff. Retrieved from http://www.sa.utah.edu /regist/ferpa/faculty/guide.htm

U.S. Department of Education. (n.d.). Safeguarding Student Privacy. Retrieved from https://www2.ed.gov/policy/gen/guid/fpco/ferpa/safeguarding-student-privacy.pdf

U.S. Department of Education. (2001, January). Revised Sexual Harassment Guidance: Harassment of Students by School Employees, Other Students, or Third Parties. Retrieved from https://www2.ed.gov/offices /OCR/archives/pdf/shguide.pdf

U.S. Department of Education. (2004, November). Letter to University of North Alabama re: Disability Office Records. Retrieved from https://www2 .ed.gov/policy/gen/guid/fpco/ferpa/library/copeuna.html

U.S. Department of Education. (2011, June). Addressing Emergencies on Campus. Retrieved from http://rems.ed.gov/docs/ED _AddressingEmergenciesOnCampus.pdf

U.S. Department of Education. (2015, June). FERPA General Guidance for Students. Retrieved from https://www2.ed.gov/policy/gen/guid/fpco /ferpa/students.html

U.S. Department of Education. (2017). Protecting Student Privacy. Retrieved from https://studentprivacy.ed.gov/file-a-complaint

One Possible Solution for the Future of Career and Technical Education

A new program in Tennessee lets students to progress at their own pace – and learn job skills

By Nichole Dobo

SOMETIMES, students need a little nudge – and some freedom – to finally understand how to succeed in school.

That was the case for one teenager in Hamilton County, Tennessee. She was encouraged to enroll in a program that allowed her to take classes at her own pace. She had a 1.6 GPA when she entered the program last fall, in her junior year of high school. Then she made honor roll for the first time in her life.

"She has worked her tail off," said David Cowan, director of career and technical education at the Hamilton County Department of Education.

This student flourished at the Mechatronics Akademie, a modern iteration of career and technical education for high school students. Created through a partnership between the local department of education, the Volkswagen Chattanooga factory and Chattanooga State Community College, it uses online and in-person instruction in an out-of-school setting to prepare students who might not pursue higher education after high school. But this isn't the easy way out. The students are tackling tough courses, such as advanced math, and classes that qualify them for college credits and job certifications.

"Our kids have risen to the expectation," said Cowan. "We thought they would, but you never count your chickens before they hatch."

> **"We think it's filling up new ground. It's changing the way we think about the high school experience."**
>
> *David Cowan, director of career and technical education, Hamilton County (Tenn.) Department of Education*

The 26 students, from four local public high schools, report to school at the Volkswagen plant, a major new employer in the region. (The program, which started in August, is expected to grow to include more students and other employment tracks.) Students spend the morning in "lab time," a flexible period during which they are taking courses, such as algebra or trigonometry, through the Edgenuity platform on a computer.

They aren't left to go it alone with a computer. There's a teacher there. The computers simply allow students to work at different paces or on different courses. This was important, because the program accepted students from all levels. Some had low grades. Others were already on the honor roll.

In the afternoon they work in a hands-on setting at the Volkswagen plant. Students also take courses offered by the Volkswagen academy. About 70 percent of the day is spent in real-life, hands-on learning. One of the recent highlights: learning to drive a forklift. These courses give them skills that will make them more marketable after high school if they choose to seek employment rather than going to college.

Students can also take dual-enrollment courses to earn college credit during the flexible time dedicated each day to academics.

"We think it's filling up new ground," Cowan said. "It's changing the way we think about the high school experience."

Preparing these students so they are on the right path is of critical importance for this region. A recent report suggested that some 15,000 jobs are filled by outsiders because local people do not have the required skills to do the work.

"There has been a resurgence in opportunities in the manufacturing sector," Cowan said, "a lot of it driven [starting] eight years ago, when Volkswagen came to town and built a multi-million-dollar facility."

Cowan hopes they can expand the program to cover other careers, too. With the help of technology, and a willingness to give teachers and students flexibility to study at their own level and their own pace, this could be one solution to helping students find pathways to good jobs.

Nichole Dobo is a staff writer and social media editor 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.*

Mentoring the Next Generation of Technologists

By Charles Eaton

MY last article for **tech directions** defined the term "technologist," a label that applies to people working in companies of all shapes and sizes across the country along a broad spectrum of industries—not just those that write software and make hardware. I explained that, while technologists have diverse interests and multifaceted personalities, most share five traits:

1. A technologist thinks strategy first.
2. A technologist has a passion for solving problems and a general sense of curiosity.
3. A technologist sees technology in a constructive context.
4. A technologist believes tech is about humans, not hardware.
5. A technologist values respect, cooperation, and collaboration.

Based on this core set of qualities, I believe today's tweens and teens—especially those from groups currently under-represented in the tech industry—are suited to become tomorrow's technologists. Why? Because we asked them what they really want for their future careers in our "Teen Views on Tech Careers" report, and I feel, on the whole, their answers align well with the personality of a technologist.

But before I elaborate on our research, I want to clarify what we mean when we refer to tweens and teens as the "next generation of technologists":

In general, we are referring to young people currently in their middle- through high-school years. Some demographers call them Generation Z, a large and culturally diverse cohort of children born during the mid-90s and later. In our studies, we emphasize urban youth and girls because those populations provide perspective on the "under-represented" groups I mentioned above—namely, African-Americans, Hispanics, and

---

As Executive Vice President of Social Innovation for CompTIA and CEO of Creating IT Futures, Charles Eaton leads three philanthropic endeavors for CompTIA, the world's largest IT trade association: CompTIA Giving, Creating IT Futures, and NextUp, the organization's initiative to inspire young people to choose technology careers.

women. We also worked with IDEO, a global consulting firm, to review the broader body of research in this field and synchronize our findings with over-arching conclusions from other studies.

The reason we are focused on Gen. Z is the oldest among them are preparing to start work. Already making up a quarter of the U.S. population, Gen. Z-ers will account for more than 20% of the workforce in the next five years—and become one of the vital forces that shrinks our nation's "tech skills gap."

To refresh your memory about the tech skills gap, some sources claim there may be as many as half a million unfilled IT jobs in our country at any given time. U.S. Bureau of Labor Statistics that predict IT occupations will grow 12% by 2024 compound this skills gap issue, along with the fact that many in the tech industry are now nearing retirement age.

My organization believes the shortest path to filling this gap is tapping under-represented groups. If we increase the participation of existing populations in technology careers, we jump-start the process. And then, to develop the talent pipeline from youth to adulthood, two shifts in our educational mindset are necessary:

1. Preparation for a career working with technology must include development of hard technical skills and business sense, such as clear communication, analytical thinking, and team dynamics. In other words, as argued in my last article, we need to be educating technologists, not just technicians.

2. Mentorship programs should not wait until young people enter the workforce, as these initiatives can make a greater impact during the formative years of middle and high school.

Both beliefs are based on data. To address the first, here's my interpretation of our "Teen Views" study results in terms of a technologist's talents:

• Strategy First

My preferred definition of strategy is a "plan of action or policy designed to achieve a major or overall aim," and I believe technologists favor strategies—that is, plans or policies designed to achieve broad goals—before tactics—meaning actions and activities implemented to achieve specific objectives. I see this sort of "step back and plan before taking action" attitude among teens participating in our research. When asked to pick from a list of 60 categories careers which interest them most, teens put professions such as "business owner," "civil engineer," "lawyer," and "architect" in the top 10. Yes, classic tech titles such as "software programmer" and "computer technician" ranked high too, but overall, most of the occupations that interested young people involved putting technology to work rather than working to create technology.

Top 10 Careers of Interest

Business Owner 18%
Software Programmer 17%
Nurse or Doctor 15%
Civil Engineer 15%
Lawyer 12%
Computer Technician 11%
Military Job 11%
Computer Design Engineer 11%
Architect 7%
Engineer 7%

• Passion for Solving Problems

Roughly eight in 10 teens in our study responded that they would be motivated to learn more about IT programs if "it involved helping to solve a problem in their school." About the same proportion said they would be motivated if "it involved helping to solve a problem in their community." Those results speak for themselves.

• Constructive Context

Most teens (78%) in our survey said "learning new things all the time" and "helping other people" would be important to their future careers. To me, these answers suggests young people value technology largely for its benefit to others rather than just for its impact on their own personal or professional lives.

• Humans, not Hardware, and Respect, Cooperation, and Collaboration

In addition to the high numbers of teens surveyed who expressed a desire to solve problems for their schools and communities, a great many respondents said "helping parents" would motivate them in their careers. These results suggest to me that young people today do indeed have perspective beyond the gadgetry that surrounds them and a sense of their place in the larger society.

In terms of mentorship, our IT Futures Labs research team reached three conclusions about cultivating technologists:

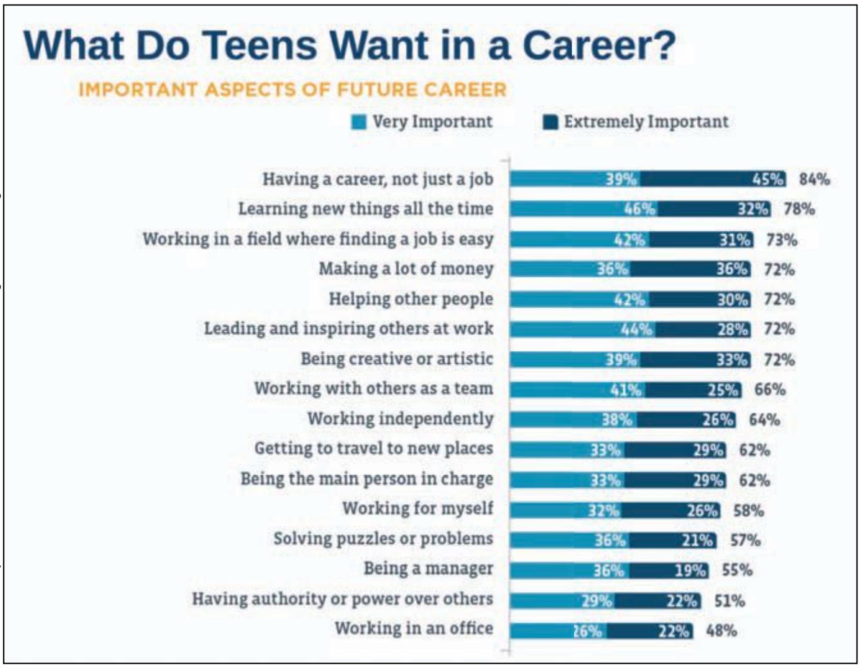
• Role models are highly persuasive.

Their ability to inspire and influence future career choices cannot be overstated. So, if we want more kids to grow up to be technologists, during their middle-school and high-school years tweenagers and teenagers should meet more technologists and learn what they do. Furthermore, a mentor's influence most likely will multiply when parents gain an understanding of technology career paths, too. Students listen to their parents two to one over any other adult in their lives, as we discovered in our studies.

• Mentors model mentality more than method.

What makes a good technologist is more mindset than best practices. Traits such as thinking "strategy first," showing a "passion for solving problems" and believing that technology is about "humans, not hardware" play out more in professional performance than technical manuals. By interacting with tweenagers and teenagers, mentors can provide an early look at how a technologist thinks and acts, enabling students to visualize a future beyond the next level of education.

• Kids have bought into the



Source: Survey of Teen Views on Tech Careers, CreatingITFutures.org

"follow your passion" message.

They want careers that allow them to do something they love. That's why meaningful contact with professionals who love their work, too, is vital. Extending mentorship out of the workplace and down to middle- and high-school years is about inspiration, not training.

What method of mentorship works best for tweens and teens? We incorporate several essential elements into mentorship models we use with NextUp, our organization's initiative to orient young people toward tech careers, that apply to any course of education:

- **Timing is key.**

It's important to work with kids in middle school or early high school, the time in their lives when we classify them as dreamers, meaning they have yet to consider the practicalities of a career, money, or security.

- **Guest speakers only go so far.**

Don't stand up and lecture to students. To make connections with young people, work on projects together. The more sustained the connection, the more likely it is that growth will happen. Show kids how numbers in a database translate into infographics on websites. In addition to showing charts, tell stories with data. Help them visualize how the information captured by businesses with technology influences day-to-day decisions and operations.

- **Guide, don't control.**

A student will never become passionate about something without having some amount of autonomy. Give them the tools they need to get started—then get out of their way. Let kids take over your laptop or tablet and run the apps that process information. In short, let them put their hands on the data and invent something useful and valuable to business and society. You'll be amazed at what they are able to do—and they will be, too. That just makes them hungry for more. That's when mentors step in to guide to the next stage.

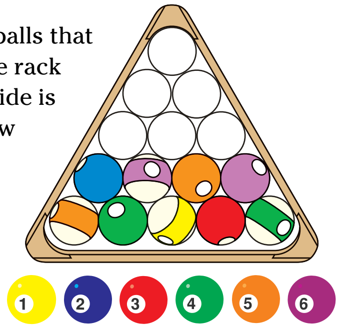
We see you, as a **techdirections** reader, as a crucial pivot point for closing the tech skills gap: A mentor guiding the next generation of technologists. That's why we are offering you a free digital version of our book released earlier this year, *How to Launch Your Teen's Career in Technology: A Parent's Guide to the T in STEM Education*.

Please visit www.TinSTEM.com and enter the coupon code TDCITF17 to download your PDF. td

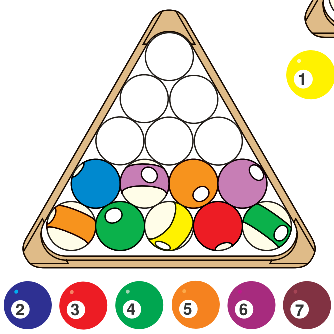
more than fun

Rack 'Em Up

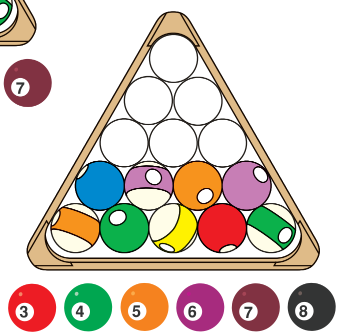
Can you place the six balls that are outside the rack in the rack so that the total of each side is equal to the number below the rack?



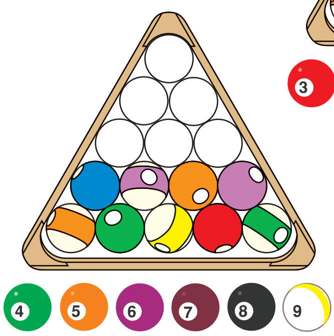
10



13



16



21

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

Checkmate!

Mike and Barbara are both good chess players. They have completed five games and each has won the same number of games. There were no ties. How did this happen?

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

Driving Me Crazy

Can you match the following celebrities, characters, and professions to the cars that they might drive? For example, Richard Simmons might drive a Honda Fit.

1. Patrick Henry	**A. Chevrolet Volt**
2. Homer	**B. Smart Car**
3. Phil Collins	**C. Ford Explorer**
4. Tiger Woods	**D. Mercury Mountaineer**
5. Jacques Cousteau	**E. Subaru Outback**
6. Carl Sagan	**F. Ford Falcon**
7. Albert Einstein	**G. Ford Escape**
8. Keanu Reeves	**H. Nissan Cube**
9. Thomas Edison	**I. Hyundai Genesis**
10. Dizzy Gillespie	**J. Honda Odyssey**
11. Mr. T	**K. Chevrolet Blazer**
12. Picasso	**L. Acura**
13. Crocodile Dundee	**M. Ford Focus**
14. Christopher Columbus	**N. Volkswagen Golf**
15. Prison warden	**O. Mercury Comet**
16. Lawyer	**P. Jeep Liberty**
17. Accountant	**Q. Dodge Coronet**
18. West Virginian	**R. Plymouth Barracuda**
19. Mathematician	**S. Ford Model T**
20. Calculus teacher	**T. Mitsubishi Spyder**
21. Orinthologist	**U. Toyota Matrix**
22. Optician	**V. Infiniti**
23. Entomologist	**W. Honda Civic**
24. Fire fighter	**X. Nissan Maxima**

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

Scientist's Word Scramble

Unscramble the five words at right, then name the famous scientist to whom they refer.

C Y R E C T I L E T I
I N G M S T E A M
D R A A F
L A C E V E N
Z E B E N E N

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 6.