www.techdirections.com

techdirections

linking education to careers

MARCH 2014

Robotics Team Goes Varsity

ITEEA Conference Preview

Teach Microsystems on a Tight Budget

Spring Spotlight Products to Grow Your Program

March 2014

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	29	www.3rockstech.com	909-297-5173
All Electronics Corp.	29	www.allelectronics.com	800-826-5432
Badger Graphic Sales, Inc.	29	www.badgergraphic.com	920-766-9332
Ball State University	2	www.bsu.edu/online/education	
Edmund Scientifics	17	www.ScientificsOnline.com	800-818-4955
Electronix Express	11	www.elexp.com	800-972-2225
ETCAI Products	28	www.etcai.com	800-308-0154
Hobart Institute of Welding Technology	28	www.welding.org	800-332-9448
Intelitek	16	www.intelitek.com	800-221-2763
jds Products	29	www.jdsproducts.com	916-933-2699
John Deere Publishing	19	www.johndeere.com/publications	800-522-7448
Kelvin	29	www.kelvin.com	800-535-8469
Mastercam	32	www.mastercam.com	800-ASK-MCAM
Pitsco	15	www.shop.pitsco.com	800-835-0686
Satco Supply	29	www.tools4schools.com	800-328-4644
The Shoprat Foundation	29	www.shoprat.org	517-769-2100
Tech Directions	6	www.techdirections.com	800-530-9673
Tech Directions Books & Media	11, 31	www.techdirections.com/products.html	800-530-9673
Technology Education Concepts, Inc.	28	www.TECedu.com	800-338-2238
Test Equipment Depot	2	www.TestEquipmentDepot.com	800-517-8431

Super fast and easy renewal option!!

- Email vanessa@techdirections.com with “Renew Me” in the subject line.
- Include your first and last name and your school’s name in the body of your email message.
- Send it.

Make sure you don’t miss a single issue! Do it today!

technically speaking

Susanne Peckham susanne@techdirections.com

As noted in last month's "News Report" column, February 16-22 was National Engineers Week. In advance of the occasion, in January TE Connectivity, a $13 billion leader in connectivity that employees over 7,000 engineers, conducted a survey of 1,017 adults in the United States regarding their views on the field of engineering. The results of the survey will interest many technology, engineering, and CTE educators. They were reported in a press release titled "Americans Say Engineering Is the Leading Profession Driving U.S. Innovation."

The survey found that the majority of respondents most commonly associate innovation and inventions in society with engineers (87%) when compared with other prominent and impactful professions such as doctors, lawyers, and others. This positive sentiment is reflected in respondents' belief that the role engineers play in innovation and invention today versus 20 years ago has increased (73%).

Regarding the impact of engineers working in particular areas, survey respondents feel that connected devices, which allow consumers to connect their phones to TVs and cars, are most likely to positively impact society over the next 10 years (33%). This is followed by robot development (22%) and wearable technologies such as Google Glass, computer watches, and fitness bands (14%); 3D printing (13%); and driverless vehicles (12%).

As an increased emphasis is placed on the importance of the engineering profession, those surveyed think that positive experiences with science, technology, engineering, and math (STEM) during young people's formative years in elementary and middle school will most significantly contribute to advancing careers in these areas (31%). Other contributions to advancements include work preparedness programs (17%), mentorship (17%), internships (15%), and college or university resources and support to prevent students from dropping out of STEM-related fields (15%).

In commenting on the survey, Rob Shaddock, executive vice president and chief technology officer at TE Connectivity said, "Engineers have an inherent and very meaningful impact on society. Although it's not something consumers will typically consider as they turn on the light, get on a flight, make a phone call, stay fit, or push the brake pedal in a car—it's the relationship engineers have with society that fuels the advancements that we all experience every day."

Shaddock added, "From the steam engine in the 1800s to the autonomous vehicle today, transformative technology and engineered innovations will continue to drive the future forward.... To meet the evolving demands of society, an increased focus in cultivating interest and talent in the areas of STEM is paramount to the continued successes we experience at TE Connectivity and throughout the world."

Susanne Peckham

techdirections
A Prakken Publications Magazine

Digital Tech Directions (ISSN 1940-3100) is published monthly, except June and July, by Prakken Publications, Inc., 2851 Boardwalk Drive, Ann Arbor, MI 48104. Executive, editorial, and advertising offices are at PO Box 8623, Ann Arbor, MI 48107-8623, telephone 734-975-2800; fax 734-975-2787. Vol. 73, No. 8.

Board of Directors Turalee A. Barlow, Susanne Peckham

Business Manager Turalee A. Barlow, tbarlow@techdirections.com

Managing Editor Susanne Peckham, susanne@techdirections.com

Associate Editor Pam Moore

Art, Design, and Production Manager Sharon K. Miller

Advertising Sales Manager Matt Knope, 800-530-9673 x302, matt@techdirections.com

Subscription Dept. Vanessa Revelli, vanessa@techdirections.com, 800-530-9673 x306

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.

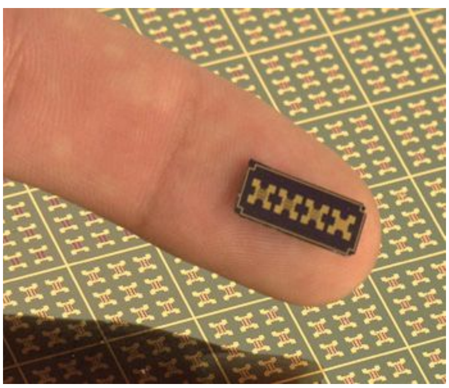
POSTMASTER: Please send change of address information to Tech Directions, PO Box 8623, Ann Arbor, MI 48107-8623.

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

contents

March 2014
Vol. 73, No. 8

page 13



page 18

About the cover: The back of a varsity jacket worn by a proud member of the Newton (NJ) robotics team. Photo courtesy of James Hofmann. Cover design by Sharon K. Miller.

Help Keep techdirections Free!

techdirections comes to you free through the support of our advertisers. Please support them in return.

When you need equipment and supplies, buy from techdirections advertisers.

Tell companies you saw them in techdirections!

Subscribe to techdirections for FREE!

techdirections is free to educators at their school address.

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

Check all subjects you teach or supervise:

- (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/ Applied Science
- (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!

FAX: 734-975-2787

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

Online:
www.techdirections.com/sub.html

the news report

Susanne Peckham
susanne@techdirections.com

Senators Form Career and Technical Education Caucus

The Association for Career and Technical Education (ACTE) reports that U.S. Senators Tim Kaine (D-VA) and Rob Portman (R-OH) have started a Senate Career and Technical Education Caucus. The association lauds the bi-partisan effort to form the caucus, which it says will serve as "the voice for career and technical education on Capitol Hill."

"Career and technical education programs nationwide have a rich history of equipping students with the skills that they need for success in high-wage, high-skill, and in-demand careers in growing industries," said ACTE Executive Director LeAnn Wilson. "ACTE is pleased that Senators Kaine and Portman have committed themselves to supporting millions of CTE students, educators, and administrators nationwide and helping to prepare America's 21st-century workforce.... We look forward to partnering with the senators to build congressional support for federal policies that will ensure the continued success and growth of our nation's CTE programs."

"Through career and technical programs we can strengthen the links between the classroom and the workplace, helping students acquire the education and skills that will help them find employment and enjoy productive, successful lives after graduation.... I am proud to launch the Senate Career and Technical Education Caucus with Senator Portman and I look forward to working together to improve CTE," said Kaine.

Portman added that "we must close the skills gap to get Americans working again. One way we can do that is by focusing on career and technical education that equips workers with credentials, certificates, and other training that will match them with open jobs. I look forward to working with Senator Kaine as a co-chair of the Senate Career and Technical Education Caucus to bridge the skills gap and get Americans back to work."

ACTE notes that CTE programs provide rigorous academic and technical training to 94% of American high school students and 12 million postsecondary students.

Analysis of Entry-Level STEM Jobs Released

Burning Glass Technologies, a Boston-based labor market analytics firm, has conducted an analysis of STEM job postings in 2013. The firm's research reveals that the demand for STEM talent is significantly greater than commonly reported, and the supply of STEM college graduates continues to lag far behind employer STEM talent needs.

Some key findings:

- Forty-eight percent of all entry-level jobs requiring a bachelor's degree or higher (BA+) are in STEM fields, while only 29% of bachelor's degree graduates earn a STEM degree. At the sub-baccalaureate level, 24% of entry-level jobs are in STEM fields, while 32% of sub-BA degrees are in STEM concentrations.
- Looking across all jobs, STEM jobs account for 38% of total online postings but only 16% of total employment. The Bureau of Labor Statistics predicts that STEM jobs will grow 55% faster than non-STEM jobs over the next decade.
- There are 2.5 entry-level job postings for each new four-year graduate in STEM fields compared with 1.1 postings for each new BA graduate in non-STEM fields.
- STEM jobs offer a substantial salary premium. The advertised salary for entry-level STEM jobs requiring a BA or higher is $66,123 compared with $52,299 for non-STEM jobs. This difference of approximately $14,000 represents a 26% premium. At the sub-BA level, the average entry-level salary is $47,856 for STEM jobs and $37,424 for non-STEM jobs. This difference of over $10,000 represents a 28% premium.

To see the full report, go to www.burning-glass.com/stem.

Free Webinars on Metal Cutting

Hypertherm, a manufacturer of plasma, laser, and waterjet cutting systems, has announced new free, educational webinars on cutting metal and other industrial materials. Webinar topics include optimizing CAM nesting software for increased performance; working with waterjet technology; gouging, beveling; cutting tube, pipe, and stainless steel; and a comparison webinar that looks at how different cutting technologies stack up against one another. The series is free and open to everyone. To register, go to http://response.hypertherm.com/CurrentWebinars.

Hypertherm also offers a number of other free webinars and training and educational materials at www.hypertherm.com.

Calendar

Mar. 3-5. Association for Career and Technical Education's National Policy Seminar. Washington, DC. www.acteonline.org/nps.

Mar. 5-7. New York State Technology and Engineering Educators Association Annual Conference. Hudson Valley Community College, Malta, NY. http://nysteea.org.

Mar. 26-28. American Technical Education Association National Conference. Minneapolis, MN. www.ateaonline.org.

Mar. 27-29. International Technology and Engineering Educators Association Annual Conference. Orlando, FL. www.iteea.org/Conference/conferenceguide/htm.

Apr. 26-27. USA Science and Engineering Festival, Washington, DC. www.usasciencefestival.org.

Susanne Peckham is managing editor of Tech Directions.

technology today

Alan Pierce
pierceaj@techtoday.us; follow on Twitter @TechToday_us

The Birth of the Personal Digitally Connected World

When it comes to consumer electronics, the place to go each year to learn about evolutionary, revolutionary, and incremental technology advances is the Consumer Electronics Show (CES). CES is held each January in Las Vegas, NV. Getting a print magazine through the editing, printing, and mailing process takes time and that is why this CES-themed column, which was written in January, didn't reach your hands until this March issue.

This year's CES was the largest in the show's history. According to the Consumer Electronics Association, which hosts CES, the 2014 show had 3,200 exhibitors spread over 2 million square feet. This area included the full convention center and a number of the hotels on the Las Vegas strip. On the streets of Las Vegas were two experimental cars on the go and one driverless VW repeatedly parking itself. I felt like I walked a hundred miles in an attempt to find the most interesting new products to introduce to you in this column and in online product reviews at www.technologytoday.us/ProductReviews.html.

The most interesting new products had digital interfaces that allowed them to use the Internet for two way communication with a smartphone, wearable tech, or other networks of your choosing. These products were, in a sense, announcing that the birth of your personal connected world is at hand. The ultimate goal is for all your digitally enabled devices to be capable of performing tasks for you automatically.

This technology might now be in its infancy but it is expected to quickly grow smarter as your smartphone and other devices continue to analyze what you are doing and then slowly start to perform these tasks automatically. This is called *ubiquitous computing,* defined as the automatic seamless integration of everything digital that you come into contact with on a daily basis.

Your connected home can become part of your personal connected world at your front door. A near field communication (NFC) lock can automatically lock or unlock itself when your enabled NFC devices detect that you are walking toward or away from a locked entrance.

Samsung has created its new Integrated Samsung Smart Home Service Platform and LG has developed a similar smart digital system that it calls Smart Thin Q. Both systems digitally empower their new smart appliances so they can take instructions from an app on your smartphone. Imagine your refrigerator sending you a shopping list of needed items or your oven telling you the roast that is cooking is now ready to be served. (See Photo 1.) Basically, at this year's CES, companies were showing hardware and apps that could control any item in your home that has a switch.

LG

Photo 1—Digitally enabled appliances allow you to monitor and control them by using the manufacturer's smartphone app.

The Nest company makes smart home thermostats, smoke detectors, and carbon monoxide detectors. Nest devices can automatically control your home environment because they are designed to learn your preferences from your actions in combination with a Nest smartphone app. The dial of the Nest Learning Thermostat turns blue when cooling and orange when heating. When you are not home, it turns itself down to save money. The thermostat can be remotely controlled using a smartphone, tablet, or computer. (See Photo 2.)

Nest

Photo 2 —The Nest Learning Thermostat remembers the temperatures you set and builds its own custom schedule for your home based on what you do.

Days after CES closed, Google purchased Nest, a 300-person company loaded with past Apple engineers, for $3.2 billion. No doubt, Google's goal is to expand what Nest products can automatically control for you in the near future.

To help make your personal world digitally connected, many companies are marketing wearable digital devices that gather data and then transmit it to your smartphone or home network for analysis. Different devices are designed to collect different types of data. Under the fitness heading, you have Fitbit, with wearable devices that can track walking, running, calories burned, and stairs climbed during the day. At night, the same device can gather data on your sleep patterns so its app can help you use all the collected data to lose weight, get in shape, and/or improve your sleeping habits.

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

Other wearable devices on display can gather medical data through contact with your skin. These devices could use your smartphone as a data link to your doctor's office. Sports and safety wearables were shown that can track physical activities to improve your game or detect blows to your head to warn of concussions. The most technologically advanced wearable shown at CES was the Samsung Galaxy Gear watch, which would be the perfect accessory for an international spy if it wasn't getting so much publicity. (See Photo 3.)

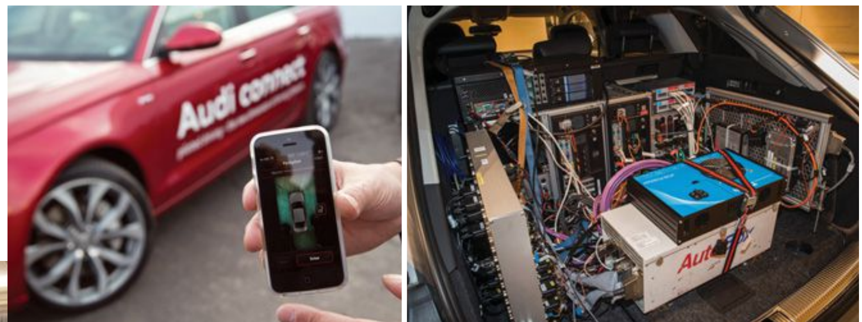
Samsung

Photo 3—Wearables are the new link to your digital world. With them you don't have to constantly check your phone.

The final category of wearable technology was digital glasses that augment the wearer's view of reality. A number of people at this year's CES were wearing Google Glass, but Google was not displaying any of its products.

It was definitely a letdown that Google did not have its fleet of self-driving cars traveling the local roads of Vegas. The almost autonomous experimental vehicles that were on display didn't have the Velodyne rotating electronic vision unit that Google has made famous. (See Photo 4.) The Velodyne roof laser array provides the electronic vision that the car's computer system uses to locate the road and all objects that need to be avoided. Other car manufacturers are trying to perform the same tasks using multiple sensors that are hidden throughout the bodywork of their vehicles.

Photo 4—The Velodyne rotating roof laser array, found on Google's self-driving cars, provides the car's electronic vision.



Audi

Photo 5—The Audi Connect Piloted Driving vehicle could, under certain driving conditions, take over full control of the car. The equipment to perform this task completely fills the vehicle's trunk.

Audi did have some Connect Pilot Driving vehicles on the road that could, under certain driving conditions, take over full control of the car while the driver sat relaxed in the driver's seat ready to take back control at a moment's notice. The sensors to perform this task are located in many parts of the vehicle and also completely fill the vehicle's trunk. (See Photo 5.)

I did get to drive the BMW i3 concept electric vehicle. As I drove around Las Vegas, I controlled my forward and stopping motion using, for want of a better term, only the "gas" pedal. This all-electric vehicle has regenerative braking, which was automatically activated when I released pressure from the "gas" pedal to slow the vehicle.

The regenerative braking system also generates some electricity each time the car is stopped. The vehicle does have a brake pedal, but during my 20-minute drive around Las Vegas, at varying speeds, I never needed to press it. (See Photo 6.)

Photo 6—The BMW i3 concept electric vehicle that I test-drove at CES doesn't require the driver to use a brake pedal to stop the vehicle.

Recalling the Facts

1. List all the items around your house that could eventually be controlled by your smartphone.

2. If you could have an app take over something that you now do at home or school, what would you have it do? Would your app be practical?

technology's **past**

Dennis Karwatka
dkarwatka@moreheadstate.edu

Leroy Grumman and His Fighter Airplanes

Many young people who heard about the Wright brothers' first flight in 1903 immediately became interested in flying. But few of them manufactured thousands of carrier-based Navy airplanes used during World War II. Or had their company design and build the Lunar Excursion Module (LEM) that landed American astronauts on the moon in 1969. Leroy Grumman was involved in those projects and many more.

Leroy Grumman

Grumman was born in Huntington, NY, on Long Island in 1895. His father owned a carriage shop and Grumman was raised in a comfortable environment. He graduated from Cornell University with a degree in mechanical engineering and entered the United States Navy.

World War I had just begun and Grumman earned his pilot's license before becoming a test pilot at a Philadelphia naval factory. He married Rose Werther about that time and they had four children. Grumman remained in the Navy until 1920 when he went to work for the Loening Aeronautical Engineering firm.

During almost 10 years with Loening, he served as a test pilot, design engineer, and plant manager. Grumman worked with amphibious biplanes, which could land either in water or on the ground. He also developed a retractable landing gear assembly for which he received a patent in 1932.

The Loening firm moved to Pennsylvania in 1929, and at that point Grumman decided to join forces with a few others and establish the Grumman Aircraft Engineering Company.

With 16 employees in a converted Long Island garage, they went looking for a product to build and sell. The new company started out operations on two fronts: building floats for Navy amphibians and refurbishing damaged airplanes. The company's reputation grew and Grumman won a 1932 contract for the first Navy plane to feature fully retractable landing gear. It became the FF-1 Fifi, a stubby-looking, two-seat biplane fighter with a 750 hp radial engine. Grumman made 120 of them.

Grumman FF-1 Fifi

Grumman also tried his hand at civilian amphibians such as the 1937 G-21 Goose. It was a twin-engined, high-winged commuter monoplane with a deep boat-type hull. The Goose could carry eight passengers; 345 were eventually built. Department store owner Marshall Field bought one of the $60,000 airplanes.

Grumman G-21 Goose

One of Grumman's more interesting innovations was a folding wing design he called the sto-wing. His carrier-based fighters had wings that could rotate and then fold back along the fuselage. This design greatly increased the number of airplanes that could be stored on an aircraft carrier.

The sto-wing appeared on Grumman's highly successful F6F Hellcat that was introduced during World War II. Using a Pratt & Whitney 2,000 hp Double Wasp radial engine, it flew faster than 400 mph. Superbly maneuverable fighters, Hellcats accounted for almost 80% of all the American carrier-based wartime flight victories. Over 12,000 were manufactured.

Roy Grumman was a casual person who often smoked a pipe while walking around his plant to talk with his workers. His office had countless

---

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

Grumman F6F Hellcat

Hangar full of Grumman planes with folded wings

model airplanes hanging from the ceiling. The soft-spoken, well-liked Grumman, who spoke with a New England accent, provided employee benefits like group health insurance, a company-funded retirement plan, child care, and repair trucks for stranded employees.

Employment at the Bethpage, Long Island, plant peaked at over 25,000 during World War II. Grumman's company designed and built the lunar mission's LEM before Grumman fully retired. He had an allergic reaction to a penicillin injection in the 1940s, which affected his sight later in life. Grumman died in 1982.

Navy pilots called the company the "Grumman Iron Works" because their planes could take lots of punishment during aerial combat and still return safely. Many of Grumman's Hellcats and Avenger torpedo bombers survived World War II and are displayed at museums throughout the United States. td

References

Garraty, John A., et al. (Eds.). (1999). *American national biography.* Oxford University Press.

Gunston, Bill. (1988). *One of a kind—The story of Grumman.* London: TRH Pictures and Chevprime Ltd.

Rothe, Anna (Ed.). (1945). *Current biography.* H. W. Wilson Publishers.

Reid Goldsborough
reid_goldsborough@yahoo.com

Tablets Versus Laptops

These days, when you or your students need to buy a new portable computing device, the question often arises, tablet or laptop?

More people are choosing the smaller, lighter, and less expensive tablets, but this may not always be the best decision. Here are the pros and cons of each.

Tablet computers are designed as consuming devices. They're great for exchanging email, posting to social networks, surfing the Web, watching a movie, listing to music, or reading a book.

Tablets cost less than laptops. On the tablet side, Apple's iPad starts around $500, Google's Nexus 7 around $230, Samsung's Galaxy Tab 3 around $200, and Amazon's Kindle Fire HD around $150. On the laptop side, Apple's MacBook Pro starts around $1,100, Lenovo's IdeaPad around $360, and Acer's Aspire around $350.

Tablets are easier to set up and use than a PC or Mac. The touchscreen interface is intuitive, easier than navigating a file tree if not as versatile. Instead of having to wait for the operating system to load on a laptop, you have nearly instant-on usability with a tablet.

Compared with laptops, tablets have a longer battery life. You can partly get around this by plugging a laptop into an outlet, provided one is around, or carrying around a second laptop battery. On the other hand, some tablets have batteries you can't replace yourself, which will cause people to replace their devices when the batteries fail to hold a charge.

If you need to work while truly on the move, while walking around a school or classroom/lab, store, or factory, tablets are more convenient than laptops. Tablets are also great while on the bus, in the kitchen, on the couch, or in bed.

A great variety of software in the form of apps is available for tablets, and many are low-cost or free. The software for PCs and Macs is typically more expensive and more powerful.

Laptop computers are designed as producing devices. They're great for writing papers for school or work, creating presentations, working numbers in spreadsheets, editing photos, or producing websites.

> **If you need heavy-duty horsepower, the best choice in personal computing, better than laptops or tablets, remains a desktop PC.**

You can perform these production-oriented tasks on a tablet, and many people do, but tablets' on-screen keyboards and smaller screens make this slower and more tedious than on a laptop.

Workarounds exist, such as buying an external keyboard or attaching the tablet to a desktop PC's monitor. But in trying to turn a tablet into a laptop, you're still left with the typical tablet's limited multitasking and slower processing speed.

Laptops can smoothly handle the consumption-oriented activities that are tablets' strong point, though this is easier to get started with on tablets.

Hybrid tablet-laptops exist, such as Microsoft's Surface line, which come with detachable keyboards to use the device as a tablet or laptop. The Microsoft Surface also comes with robust multitasking and Microsoft Office. These are more expensive than tablets, with the Microsoft Surface Pro 2 starting around $950 and Microsoft Surface 2 around $500.

You can get Microsoft Office compatibility with both Android and Apple iOS tablets for free through Google's Quickoffice (www.quickoffice.com), and you can get Microsoft Office proper through CloudOn (www.cloudon.com), with the pro version costing $2.99 per month or $29.99 per year.

Other tablet-laptop hybrids have keyboards that can flip shut when you want to use the device as a tablet, such as Dell's XPS 12, which starts around $800.

Another compromise between a laptop and a tablet is a cloud laptop, designed for computing while connected to the Internet. Apple's MacBook Air starts around $850, HP's Pavilion Chromebook around $290, and Samsung's Chromebook around $270.

Digital devices have always yielded strange behavior in people regarding bragging rights. It used to be the power of your CPU or the size of your hard drive or monitor. Now it's how small you can go.

You see people showing off their tablet setup, bragging how little it weighs, when the reality is that a slighter larger and heavier laptop setup could help them get work done twice as fast.

The extra weight isn't great. Thin and light laptops, sometimes called Ultrabooks, start around 2.8 pounds, which is less than the weight of a middle school student's book bag. Still, some people just don't want to or can't carry around this extra weight.

Tablets can make great companion devices if you already have a laptop or desktop computer.

If you need heavy-duty horsepower for computer-aided design, computer programming, music or video editing, or serious gaming, the best choice in personal computing, better than laptops or tablets, remains a desktop PC. td

---

Reid Goldsborough is a syndicated columnist and author of the book Straight Talk About the Information Superhighway.

Robotics Team Goes Varsity

By James Hofmann, Anita Welch, and Bradley Bowen
jhofmann@newtonnj.org; Anita.Welch@ndsu.edu

VARSITY jackets are typically associated with members of sports teams, but robotics students at Newton (NJ) High School proudly wear their school colors as well—with an image of a robot on their backs. This article describes how high school teacher James Hofmann created an award-winning varsity robotics team and brought the *FIRST* (For Inspiration and Recognition of Science and Technology) experience to his community.

The Launch

It started about seven years ago with a week-long summer camp that focused on introducing STEM concepts to students through *FIRST* LEGO League projects. The interest was so overwhelming that Hofmann, who also serves as a technology teacher at Halsted Middle School, has been able to grow the effort since then into a full competitive team. Students gather to create robots made with LEGO kits to accomplish the season's "game" and compete against other teams in an attempt to bring home a win for their school, all while learning valuable lessons in STEM (science, technology, engineering, and math).

James Hofmann is a technology teacher, Halsted Middle School, and a robotics teacher, Newton High School, both in Newton, NJ. Anita Welch is an assistant professor, School of Education, and Bradley Bowen is an assistant professor, in both civil engineering and teacher education, North Dakota State University, Fargo.

Hofmann knew there was another level of *FIRST* competition that involved high school students. Encouraged by the interest of his students, he decided to investigate and attended an FRC New York State Regional event at New York City's Jacob Javits Center.

After talking with many robotics students and their team mentors, Hofmann began to see a pattern. Student's interest in and attitude towards math and science classes were heightened when they were able to apply what they learned in hands-on activity. Robotics team members use the formulas and calculations that calculus and physics teachers can only show on a page in a textbook. Bringing 120 pounds of metal, plastic, and electrical components together to form a robot, and making it operate after six weeks of effort, intrigued Hofmann and led him to create a *FIRST* FRC team for his school.

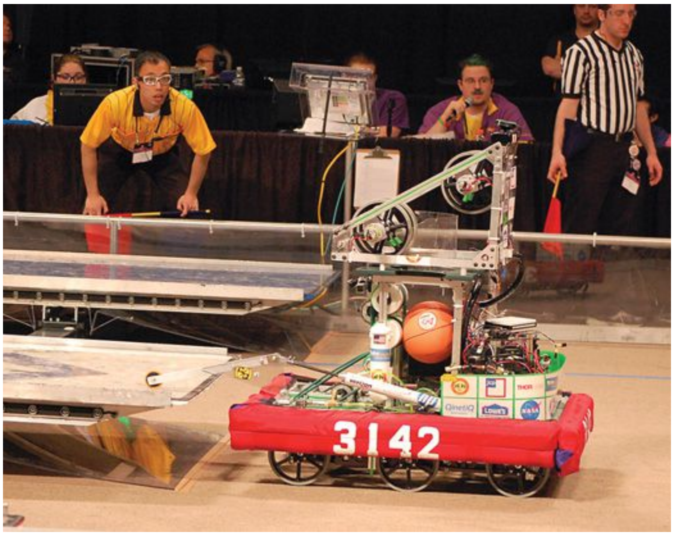
Students respond to the robotics team winning the Engineering Inspiration Award at the 2012 Mount Olive district event.

Building the Robotics Team

The biggest hurdle was funding. Just building a robot is expensive in an every-penny-counts high school environment. Add in the expense of entry fees and traveling to competitions and the wall seems almost impossible to climb. But Hofmann did not give up. He applied for and received a National Defense Education Program grant in 2009 to be used to develop *FIRST* Robotics Competition teams.

In 2010, Newton Robotics made its way to its initial competition and earned the Rookie All Star Award and their first trip to the International *FIRST* Championship held that year in Atlanta, GA. This early success created a foundation for future successes.

During the initial two years of the team's existence, students who were not involved sometimes cracked jokes in the hallways, snickering at



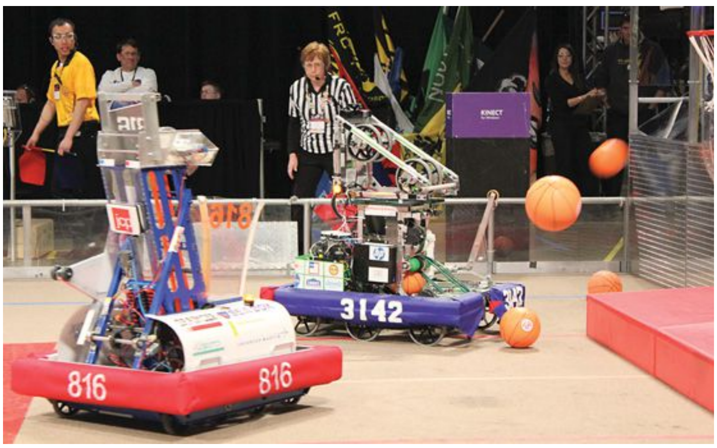
The 2012 Temple University regional event game challenge: basketball/bridge balancing

the mention of the robotics team. After winning the Innovation in Control Award and the Engineering Inspiration Award at the district level, which advanced the team to the Mid-Atlantic-Robotics Regional Championship event held in Philadelphia in April 2012, the image of the team began to change on campus.

At Temple University in Philadelphia, the team competed against the best 67 teams in the region and earned the Engineering Inspiration Award again, the second most prestigious award available to FRC teams, which propelled them to the International *FIRST* Championship in St. Louis, MO. Here, the team not only competed against others from Brazil, Great Britain, and Australia, but they changed their reputation. In just three years, the team, formally called Aperture Team 3142, became accepted by the student body as one of the top competitive teams at Newton High School.

Success brings affection and Newton Robotics Team alumni, proud of their association with *FIRST*, come back regularly to visit the team and host design-and-build workshops. Alumni who are far away have linked with the team via Skype to help pass information and tips to team members.

Throughout the course of the *FIRST* robotics season, students on the team learn basic principles of mechanics and robotics through the manipulation of optical rail structures they use to construct the team robot. They use LabView, C++, and RobotC software to program their creations to move and operate autonomously. Concepts related to math, mechanical, electrical, and computer engineering are explored along with computer-aided drafting and design, business, and marketing to introduce and develop the skills needed to create and bring an innovative product to market.



Shooting the basketball at the Temple University regional event

Varsity Status

The first three years of experiences, competition, and tremendous community interest set the stage for achieving the next level of success. Hofmann realized early on that elevating robotics and putting it on par with his school's athletic teams would help attract students who valued the development of both body and mind as well as students who were otherwise overlooked for other activities.

He wanted to quell the snickering in the halls and give formal recognition to the hundreds of hours team members devote to the team. Varsity status was the vehicle to make that happen. Hofmann knew that enlisting the help of parents and other community members would be important to the cause.

Even more important was identifying student team members who were determined in their quest to attain recognition of the value of STEM. Their voices, participation, and commitment were the essential components that school administrators looked for when determining the value and worthiness of a program. Notable among the team's supporters were Theresa Bugay, the captain of this year's team, and her mother, Laura Bugay.

Hofmann connected team members with business members from the community and asked for their partnership in this endeavor. Letters poured into the principal's office and the Board of Education requesting that the team, whose dedication to STEM and the community's future, be recognized with this honor.

Though administrators were tentative at first—as there were no other schools in the area recognizing robotics and academics with varsity status—the team received the principal's assurance in March 2011 that he would support their efforts with the Newton Board of Education. In early May, the news the team had waited for arrived: They were officially recognized as one of the few high schools, and the first public school in the state, to honor robotics with varsity status.

Students were unable to find robotic symbols for the back of a letter jacket, so Aperture team members had to create their own. A partnership with the local Picatinny Arsenal provided an inspiration. The Arsenal invited team members to take an

The team's motto, "Make It Happen," displayed on a team varsity jacket

inside look at its state-of-the-art military installation, which concentrated on robotic design.

After touring and climbing through tanks, team members took turns driving the Talon bomb-defusing robot. This peace-keeping robot embodied their ideals. It was innovative, rugged, fearless, and determined to accomplish its mission to protect and serve.

It took more than a year of communications, explanations, and special requests to a variety of agencies and individuals to secure permission to use the copyrighted and highly protected image of the Talon on team varsity jackets. Eventually, Aperture succeeded and students now proudly wear a QinetiQ Talon© robot patch on their varsity jackets. Students understand the great honor that they received, not only by the school giving the team varsity status, but also from QinetiQ and other STEM partners in granting permission to use the image of the Talon.

With an increased understanding of the value of this type of program, Principal James Tasker asked Hofmann to facilitate a STEM Robotics 101 class. Students enrolled in the course have the opportunity to access cutting-edge online tutorials, including the use of both physical and virtual robot programming software.

Newton High School is one of more than 10,000 schools using VEX as a platform to educate students in this fashion. This teaching method incorporates periodic assessments and is continually monitored by the National Robotics Engineering Center, whose research will benefit future students.

FIRST Robotics requires a true integration of knowledge, and technology education courses are a perfect complement for this type of activity. Robotics integrates knowledge with hands-on experience using tools, a wide variety of materials, and the exploration of many manufacturing processes. Although the mechanics of the build is the focus of the program, students are encouraged to pursue their own interests in working with broader technology, which includes photography, website design, and audio-visual technology. Students create marketing materials, hone presentation skills, and manage budgets, all important and necessary work-place skill sets.

Studies have shown that project-based learning environments, like FRC, can have a positive impact on student achievement in science and mathematics (Welch, 2010). Aperture's coach and mentors can attest to the increase in self-confidence that team members acquire in a number of areas over the six-week build period.

At the 2012 Temple University regional event, from left to right, Shane Best, Tess Bugay, Bart Kamen, and Jacob Kolzow. Kamen, brother of *FIRST* founder Dean Kamen, served as a judge.

Additional Local Industry Support

Developing relationships with local STEM partners was essential to creating a solid foundation for the team. Class trips to STEM partners add to the learning experience and show students the many types of equipment that the industry uses to create one-of-a-kind machines.

Inventor and scientist Alex Cable, who built his company, Thorlabs, into a world-class photonics manufacturer, shared his vision with Hofmann and provided a business model for the team. He also provides financial support to school robotics teams throughout Sussex County and has offered internships to high school and college students interested in careers similar to those offered at Thorlabs.

Another valuable STEM partner, Johnson & Johnson also played a vital role in the robotics team's success. Michael Connolly, senior director of the company's consumer division's North American facilities, invites Aperture members to share their experiences through a demonstration to Johnson & Johnson employees. Students work on their presentation and public speaking skills and engage with an audience of engineers. Aperture is also mentored by Paul Hiler, a Johnson & Johnson facilities engineer and energy and sustainability expert, who offers advice, support, and engineering expertise, allowing students to see what lies ahead for them if they stay the course of STEM education and explore STEM career opportunities and employment.

After seeing a student demonstration, retired mechanical engineer Edward Griffiths funded the purchase of a new mill-drill used for the first time during the 2012-2013 season's build period. He has become a STEM hero and role model for the students on the robotics team.

Students Giving Back—and Benefiting

Seeing students develop skills and thrive as they demonstrate the robot and deliver the message of STEM throughout their community is inspiring. Showcasing their robot for 10 days at the New Jersey State Fair/Farm and Horse Show further raises awareness of STEM and robotics programs in rural northern New Jersey. The team also takes its robot on a "road show" to local elementary and middle schools after the end of the competition season, encouraging a future generation of team members to get involved and to see the importance of STEM classes. And after they finish talking about robotics and the importance of STEM, the team finds time to give back to a community that has supported it as its members participate in variety of community service events like collecting toys for hospitalized children and participating in a food drive for a neighborhood food pantry.

Measureable data has been collected over the past four years. Nine past and present team members have earned internships, part-time, or full-time employment from their robotics partnership with Thorlabs. Members have received private tutorials from corporations that have introduced new career paths and several team members have received scholarships. To date, all of the team's graduating members attend respected universities with majors declared in STEM fields. At this point, the team has experienced a 166% membership increase, including a 350% increase in female membership.

Notably, Aperture now has a ratio of one-to-one, male-to-female membership.

Some politicians and education leaders question whether our nation's students are receiving the rigorous math and science education necessary to prepare them for the STEM careers so important in our global 21st-century marketplace. With programs like *FIRST*—and high schools willing to acknowledge STEM with varsity status—our young people can successfully make the transition into the 21st-century job market and keep America at the forefront of technical innovation and industry.

Five years ago, a mentor said to Hofmann, "If you do FRC with your students, you will have a life-changing experience during those six weeks." Through their efforts, the members of Newton Robotics Team Aperture 3142 and all of partners know that they have made a difference in their own lives and have helped to further the cause of STEM in their community and nation.

The Chairman's Award team at the 2012 Mount Olive district event

References

Bowden, T. (1998). Robotics: The ultimate mind sport. *Tech Directions*, 57(10), 18-20.

Caine, G. & Caine, R. N. (2001). *The brain, education, and the competitive edge.* Lanham, MD: Scarecrow Press.

Donlan, T. (2005, May 2). Robots to the rescue. *Barron's Online.* Feature Article. Retrieved from http://webreprints.djreprints.com/1466510329358.html.

FIRST. (2006, March). *About FIRST.* Retrieved from http://www.usfirst.org/about.

FIRST. (2006). *FIRST Robotics team information.* Retrieved from http://www.usfirst.org/teaminfo.

Murphy, P. (1998, spring). Everyone finishes *FIRST*. *Technos*, 7(1), 27-30.

Welch, A. G. (2007). *The effect of the FIRST Robotics Competition on high school students' attitudes toward science.* (Doctoral dissertation), University of Kansas: Lawrence.

Welch, A. G. (2010, March). Using the TOSRA to assess high school students' attitudes toward science after competing in the *FIRST* robotics competition: An Exploratory Study. *Eurasia Journal of Mathematics, Science, & Technology Education*, 6(2), 101-110.

Teach Microsystems Technology on a Tight Budget

By Matthias Pleil and G. H. Massiha
mpleil@unm.edu; Massiha@louisiana.edu

HIGH schools, technical schools, and colleges have an important role to play in preparing today's students for the STEM workforce. Educational institutions must also allow currently employed STEM professionals and those in newly emerging tech industries to keep up to date on their skills and education. Many educational institutions have limited resources—in terms of both budget and faculty expertise—when it comes to teaching technically advanced subjects.

To address that concern, over the last 20 years the National Science Foundation (NSF), through its Advanced Technological Education (ATE) program, has funded many ATE centers across the United States to advance the technician-level workforce. One such center is Southwest Center for Microsystems Education (SCME), located at the University of New Mexico.

SCME offers educational materials and professional development at no cost. These materials and professional development opportunities include sponsored conferences; downloadable written materials for instructors and students; YouTube channels that provide lectures, animations, and videos; hands-on kits for the classroom; micro and nano films; webinars; online distance learning courses; and mentoring opportunities for educators. This article provides information on microsystems technology and on related support available to educators from SCME.

The overall micro-electro-mechanical systems (MEMS) industry has grown at a 9% overall compound annual growth rate (CAGR) over the last 10 years and is projected to grow at 12-13% CAGR through 2018. Certain MEMS sectors are growing at much higher rates, including bioMEMS (30%) and surface-acoustic wave (SAW) devices (27%).

MEMS applications in smartphones and tablets are growing at 34% and are expected to reach $2.4 billion in revenue in 2014. The motion sensors segment (gyros, accelerometers, compass, pressure sensors) related to consumer applications is growing at the even higher rate of 46%.

The United States produces approximately half of all microsystems and has more MEMS foundries than any other country. In addition, there are many small startup companies poised for rapid growth, which means there will be increased need for technicians as these companies move from the prototype to the high-volume-production phase.

Matthias Pleil is research professor of mechanical engineering, University of New Mexico, Albuquerque, and faculty member in the School of Applied Technologies and the School of Math, Science, and Engineering, Central New Mexico Community College, Albuquerque; and G. H. Massiha is professor, Department of Industrial Technology, University of Louisiana at Lafayette.

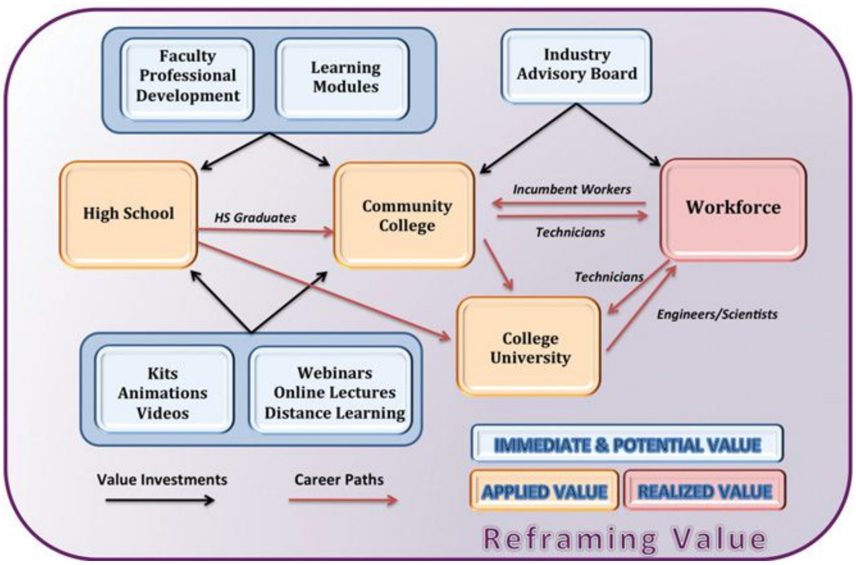


Fig. 1—SCME value creation roadmap

The Southwest Center for Microsystems Education

SCME is an NSF-funded ATE Center of Excellence that identifies microsystems technician competencies, creates and disseminates educational materials and models, and provides professional development activities to create and maintain a skilled microsystems workforce that is ready for both research-and-development and industrial manufacturing environments. By supporting the growth and enrichment of technician education programs, the SCME will improve the competitive position of established and emerging economic clusters. As a consequence, it will improve the United States' capability to support the micro/nano industry and related sector. Fig. 1 presents a graphic depiction of how SCME provides value to its stakeholders.

What Are MEMS?

MEMS (micro-electro-mechanical systems) are also referred to as microsystems, which include MOEMS (micro-optical), microfluidics, bioMEMs, and semiconductors. MEMS include very small devices or groups of devices that integrate both mechanical and electrical components. The sizes of these systems range from a few microns to millimeters.

MEMS are usually constructed on a single chip that contains one or more micro-components and the inputs/outputs for electrical signals, fluidic micro channels, optical fibers, and openings to the environment. The components may include different types of sensors, transducers, actuators, electronics, chemically and biologically functionalized parts, and structures (e.g., cantilevers, valves, channels chambers, gears, sliding mirrors, and thin film diaphragms). Each component type is designed to interface with an input such as light, gas molecules, specific types of radiation, pressure, temperature, or biomolecules.

MEMS devices can, in effect, sense, think, act, and communicate, and, more recently, harvest energy. Through the miniaturization of macro-sized devices, improved fabrication quality controls, and the ability to fabricate large numbers of devices, the costs of manufacturing per part continues to decline, resulting the double-digit market growth rates seen in bio-medical and consumer product applications.

MEMS are wide ranging in their applications and construction. On a single chip there can be one micro-device or element or many devices containing dozens of components or elements. The interaction of these components makes up a micro-electro-mechanical system. MEMS elements work independently as a solitary device or together in large arrays or combinations to perform complicated tasks.

As an example, Figs. 2 and 3 show different views of Texas Instruments' digital light processor (DLP) chip. The DLP has been one of the most commercially successful MEMS-based systems to date. The DLP chip is made of over 1 million electrostatically driven individual MEMS mirrors, nine of which are shown in Fig.

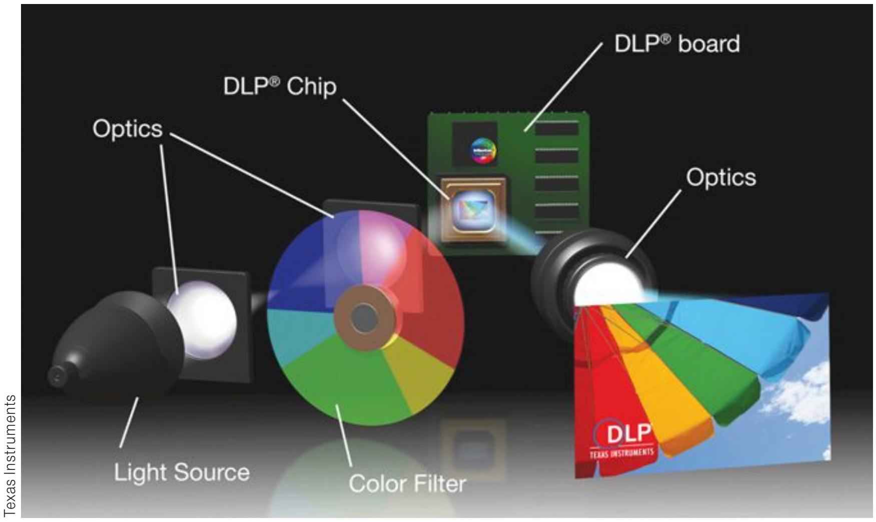


Fig. 2— Texas Instruments' digital light processing system shown here as part of a high-definition projection system

3. The MEMS component is referred to as the digital mirror device (DMD). This MEMS-based system was developed by Larry Hornbeck of Texas Instruments starting in the 1980s, resulting in the first commercially viable product in 1995 with a VGA (640 × 480) resolution projection system. Current systems for movie theaters and large venues contain three chips (one for each color) of over 8 million mirrors each.

Therapeutic biomedical MEMS is another rapidly growing market segment. These applications include cochlear implants, artificial retinas, subcutaneous drug delivery systems, and glucose micro-sensors with microfluidic pumps to dispense insulin. Photo 1 shows how small a micro-fluidic insulin pump can make subcutaneous drug delivery systems a reality. Bio-chemical MEMS used in diagnostics systems include lab-on-a-chip devices that detect genetic variations; test drugs; grow cells on micro-array platforms; detect harmful bio-chemical gasses in homeland security applications and food contamination using micro-cantilever-based arrays or surface-acoustic wave (SAW) based devices.

How MEMS Can Enhance Tech Programs

MEMS are found in a wide range of biotechnology, transportation, homeland security, and consumer product applications, and, as such, are effective at engaging STEM students at the secondary and postsecondary levels. Common microsystems applications that spark students' interest include air bag crash sensor systems; inkjet print heads; DLP projection systems; motion sensors found in cell phones, tablets, and game controllers; as well as pressure sensors, accelerometers, and micro-gyros found in automotive and aerospace applications.

MEMS typically contain an integrated set of otherwise disparate technologies (e.g., mechanics, fluidics, materials, energy, photonics, biology) that span the entire spectrum of STEM components. Moreover, at the postsecondary level, MEMS is one of the last bastions of hands-on learning, as colleges and universities move to replace physical labs with computer stations and simulators.

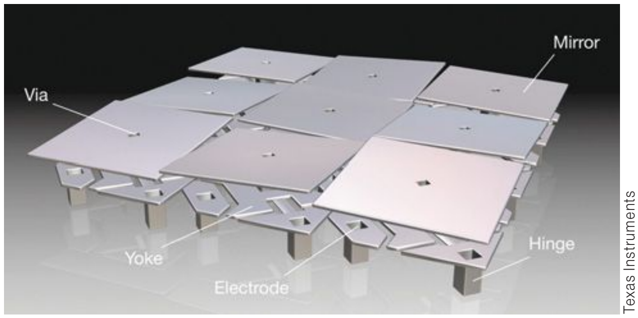


Fig. 3—A small portion of the digital mirror device showing nine of the million mirror components found in this Texas Instruments MOEMS. Each mirror is approximately 20 micrometers per side.

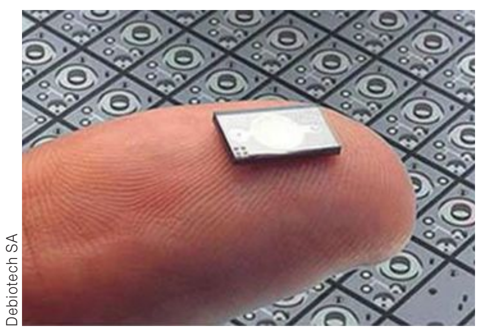


Photo 1—An insulin micro fluidic pump

SCME: A Source of Materials and Support

The Southwest Center for Microsystems Education is the only ATE center to focus on microsystems and is a source for educational materials to enhance the STEM curriculum and bring up-to-date curriculum found in electronics, bio-tech, photonics, and engineering technology programs.

Through a faculty development strategy that includes one-day, two-day, and week-long workshops, as well as online webinars and short courses, SCME staff train educators who adapt and integrate MEMS education and training into their classes. To date, more than 400 educators from 30 states have participated in MEMS workshops and short courses hosted by the SCME at the University of New Mexico and its partner institutions: Central New Mexico Community College, Southwestern Indian Polytechnic Institute, North Dakota State College of Science, the University of South Florida, and most recently, the University of Michigan's Lurie Nanofabrication Center. Educators report having impacted thousands of students and delivered over 70,000 student-hours of instruction.

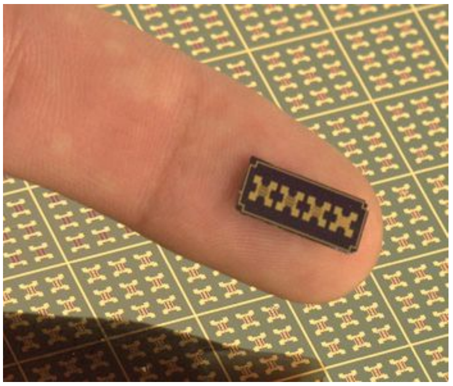


Photo 2—A simple MEMS pressure sensor chip containing four individual sensors. The front side shown here contains the Wheatstone bridge circuit on top of the silicon nitride membrane.

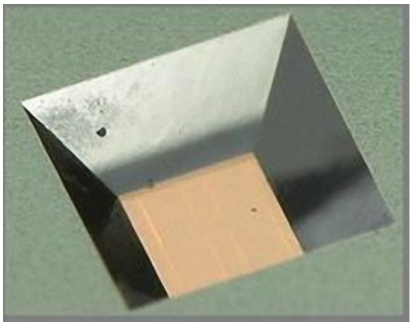


Photo 3—The backside of an individual pressure sensor shows the anisotropically etched crystalline silicon chamber. Students learn to apply crystallography concepts to the fabrication of a MEMS device.

The center will continue to host workshops for approximately 80 faculty per year and provide classroom resources for eductors to use in teaching microsystems design and fabrication. SCME reaches out to community colleges nationwide that have an expressed interest in microsystems. SCME staff also work with secondary schools, as part of its MEMS awareness mission, by engaging secondary educators as MEMS cleanroom trainees, educational materials developers, and classroom adopters.

The organization supports a dual-credit/dual-enrollment Introduction to MEMS course that brings in area high school students and teachers. Through periodic industry advisory meetings, SCME staff ensure that they support the development of microsystems-educated technicians to support this rapidly growing industry. The organization has developed a large number of learning modules based on the needs expressed by the microsystems industry advisory board and surveys.

Many modules were built around the STEM concepts necessary to fabricate a simple MEMS device, the pressure sensor. These include topics on cleanroom safety (MSDS, NFPA, PPE) and protocol, crystallography and anisotropic etching, photolithography, thin film deposition, silicon oxide growth, and metal evaporation. Hands-on kits to bring the cleanroom into the classroom have been developed and are available for sale (on a cost-recovery basis). All written materials are available for download from the SCME-NM.org website and there are many supplemental videos and animations on the SCME YouTube Channel.

Photos 2 and 3 show the front and back sides of student-fabricated MEMS pressure sensors. This is the end product of a series of processes that include silicon nitride deposition, photolithography patterning (resist coat, expose, and develop), deep reactive ion etching, metal evaporation, lift-off, and anisotropic wet etching of silicon crystal. These chips are fabricated by students and workshop attendees at the University of New Mexico's Manufacturing Training and Technology Center (MTTC). This process has been transferred to the USF, NDSCS, and, most recently, to the University of Michigan.

To bring the concepts of how a pressure sensor is made and how it works, SCME has developed a Pressure Sensor Macro Model Kit. Photo 4 shows the working system in a classroom environment. The Wheatstone bridge circuit theory is a component of the kit, shown in Fig. 4. ▶

Photo 4—A functioning macro version of the micro-pressure sensor

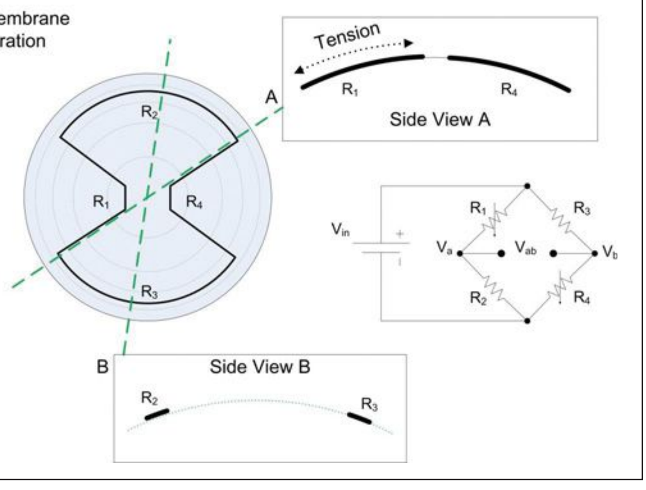


Fig. 4—Schematic of the pressure sensor showing how the piezo resistive elements react to stress and the corresponding Wheatstone bridge diagram

Since the bioMEMS market segment is one of the fastest-growing areas in the MEMS field, SCME has collaborated with bio-tech partners associated with the Bio-Link ATE center to create a series of bioMEMS educational modules and kits. Photo 5 shows educators learning about one of the more interesting application of bioMEMS, the DNA micro-array.

Photo 5— College educators learning about DNA micro-array MEMS at the annual MNT Conference

More on How SCME Can Assist Faculty and Students

SCME offers many ways for educators to bring MEMS into the STEM classroom. All of its more than 40 learning modules can be downloaded from the SCME website. Each is built from several shareable content objects (SCOs) that include primary knowledge (reading), activity (homework, hands-on labs, worksheets), and assessments.

Every learning module comes in pairs consisting of "Participant" and "Instructor" guides, the latter having the answers to the assessment and activity questions, learning maps, and notes to assist with facilitating student learning. There are also PowerPoint files for each module, which the instructor may use, modify, and adapt for his or her specific application. Supplemental materials are available in the form of lectures, animations, and videos on the SCME and YouTube channels.

SCME is in the process of building a series of online distance-learning short courses to enhance its ability to spread its educational materials to a larger audience. These courses can be configured to meet the needs of individual instructors and institutions. This is being done on an open source learning management system (MOODLE) housed on the SCME website.

Among the best resources are the dozen hands-on kits that can be obtained through the SCME kit store. These include Anistropic Etch Kit, Chrystallography Kit, Dynamic Cantilever Kit, GeneChip Kit, Lift-Off Kit, LIGA Micromachining Simulation Kit, MEMS Innovators Kit, MEMS Making Micro Machines Kit, Pressure Sensor Model Kit, and Rainbow Wafer Kit.

All kits are available for online order at reasonable cost (all proceeds are used to replenish the kit stock).

The SCME website, http://scme-nm.org, offers all of its written materials for free download. Teachers should register as educators to gain access to additional materials like the instructor resources as mentioned above. SCME also presents webinars and more than a dozen are currently archived on the website.

SCME presents workshops, which are generally free, at its UNM site and at partner institutions. An annual Micro Nano Tech Conference is co-sponsored and hosted by SCME and the Nano ATE Centers (NACK, Nano-Link, SHINE, NEATEC) as well as MATEC. All of these centers also offer ample educational materials. td

Online SCME Resources for Educators

Main Website: http://scme-nm.org

Catalog: http://scme-nm.org/index.php?option=com_docman&task=cat_view&gid=97&Itemid=226

Educational materials (downloadable; create an account to access instructor materials) http://scme-nm.org/index.php?option=com_docman&task=cat_view&gid=97&Itemid=53

Kit Store: https://secure.touchnet.com/C21597_ustores/web/store_cat.jsp?STOREID=44&CATID=67&SINGLESTORE=true

YouTube Channel:
https://www.youtube.com/user/SCME2012
https://www.youtube.com/channel/UCyAvnKdlKo3WKkQOragW2EA

Partner ATE Centers

NACK (Nanotechnology Applications and Career Knowledge Network): http://nano4me.org

NEATEC (Northeast Advanced Technology Center): http://neatec.org

Nano-Link (Nano-Link Center for Nanotechnology Education): http://www.nano-link.org

MATEC (Maricopa Advanced Technology Education Center): http://matec.org

SHINE (Seattle's Hub for Industry-Driven Nanotechnology Education): http://www.seattlenano.org

Bio-Link (Educating the Biotechnology Workforce): http://www.bio-link.org/home

ITEEA Orlando
March 27-29, 2014

Technological and Engineering Literacy

"TECHNOLOGICAL and Engineering Literacy—Core Connections" is the theme of this year's International Technology and Engineering Educators Association (ITEEA) annual conference, which meets March 27-29 in Orlando, FL. "The current push in education is interdisciplinary education," says ITEEA's president, R. Steven Price. "I believe that our programs are the setting where students take the basics and create the exceptional. Our teachers and supervisors are in a unique position to initiate interdisciplinary activity involving math, science, and other courses, with technology and engineering as the guide."

With that in mind, Price invites all technology and engineering educators to attend the annual conference. As always, this annual event will feature opportunities for professional development and networking with other educators, in addition to a number of inspiring speakers.

Attendees at last year's "Hands-on STEM" Pre-conference Workshop

Featured Speakers

The First General Session, on Thursday, will feature the STEM Center for Teaching and Learning's (STEM CTL) staff and the much-acclaimed Teacher Effectiveness Coaches (TECs). This interactive session (attendees are asked to bring a smartphone and/or tablet) will give attendees insights on how current STEM initiatives challenge current perceptions about STEM and stimulate questions about the role of the "T & E" in STEM education programs around the country. Attendees will learn about the "Nine Defining Features" and how technology and engineering educators are the central focus of school improvement plans.

The session will be led by Barry Burke, the director of STEM CTL and a former middle school teacher, resource teacher, teacher specialist, curriculum coordinator, and director of career and technology education for Montgomery County (MD) Schools. Co-leader Tanner Huffman is the associate director for research, special projects, and assessment at STEM CTL. Huffman is a former middle and high school teacher and teacher effectiveness coach.

Friday's general session features Jimmie L. Davis, Jr., president of STEMflorida, Inc., a not-for-profit that aims to ensure Florida's leadership and proficiency in STEM by connecting business, industry, economic development, philanthropy, workforce, and education around the issues that impact innovation and growth in Florida's existing and emerging industries, employers, and entrepreneurs. Davis is an engineer who also works with the MITRE Corporation, a not-for-profit corporation devoted to science and engineering research in the public interest. He was also named the 2007 Black Engineer of the Year for Community Service in Industry. Davis's presentation—"We STEM, Therefore We Develop, We Educate, and We Create"—will focus on how integrative STEM (iSTEM) impacts development—including workforces, economies, and businesses—education for both students and teachers, and rigorous creativity.

Pre- and Post-Conference Workshops

Three specialized pre-conference workshops will be offered on Wednesday. Participants in Hands-on STEM with Energy, Motion, and Aeronautics will build, test, improve, and retest K'NEX rocket launchers and rubber-band racer models while investigating a variety of concepts related to Newton's laws and aero-

Professional Development Session Highlights

Thursday

- Lessons Learned from Elementary iSTEM Implementation
- New Toolbox for Design and Invention
- Center of Applied Learning, ITEEA Model STEM Laboratory
- Increase Enrollment by Offering Engineering Classes
- Artful Thinking for Technology and Engineering Education
- Challenge Your Students to "Engineer Your World"
- STEM Thinking
- Chase in Space: Collecting Data @ 97,000 ft.
- Design Squad Nation: Dream It, Build It
- Travel with Robot Ralph Around the Country

Friday

- Delivering CCSS/NGSS Through Integrated STEM in Elementary
- Teaching Engineering Design Through Global Challenges
- Establishing VEX Robotics Through Partnerships
- Building STEM Leadership Capacity: NGSS and Beyond
- A Secret Formula? Female Interest in STEM
- Preparing STEM-Centric Elementary Teachers
- Video Game Design Implements STEM and CORE
- STEM in a Bottle
- Enhancing STEM for African Americans in Low-Income School Districts
- Cell Phone Design Challenge

Saturday

- 3D Printing in the STEM Classroom
- SeaPerch—Bringing a Student-Built Underwater ROV into Your STEM Program
- Instructional Geocaching: Let's Treasure Hunt with Smartphones
- "I Chose a Pre-Engineering Pathway in High School Because..."
- Best Practices for Mentoring Competitive Robotic Teams
- Elementary School Students as Creators and Builders
- Engineering in Afterschool: Imagine the Possibilities
- IB Design Technology Program Implementation
- NASA Powers of Ten: Scaling the Universe
- STEM Made Easy

nautics. Concepts and activities are fashioned around rigorous content and national STEM education standards. K'NEX materials were developed in conjunction with the NASTAR Center, a premier commercial air and space training, research, and educational facility in Southeast Pennsylvania. Workshop participants will learn ways they can relate the set-related materials to the state-of-the-art flight simulation and physiology-based simulators used to optimize human performance in extreme environments.

In the Designing Media-Rich Learning Experiences standards-based session, participants will use free software to design media-rich learning experiences for grades 9-12. The software packages being used are Gimp (image editing), Scratch (visual programming environment), and Aurasma (augmented reality). The goal of this session is to demonstrate animation development through self-directed learning by experimenting with different methods and by collaboration. Topics to be covered include photomation using Gimp, photomation using Scratch, making your own photomation, creating augmented reality supplements, making music using Scratch, and integrating sounds into photomations.

At the Elementary STEM Literacy workshop, participants will investigate why STEM literacy in grades K-6 is essential to the United States' economic success and to the elementary child's success in an increasingly technologically dependent world. The engineering design process will be modeled as a problem-solving tool for students and a teaching guide for teachers. The relationship between scientific inquiry and engineering design will be discussed.

Participants will also engage in standards-based, hands-on activities that correlate to national science standards and the K-6 curriculum and will include paper engineering (pop ups, linkages, geometric nets), pizza box solar cookers, and sail cars.

Wednesday's lineup will also feature a WaterBotics workshop funded by the National Science Foundation and created by the Stevens Institute of Technology. The workshop is described as "a rich and exciting underwater robotics project using LEGO building materials." WaterBotics consists of a full-day workshop at the conference to be followed by four online modules after the conference.

A specialized post-conference workshop, High School EbDLab (Engineering by Design Lab): PathwayExtension—Robotics, Engineering, and Automation, will take place on Saturday. This workshop will provide hands-on instruction for teachers and administrators on the new EbD PathwayExtension in Robotics, Engineering, and Automation.

During the full-day session, participants build, program, and compete with robots using the blended learning curriculum featured in EbD's Robotics PathwayExtension. Participants will also learn how the Robotics PathwayExtension enables students to obtain the Certified Robotics Engineering Associate (CREA) credential, validating industry-recognized skills. Each workshop participant will receive one seat of easyC for Cortex robotic programming and Competitive Robotics e-learning curriculum for their robotics program.

Additional EbDLabs sessions will be held on Thursday, Friday, and Saturday.

Professional Development Sessions

Over 100 professional development learning sessions will take place at this year's conference. Sessions run 50 minutes in length and take place on Thursday, Friday, and Saturday. (See highlights at left.)

This year's conference will also feature a Teaching Technology and Engineering STEM Showcase, where educators selected from around the nation will exhibit best practices in the teaching of technology and engineering education. The Showcase will take place on Thursday and will include such items as photographs, posters, student work, teacher-made products, video clips, and handouts

Program Excellence Award recipients are congratulated by Bud Johnson (center) of corporate sponsor Paxton/Patterson.

Tours

On Thursday, attendees can tour the Orlando Science Center and explore the Center's STEM design challenges for students. Science Center educators will lead teachers through our STEM field trip experience, where teachers will get hands-on experience with a design-based discovery lab and two design challenge experiences. Teachers will participate in competitions against their peers while completing the engineering design cycle through challenge-based tasks.

TEECA (Technology and Engineering Education Collegiate Association) student competitors tackle the "Transportation Challenge."

Also on Thursday, educators can tour the UCF Institute for Simulation and Training (IST). The Florida high-tech corridor boasts the highest concentration of simulation and training-related activities in the nation. IST is an internationally recognized research institute that focuses on advancing human-centered modeling and simulation technology and increasing our understanding of simulation's role in training and education.

On Friday, attendees can tour the state-of-the art JetBlue training center in Orlando. JetBlue uses the latest in simulation technology to train pilots, mechanics, and flight staff to provide development for its international workforce. Participants will tour the facility and see the cockpit simulator trainers in action.

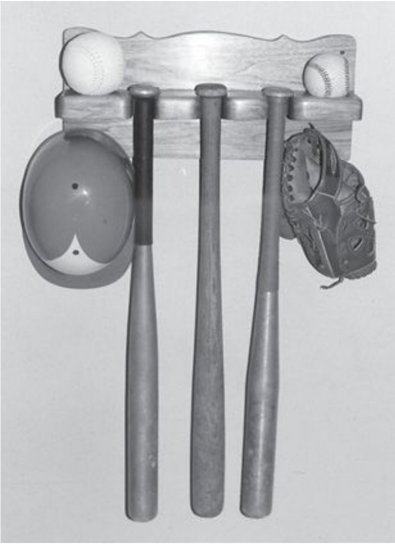
Attendees should be sure to visit the Exhibit Hall, which features an excellent selection of tools, materials, and media resources to help educators and their students excel. Exhibit Hall hours are Thursday 11:00 A.M. to 6:00 P.M. and Friday 11:00 A.M. to 6:00 P.M.

The Host City

Orlando offers world-renowned theme parks and attractions, shopping and restaurants, and arts and cultural events, along with entertainment options for everyone. You can swim with dolphins, tee up on an award-winning golf course, drive a race car, or conquer roller coasters. Attractions include Walt Disney World, Universal Orlando, Sea World, Gatorland, Ripley's Believe It or Not Odditorium, LEGOLAND Florida, and IFLY Orlando Indoor Skydiving Center.

Orlando also has many excellent restaurants, upscale shopping, and a thriving arts scene. It's a place where conference attendees get to be a kid again after a day of meetings and walking the exhibit floor.

For more information on Orlando, visit www.visitorlando.com. For more information on the 2014 ITEEA Conference, visit www.iteaconnect.org/Conference/conferenceguide.htm.



A *Tech Directions* Classic

Baseball Equipment Rack Project

By Richard Johnson

STUDENTS can build this sports rack to hold their baseball equipment. The project teaches a variety of construction techniques plus face-to-face and edge-to-edge build-up sequences. If used as a hand woodworking project, the teacher will have to joint the edges of the back pieces for edge-to-edge build-up.

The equipment rack can be built in a variety of sizes: the 7" size will hold one ball, one bat, and one glove or hat; a 14" rack holds twice as much; and an 18" rack holds one more bat. The size can be increased to hold all the balls and bats of your softball team.

Before starting, students should measure the neck sizes of their bats—neck diameters will vary from softball to baseball bats and with metal bats or wooden bats. To determine the width of the bat neck slots, have students cut a variety of slots in a piece of cardboard.

The project plans include two types of checkpoints: ① _X_, the instructor's checkpoint to keep on top of the student's progress, and _✓_, the student procedure check to emphasize the need to follow directions. The checkpoint system requires less instructor time because the students actually follow directions.

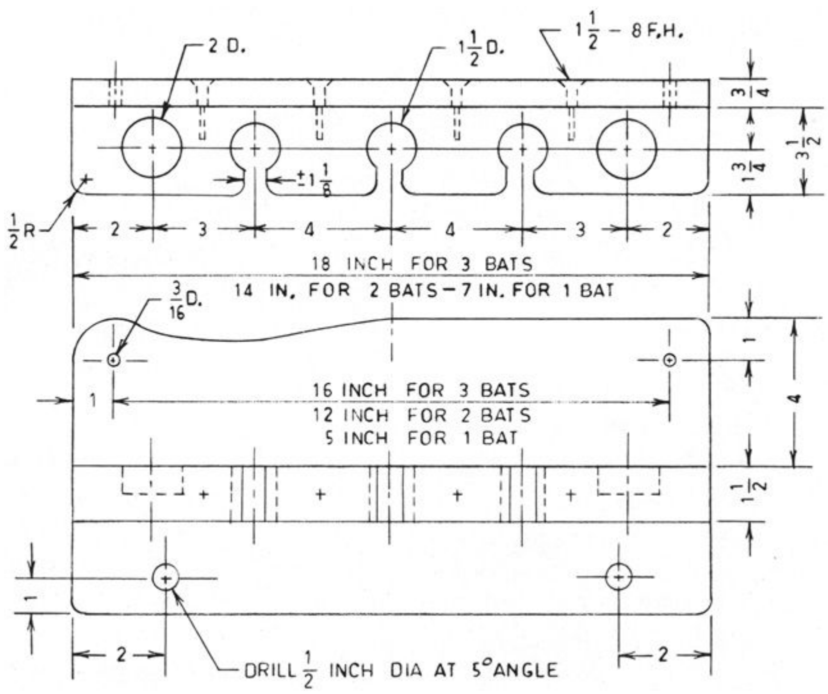


Fig. 1 —Construction details

Bill of Materials

Qty.	Name	T × W × L (rough size)
2	Back pcs.	4/4 × 4-1/2 × 8 or 15 or 19
2	Support pcs.	3/4 × 4 × 8 or 15 or 19
Qty.	**Name**	**T × W × L (actual size)**
1	Back	3/4 × 8 × 7 or 14 or 18
1	Support	1-1/2 × 3-1/2 × 7 or 14 or 18
2	Dowels	1/2 dia × 2

This article first appeared in the May 1983 issue of this magazine. At that time, Richard Johnson was an industrial arts instructor. Perry Tipler Middle School, Oshkosh, Wisconsin.

Project Plans—Baseball Equipment Rack

Upon completion of each step with an Ⓘ____ before it, have the instructor check off the step. Upon completion of each numbered procedure step, check off the step.

Ⓘ____ Obtain instructor's approval
____ Student check upon completion

____ 1. Check bill of materials and lay out stock to rough dimensions.
a. Back pieces from rough lumber.
b. Support pieces from 3/4" lumber.
Ⓘ____ 2. Cut out all pieces to rough dimensions.

Back

____ 1. Plane one edge of both back pieces. Instructor may have to joint on jointer.
____ 2. Build-up (glue edge to edge) two rough pieces.
Ⓘ____ 3. Complete instructional package on surface planer. Take safety test and machine demonstration.
____ 4. Plane stock to 3/4" thickness.
____ 5. Square up back to actual size.
a. Square better edge—jack plane.
b. Square better end—jack plane.
c. Lay out length—framing square.
d. Square to length— plane or miter box saw.
e. Lay out width—2' steel rule.
f. Plane to width—jack plane.
Ⓘ____ 6. Trace pattern on top edge.
____ 7. Cut out pattern—jigsaw.
____ 8. Sand pattern on disc and drum sander.
Ⓘ____ 9. Lay out position of 3/16" hanging holes and 1 /2 " dowel rod holes.
____ 10. Drill 3/16" hanging holes.
____ 11. Drill 1/2" dowel rod holes at 5° angle.
____ 12. Sand all exposed surfaces.

Support pieces

____ 1. Square one edge of both support pieces—jack plane.
Ⓘ____ 2. Lay out position of all holes on top of support board (Fig. 1).
____ 3. Bore 2" dia outside holes in top board with fly cutter.
Ⓘ____ 4. Glue two support pieces together carefully.
a. Squared edges must line up evenly (flush).
b. Wipe excess glue from hole areas.
Ⓘ____ 5. Square up support piece.
a. Locate center of support piece and measure 1 /2 of the length to the right and left of center. Draw length lines with try square.
b. Crosscut better end—miter box saw.
c. Crosscut to length—miter box saw.
d. Lay out width—2' steel rule.
e. Plane to width—jack plane.
____ 6. Drill 1-1/2" dia bat hanging holes.
Ⓘ____ 7. Lay out 1-1/8" to 1-1/4" bat neck slots with try square and 1 /2" radius with 1" dia circle template (Fig. 1).
____ 8. Cut out slots and 1 /2" radii on jigsaw. Cut ***inside*** slot lines.

Empty equipment rack

Ⓘ____ 9. Hand file and disc sand slots and curves to pattern line.
Ⓘ____ 10. Complete instructional package on router. Take safety test and machine demonstration.
____ 11. Rout top outside edge with round-over bit with pilot tip. Do not rout back squared edge.
____ 12. Sand all exposed surfaces. Do not sand squared back edge of support.

Assembly

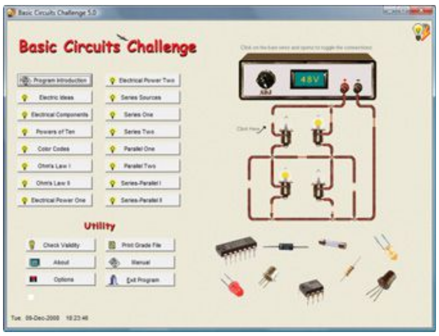
Ⓘ____ 1. Locate wood screw hole position on back of back piece—4-3/4" down from top patterned edge. Lay out center line down middle of back edge of support piece. Wood screws must be placed between bat hanging slots and ball storage holes (Fig. 1).
____ 2. Drill 5/64" pilot holes in back edge of support piece.
____ 3. Drill 11/64" shank holes in back of back and countersink for #8 flat head wood screw.
____ 4. Assemble with a small amount of glue and 1-1/2" #8 flat head wood screws.
____ 5. Sand end grain of support and back flush on disc sander.
____ 6. Touch up sand all exposed surfaces.
____ 7. Cut 1/2" dowel rods to length.
____ 8. File one end of dowel rod round and sand smooth.
____ 9. Glue two dowel rods in holes on back. Apply glue in holes with scrap piece 1/4" dowel rod.
____ 10. Apply three coats of finish, sanding between coats with wet and dry abrasive (360 grit).
____ 11. Glue felt in base and sides of ball storage holes and back of bat hanging holes.
Ⓘ____ 12. Have instructor grade project.

Spring Spotlight

Welcome to **tech**directions' Spring Spotlight, a selection of excellent equipment, supplies, and media to make your teaching efforts easier and more effective! When you contact these companies, be sure to mention that you saw their product in **tech**directions!

Electronics/Electricity Training Activities

Interactive software makes learning exciting. Topics from Ohm's law to op amps and digital troubleshooting are covered. Programs are available for teaching digital meter use. Use your current textbooks and curriculum. Activities provide immediate feedback and grading. Scores can be printed or stored on disks. Learning activities are constructed using random variables to assure varied experiences. Download "no obligation" trial software programs from our website.



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

Welding Training Curriculum

Complete training programs including DVDs, instructor guides, and student workbooks. Designed with input from welding instructors, video modules present core information and model proper technique so that students can work through the videos and practice sessions 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
800-332-9448
www.welding.org

Make STEM "Real" with 3D Printing

Today's smaller, more affordable, and easy-to-use 3D printers are a fun, real world way to teach STEM while encouraging creativity and teamwork. 3D printers enable students to learn the value of turning abstract ideas into real objects. Students develop a technical foundation for STEM concepts that they expand upon as they prepare for college and beyond. 3D printing makes STEM real—and the excitement level in the classroom is contagious! Ask about the new Cube®—less than $1000!

Technology Education Concepts, Inc.
800-338-2238 • Fax: 603-225-7766
www.TECedu.com • info@TECedu.com

monthly marketplace

Robotics Technician Poster

Poster details the responsibilities and requirements of a robotics technician, as well as lists entry-level and potential salaries, current and projected job openings, and sources for more information. Colorful 18" × 24" poster is printed on glossy poster stock. Great for your classroom or the counselor's office! Only $5.95! More careers available, check out our website!

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

Fun STEM 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

Tell advertisers you saw their ad in techdirections.

They make your subscription possible!

More than Fun Answers

Rocketry Puzzle

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

more than fun

Rocketry Word and Definition Match-Up

Rocketry is defined as the science and technology of the design, operation, maintenance, and launching of rockets. See if you can match the terms (1-25) with their definitions (A-Y).

1. Module
2. O-Ring
3. Nozzle
4. Retainer
5. Apogee
6. Aerodynamics
7. Ballast
8. Inclinometer
9. Fuselage
10. Abort
11. Altimeter
12. Pitch
13. Anemometer
14. Canard
15. Planform
16. Pinwheel
17. Stability
18. Actuator
19. Shear Pin
20. Igniter
21. Aileron
22. Thrust
23. Flap
24. Buffeting
25. Airfoil

A. Failure of an aerospace vehicle that prevents completion of its mission.

B. A mechanical, electrical, or electronic device that sets a mechanism in operation or performs a specific action such as throwing a switch.

C. The study of the motion and forces of gases moving around solid objects.

D. The hinged portion of a wing that is designed to impart roll to the aircraft.

E. The streamlined shape given to fins or wings for maximum aerodynamic efficiency in flight.

F. A device that measures altitude.

G. An instrument used to measure the speed of an airflow.

H. The highest point a rocket achieves before beginning its descent.

I. Mass added to a model to bring the model into balance.

J. Repeated forces experienced by a model due to disturbed unsteady airflow.

K. A fin or wing located at the middle or front of a rocket.

L. A movable control surface on an aircraft or rocket that deflects air.

M. The structure or airframe that houses payload, crew, or passengers.

N. A length of high-resistance wire that is placed in contact with the motor propellant prior to the rocket's launch.

O. A device for determining a rocket's apogee without the use of electronics.

P. A combination of parts or components arranged and mounted or packaged as a single unit.

Q. The part of the rocket motor that smoothly expels gas from the combustion chamber.

R. A rubber gasket used to contain gasses in solid rocket motors.

S. A condition in which a rocket spins on its horizontal axis.

T. A back-and-forth motion of the nose of a rocket in flight on the axis determined as "up-and-down."

U. The geometric shape of a wing or fin.

V. A device for keeping the rocket motor from being ejected by the force of the deployment charge.

W. Pin(s) that retains a nosecone to avoid drag separation.

X. The tendency of a rocket to move in a straight line in the direction it is pointed at launch.

Y. The propulsive force developed by a rocket motor during the rocket's powered ascent.

See answers
on page 29.

We pay $25 for brainteasers and puzzles and $20 for cartoons used on this page. Preferable theme for all submissions is technology, engineering, and career/technical education. Send contributions to susanne@techdirections.com or mail to "More Than Fun," PO Box 8623, Ann Arbor, MI 48107-8623.

POSTERS

Only $12.95 or less!

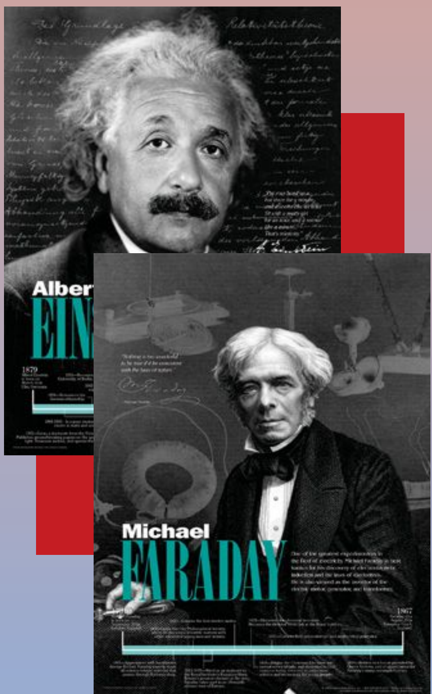
Many to choose from

18" × 24"

Printed on heavy glossy stock

www.techdirections.com/posters.html

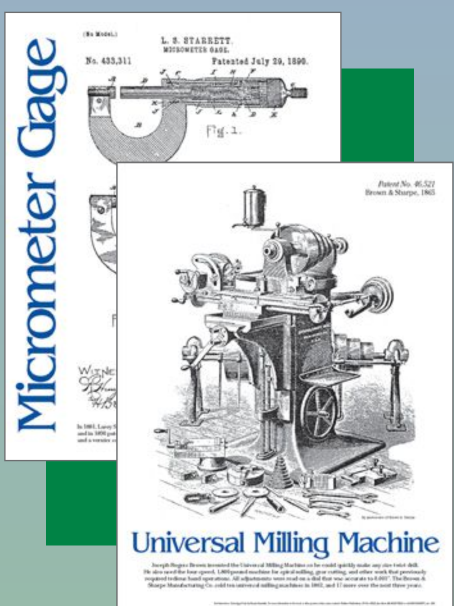
Questions? Contact Matt: 800-530-9673 x300; matt@techdirections.com



Heroes of Science and Techology
Series of 14

Technology's Past
Series of 12

Career Directions
Series of 10



Machinists
Series of 3

History of Machine Trades
Series of 8