

SCIENCE,
TECHNOLOGY,
ENGINEERING &
MATHEMATICS

STEM
edition



A
GUIDE
TO
GOALS
AFTER
GRADUATION



DESIGN THE FUTURE OF YOUR DREAMS

LEARN HOW TO BREAK INTO THE HIGH-TECH, HIGH-WAGE WORLD OF
SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS

INSIDE: EXPLORE 25 HOT STEM CAREERS

DISCOVER WHY TECHIES GET THE BIG BUCKS

LEARN HOW TO GET FROM HIGH SCHOOL TO
A SUCCESSFUL STEM CAREER



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THE WORLD OF STEM

SCIENCE, TECHNOLOGY,
ENGINEERING
& MATHEMATICS
ARE EVERYWHERE

HOME



When you flip on the lights, check your Facebook page, zap a frozen pizza in the microwave, or play your favorite Xbox game, that's STEM in action. Electricity, technology, social media, computers, the Internet, and video games are all built on platforms of solid STEM knowledge.

COMMUNITY



STEM keeps the streetlights on, the stoplights working, and the public water supply clean. Environmental scientists and technicians test the soil, air, and water; engineers help design safe roads, bridges, and buildings; and meteorologists use science and technology to forecast severe weather such as tornadoes, hurricanes, and flash floods.

CAR



Starting, driving, steering, and stopping a car are all STEM in motion. STEM professionals design, test, and produce every part needed to create cars, trucks, motorcycles, ATVs, and other vehicles.

MUSIC



The technology used to record and mix music, purchase and store audio files, and listen to tunes on a portable media player was developed by STEM professionals.

HOSPITAL



Every device used in health care involves some science or math, including robotic surgical systems and artificial body parts such as hip joints and heart valves.

FACTORY



Systems engineers use computer-aided design (CAD) and engineering analysis to design state-of-the-art production facilities.

SPORTS



Engineers invent the lightest and strongest materials for helmets, shin guards, shoulder pads, and uniforms. Designers use art, computers, and STEM skills to build high-tech footwear. Coaches use computers to analyze athletes' performance and to help them reach their highest potential.

SHOPPING



Gift, debit, and credit cards use computer technology and privacy safeguards. Engineers design energy-efficient heating, cooling, lighting, and security systems for stores and malls.

FARM



Farmers use STEM skills and tools to determine plantable areas, calculate the optimal seed density per crop, engineer systems to increase crop yields and improve productivity, and calculate and compare the growth rates and break down of different crops.

ROADS



Engineers survey the area where new roads are to be built using GPS systems and laser surveys. Scientists test the soil and terrain, and identify potential drainage problems. Engineers create the designs used to build highways and bridges.

SCHOOL



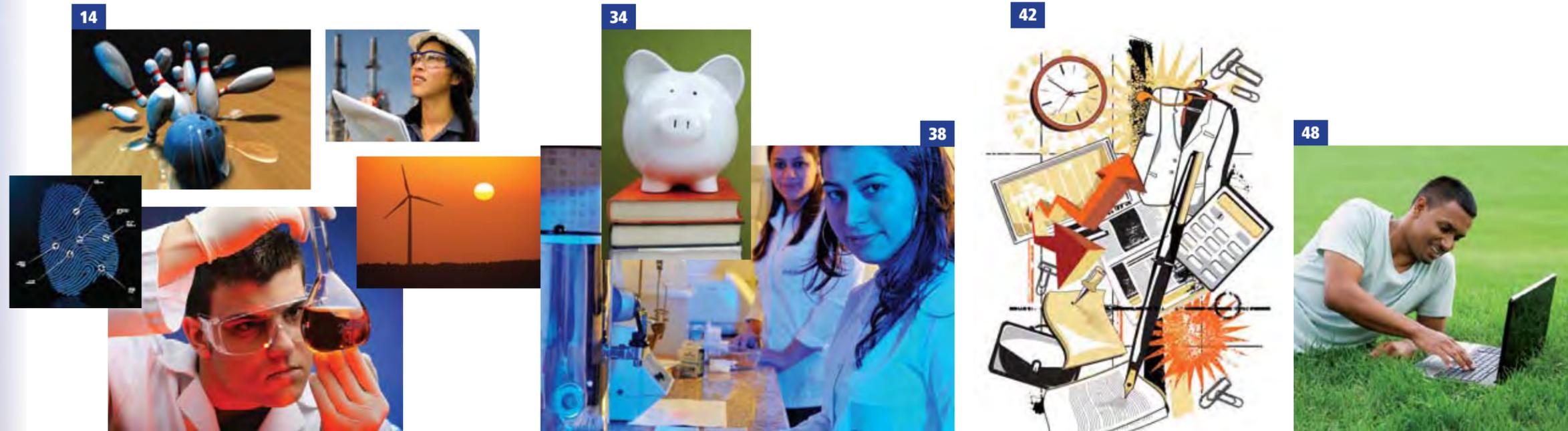
Laptops, wireless tablets, interactive whiteboards, LCD projectors, and tools used to create online tests and assessments are a few of the STEM elements found in today's classrooms.

AND MORE

Look around your world for STEM in action. If you want to build a future full of new opportunities for learning, for career, and for life, start with STEM.



A GUIDE TO GOALS AFTER GRADUATION



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Find out how the 16 federal career clusters connect what you learn in the classroom to the real world

■ **SPECIAL STEM PROGRAMS**...Take advantage of any of these STEM-related learning experiences that may be available in your school or district

■ **DOCUMENTING YOUR EDUCATION**...Learn how creating a plan and a portfolio will help you get ready for college and a career

STEM • STATE BY STATE

Spread throughout the Publication...51 examples

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Take a look inside this high-tech house to see some of the current and future innovations designed, built, and installed by STEM professionals with a variety of STEM skills

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Use these websites and other STEM career and education resources available from your school counselor or online to help you design the future of your dreams



Take this quick quiz to start figuring out if STEM is the right field for you. Answer “yes” or “no” to the 10 questions below.

Do YOU Have What It Takes?



QUIZ RESULTS

If you answered “yes” to one or more of the questions, then you may have what it takes to succeed in a Science, Technology, Engineering & Mathematics field. To get a more specific and scientific measurement of your interests and abilities, ask your guidance counselor or teacher about taking a career assessment test or interest inventory (see below). It’s smart to do lots of research into your options before you settle on any particular education or career pathway. This quiz is just designed to help you *begin* to assess your interest in STEM; do more digging and consult with your parents/guardian, counselors, and teachers before making any final decisions.

1 Have you ever taken apart an old cell phone, iPod, computer, household appliance, or toy to see how it worked? **YES or NO**

WHY IT COUNTS: Anyone can own a high-tech tool, but it takes a special person to design, build, and repair the latest gizmos and gadgets. If you’re a curious, creative problem solver, then STEM offers you the chance to do what you love in class and in a career.



2 Do you enjoy working on cars, motorcycles, or other machines? **YES or NO**

WHY IT COUNTS: Diagnosing and solving car problems takes technical talent, hands-on skills, and experience with high-tech and low-tech tools. A background in automotive or machine repair gives you a head start in the STEM field.



3 Are you interested in the environment and nature? **YES or NO**

WHY IT COUNTS: Protecting the earth’s natural resources, by analyzing and interpreting weather data, for example, requires a solid foundation in STEM. If you enjoy being outside, then building STEM skills is a great way to make the great outdoors your classroom or office.

4 Is math one of your favorite or best subjects? **YES or NO**

WHY IT COUNTS: There’s no way around it: Math matters in any STEM course or career. If math comes easily to you, then STEM is a logical choice. The higher the level of math you take in high school, the more options you’ll have after graduation. If you struggle with math, don’t count yourself out. Prepare for a STEM future by getting extra help from teachers and tutors, building your confidence with basic courses, and making it a personal goal to improve your math skills.

5 Do you get good grades in science and technology classes? **YES or NO**

WHY IT COUNTS: Even if you’re not a math whiz, doing well in science, computer, or technology classes means that you could have a bright future in a STEM field. Take all the STEM-related courses your school offers to start figuring out what you like to do best.

6 Do you like to keep your room, locker, and home neat, clean, and organized? **YES or NO**

WHY IT COUNTS: Whether you’re inventing the next handheld communications device or monitoring complex computer systems on a nuclear submarine, precision, organization, and attention to detail are key qualities needed for success. If you prefer order to chaos, then the logical structure and process of STEM will appeal to you.

7 Do you play team sports, play in a band, or belong to a service group? **YES or NO**

WHY IT COUNTS: It takes teamwork to run a winning NASCAR pit crew, design the latest videogame, or complete any other complex STEM task. Most STEM fields are project-based, meaning that your talents are combined with those of others to create the final product. Knowing how to work and play well with others gives you an advantage in school and career.

8 Do friends or family count on you to fix or install electronic gear and appliances? **YES or NO**

WHY IT COUNTS: If you’re the “go-to” person for repairs and tech-related questions, then your friends and family realize that you have a talent for STEM. Follow their lead and find a STEM field that lets you do what you love most—using your technical know-how to make life better for other people.

9 Do you enjoy working with high-tech tools? **YES or NO**

WHY IT COUNTS: If you love using the latest handhelds, applications, and computers, or enjoy building robots or other machines, then you’re already building strong STEM skills. With STEM, you can turn your love of new technologies into a fast-paced and fulfilling career.

10 Would you like to fly planes or explore the solar system? **YES or NO**

WHY IT COUNTS: STEM explorers discover new ways to soar higher, faster, and farther. Engineers, technicians, scientists, astronauts, pilots, and statisticians are just a few of the STEM professionals needed to design, build, and fly the next generation of aerospace vehicles.

CAREER ASSESSMENTS AND RESEARCH RESOURCES

Career assessments, interest inventories, and occupational databases help connect your talents, strengths, and interests to real careers. When you imagine yourself in the future, who do you see? An engineer? A technician? A teacher? A physician? Career resources are the place to start to figure out what occupations best fit your abilities and goals. Ask your guidance counselors or teachers how to use one or more of these services as a starting point for your college and career searches.

- **Kuder** (www.kuder.com)
- **Bridges** (www.bridges.com)
- **Myers-Briggs** (www.myersbriggs.org)
- **OSCAR** (Occupation and Skill Computer-Assisted Researcher) at www.ioscar.org/tx offers career search tools available to students and counselors.
- **O*NET** (Occupational Information Network) at online.onetcenter.org provides information on occupations, compensation, employment prospects, and skill matching.



The 3-D simulation modeling technician (SMT) program

ALABAMA

(3dsmt.tech.officelive.com) offered at Enterprise State Community College in Enterprise combines all phases of interactive 3-D, real-time, and virtual reality development, and requires a Capstone project from each student.



The renewable energy occupational certificate

ALASKA

program at Matanuska-Susitna College (www.matsu.alaska.edu) in Palmer combines eight classes and hands-on work experience to introduce students to the field of renewable energy.

MEET A STEM STUDENT

NAME: **Chris Kennedy**

MAJOR: Materials Science and Engineering

SCHOOL: Rensselaer Polytechnic Institute (RPI), Troy, New York

AS A HIGH SCHOOL STUDENT in New Hampshire, Chris Kennedy thought he wanted to study either international relations or military science after graduation. But when it came time to apply to colleges, Kennedy decided to choose a major closer to home.

"I had no idea what I wanted to do, so I chose civil engineering because my dad is a civil engineer," Kennedy says. "When I got to Rensselaer Polytechnic Institute (RPI) and took a Material Science for Engineers class, I switched majors. I really liked the material. It wasn't pure science like chemistry or biology, and it wasn't pure engineering."

Although Kennedy found a major he enjoyed, he says that he felt overwhelmed at first by RPI's challenging STEM courses. "I wish that I had taken more math and science courses in high school. For me the first semester of college was particularly tough, mostly because I had just chosen a school for engineering and I hadn't really prepared myself for that during high school. My classes were really tough because I didn't have the base that many of my fellow students had. In high school I got all "A"s and "B"s, and all of a sudden I got exams back with 60s and 70s on them. That really frustrated and shocked me."

Kennedy quickly realized that *wanting* to major in Materials Science and Engineering wasn't enough. To succeed, he needed to ask for extra help, stay positive, and study more effectively.

"Studying for hours on end is not the key for success in STEM fields," Kennedy explains. "You need to study smarter, not harder. I would recommend doing the homework the first day it's assigned even if you have a week until it is due. Read ahead, and ask questions when you don't understand. I learned these steps the hard way my first semester freshman year."

Today, Kennedy is ranked in the top 25 percent of his engineering class; it's an achievement he says he never would have dreamed possible during that rocky first year. He attributes his success to two factors: "drive and discipline."

Explains Kennedy, "I am not the world's smartest person, I am not the best student, and I definitely did not have the experience in math and science that some of my peers had coming into RPI. What I did have was the motivation to do well. If you want to do well you need to be disciplined and not procrastinate. Ask questions in class when you don't understand what is going on, because chances are that there are a number of people who don't get the material either and are too timid to ask. STEM majors are a challenge, but I firmly believe that anyone can do this if that is his or her goal."



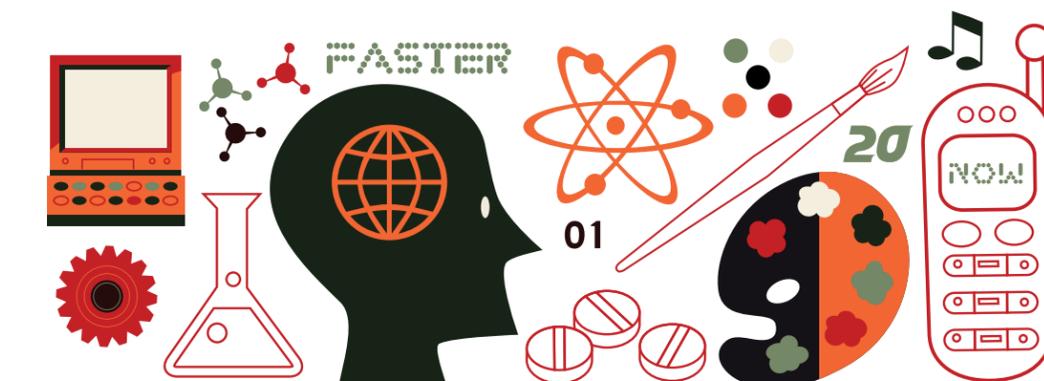
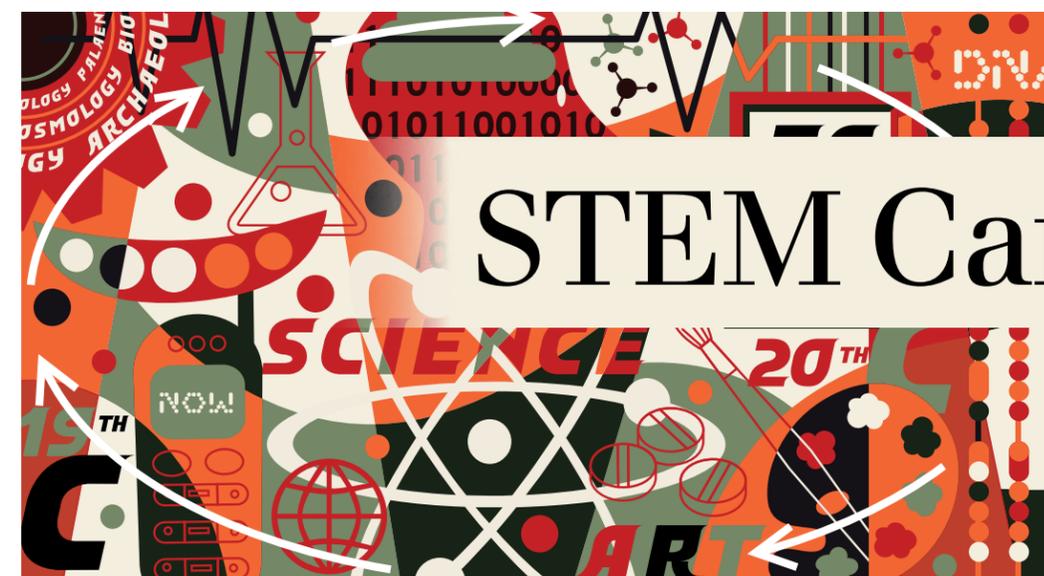
STEM SCOOP:

"If I have a sufficiently long break between classes, I study. After class, I start my homework right away. After a couple of hours, I have usually accomplished what I needed to do for the day."

— CHRIS KENNEDY

STEM Careers

If you think that STEM is only for math and science whizzes, think again. There are STEM career options for every kind of student. Start exploring by learning about the STEM sector.



■ WHERE THE JOBS ARE: HOT SECTORS IN STEM

Building a leaner, cleaner, and greener nation begins with STEM. For students interested in STEM careers, future opportunities will be plentiful in sectors related to eco-friendly energy generation, sustainable resources, "green chemistry," and environmental stewardship and protection.

Another emerging STEM sector is geospatial technology, which combines knowledge of Earth and space with high technology. Photogrammetrists and remote sensing specialists use pictures and other information from satellites, planes, and ground sensors to plot and gather data about where things are on Earth.

Want to focus your STEM studies on a sector where the job outlook is brightest? Start by researching these 15 hot, high-demand STEM jobs chosen by the U.S. Bureau of Labor Statistics.

15 HOT, HIGH-DEMAND STEM-RELATED JOBS

JOB TITLE	PROJECTED GROWTH THROUGH 2016
Computer software engineer (software)	27%+
Environmental science and protection technician, including health	27%+
Computer software engineer, applications	27%
Architect (except landscape and naval)	18–26%
Cartographer and photogrammetrist	18–26%
Civil engineer	18–26%
Cost estimator	18–26%
Environmental engineer	18–26%
Geoscientist (except hydrologist and geographer)	18–26%
Industrial engineer	18–26%
Medical equipment repairer	18–26%
Medical scientist (except epidemiologist)	18–26%
Surveying and mapping technician	18–26%
Surveyor	18–26%
Technical writer	18–26%

Source: U.S. Bureau of Labor Statistics 2006–2016 projection series

The STEM program at Central Arizona College

ARIZONA

(www.centralaz.edu) in Pinal County begins with the Success in Science introductory course, which allows students to explore different areas of science.



Arkansas State University in Jonesboro trains future CSIs

ARKANSAS

(crime scene investigators) through its forensic science bachelor's degree program (forensics.astate.edu). Graduates have the skills and knowledge to work in a crime laboratory, or go to medical or graduate school.

A spotlight on some of the most popular high-tech innovations and most successful STEM professionals of our time.

Why TECHIES Get the Big Bucks



■ APPLE FOUNDER STEVEN JOBS Whether or not you own an iPod, iPhone, or iPad, you know that the ultimate techie—Apple co-founder and design visionary Steve Jobs—is an international celebrity and extremely rich guy. What you may not know is that Jobs only gets paid \$1 a year for being Apple CEO. He earns so little because he is worth so much. According to the Associated Press, Jobs reportedly owns about \$1.2 billion worth of Apple stock and another \$4.4 billion worth of Walt Disney Company stock (he sold Pixar Animation Studios to Disney in 2006). Jobs launched his STEM career as a high school student in Cupertino, California. He attended after-school lectures at Hewlett-Packard Company (HP) in nearby Palo Alto, and worked at HP during summer vacations. Whether you are a Mac or a PC fan, you know that Apple is a high-tech trailblazer. To follow in the STEM footsteps of Jobs, you need solid math, computer, and communication skills, as well as extra helpings of imagination. Jobs often sums up his visionary approach this way: “There’s an old Wayne Gretzky quote that I love. ‘I skate to where the puck is going to be, not where it has been.’ And we’ve always tried to do that at Apple. Since the very, very beginning. And we always will.”

■ HYBRID CARS Hybrid gas–electric cars are engineered to save gas and help reduce air pollution. Most hybrids can reduce air emissions of smog-forming pollutants by up to 90 percent and cut carbon dioxide emissions in half. Basic hybrid models add an electric motor and rechargeable batteries to a conventional gas engine. Plug-in hybrid cars use larger battery packs that can be recharged when connected to a regular electrical outlet at home or at work. The plug-in hybrids can be driven for long distances—as much as 40 miles—without using any gasoline. A plug-in hybrid running on biofuel (for example, 85 percent ethanol or biodiesel) could almost entirely eliminate its use of petroleum. The eco-friendly vehicles being unveiled today move beyond hybrid and go totally electric. No need for any gasoline here: just plug in, charge up, and you’re off. The priciest of these lean, green, EV (electric vehicle) machines is the \$130,000+ Tesla Roadster Sport. This carbon fiber–body sports car can go from 0–60 in 3.7 seconds, all without a drop of gas.



■ FACEBOOK You may not realize it, but there was a time—not so long ago—when writing on someone’s wall was considered an act of vandalism, *friending* wasn’t a word, and you had to remember friends’ birthdays (or at least write the dates on a paper calendar). Facebook has changed how we communicate, connect, and share our awkward family vacation photos. Mark Zuckerberg, who is worth \$4 billion, was only a sophomore in college when he invented Facemash, which evolved into Facebook. It may be hard to remember when you weren’t on Facebook, but the social networking site has been open to high school students only since September 2005. If you ever wonder how having STEM knowledge and skills can change the world, just sign on to your Facebook account.



■ UNCLE SAM WANTS YOU TO CHOOSE STEM

President Barack Obama has launched an “Educate to Innovate” campaign to improve the participation and performance of America’s students in STEM.

The campaign includes efforts from the federal government and encourages leading companies, foundations, nonprofits, and science and engineering societies to work with students across the United States to help them excel in science and math.

While our nation has many great schools, excellent teachers, and successful students, we’re no longer leading the way in math and science. In the 2006 OECD Programme for International Student Assessment, U.S. students ranked 21st out of 30 in science literacy among students from developed countries, and 25th out of 30 in math literacy.

“Educate to Innovate” seeks to:

- Increase STEM literacy so that all students can

learn deeply and think critically in science, math, engineering, and technology.

MORE MONEY IS GOING TO STEM EDUCATION

- Move American students from the middle of the pack to the top in the world over the next decade.

- Expand STEM education and career opportunities for underrepresented groups, including women and girls.

Now is the time to study STEM. Business, industry, government, and education leaders recognize the need to invest in the next generation of STEM innovators. That means that more programs, scholarships, and training—along with more money for those searching for a job—will be available to U.S. students interested in pursuing STEM careers—students just like you.

GREATEST ENGINEERING ACHIEVEMENTS OF THE 20th CENTURY



The 1900s brought the following wealth of inventions driven by STEM. What incredible innovations could you be a part of in the 21st century?

- | | | |
|----------------------------------|--|--|
| 1. Electrification | 9. Telephone | 16. Health Technologies |
| 2. Automobile | 10. Air Conditioning and Refrigeration | 17. Petroleum and Petrochemical Technologies |
| 3. Airplane | 11. Highways | 18. Laser and Fiber Optics |
| 4. Water Supply and Distribution | 12. Spacecraft | 19. Nuclear Technologies |
| 5. Electronics | 13. Internet | 20. High-performance Materials |
| 6. Radio and Television | 14. Imaging | |
| 7. Agricultural Mechanization | 15. Household Appliances | |
| 8. Computers | | |

Source: *Greatest Engineering Achievements of the 20th Century*, National Academy of Engineering, www.greatachievements.org.

The coolest classroom at the University of Southern

CALIFORNIA

California (USC) is on Catalina Island off the coast of Los Angeles. During the spring “Catalina semester,” USC Wrigley Institute for Environmental Studies (college.usc.edu/wrigley), students take environmental studies and biology courses, as well as hike, bike, swim, sail, and snorkel.



Red Rocks Community College’s Green Career

COLORADO

website (rrcc.edu/green) has partnered with various organizations to create degree and certificate programs in areas such as renewable energy, energy and industrial maintenance, and water-quality management.

Marine and environmental sciences (MES) majors at the

CONNECTICUT

United States Coast Guard Academy (www.cga.edu) in New London conduct hands-on research aboard a 30-foot Coast Guard research vessel. This multidisciplinary major combines oceanography, chemistry, and biology.



The quantitative biology major at the University of

DELAWARE

Delaware (www.udel.edu) in Newark was created to address the needs of 21st-century biology in ways that traditional biology or math programs cannot. Students solve biological problems, preparing them for postgraduate education or careers in industry.



How STEM professionals help make the world greener and cleaner

Go GREEN

EMERGING GREEN STEM CAREERS Many of tomorrow's green STEM jobs don't exist today. But by the time you graduate from a two- or four-year college STEM program, there will be a world of green opportunities waiting for you. Explore these five eco-friendly jobs with bright "green" futures:

WIND TURBINE TECHNICIAN Mid-sized commercial and industrial wind turbines power farms, homes, companies, and communities across the United States. As the demand for clean wind energy grows, so does the demand for U.S.-made turbines.



GEOSCIENTIST Geoscientists work to find natural resources, including sources of geothermal heat from hot rock beds and rock formations. They also work closely with environmental scientists to preserve and clean up the environment.



ENVIRONMENTAL ENGINEER Environmental engineers solve environmental problems within various projects. For example, when a power plant in southern Virginia was relocated onto a wetland, environmental engineers created a new wetland in another area.

SOLAR PANEL INSTALLER AND TECHNICIAN Solar photovoltaics, also known as Solar PV, is the field of technology and research related to the application of solar cells for energy. These cells convert sunlight directly into electricity. Solar PV technicians are trained to use, install, and service solar electric systems and solar collection panels.



ECO-FRIENDLY CAR DESIGN ENGINEER Hybrid and electric cars help protect the environment by saving gas and reducing pollution. Future design engineers will be challenged to use imagination and STEM skills to create vehicles that run even cleaner and greener than today's most eco-friendly models.



CAREERS AVAILABLE AT EVERY EDUCATION LEVEL

Nearly every STEM job requires some education or training after high school, but, because the options are so varied and the demand for skilled workers is so great, you don't necessarily need a four-year college degree. Take a look at the different levels of education required for these careers related to the environment.

EDUCATION/TRAINING	JOB
ON-THE-JOB-TRAINING	Weigher, Measurer, and Sampler Record-Keeping
OCCUPATIONAL CERTIFICATE	Renewable Energy Technician
ASSOCIATE'S DEGREE (2 YEARS)	Environmental Science and Protection Technician
BACHELOR'S DEGREE (4 YEARS)	Atmospheric and Space Scientist
MASTER'S DEGREE (5-6 YEARS)	Environmental Scientist and Specialist
DOCTORAL DEGREE (6+ YEARS)	Microbiologist



WHERE THE GREEN JOBS ARE Rising energy costs, environmental regulations, and federal energy tax incentives are just a few of the reasons that cities and states are focused on eco-friendly initiatives. Today's investment equals tomorrow's job opportunities for STEM students with sought-after green skills. The U.S. Department of Labor estimates that the environmental sector will become a \$27 billion market by 2020, and that more than 250,000 people will be needed. Other research indicates that approximately 2.7 million workers will be required for the wind and solar industries alone over the next decade. All that means job opportunities for you. Here's a rundown of some places to find them.

IN THE NORTH: Minnesota is investing in a pipeline to supply a plant-based alternative to petroleum products. The University of Minnesota Morris has installed a biomass gasifier that converts biomass from corn and grasses, including biomass from woods, into a biogas as a natural-gas substitute. That means trees may power the state's energy needs.

BRIGHT IDEA: CleanTech Recruits specializes in recruiting employees for renewable energy jobs. To get a better idea of what jobs are available, check out the listings at www.cleantechrecruits.com.

sustainably grown and harvested agricultural crops and forests in the region can adequately supply an \$8 billion biofuels and bio-based products industry without having a negative impact on the food and feed supply chain. In addition, the study estimates that this bioeconomy will produce 25,000 direct and indirect jobs in the region over the next 10 years, and 50,000 by the year 2030.

According to University of Maine estimates, the state could generate electrical energy from the wind equivalent to 149 nuclear power plants—three to four times the current peak demand for all of New England, meaning that Maine could also export energy to other states and Canada.

IN THE SOUTH: Memphis Bioworks Foundation is leading an effort to create a "bioeconomy" in the five-state Mississippi Delta region. A foundation-sponsored study concludes that

region over the next 10 years, and 50,000 by the year 2030.

IN THE WEST: Solar power is the most widespread available energy source in the world. California leads the nation in the number of homes with solar panels, followed by New Jersey, Colorado, Nevada, and Arizona, according to a report by the Interstate Renewable Energy Council. A California legislative mandate calls for one million solar roofs in the state by 2018.

GREEN SCHOLARSHIPS To help inspire and engage the next generation of green energy innovators, the National Science Foundation (NSF) offers these scholarships and fellowships to undergraduate and graduate schools and students. Ask college financial aid offices for more information.

NSF SCHOLARSHIPS IN SCIENCE, TECHNOLOGY, ENGINEERING & MATHEMATICS The NSF makes grants to institutions of higher education to support scholarships for academically talented, financially needy students, enabling them to enter the workforce following completion of an associate, baccalaureate, or graduate-level degree in science and engineering disciplines.



RESEARCH EXPERIENCES FOR UNDERGRADUATES (REU) IN ENERGY The NSF provides funding for new REU courses and research opportunities for undergraduate students to learn about clean energy and gain experience in active research projects.

INDIVIDUAL FELLOWSHIPS TO GRADUATE STUDENTS INVOLVED IN CLEAN ENERGY RESEARCH The NSF Graduate Research Fellowship Program provides highly flexible three-year fellowships for American graduate students pursuing a Ph.D. degree in topics related to clean energy research and development.

INTEGRATIVE GRADUATE TRAINING PROGRAMS INVOLVING CLEAN ENERGY The IGERT (Integrative Graduate Education Research Traineeship) projects are interdisciplinary programs for Ph.D. students that consider energy topics from a high-level systems perspective, including science, engineering, design, environmental impact, economics, social aspects of adoption and use, and public policy.

Embry-Riddle Aeronautical University (www.erau.edu)

FLORIDA

in Daytona Beach is home to the nation's largest aerospace engineering and undergraduate aeronautical science programs. Six alumni are current or former astronauts, and the major airlines hire more graduates from Embry-Riddle than from any other college aviation program.



Engineering majors at the Georgia Institute of

GEORGIA

Technology, or Georgia Tech (www.gatech.edu), in Atlanta can take a five-year co-op program that alternates semesters of on-campus study with paid, full-time employment. Many co-op graduates are hired by their co-op employers.

STEM • STATE BY STATE



Students earning a plant biotechnology academic

HAWAII

certificate at Windward Community College (windward.hawaii.edu) in Kaneohe can find jobs in food and medicine production or pursue a bachelor's degree in majors such as botany, pre-medicine, and horticulture. Classrooms include an orchid identification facility and the medicinal plants garden.

The growing demand for STEM professionals means that now is the ideal time for women and minority members to build careers in STEM fields.



STEM for Everyone

WOMEN AND STEM The idea that STEM careers are only for guys is old-fashioned and just plain wrong. Since 1809, when a U.S. patent was first issued to a woman, female engineers and scientists have invented scores of world-changing innovations, including the automatic dishwasher, windshield wipers, the disposable cell phone, and a computer language (COBOL). Today, women lead Fortune 500 technology companies as CEOs, and serve in executive roles as principal engineers, project managers, technical directors, and chief technical officers.



The Society of Women Engineers (SWE) helps support young women interested in engineering. The not-for-profit educational and service organization empowers women to succeed and advance in the field by awarding nearly \$500,000 in scholarship funding each year to women engineering students. In addition, SWE offers training and development programs and networking opportunities. Learn more about SWE at www.swe.org.

DREAM IT. DO IT. “When I was a girl, I had a teacher who encouraged my interest in science. She challenged me to be curious, to ask questions, and to think about things for myself. She helped build my self-confidence. All of these things helped me to become a scientist and astronaut.”

—SALLY RIDE, U.S. PHYSICIST AND FORMER ASTRONAUT WHO BECAME THE FIRST AMERICAN WOMAN TO ENTER SPACE, AS A CREW MEMBER ON THE SPACE SHUTTLE CHALLENGER IN 1983

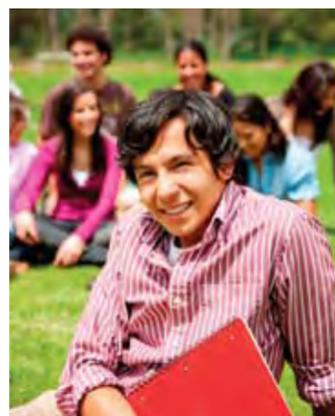
EXPLORE NACME The National Action Council for Minorities in Engineering (NACME) works to improve STEM education opportunities for African American, American Indian, and Latino students. Visit NACME Backs Me (www.NACMEBacksMe.org), the special NACME website for students, parents, and teachers, for helpful information about:

- Engineering careers
- NACME Scholar engineering scholarships
- NACME-sponsored Academies of Engineering

You can also learn more about any engineering college program in the United States in the *NACME Guide to Engineering Colleges*, created by NACME and the Princeton Review. Download it free at www.nacmebacksme.org/NBM_C.aspx?pageid=24.

MEET A MINORITY INVENTOR:
Dr. Patricia Bath

Dr. Patricia Bath—eye surgeon, professor of ophthalmology, inventor of the Laserphaco Probe for the treatment of cataracts, and founder of the American Institute for the Prevention of Blindness—was the first African American woman to receive a U.S. patent for a medical invention (*Pat. No. 4744360: Apparatus for ablating and removing cataract lenses, issued 17 May 1988*).



MEET A STEM STUDENT

NAME: **Monica Yellowhair**

MAJORS/MINORS: Chemistry (Bachelor’s Degree); Chemistry and Biochemistry (Master’s Degree); Pharmacology and Toxicology (Doctoral Degree)

SCHOOLS: Northern Arizona University, Flagstaff, Arizona, and University of Arizona, Tucson, Arizona

GROWING UP ON A Navajo reservation in the Four Corners region of the United States (where Arizona, Utah, Colorado, and New Mexico meet), Monica Yellowhair says she always dreamed of going to college but wasn’t sure how she would get there.

“For a high school student, I think the fear of not being able to afford college tuition is very common,” she says. “It seemed like I was being pulled in various directions, and at times I felt a little overwhelmed. With guidance and encouragement from my family, guidance counselors, and teachers, I was able to overcome any obstacle and achieve my goal.”

During her junior year in high school, Yellowhair began researching colleges and scholarships. She created a checklist with important dates and deadlines as a constant reminder of when applications and financial forms were due. Her hard work and determination paid off. In her senior year, Yellowhair earned scholarship money to attend Northern Arizona University (NAU), where she majored in microbiology and minored in chemistry.

“The scholarships and financial aid have played a major role in helping me achieve my academic goals,” she explains. “Without funding from various organizations such as the National Action Council for Minorities in Engineering (NACME) and the Sloan Indigenous Graduate Partnership (SIGP) Program, I would not be able to pursue my higher education.”

After completing her undergraduate degree, Yellowhair continued her education at Northern Arizona. She earned a master’s degree in chemistry with a minor in biochemistry in a special collaborative program between her school and the University of Arizona. That experience led her to a doctoral program at the University of Arizona, where she is a fifth-year Ph.D. candidate in pharmacology and toxicology.

Yellowhair decided to focus on science in college as a way to give back to her home community of Kayenta, Arizona. The area is close to several abandoned uranium mines, Yellowhair says, and she grew up hearing stories about the negative health effects suffered by the miners and their families. As a genotoxicity researcher, she hopes to determine how exposure to radiation from processed uranium might cause the DNA damage that can lead to a susceptibility to cancer.

“Uranium miners and their families were not compensated for the injustice endured over the many years uranium was stripped from the earth,” Yellowhair adds. “The lack of compensation was attributed mostly to a lack of research and knowledge concerning the potential threat of cancer caused by its chemical properties rather than its radioactivity. Working on my research project has given me the opportunity to see the effects of this research on a personal level, knowing it will contribute to providing answers for the Diné [Navajo] people and other families affected by uranium exposure.”



STEM SCOOP:
“I personally think students should participate in the STEM fields. Many obstacles facing each community can be solved through STEM-based research and solutions. Being part of STEM gives you plenty of opportunities to meet new people and work together to help your community.”
— MONICA YELLOWHAIR



A five-year, dual-degree program in engineering gives

IDAHO

students the opportunity to earn both a bachelor’s degree in mathematics-physics from the College of Idaho (www.collegeofidaho.edu) in Caldwell and a bachelor’s degree in civil, electrical, or mechanical engineering from Boise State University (www.boisestate.edu) in Boise.



The University of Illinois at Urbana-Champaign’s

ILLINOIS

I-STEM Education Initiative (www.istem.illinois.edu) is focused on increasing the number and quality of STEM teachers who graduate from the Urbana campus, along with improving student recruitment and retention rates in science and technology-affiliated programs, especially women and minorities.



25 STEM Careers



Explore ideas for more than two dozen jobs that span the different education levels required to enter a STEM profession.

#	SOC	JOB TITLE	EDUCATION	WAGES	OUTLOOK
1	19-2041	ENVIRONMENTAL SCIENTIST AND SPECIALIST	▩▩▩▩	\$\$\$	👍👍
2	17-3027	MECHANICAL ENGINEERING TECHNICIAN	▩▩▩	\$\$\$	👍
3	19-4031	CHEMICAL TECHNICIAN	▩▩▩▩	\$\$\$	👍
4	15-1011	COMPUTER AND INFORMATION SCIENTIST (RESEARCH)	▩▩▩▩▩▩▩	\$\$\$\$\$	👍👍👍
5	19-3091	ANTHROPOLOGIST AND ARCHEOLOGIST	▩▩▩▩▩	\$\$\$	👍👍👍
6	19-2032	MATERIALS SCIENTIST	▩▩▩▩▩	\$\$\$\$	👍
7	17-2199.10	WIND ENERGY ENGINEER	▩▩▩▩▩	\$\$\$\$\$	👍👍
8	19-4092	FORENSIC SCIENCE TECHNICIAN	▩▩▩▩	\$\$\$	👍👍
9	17-3031	SURVEYING AND MAPPING TECHNICIAN	▩▩▩▩▩	\$\$	👍👍
10	43-5111	WEIGHER, MEASURER, AND SAMPLER (RECORD-KEEPING)	▩	\$\$	👍👍
11	19-4021	BIOLOGICAL TECHNICIAN	▩▩▩▩	\$\$	👍👍
12	17-1022	SURVEYOR	▩▩▩▩▩	\$\$\$	👍👍
13	17-2031	BIOMEDICAL ENGINEER	▩▩▩▩▩	\$\$\$\$	👍👍
14	19-2010	ASTRONOMER AND PHYSICIST	▩▩▩▩▩▩▩	\$\$\$\$\$	👍👍
15	19-2021	ATMOSPHERE AND SPACE SCIENTIST	▩▩▩▩▩	\$\$\$\$	👍
16	17-3024	ELECTRO-MECHANICAL TECHNICIAN	▩▩▩▩	\$\$\$	👍
17	17-1022.01	GEODETTIC SURVEYOR	▩▩▩▩▩	\$\$\$	👍👍👍
18	17-2051	CIVIL ENGINEER	▩▩▩▩▩	\$\$\$\$	👍👍
19	17-3025	ENVIRONMENTAL ENGINEERING TECHNICIAN	▩▩▩	\$\$	👍👍👍
20	17-3011	ARCHITECTURAL AND CIVIL DRAFTER	▩▩▩	\$\$\$	👍👍
21	17-2199.08	ROBOTICS ENGINEER	▩▩▩▩▩	\$\$\$\$\$	👍👍👍
22	17-3029	ENGINEERING TECHNICIAN (EXCEPT DRAFTERS)	▩▩▩▩	\$\$\$	👍
23	15-1099.13	VIDEOGAME DESIGNER	▩▩▩▩	\$\$\$\$	👍👍👍
24	17-2121	MARINE ENGINEER AND NAVAL ARCHITECT	▩▩▩▩▩	\$\$\$\$	👍👍
25	17-2072	ELECTRONICS ENGINEER (EXCEPT COMPUTER)	▩▩▩▩▩	\$\$\$\$\$	👍👍

HOW TO READ THIS CHART On the chart above, you will find 25 career ideas in STEM. Here are explanations of what abbreviations or symbols mean. For detailed information, please see the occupational descriptions on the following pages.

JOB NUMBER
This corresponds to the number of the description of the occupation found on the following pages.

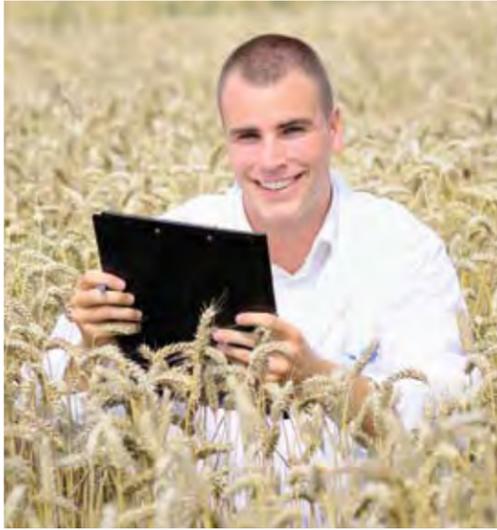
SOC STANDARD OCCUPATIONAL CODE
Use this number to look up more information about this occupation in career information databases.

SOURCE: The information on the chart and for the occupations on the following pages is excerpted from the *Occupational Outlook Handbook, 2010-11 Edition* (www.bls.gov/oco) and O*Net Online (online.onetcenter.org). Inexact or ambiguous information has been interpreted. These jobs are only ideas; always do additional research to make the right education and career decisions for you.

EDUCATION
The minimum level of education usually needed to enter the occupation.
▩ On-the-job training
▩▩ Postsecondary vocational training
▩▩▩ Associate's degree
▩▩▩▩ Bachelor's degree
▩▩▩▩▩ Master's degree
▩▩▩▩▩▩ Doctoral degree, first professional degree, or Ph.D.

WAGES
The average pay for the occupation.
\$.01–10 dollars per hour
\$ 10.01–20 dollars per hour
\$\$\$ 20.01–30 dollars per hour
\$\$\$\$ 30.01–40 dollars per hour
\$\$\$\$\$ 40.01–50+ dollars per hour

OUTLOOK
Opportunities for finding employment.
👍 Keen competition. There may be fewer job openings than job seekers.
👍👍 Good or favorable. The number of job openings and the number of job seekers may be roughly equal.
👍👍👍 Very good or excellent. There may be more job openings than job seekers.



1 ENVIRONMENTAL SCIENTIST

WHAT YOU DO: Environmental scientists and specialists use their knowledge of the natural sciences to protect the environment by identifying problems and finding solutions that minimize hazards to the health of the environment and the population. They analyze measurements or observations of air, plants, animals, water, and soil to determine the best way to clean and preserve the environment. They often use this understanding to design and monitor waste disposal sites, preserve water supplies, and reclaim contaminated land and water.

MINIMUM EDUCATION: Bachelor's degree.

AVERAGE WAGES: \$28.72 per hour.

EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.

SOC: 19-2041.

2 MECHANICAL ENGINEERING TECHNICIAN

WHAT YOU DO: Mechanical engineering technicians help engineers design, develop, test, and manufacture industrial machinery, consumer products, and other equipment. They may assist in product tests by, for example, setting up instrumentation for auto crash tests. They may make sketches and rough layouts, record and analyze data, make calculations and estimates, and report on their findings. When planning production, mechanical engineering technicians prepare layouts and drawings of the assembly process and of parts to be manufactured. They estimate labor costs, equipment life, and plant space. Some test and inspect machines and equipment or work with engineers to eliminate production problems.

MINIMUM EDUCATION: Associate's degree.

AVERAGE WAGES: \$23.14 per hour.

EMPLOYMENT OUTLOOK: Keen competition. There may be fewer job openings than job seekers.

SOC: 17-3027.

4 COMPUTER AND INFORMATION SCIENTIST, RESEARCH

WHAT YOU DO: By designing, inventing, and creating new technologies, or finding alternative uses for existing ones, computer scientists solve complex business, scientific, and general computing problems. They conduct research on a wide array of topics. Examples include computer hardware architecture, virtual reality, and robotics. They design computer chips and processors, using new materials and techniques to make them work faster and give them more computing power.

MINIMUM EDUCATION: Doctoral degree, first professional degree, or Ph.D.

AVERAGE WAGES: \$47.10 per hour.

EMPLOYMENT OUTLOOK: Very good or excellent; may be more job openings than job seekers.

SOC: 15-1011.

5 ANTHROPOLOGIST AND ARCHEOLOGIST

WHAT YOU DO: Anthropologists study the origin, development, and behavior of humans. They examine the ways of life, languages, archeological remains, and physical characteristics of people in various parts of the world. Archeologists examine and conserve material evidence, including tools, pottery, cave paintings, the ruins of buildings, and other objects remaining from past human cultures in order to learn about the history, customs, and daily life of earlier civilizations.

With continued technological advances making it increasingly possible to detect the presence of underground anomalies without digging, archeologists can now target excavation sites better than they previously could.

MINIMUM EDUCATION: Master's degree

AVERAGE WAGES: \$25.92 per hour.

EMPLOYMENT OUTLOOK: Very good or excellent; may be more job openings than job seekers.

SOC: 19-3091.

6 MATERIALS SCIENTIST

WHAT YOU DO: Materials scientists study the structures and chemical properties of various materials to develop new products or enhance existing ones. They also determine ways to strengthen or combine materials or develop new materials for use in a variety of products. Materials science encompasses the natural and synthetic materials used in a wide range of products and structures, from airplanes, cars, and bridges to clothing and household goods. Materials scientists often specialize in a specific type of material, such as ceramics or metals.

MINIMUM EDUCATION: Bachelor's degree.

AVERAGE WAGES: \$38.57 per hour.

EMPLOYMENT OUTLOOK: Keen competition. There may be fewer job openings than job seekers.

SOC: 19-2032.

3 CHEMICAL TECHNICIAN

WHAT YOU DO: Science technicians use the principles and theories of science and mathematics to assist in research and development and to help invent and improve products and processes. However, their jobs are more practically oriented than those of scientists. Chemical technicians set up, operate, and maintain laboratory instruments, monitor experiments, make observations, calculate and record results, and often develop conclusions. As laboratory instrumentation and procedures have become more complex, the role of science technicians in research and development has expanded. In addition to performing routine tasks, many technicians, under the direction of scientists, now develop and adapt laboratory procedures to achieve the best results, interpret data, and devise solutions to problems.

MINIMUM EDUCATION: Associate's degree.

AVERAGE WAGES: \$20.25 per hour.

EMPLOYMENT OUTLOOK: Keen competition. There may be fewer job openings than job seekers.

SOC: 19-4031.



STEM • STATE BY STATE

In 2008, Indiana introduced the Hoosier High School

INDIANA

Math and Science Awards (<https://secure.in.gov/lapps/mathscienceawards/>); note the "s" after "http" in the URL) to name Mr./Miss Math and Mr./Miss Science just as it does with the state's legendary Mr. and Miss Basketball awards, which are given each year to the its best hoops players.

STEM • STATE BY STATE

The Iowa Lakes Community College (www.iowalakes.edu)

IOWA

campus in Estherville offers the state's only two-year associate's degree program in wind energy and turbine technology. A three-term diploma program is also available to students seeking entry-level jobs in the wind energy industry by being able to install, service, and maintain wind turbines.



7 WIND ENERGY ENGINEER

WHAT YOU DO: Engineers apply the principles of science and mathematics to develop economical solutions to technical problems. Their work is the link between scientific discoveries and the commercial applications that meet societal and consumer needs. Wind engineers design underground or overhead wind farm collector systems. They analyze operation of wind farms or wind farm components to determine reliability, performance, and compliance with specifications, and create models to optimize the layout of wind farm access roads, crane pads, crane paths, collection systems, substations, switchyards, or transmission lines. They also develop active control algorithms, electronics, software, and electromechanical or electrohydraulic systems for wind turbines.



MINIMUM EDUCATION: Bachelor's degree.

AVERAGE WAGES: \$42.58 per hour.

EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.

SOC: 17-2199.10.

8 FORENSIC SCIENCE TECHNICIAN

WHAT YOU DO: Forensic science technicians investigate crimes by collecting and analyzing physical evidence. Often, they specialize in areas such as DNA analysis or firearm examination, performing tests on weapons or on substances such as fiber, glass, hair, tissue, and body fluids to determine their significance to the investigation. Proper collection and storage methods are important for protecting the evidence. Forensic science technicians also prepare reports to document their findings and the laboratory techniques used, and they may provide information and expert opinions to investigators. When criminal cases come to trial, forensic science technicians often give testimony as expert witnesses.

MINIMUM EDUCATION: Associate's degree.

AVERAGE WAGES: \$23.97 per hour.

EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.

SOC: 19-4092.



STEM • STATE BY STATE

Engineering students at the University of Kansas in

KANSAS

Lawrence can earn credits by spending semesters or summers in countries such as Australia, China, and England (www.studyabroad.ku.edu).

9 SURVEYING AND MAPPING TECHNICIAN

WHAT YOU DO: Surveyors, cartographers, photogrammetrists, and surveying and mapping technicians are responsible for measuring and mapping the earth's surface. Surveying and mapping technicians assist professionals by collecting data in the field, making calculations, and helping with computer-aided drafting. Surveyors measure distances, directions, and angles between points on, above, and below the earth's surface. In the field, they select known survey reference points and determine the precise location of important features in the survey area using specialized equipment.

MINIMUM EDUCATION: Bachelor's degree.

AVERAGE WAGES: \$16.88 per hour.

EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.

SOC: 17-3031.



12 SURVEYOR

WHAT YOU DO: Surveyors, cartographers, photogrammetrists, and surveying and mapping technicians are responsible for measuring and mapping the earth's surface. Surveyors establish official land, airspace, and water boundaries. They write descriptions of land for deeds, leases, and other legal documents; define airspace for airports; and take measurements of construction and mineral sites. Other surveyors provide data about the shape, contour, location, elevation, or dimension of land or land features.

MINIMUM EDUCATION: Bachelor's degree.

AVERAGE WAGES: \$25.47 per hour.

EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.

SOC: 17-1022.

10 WEIGHER, MEASURER, AND SAMPLER, RECORD-KEEPING

WHAT YOU DO: Weighers, measurers, checkers, and samplers weigh, measure, and check materials, supplies, and equipment to keep accurate records. Most of their duties are clerical. They verify the quantity, quality, and overall value of the items they are responsible for and check the condition of items purchased, sold, or produced against records, bills, invoices, or receipts.

MINIMUM EDUCATION: Associate's degree.

AVERAGE WAGES: \$12.95 per hour.

EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.

SOC: 43-5111.

11 BIOLOGICAL TECHNICIAN

WHAT YOU DO: Biological technicians work with biologists studying living organisms. Many assist scientists who conduct medical research—helping to find a cure for cancer or AIDS, for example. Those who work in pharmaceutical companies help develop and manufacture medicines. Those working in the field of microbiology generally work as laboratory assistants, studying living organisms and infectious agents. Biological technicians also analyze organic substances, such as blood, food, and drugs.

MINIMUM EDUCATION: Associate's degree.

AVERAGE WAGES: \$18.46 per hour.

EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.

SOC: 19-4021.

Biological technicians working in biotechnology apply knowledge and techniques gained from basic research, including gene splicing and recombinant DNA research, and apply them to product development.



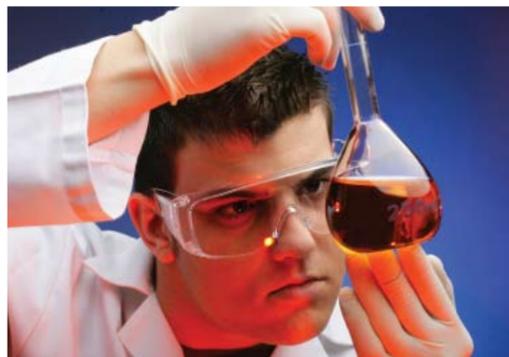
The Kentucky Transportation Cabinet awards 10 to 20

KENTUCKY

scholarships worth up to \$50,400 (transportation.ky.gov/scholarship/) to students studying civil engineering at the University of Kentucky, Western Kentucky University, community or technical colleges, or other Kentucky schools.

13 BIOMEDICAL ENGINEER

WHAT YOU DO: Biomedical engineers develop devices and procedures that solve medical and health-related problems by combining their knowledge of biology and medicine with engineering principles and practices. Many do research, along with medical scientists, to develop and evaluate systems and products such as artificial organs, prostheses (artificial devices that replace missing body parts), instrumentation, medical information systems, and health management and care delivery systems. Biomedical engineers also may design devices used in various medical procedures, imaging systems such as those used for magnetic resonance imaging (MRI), and devices for automating insulin injections or controlling body functions.



MINIMUM EDUCATION: Bachelor's degree.
AVERAGE WAGES: \$37.21 per hour.
EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.
SOC: 17-2031.

14 ASTRONOMER AND PHYSICIST

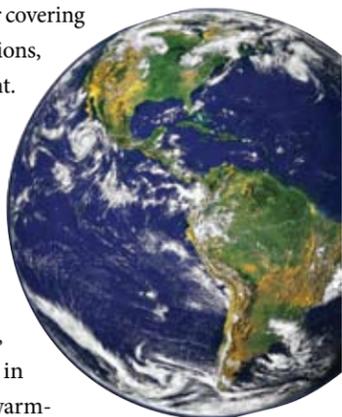
WHAT YOU DO: Physicists and astronomers conduct research to understand the nature of the universe and everything in it. These scientists observe, measure, interpret, and develop theories to explain celestial and physical phenomena using mathematics. From the vastness of space to the infinitesimal scale of subatomic particles, they study the fundamental properties of the natural world and apply the knowledge gained to design new technologies. Physicists explore and identify basic principles and laws governing the motion, energy, structure, and interactions of matter. Astronomers use the principles of physics and mathematics to learn about the fundamental nature of the universe and its components, including the sun, moon, planets, stars, and galaxies.

MINIMUM EDUCATION: Doctoral degree, first professional degree, or Ph.D.
AVERAGE WAGES: Astronomer: \$48.70 per hour; Physicist: \$49.47 per hour.
EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.
SOC: 19-2010.

15 ATMOSPHERE AND SPACE SCIENTIST

WHAT YOU DO: Atmospheric science is the study of the atmosphere—the blanket of air covering the earth. Atmospheric scientists study the atmosphere's physical characteristics, motions, and processes, and the way in which these factors affect the rest of our environment. The best-known application of this knowledge is forecasting the weather. In addition to predicting the weather, atmospheric scientists attempt to identify and interpret climate trends, understand past weather, and analyze current weather. Weather information and atmospheric research are also applied in air-pollution control, agriculture, forestry, air and sea transportation, defense, and the study of possible trends in the earth's climate, such as global warming, droughts, and ozone depletion.

MINIMUM EDUCATION: Bachelor's degree.
AVERAGE WAGES: \$39.08 per hour.
EMPLOYMENT OUTLOOK: Keen competition. There may be fewer job openings than job seekers.
SOC: 19-2021.



16 ELECTRO-MECHANICAL TECHNICIAN

WHAT YOU DO: Electro-mechanical engineering technicians combine knowledge of mechanical engineering technology with knowledge of electrical and electronic circuits to design, develop, test, and manufacture electronic and computer-controlled mechanical systems, such as robotic assembly machines. They also operate these machines in factories and other worksites. Their work often overlaps that of electrical and electronic engineering technicians and mechanical engineering technicians.

MINIMUM EDUCATION: Associate's degree.
AVERAGE WAGES: \$22.27 per hour.
EMPLOYMENT OUTLOOK: Keen competition. There may be fewer job openings than job seekers.
SOC: 17-3024.

17 GEODETIC SURVEYOR

WHAT YOU DO: Geodetic surveyors measure large areas of the earth's surface using satellite observations, global navigation satellite systems (GNSS), light detection and ranging (LIDAR), or related sources. They conduct surveys to determine exact positions, measurement of points, elevations, lines, areas, volumes, contours, or other features of land surfaces; determine orientation of tracts of land including position, boundaries, size, and shape using theodolites, electronic distance measuring equipment, satellite-based positioning equipment, land information systems, or other geodetic survey equipment. They also analyze control or survey data to ensure adherence to project specifications or land survey standards or related information including coordinate, descriptive, or quality assurance data.

MINIMUM EDUCATION: Bachelor's degree.
AVERAGE WAGES: \$25.47 per hour.
EMPLOYMENT OUTLOOK: Very good or excellent; may be more job openings than job seekers.
SOC: 17-1022.01.

18 CIVIL ENGINEER

WHAT YOU DO: Civil engineers design and supervise the construction of roads, buildings, airports, tunnels, dams, bridges, and water supply and sewage systems. They must consider many factors in the design process, from the construction costs and expected lifetime of a project to government regulations and potential environmental hazards such as earthquakes and hurricanes. Civil engineering, considered one of the oldest engineering disciplines, encompasses many specialties. The major ones are structural, water resources, construction, transportation, and geotechnical engineering. Many civil engineers hold supervisory or administrative jobs, for example, from supervisor of a construction site to city engineer.



MINIMUM EDUCATION: Bachelor's degree.
AVERAGE WAGES: \$35.87 per hour.
EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.
SOC: 17-2051.

19 ENVIRONMENTAL ENGINEERING TECHNICIAN

WHAT YOU DO: Environmental engineering technicians work closely with environmental engineers and scientists in developing methods and devices used in the prevention, control, or remediation of environmental hazards. They inspect and maintain equipment related to air pollution and recycling. Some inspect water and wastewater treatment systems to ensure that pollution control requirements are met.

MINIMUM EDUCATION: Postsecondary training.
AVERAGE WAGES: \$19.76 per hour.
EMPLOYMENT OUTLOOK: Very good or excellent; may be more job openings than job seekers.
SOC: 17-3025.

STEM • STATE BY STATE

Nanosystems engineering at Louisiana Tech University

LOUISIANA

(www.latech.edu) in Ruston is the first program of its kind in the United States. It deals with the design and development of materials, devices, and systems of between 1 and 100 nanometers in size (one nanometer is one-billionth of a meter).

STEM • STATE BY STATE

The Portsmouth Naval Shipyard in Kittery offers

MAINE

four-year apprenticeships (<https://chart.donhr.navy.millindex.asp>; note the "s" after "http") featuring paid academic and trade training, as well as on-the-job experience, for more than 20 occupations.

20 ARCHITECTURAL AND CIVIL DRAFTER

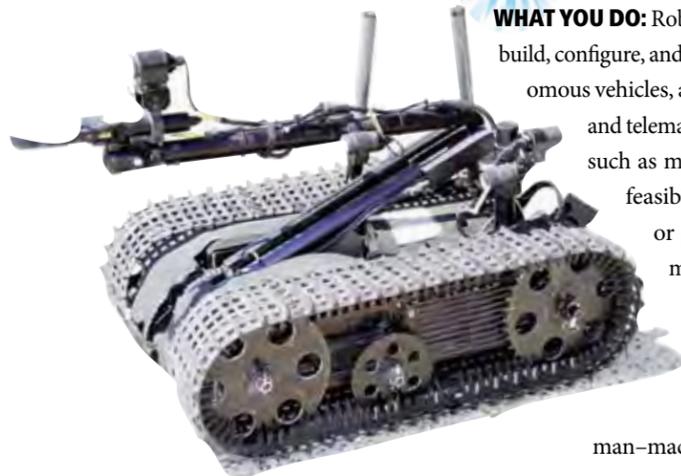
WHAT YOU DO: Drafters prepare technical drawings and plans that are used by production and construction workers to build everything from microchips to skyscrapers. Architectural drafters draw architectural and structural features of buildings for new construction projects. These workers may specialize in a type of building, such as residential or commercial, or in a kind of material used, such as reinforced concrete, masonry, steel, or timber. Civil drafters prepare drawings and topographical and relief maps used in major construction or civil engineering projects, such as highways, bridges, pipelines, flood-control projects, and water and sewage systems.



MINIMUM EDUCATION: Postsecondary training.
AVERAGE WAGES: \$21.39 per hour.
EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.
SOC: 17-3011.

21 ROBOTICS ENGINEER

WHAT YOU DO: Robotics engineers research, design, develop, and test robotic applications. They build, configure, and test robots; design robotic systems such as automatic vehicle control, autonomous vehicles, advanced displays, advanced sensing, robotic platforms, computer vision, and telematics systems; and design software to control robotic systems for applications such as military defense and manufacturing. They also conduct research into the feasibility, design, operation, or performance of robotic mechanisms, components, or systems such as planetary rovers, multiple mobile robots, reconfigurable robots, and man-machine interactions.



MINIMUM EDUCATION: Bachelor's degree.
AVERAGE WAGES: \$42.58 per hour.
EMPLOYMENT OUTLOOK: Very good or excellent; may be more job openings than job seekers.
SOC: 17-2199.08.



The Emerging STEM Leaders Program at Prince George's

MARYLAND

Community College (www.pgcc.edu) in Largo includes hands-on workshops and opportunities for students to connect with STEM leaders and professionals.

22 ENGINEERING TECHNICIAN

WHAT YOU DO: Engineering technicians (except drafters) use the principles and theories of science, engineering, and mathematics to solve technical problems in research and development, manufacturing, sales, construction, inspection, and maintenance. Their work is more narrowly focused and application-oriented than that of scientists and engineers. Many engineering technicians assist engineers and scientists, especially in research and development. Others work in quality control, inspecting products and processes, conducting tests, or collecting data.

MINIMUM EDUCATION: Associate's degree.
AVERAGE WAGES: \$27.33 per hour.
EMPLOYMENT OUTLOOK: Keen competition. There may be fewer job openings than job seekers.
SOC: 17-3029

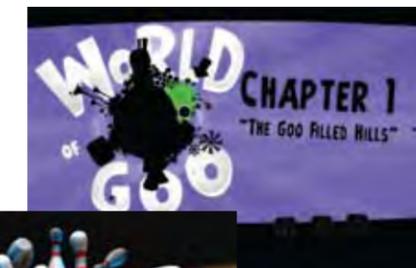


23 VIDEOGAME DESIGNER

WHAT YOU DO: Videogame designers design features of videogames. They specify innovative game and role-play mechanics, storylines, and character biographies; create and maintain design documentation; guide and collaborate with production staff to produce games as designed; and create core game features including storylines, role-play mechanics, and character biographies for a new videogame or game franchise. They must document all aspects of formal game design, using mock-up screenshots, sample menu layouts, game-play

MINIMUM EDUCATION: Postsecondary training; many jobs within the profession require more education.
AVERAGE WAGES: \$36.13 per hour.
EMPLOYMENT OUTLOOK: Very good to excellent; may be more job openings than job seekers.
SOC: 15-1099.13.

flow charts, and other graphical devices. They collaborate with artists to achieve appropriate visual style and conduct regular design reviews throughout the game development process. They devise missions, challenges, or puzzles to be encountered in game play.



24 MARINE ENGINEER AND NAVAL ARCHITECT

WHAT YOU DO: Marine engineers and naval architects are involved in the design, construction, and maintenance of ships, boats, and related equipment. They design and supervise the construction of vessels as varied as aircraft carriers, submarines, sailboats, and tankers. Naval architects work on the basic design of ships, including the form and stability of hulls. Marine engineers work on the propulsion, steering, and other systems of ships. Marine engineers and naval architects apply knowledge from a range of fields to the entire process by which water vehicles are designed and produced.

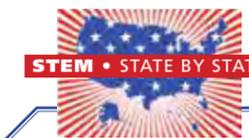
MINIMUM EDUCATION: Bachelor's degree.
AVERAGE WAGES: \$35.64 per hour.
EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.
SOC: 17-2121.

25 ELECTRONICS ENGINEER

WHAT YOU DO: Electronics engineers (except computer) are responsible for a wide range of technologies, from portable music players to global positioning systems (GPS), which can continuously provide the location of, for example, a vehicle. Electronics engineers design, develop, test, and supervise the manufacture of electronic equipment such as broadcast and communications systems. Many electronics engineers also work in areas closely related to computers. However, engineers whose work is related exclusively to computer hardware are considered computer hardware engineers. Electronics engineers specialize in areas such as communications, signal processing, and control systems or have a specialty within one of these areas—control systems or aviation electronics, for example.



MINIMUM EDUCATION: Bachelor's degree.
AVERAGE WAGES: \$41.52 per hour.
EMPLOYMENT OUTLOOK: Good or favorable. The number of job openings and job seekers may be roughly equal.
SOC: 17-2072.



Worcester Polytechnic Institute (www.wpi.edu)

MASSACHUSETTS

offers a five-year fire protection engineering option. Graduates earn two degrees: a bachelor's in a traditional engineering discipline and a master's in fire protection engineering.

STEM Education



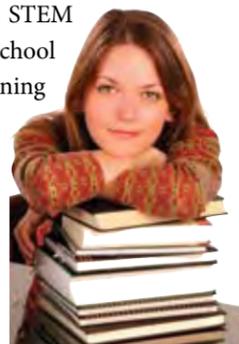
Learn how to move from high school to a successful STEM career. Here is a practical road map designed to help you get from wherever you are on your education path to wherever you want to go within STEM.



THE MORE YOU LEARN, THE MORE YOU EARN As in most other career fields, in STEM, the more training, skills, and knowledge you have, the higher your salary. STEM opportunities are available for those with only a high school diploma or GED, but continuing your education and training after high school will increase your options.

Many STEM employers offer on-the-job training, continuing education courses, or tuition reimbursement for career-related college programs. That means you can start in STEM as an entry-level employee and get the education needed to work your way up to a senior-level position.

To get a better idea of how learning more equals earning more, take a look at some sample salaries for various jobs in the engineering field.



JOB	EDUCATION LEVEL	MEDIAN SALARY
Surveying and Mapping Technician	Moderate on-the-job training	\$35,120
Engineering Technician	Associate's degree	\$56,850
Civil Engineer	Bachelor's degree	\$74,600
Engineering Manager	Bachelor's or higher degree plus work experience	\$115,270

Source: U.S. Bureau of Labor Statistics



STANDARDIZED TESTS TO TAKE EACH YEAR

Most colleges use standardized test scores to help make admissions decisions. If you know which schools you're interested in, check their websites to see the specific tests they require. If you aren't yet sure where you would like to apply, ask your guidance counselor for advice on which tests you should take.

In general, colleges require scores from either the SAT or the ACT. Both tests are offered several times a year. Explore your test options and register online for the SAT at www.collegeboard.com and for the ACT at www.actstudent.org.

In addition, some colleges require scores from SAT subject tests for admission or course placement. If you are taking an advanced placement course, you will be given the chance to take the test for that subject. AP tests are graded 1–5. Typically, scoring a 4 or 5 earns you college credit and allows you to skip first-year courses in that subject. Before you take any standardized test, practice, practice, practice.



WHY GRADES REALLY DO MATTER Grades are a fact of life. In general, the higher your GPA (grade point average), the more opportunities you will have for education and careers after high school. It's even better if those grades were earned in challenging courses, such as advanced placement and honors-level math, science, and English classes.

If you take the easiest courses and do the minimum required to graduate, then your diploma won't be worth much. To get the biggest return from your investment in high school, treat school like your job. Think of what it takes to succeed on the job, and then apply those same skills to the classroom.

By following the six tips below, you can boost your GPA, increase your after-graduation options, get into college, and earn scholarships.

- SIX JOB AND SCHOOL SUCCESS TIPS**
1. Be on time to every class. The first thing employers want is punctuality.
 2. Make sure all of your assignments are turned in neat, complete, and on time.
 3. Pay attention in class. In school and on the job, focus matters.
 4. Ask questions and ask for help when you don't understand something.
 5. Contribute to class discussions. Collaboration is part of job success.
 6. Make time each day for homework and studying. Treat school like a job.

STEM SCHEDULE: SAMPLE CLASSES TO TAKE AT EACH GRADE LEVEL

Wherever you are in your high school career, there are things you can do to build your STEM skills, knowledge, and experience. Of course it helps to start sooner, but it's never too late to start learning.

At right is a sample four-year high school class schedule for a student who wants to prepare for a STEM college program or career after high school. Don't worry if your school doesn't offer all of the courses listed. These are only examples based on what is typically available at a public high school.

Create your own four-year plan based on this sample using your school's course offerings as a starting point. The goal is to build the strongest STEM foundation possible by taking a math and a science class each year.

Ask your guidance counselor, teachers, and parents for help in identifying additional learning opportunities available online or in the community to supplement your STEM education.



- OTHER COURSES THAT MAY BE REQUIRED**
- Computer Applications
 - Fine Arts
 - Foreign Language
 - Health
 - Physical Education

- SUGGESTED ADVANCED PLACEMENT COURSES (IF AVAILABLE)**
- Calculus AB
 - Calculus BC
 - Chemistry
 - Environmental Science

- Physics B
- Physics C: Electricity and Magnetism
- Physics C: Mechanics

SAMPLE STEM STUDENT FOUR-YEAR PLAN

NAME: Taylor Jones | SCHOOL: Central High School | CAREER GOAL: Engineer
POSTSECONDARY GOAL: Bachelor of science degree in engineering

	MATH	ENGLISH	SCIENCE	SOCIAL STUDIES
9th Grade	Algebra I	English I	Biology or Physical Science	World History or Geography
10th Grade	Geometry	English II	Chemistry or Biology	U.S. History or World History
11th Grade	Algebra II with Trigonometry	English III	Physics or Chemistry	Government/Economics or U.S. History
12th Grade	Pre-calculus or Calculus	English IV	Engineering or Physics	European or Art History

- SAMPLING OF CAREER AND TECHNICAL STEM-RELATED COURSES (IF AVAILABLE)**
- Foundations of Engineering
 - Engineering Applications

- Engineering Research and Design
- Engineering Systems
- Engineering Graphics
- Electricity/Electronics Technology

- Research Design and Development
- Bio-related Technology Systems
- Research and Technical Writing



Central Michigan University (www.cmich.edu) in

MICHIGAN

Mount Pleasant is the only university in the state offering an undergraduate degree in meteorology, including weather forecasting, air pollution, agricultural meteorology, and tropical meteorology.



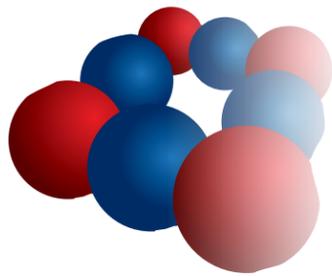
The Perspectives in Engineering (PIE) scholarship

MINNESOTA

program at Itasca Community College (www.itascacc.edu) in Grand Rapids provides tuition and travel funds, as well as mentoring by professional engineers. Students from cultures traditionally under-represented in engineering are encouraged to apply.

Find out how the 16 federal career clusters connect what you learn in the classroom to the real world.

All ABOUT Career Clusters



CAREER CLUSTERS are a way of organizing courses, electives, and extended learning experiences around groups of related occupations and industries. Students in schools offering career clusters are able to choose a cluster based on their interests, strengths, and goals.

Within each cluster are pathways or programs of study—similar to college majors. For example, the federal Science, Technology, Engineering & Mathematics (STEM) career cluster includes a Science and Math pathway and an Engineering and Technology pathway. The courses and electives offered in each pathway help students gain the knowledge and skills needed to enter a challenging STEM college program or career after high school.

The United States Department of Education has designated these 16 career clusters:

- Agriculture, Food & Natural Resources
- Architecture & Construction
- Arts, A/V Technology & Communications
- Business Management & Administration
- Education & Training
- Finance
- Government & Public Administration
- Health Science
- Hospitality & Tourism
- Human Services
- Information Technology
- Law, Public Safety, Corrections & Security
- Manufacturing
- Marketing
- Science, Technology, Engineering & Mathematics
- Transportation, Distribution & Logistics

Individual states and school districts may offer all or some of these clusters to students. In some communities, career clusters are part of career academies or career and technical schools. Other districts make career clusters available to all students to better prepare them for postsecondary education and careers.

If a formal career cluster system isn't in place in your school, ask your guidance counselor if another school in your district offers the STEM career cluster or a more focused STEM career and technical education (CTE) program. In many districts, academic transfers to an out-of-zone school are available to students who cannot get the courses they need at their local schools.

Even if career clusters aren't available in your area, you can still use the STEM career cluster as a guide for choosing the most rigorous and relevant STEM-related courses and electives at your school.

For more information on career clusters, visit www.careerclusters.org.



The Xawk X-2C unmanned aerial system designed,

MISSISSIPPI

built, tested, and automated by a team of students at Mississippi State University Bagley College of Engineering (www.bagley.msstate.edu) took top honors—and \$10,000 in prize money—at the 2010 Association for Unmanned Vehicle Systems International competition.



Former astronaut Tom Akers—who helped repair

MISSOURI

the Hubble Telescope in 1993—is a math professor at Missouri University of Science and Technology (www.mst.edu) in Rolla.

MEET A STEM STUDENT

NAME: **Derrick Beasley**

MAJORS: Public Health Studies and Anthropology

SCHOOL: Johns Hopkins University, Baltimore, Maryland

DERRICK BEASLEY TOOK SEVERAL challenging high school math and science courses in Asheville, North Carolina. His solid STEM-related background helped Beasley earn a spot at Johns Hopkins University, where he is completing his undergraduate degree before moving on to medical school.

As a first-year student at Johns Hopkins, Beasley says, he figured he would major in biology or another science as a premed student. But when given the chance to explore a wide variety of courses during his first year, Beasley discovered a major he had never considered before.

"My interests in public health and anthropology evolved from taking a class in those departments early on in my freshman year," Beasley says. "There are so many interesting classes in college. I'm glad I didn't restrict myself from exploring other areas of study."

While public health may not sound like a STEM major, many of Beasley's classes require using his math and science skills. The public health undergraduate program at Johns Hopkins has two tracks: natural sciences (meeting all premed requirements) and social sciences (focused on health policy, ethics, law, and environmental issues). Beasley chose the natural sciences pathway, featuring STEM-intensive coursework such as biostatistics, calculus, and epidemiology.

"Through my public health major, I've learned how to transform the way in which a community responds to health care disparities, as well as explore the socioeconomic framework in regard to health outcomes. Public health also has given me a much stronger understanding of health care throughout the world, the knowledge to better understand disease outbreaks, and the use of epidemiological statistics."

Beasley says he enjoys his major because it connects directly to the real world. "Everyone has experienced a sickness within their family, or had to go to the doctor. When we think about visiting our family physician, we rarely think about how many others might have had the same sickness or occurrence that same week. Public health allows one to take a step back, to better understand what is happening within a population or community as a whole. This also enables us to implement better routines to tackle sickness within a community, whether it is a flu outbreak, or cancer or diabetes risk."

After graduating from Johns Hopkins, Beasley plans to go to medical school and earn a master's degree in public health. Although his pathway to medical school took an unanticipated turn into the public health field, Beasley says that he couldn't have charted a better course.

He adds, "My ultimate goal has always been to attend medical school. I am very happy that I stumbled upon public health along the way. Having this knowledge will help me to become a better physician one day."



STEM SCOOP:
"The great thing about my career choice is that there are many options. I am very happy that I will be in a career where I will be giving back to my community."
 — DERRICK BEASLEY



Students enrolled in the Process Plant Technology

MONTANA

associate's degree program at Montana State University Billings (www.msbillings.edu) can apply for one of two \$4,750 scholarships sponsored by ConocoPhillips.

Take advantage of any of these STEM-related learning experiences that may be available in your school or district.

Special STEM Programs

PROJECT LEAD THE WAY



Project Lead The Way (PLTW) makes math and science come to life for students by connecting what they learn in the classroom to real-world engineering and biomedical sciences careers. The PLTW model combines a rigorous and relevant curriculum with project-based/problem-based instruction. PLTW is offered in almost 4,000 schools in 50 states and the District of Columbia.

If you are interested in exploring the STEM field and PLTW is available in your district, enrolling in the PLTW engineering curriculum will give you a head start on college and career. Research shows that PLTW students are five times as likely as other students to choose engineering and related disciplines in college, and they are more likely to stay in those majors and graduate than other students who select those majors.

The four-year sequence of the PLTW engineering curriculum is designed to fit any student schedule, and is taught in conjunction with traditional math and science courses. Here's a quick overview:

FOUNDATION COURSES

- Introduction to Engineering Design
- Principles of Engineering
- Digital Electronics

SPECIALIZATION COURSES

- Computer Integrated Manufacturing
- Civil Engineering and Architecture
- Biotechnical Engineering
- Aerospace Engineering

CAPSTONE COURSE

- Engineering Design and Development
- For more information, visit the PLTW website at www.pltw.org.

STEM CTSOs

CTSOs (career and technical student organizations) give students who are interested in specific industries and occupations the opportunity to build skills and knowledge related to their chosen field; take part in competitions that reach national levels; meet other students who share their interests; take leadership positions; and connect with career mentors, employers, and other professionals.

Most public school districts offer these CTSOs related to the STEM career cluster.

SkillsUSA www.skillsusa.org

SkillsUSA provides cocurricular activity opportunities that help develop academic and technical skills, while encouraging students to become better citizens. Students participate in competitions requiring higher-order thinking skills such as problem solving, synthesis, and critical and reflective thinking. Through SkillsUSA service projects, students put their education into action building playgrounds, parks, and other structures that benefit their communities. SkillsUSA serves more than 300,000 students and instructors annually.

Technology Student Association (TSA) www.tsaweb.org

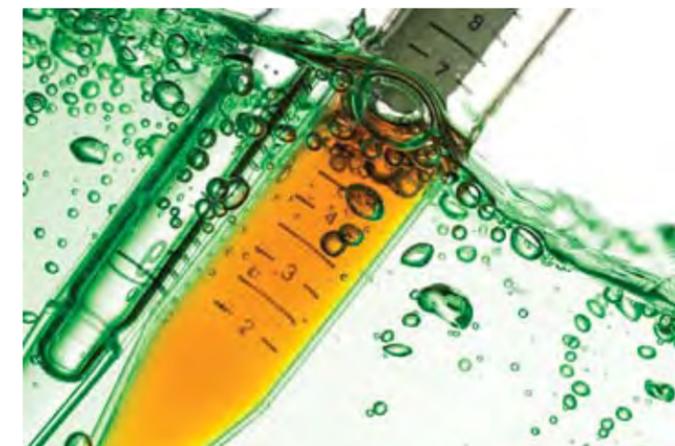
TSA prepares students to meet the challenges of a high-tech world by promoting technological literacy, leadership, and problem-solving skills. Members have opportunities to develop and showcase their technology skills through individual and team competitions.

SPECIAL STEM SCHOOLS

A growing number of school districts nationwide are starting special schools to teach STEM skills as part of the broader curriculum, including:

- Career academies, such as the Academies of Engineering (www.academyofengineering.org) sponsored by Project Lead The Way (PLTW), the National Action Council for Minorities in Engineering (NACME), and the National Academy Foundation
- Math and science or engineering and technology magnet high schools
- Career and technical education (CTE) or vocational-technical high schools
- STEM charter schools
- PLTW high schools (www.pltw.org)
- Ford Partnership for Advanced Studies (FordPAS) schools (www.fordpas.org).

If special STEM schools are offered in your district, schedule visits to learn more about the programs and admissions requirements.



TAKE A LOOK INSIDE HUGHES STEM HIGH SCHOOL

To get a better idea of how a special STEM school benefits students, take a quick look inside Hughes STEM High School in Cincinnati, Ohio (hughesstem.cps-k12.org). Hughes High School opened in August 2009 as a partnership between the University of Cincinnati and Cincinnati public schools. Students take a common core academic program, and then choose a major area of concentration in one of four STEM programs of study: Engineering Futures, Health Sciences, Digital Education, or Zoo Academy. In addition:

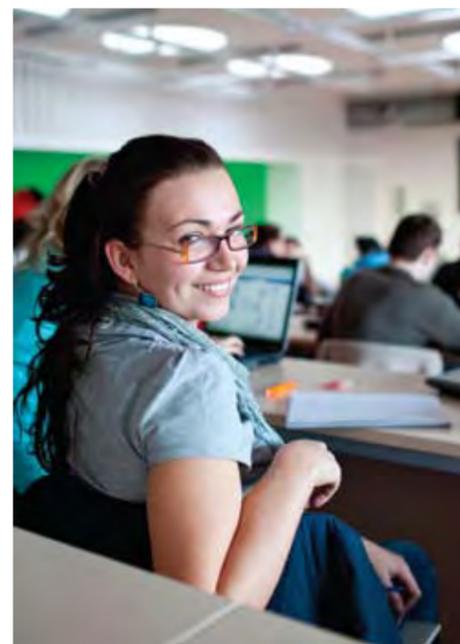
- Ninth graders receive digital backpacks filled with iPods, digital camcorders, tripods, and microphones to complete multimedia assignments.
- Students can earn college credit while in high school by attending classes developed in partnership with the University of Cincinnati and Cincinnati State Technical and Community College.
- Students develop advanced skills in technology applications and critical thinking.

STEM SKILLS

TEN THINGS YOU NEED TO SUCCEED

Wanting to be part of the high-tech, high-pay world of STEM isn't enough. To succeed in a challenging STEM college program, apprenticeship, or career, you need to graduate from high school with these 10 essential skills and qualities.

1. STRONG MATH AND SCIENCE SKILLS
2. STRONG VERBAL AND WRITTEN COMMUNICATION SKILLS
3. STRONG TEAMWORK SKILLS
4. STRONG LEADERSHIP SKILLS
5. CREATIVE PROBLEM-SOLVING SKILLS
6. TIME MANAGEMENT AND ORGANIZATIONAL SKILLS
7. THE ABILITY TO FOLLOW DETAILED DIRECTIONS
8. CURIOSITY AND IMAGINATION
9. EXPERIENCE WITH COMPUTERS AND HIGH-TECH TOOLS
10. A DESIRE TO LEARN NEW THINGS EVERY DAY



S.T.E.P. (Strengthening Transitions into Engineering

NEBRASKA

Programs) (www.step.unl.edu) enables pre-engineering students from participating community colleges to transfer seamlessly into the University of Nebraska–Lincoln as juniors.



The interdisciplinary geological engineering

NEVADA

major at the University of Nevada, Reno (www.unr.edu) combines physics, chemistry, meteorology, hydrology, biology, geology, and engineering science.



Students in the ocean engineering master's degree

NEW HAMPSHIRE

program at the University of New Hampshire (www.unh.edu/oe/) conduct research in a state-of-the-art tank equipped with a hydraulic wave generator.

Learn how creating a plan and a portfolio will help you get ready for college and career.

Documenting *Your* Education



PLAN FOR SUCCESS

Many states and school districts ask students to create formal education plans for high school. Even if it's not required, it's smart to make a six-year plan (four years of high school plus two of postsecondary education) so that you can take control of your education and career choices. Include in the plan:

- **Your chosen career cluster** (if available at your school) and program of study (see page 26). Students interested in a STEM career would create a plan focused on STEM-related courses such as technology, math, and science.
- **Your postsecondary goal**, or what you plan to do after high school, such as the name of the colleges to which you want to apply. This objective will influence the classes you take in high school. If you want to attend a four-year engineering program, for example, you'll need certain math and science courses for admission. Other goals include joining the military, attending a technical school or community college, or completing an apprenticeship or on-the-job training program.
- **Your class schedule for all four years.** A lot of the schedule will be filled with required courses, but there will be chances for you to add in career-related electives that will help you toward your goals.
- **Extended learning activities** that expand your STEM knowledge, skills, and experience. Examples are career and technical student organizations (CTSOs), volunteering, internships, job shadowing, mentoring, summer and part-time jobs, and

school clubs. For more ideas, see "Get Experience" below.

Once you have your plan, revisit, review, and update it each year. Reviewing the plan with your counselor and parents will let you make improvements as you learn and grow. Having a plan, even if it changes, is far better than having no plan at all.

CREATE A CAREER PORTFOLIO

A career portfolio is like a locker where you store all your high school achievements, honors, work experiences, transcripts, employer and teacher recommendations, and best work (such as papers and tests for which you earned top grades). The information stored in this locker will come in handy when you apply to colleges and for internships and jobs.

If you have your own computer, a lot of this information can be stored in a single "career portfolio" file on your desktop. You can then print out all or part of the portfolio as needed, or e-mail the file as part of an application. Be sure to include any multimedia work examples, such as Web design, 3-D modeling, robotics, videos, and digital art. A paper portfolio in a file folder works just as well, so don't worry if you don't have the capacity to scan and store everything. Label every item in your portfolio with key dates and a description. For example, if you have an employer recommendation, include the dates you worked, your job title and duties, and what you learned. This will help you answer questions on college applications and in interviews.

GET EXPERIENCE: SUMMER INTERNSHIPS, PART-TIME WORK, AND JOB SHADOWING

Trying out different STEM careers before you graduate from high school is a great way to figure out what you like—and don't like—to do. If a career interests you, spending a day or more at work with someone in that field will give you a realistic picture of what the job requires. Ask your guidance counselor and parents to help you set up these "job shadowing" experiences with local STEM professionals. If your on-the-job experience is positive and you'd like to learn even more about the career, look for summer internships or part-time job opportunities in that field. Spending an entire summer working in a STEM-focused organization will help you make smarter, more-informed choices about what to do after high school. In addition, actual STEM work experience will be a real plus on college admissions and scholarship applications.

The MESA Center at Essex County College

NEW JERSEY

(www.essex.edu) in Newark provides an opportunity for disadvantaged students majoring in engineering, computer science, and mathematics to obtain special academic support to help them succeed.



Qualifying students in the laboratory biotechnology

NEW MEXICO

associate's degree program at Northern New Mexico College (www.nnmc.edu) in Espanola and El Rito can get paid internships at Los Alamos National Laboratory.

MEET A STEM STUDENT

NAME: **Morgan Bowser**

MAJOR: Biomedical-Chemical Engineering

SCHOOL: University of Southern California, Los Angeles, California

MORGAN BOWSER NEVER WANTED to be an engineer, and she still doesn't. Her career goal is to become a dermatologist. In high school, she figured she'd major in biology and then head to medical school after college graduation.

"If you'd asked me in high school, I never would have thought that I would become an engineer because I thought that it was just a lot of boring math and physics," says Bowser. "I discovered engineering when I was touring colleges, and realized that having a foundation in engineering will give me a more technical approach to solving problems, helping me be the best doctor I can be."

Bowser encourages students to visit colleges with STEM programs to get a firsthand look at the available courses, programs, and opportunities. It was during a campus visit to the University of Southern California school of engineering that Bowser first learned about biomedical engineering.

"Touring an engineering school is a good way to see if it might be a fit for you because you can see the labs, talk to the students who go there, and ask professors questions," she says. "I went home from my USC visit and researched the major a bit more. I saw that I would be learning about how medical devices interact with the body and how they are developed. That's when I knew that biomedical engineering was the major for me."

Whether you know you want a STEM-related career or are still exploring your options, Bowser suggests taking a math class every semester of high school. Students who take breaks between math courses are at a disadvantage, she says, because it's easy to forget math skills when they aren't used.

The more math you take in high school, the less you'll be required to take (and pay for) in college. "Math is one of the few subjects that is the same at every university. The higher the level of math you get to in high school, the more college credit you can earn in advance.

"Staying on top of math classes helped me through other science classes, and it enabled me to take all the math classes that were available at my school," Bowser explains. "For students who want to apply to an engineering program, I think it's very important to take the hardest science and math classes your school offers and do well in them. By doing that, you'll know what you will be getting into when you arrive at college and can decide if that time commitment is something that you will be willing to make."



STEM SCOOP:

"To build the time management skills needed to succeed in a STEM major or career, get involved in extracurricular activities. There is no better way to learn time management than not having much time to spare. I went to about 10 swim practices a week during high school in addition to other events at school."

— MORGAN BOWSER

STEM • STATE BY STATE

Rensselaer Polytechnic Institute (RPI) (www.rpi.edu)

NEW YORK

in Troy has one of the nation's top four-year video game design programs. Graduate Karthik Bala is CEO of Vicarious Visions, maker of Guitar Hero games for the Wii.



Almost every STEM profession requires a two- or four-year college degree or another kind of postsecondary education.

STEM After High School



STEM STEPLADDER OF POSTSECONDARY OPTIONS

With a solid STEM foundation in high school, you can move directly from graduation to postsecondary (after high school) education and training programs. But the learning doesn't stop there. Whatever career you choose, lifelong learning is needed to keep up with new technologies, develop new skills, and advance to higher levels of salary and responsibility. Here is one example of how focusing on STEM courses in high school connects to postsecondary options.



CAREER GOAL | ELECTRICAL ENGINEERING POSTSECONDARY OPTIONS

DOCTORAL DEGREE IN ENGINEERING WHERE: PUBLIC AND PRIVATE COLLEGES AND UNIVERSITIES

MASTER'S DEGREE IN ELECTRICAL ENGINEERING WHERE: PUBLIC AND PRIVATE COLLEGES AND UNIVERSITIES

BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING WHERE: FOUR-YEAR PUBLIC AND PRIVATE COLLEGES AND UNIVERSITIES

MILITARY/BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING WHERE: WHILE ON ACTIVE DUTY OR IN THE RESERVES

ASSOCIATE'S DEGREE IN INDUSTRIAL ELECTRONICS TECHNOLOGY OR PRE-ENGINEERING/ELECTRICAL WHERE: TWO-YEAR COMMUNITY AND TECHNICAL COLLEGES

CAREER CERTIFICATE IN INDUSTRIAL ELECTRONICS TECHNOLOGY WHERE: TWO-YEAR COMMUNITY AND TECHNICAL COLLEGES



BioMER, the biology and marine biology experience

NORTH CAROLINA

in undergraduate research program at the University of North Carolina–Wilmington (www.uncw.edu), gives students the chance to perform cutting-edge biology research and work with faculty mentors.

COLLEGE APPLICATION CHECKLIST

The college admissions process can seem overwhelming, especially if you are the first in your family to apply. Give yourself the best shot at getting into a college program that matches your goals by following these six steps:



MAKE A LIST Before you can apply to college, you have to figure out what you would like to study and what matters most to you (such as location, size, or religious affiliation). Use the college guides in your local or school library or counselor's office to start making a list of colleges that interest you. Use online tools like www.collegeboard.com to learn more about each school and take virtual campus tours.

PLAN FOR TESTS Most four-year colleges want scores from the ACT, SAT, or SAT II tests. See what tests the schools on your list require, sign up to take them in time to include the scores in your application, and then practice the free SAT sample questions at www.collegeboard.com or ACT tests at www.actstudent.org.

ASK FOR RECOMMENDATIONS If your applications require a teacher, coach, or employer recommendation, be sure to give the people you ask plenty of time to complete the form. In addition, provide them with a stamped and addressed envelope (if the form needs to be mailed), and thank each one with a personal note.

DO A DOUBLE-CHECK Before you send in a college application, double-check your spelling, make sure nothing is missing, and save a copy just in case you have to submit it again.

PAY THE APPLICATION FEE College application fees can range from nothing to more than \$60. Some colleges waive the fee if you meet certain financial need requirements or if you apply online. Forgetting the fee can delay your application review, so be sure to include payment or the proper waiver form when you apply.

CHECK FOR UPDATES Most schools give applicants access to a secure online website where they can check the status of their applications. Check the site regularly to make sure you aren't missing any required admissions or financial aid documents.



BOOSTING YOUR CHANCES OF GETTING INTO YOUR DREAM STEM SCHOOL

If you are set on attending a top STEM school, the best way to increase your chances of getting in is to start early. Make sure to take the high school math and science classes that the school believes are most important to college success. Get great grades in these classes and the rest of your coursework, and add outstanding scores on the SAT or ACT exams. Show you are well-rounded by taking part in extracurricular activities and work experiences such as STEM internships. Finally, show your unique personality in admissions essays and interviews.

TOP ENGINEERING COLLEGES

According to *U.S. News & World Report*

- Massachusetts Institute of Technology, Cambridge, Massachusetts (www.mit.edu)
- Stanford University, Palo Alto, California (www.stanford.edu)
- University of California-Berkeley, California (www.berkeley.edu)
- California Institute of Technology, Pasadena, California (www.caltech.edu)
- Georgia Institute of Technology, Atlanta, Georgia (www.gatech.edu)
- University of Illinois at Urbana-Champaign, Illinois (www.illinois.edu)
- Carnegie Mellon University, Pittsburgh, Pennsylvania (www.cmu.edu)
- University of Michigan, Ann Arbor, Michigan (www.umich.edu)
- Cornell University, Ithaca, New York (www.cornell.edu)
- Purdue University, West Lafayette, Indiana (www.purdue.edu)
- University of Texas-Austin, Texas (www.utexas.edu)



Two-year programs at the North Dakota State

NORTH DAKOTA

College of Science Center for Nanoscience Technology Training (www.ndscsnano.com) in Wahpeton prepare graduates for high-wage jobs in nanotechnology.



The lowdown on financial aid and other ways to afford your postsecondary STEM education.



Paying for Your STEM Education

CUTTING COLLEGE COSTS Earning a world-class STEM education is affordable if you know where to look. There are lots of sources of financial aid, as well as plenty of educational options that can replace paying for four years of study at an expensive school. Get the help you need to continue your STEM studies after high school by considering these ways to help afford school:



EARN COLLEGE CREDIT IN HIGH SCHOOL Many school districts allow high school juniors and seniors to take “dual credit” college courses, which qualify for both high school and college credit. In addition, students can earn college credits for earning top scores on advanced placement exams or, in some cases, for attending summer academic programs on college or university campuses. Earning college credit while still in high school may enable you to graduate as much as a year early, equaling huge savings in tuition, room and board, books, and other fees.

STAY CLOSE TO HOME By choosing a public college, university, or technical school in your home state, you can save thousands of dollars each year in tuition costs. Even if you select a private school, attending one within a few hours’ drive of home will cut transportation costs (and make it easier to head home to do laundry, stock up on supplies, and participate in family events). Many states offer scholarship funds to high-achieving students who choose an in-state school. Visit your state’s Department of Education website to learn more.

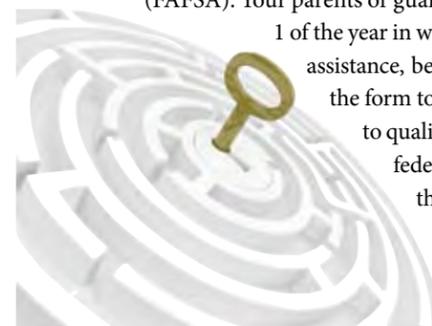
START AT A COMMUNITY COLLEGE Most STEM majors require basic or core courses the first two years, followed by specialized coursework in the junior and senior years. You can save a considerable amount of money by getting those core courses out of the way by studying your first two years after high school at a local community college. And if you also live at home and work part-time while you’re in school, you can save even more money to transfer into the four-year college of your choice after earning your associate’s degree. In addition, if you weren’t exactly a straight-A student in high school, working hard and getting good grades at a community college can boost your GPA and your chances for admission at a top college.

STEM SCHOLARSHIPS Spending a little time researching STEM scholarship opportunities could result in some serious cash for college. The first place to look is on the financial aid websites of the schools where you would like to apply. See if any special scholarships are available for students interested in STEM careers. While many college grants are awarded as part of a financial aid package, others require separate scholarship applications.

Beyond your list of colleges, check out the scholarships available from state and national STEM-related organizations and associations, including the National Society of High School Scholars Foundation (www.nshssfoundation.org) Global STEM Scholarships. In addition, register online at FastWeb (www.fastweb.com), a free college scholarship search source listing more than \$3.4 billion in financial aid funds.



FAFSA: THE KEY TO FINANCIAL AID Before you can receive any financial aid from a two- or four-year school, you need to fill out the Free Application for Federal Student Aid (FAFSA). Your parents or guardians need to help you complete this form as soon as possible after January 1 of the year in which you’ll be starting college. Don’t try to complete the FAFSA without their assistance, because they’ll need to supply salary, tax, and other financial information for the form to be processed. Even if you or your parents think your family earns too much to qualify for aid, *fill out the FAFSA anyway*. In addition to determining eligibility for federal aid, such as work-study, Pell grants, and low-interest federal student loans, the FAFSA may be used to determine college grants and even merit-based aid. Complete the form online at www.fafsa.ed.gov.



Most private schools also require you to complete a school financial aid application as well as the CSS/Financial Aid Profile form (profile.collegeboard.com). Check with each school to which you are applying to

find out the forms it requires. Often schools will request copies of completed tax returns from you and your parents, and the schools may give you the chance to explain and document special circumstances that have an impact on your family’s ability to pay for college, such as job loss or high health-care expenses.

EARNING EDUCATION AND SKILLS THROUGH THE MILITARY

Enlisting for active duty in the U.S. Army, Air Force, Navy, Marines, Coast Guard, National Guard or Air National Guard, or Reserves is a way for high school graduates to earn pay, benefits, and full or reduced college tuition in certain STEM-related majors.

In addition, high-achieving students admitted to one of the nation’s five service academies—Merchant Marine, Military (West Point), Naval, Coast Guard, and Air Force—receive free tuition and a monthly salary while in school, and graduate as commissioned officers. The service academy selection process is highly competitive, with a nomination from the student’s congressional representative required as part of the application. College students can get up to a



full four-year scholarship plus an annual stipend by serving in their schools’ Reserve Officers’ Training Corps (ROTC). Service members and veterans can also receive financial support for undergraduate and graduate degrees, vocational/technical training, and housing through the Post-9/11 GI Bill.

In exchange for free or reduced-cost education and benefits, enlisted personnel, officers, and Guard and Reserves members are required to serve in the military for a specified number of years. Individual service commitments can vary from three years to more than eight years depending on a variety of factors, including the amount of scholarship money earned. To learn more about the wide range of educational and training opportunities available through the military, talk to your guidance counselor or check out these websites:

- U.S. Army: www.goarmy.com
- U.S. Navy: www.navy.com
- U.S. Marines Corps: www.marines.com
- U.S. Air Force: www.airforce.com
- U.S. Coast Guard: www.gocoastguard.com
- U.S. Merchant Marine Academy: www.usmma.edu
- National Guard: www.nationalguard.com

Corporate Learning at Oklahoma City Community

OKLAHOMA

College (www.occc.edu) offers a certificate program for solar photovoltaics technicians. The program gives students the hands-on training needed to prepare for a career in the renewable energy industry.



University of Oregon (www.uoregon.edu) students

OREGON

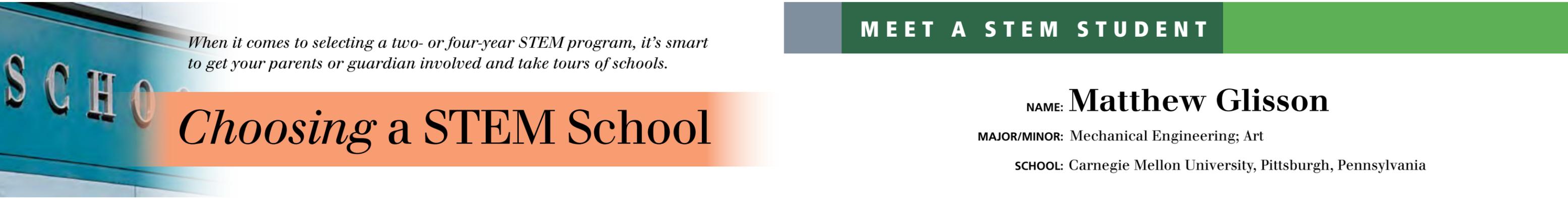
can take part in the environmental leadership program, which matches them with community organizations in Eugene to address local environmental needs.

STEM STATE BY STATE

The Ohio STEM Ability Alliance (www.wright.edu)

OHIO

osaa) works to increase the number and quality of Ohio students with disabilities who earn two- and four-year degrees in STEM majors.



When it comes to selecting a two- or four-year STEM program, it's smart to get your parents or guardian involved and take tours of schools.

Choosing a STEM School

TALKING TO YOUR PARENTS Your parents or guardians want you to graduate from high school or community college with the skills, knowledge, and focus you need to become an independent adult. Including them in the career exploration and college search process benefits all of you. Here's how:



- Your parents may have friends, neighbors, or work associates who are in STEM careers or who graduated from a STEM postsecondary program. By letting them know you are interested in STEM, you may find they are able to help arrange job shadowing, mentoring, or internship opportunities for you to explore different careers.
- You want your parents to take you seriously and recognize that you aren't a kid anymore. Talking to them about your goals beyond high school and creating a real plan to achieve those goals demonstrates that you are ready to take control of your life.
- You'll need your parents' help in the form of possible financial support, information for completing financial aid forms, permission form signatures if you are under 18, and so on. Involving them as part of the career exploration and college search process early on makes it easier to ask for and receive their help in meeting application deadlines or in paying tuition.
- You may not realize it now, but your parents have a lifetime of education and work experience. However far they went in school and whatever jobs they have had, they have valuable experience to share that can help you make more informed decisions. Let them tell you their stories, and really listen to their opinions.

TOURING COLLEGES

Any college can look like the perfect fit when viewed on a website or in a glossy brochure. But to get the inside scoop on what a two- or four-year college is really like, you need to make a personal visit. Walk around the campus, talk with current STEM students, and step inside STEM classrooms and research facilities to help decide which school is right for you. Use the tips below to get the most out of every campus visit.

LOCATION Is the college located in an area—urban, suburban, rural—where you would feel comfortable living for two or more years? Are there stores and restaurants nearby? Would you need a car to get to a grocery store or movie theater?

GUT CHECK How do you feel when you walk around the campus? Could you see yourself there? You can't expect every student to look or dress like you, but do the current students you meet seem like people you would like to get to know? Are they welcoming and positive about their school?

REAL COSTS Any scholarships, loans, and grants you get for school will likely cover only tuition and room and board. Ask current students, faculty, and admissions staff about the real, total costs of attending the school. How much

will you need to budget for books, fees, transportation to and from school, and other expenses? Can you realistically afford to attend the school for two to four years?

STEM OPTIONS You may want to become an environmental scientist now, but what if you get to college and discover a new STEM career you hadn't even considered before? Find out how easy or hard it is to switch majors. Are there lots of STEM majors available or will you be limiting yourself to a few choices? What kinds of internship and cooperative work experiences are available?

EXTRA HELP Everyone needs a little help now and then. That's particularly true in STEM majors, in which challenging math and science courses are part of every program. Does the school offer tutoring or extra help sessions? Is there a first-year program that allows you to sample a variety of STEM majors to better understand what you need to succeed?

TAKE NOTES All the colleges you see will start to blur together into one big, confusing memory. By taking notes at each school—on paper, on your laptop, or on a smart phone—you will find it easier to remember and review the pros and cons of each school when it is time to make a final decision.

MEET A STEM STUDENT

NAME: **Matthew Glisson**

MAJOR/MINOR: Mechanical Engineering; Art

SCHOOL: Carnegie Mellon University, Pittsburgh, Pennsylvania

MATTHEW GLISSON HAS BEEN building things for as long as he can remember. As a child growing up in Knoxville, Tennessee, Glisson loved creating forts out of couch cushions and anything out of Legos. For him, building was play, until he joined his high school's robotics team. It was then that Glisson realized he could turn his passion for creating into a real career as an engineer.

"I loved working on the robot and would often stay at school past midnight to try and finish it," Glisson recalls. "I enjoyed having a real, physical problem in front of me, and having the tools and freedom to solve problems. Whenever I got a gear box to run or an arm to move, I had a strong feeling of accomplishment and excitement. I didn't want to be anywhere else."

Building robots inspired Glisson to study mechanical engineering after high school. "What I love most about my major is that I get to solve interesting and challenging problems. Right now, I'm working on a project with a partner designing a robot that can walk up walls. We have access to materials, money, and even a laser cutter that can cut new parts out of plastic. Nearly any idea we come up with, we can build from scratch right in the lab."

Glisson's robotics experience helped him land a prestigious summer internship at Oak Ridge National Laboratories (ORNL) in Oak Ridge, Tennessee, where he helped design a "beam dump." This special shield blocks a beam of high-intensity radiation, and is so radioactive that humans can't touch it.

"The shield has to be moved around by robots," explains Glisson. "My job was to help create the machinery that was needed to support and move these very deadly beam dumps. It was exciting to know that I had been trusted with the design of something that was so important and powerful, and I had a lot of fun."

Through the summer internship, Glisson says, he gained real-world engineering experience and some valuable technical and teamwork skills.

"Before my internship I was very slow at CAD (computer-aided design) software," he explains. "It would take me a few hours to create even a simple part. Now, I can very quickly model complicated structures like motors, cranes, and even entire robots. Another benefit was that I learned how to work in large, spread-out groups. Some of the people working with me lived halfway across the country, so I could not walk over to their offices and see what they had done. I learned how important it was to be able to explain your idea clearly to someone you could only see over a computer screen."



STEM SCOOP:

"An important skill for a mechanical engineer is to know how to use CAD (computer-aided design) software. With CAD, you can create 3-D models of what you are building on the computer. This lets you examine your idea from all angles and even model how much hot it will get."

— MATTHEW GLISSON



Student engineering ambassadors from Penn

PENNSYLVANIA

State University (www.psu.edu), in State College, visit high schools in Pennsylvania to give presentations and encourage students to explore careers in engineering.



The five-year international engineering program at

RHODE ISLAND

the University of Rhode Island (www.uri.edu) in Kingston leads students simultaneously to bachelor's degrees in engineering and either German, French, or Spanish, or minors in Chinese and Asian studies.

Check out these STEM learning experiences where you can explore careers, build skills, and discover if STEM is the right field for you.

STEM for Fun



GOVERNORS' SCHOOLS

Several states sponsor free four- to-six-week residential summer Governor's School programs for rising high school juniors and seniors. Students are selected on the basis of grades, standardized test scores, personal essays, and recommendations, and participants can often earn college credits for Governor's School coursework. The schools are typically held on college campuses and include career exploration and recreational field trips. Some

states also offer tuition-free, school-year residential Governor's Schools in focused subject areas, such as the South Carolina Governor's School for Science and Mathematics (www.scgssm.org). To learn more about the free summer and school-year Governor's School opportunities in your state, talk to your guidance counselor or visit your state's Department of Education website.

The College of Charleston offers the nation's first

SOUTH CAROLINA

undergraduate program in discovery informatics (discovery.cofc.edu), a field integrating computers and mathematics to get information from complex data sets and systems.



STEM • STATE BY STATE

For geological engineering students at the South

SOUTH DAKOTA

Dakota School of Mines and Technology (sdmins.sdsmet.edu) in Rapid City, the nearby Badlands and Black Hills are natural laboratories for studies of geologic processes.

INTEL SCIENCE TALENT SEARCH

www.societyforscience.org/STS

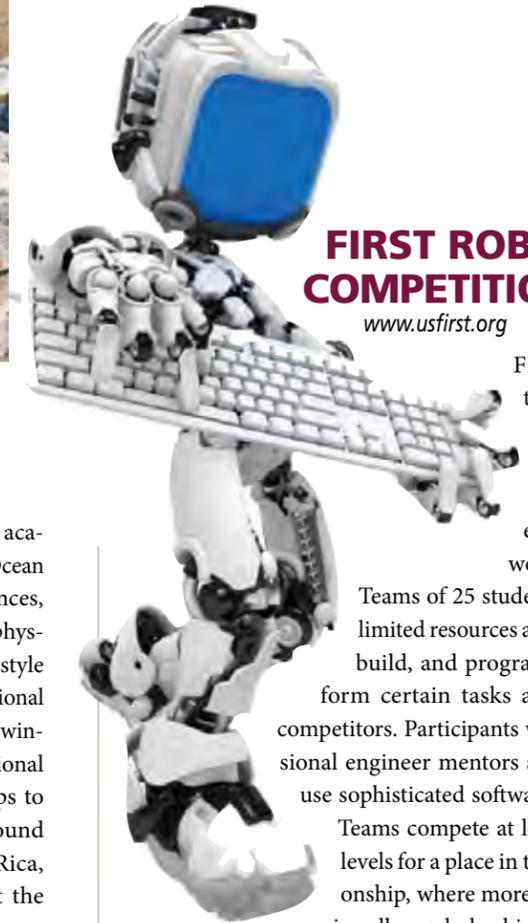
The Intel Science Talent Search is a prestigious national research competition open to high school seniors. Students perform individual science research either on their own, in conjunction with a scientist in their area, or through a pre-existing summer research program for high school students. When the research project is complete, participants write a 20-page report explaining their experiments and conclusions. The complete application also includes transcripts, test scores, a list of extracurricular activities, and teacher recommendations. Forty finalists are awarded Intel-powered laptop computers, at least \$7,500, and an all-expenses-paid trip to Washington, D.C., for the Intel Science Talent Institute. Finalists compete for additional awards ranging from \$20,000 to \$100,000.



NATIONAL OCEAN SCIENCES BOWL (NOSB)

www.oceanleadership.org/education/national-ocean-sciences-bowl

The Consortium for Ocean Leadership coordinates this national academic competition for high schools on topics related to the oceans. Ocean Sciences student teams test their knowledge of the marine sciences, including biology, chemistry, physics, and geology, in a *Jeopardy*-style game staged at more than 25 regional competition locations. Regional winners advance to the NOSB. National winners earn experiential trips to marine research locations around the world, including Costa Rica, Panama, and Bermuda. Visit the Ocean Leadership website to learn about competitions in your area or how to create an Ocean Sciences Bowl team at your school.



FIRST ROBOTICS COMPETITION (FRC)

www.usfirst.org

FIRST combines teamwork, science, and cutting-edge technology to help students experience real-world engineering.

Teams of 25 students or more have limited resources and time to design, build, and program robots to perform certain tasks against a field of competitors. Participants work with professional engineer mentors and learn how to use sophisticated software and hardware.

Teams compete at local and regional levels for a place in the world championship, where more than \$12 million in college scholarships is awarded. Sign up to participate on your school's FIRST

Robotics team, or visit the FRC website to learn how to start a team.

ENGINEERING COLLEGE SUMMER CAMPS

Numerous colleges and universities nationwide sponsor residential summer camps for high school students interested in learning more about engineering. For example, the University of Illinois at Urbana-Champaign (www.engr.uiuc.edu/wyse/EYO/index.html) offers a one-week Exploring Your Options camp for rising juniors and seniors, as well as a one-week Discovering Engineering program for rising sophomores. The engineering camps are led by current engineering students and faculty and include lots of hands-on activities and team projects. To explore college pre-engineering camp opportunities in all 50 states, visit the Engineering Education Service Center website at www.engineeringedu.com/camps.



STEM • STATE BY STATE

Graduate students at the University of Tennessee

TENNESSEE

Forensic Anthropology Center (web.utk.edu/~fac/), or "Body Farm," in Knoxville learn how to identify decomposing and skeletal remains for law enforcement, such as forensic investigation teams.

CSI SUMMER CAMPS

Several crime scene investigator (CSI) summer camps are held throughout the United States. Each one introduces high school students to forensic science, and most involve working in teams to conduct investigations and solve problems. At the weeklong CSI: Camp Science Investigators camp at Hampshire College in Amherst, Massachusetts (www.hampshire.edu), for example, students excavate a “burial ground” to learn how to determine the age, sex, stature, and identity of a body by studying its bones and teeth. Stockton CSI (loki.stockton.edu/~stockcsi) at the Richard Stockton College of New Jersey in Pomona includes a field trip to the local medical examiner’s office and concludes with a mock criminal murder trial. To find similar camps in your area, perform an Internet search for “CSI summer camps” plus a state name.



GIRLS-ONLY SUMMER STEM ACADEMIES

The Curie Academy (www.engineering.cornell.edu/curie) at Cornell University in Ithaca, New York; the Women in Engineering Summer Camp at the University of Dayton in Ohio (www.udayton.edu/engineering/hs_programs/women_in_engineering_summer_camp.php); and Purdue University’s Edge camp (<https://engineering.purdue.edu/WIEP>) in West Lafayette, Indiana, are three examples of the U.S. summer camps available to young women interested in exploring STEM fields. Most girls-only STEM camps are hosted by engineering colleges and are open to students from any state. Check the websites of local engineering schools to find out if a girls-only summer program is offered in your area.

FREE ONLINE COLLEGE COURSES

ocw.mit.edu/OcwWeb/web/home/home/index.htm

One of the best ways to figure out what it takes to succeed in STEM at the college level is taking a free, online course offered by one of the nation’s top universities. You can’t earn college credit, but you can gain valuable experience. For example, the Massachusetts Institute of Technology (MIT) offers more than 1,800 free courses through its OpenCourseWare project. Courses are in text, audio, and video formats and are translated into a number of different languages. Introductory STEM-related courses offered typically include:

- Introduction to Aerospace Engineering and Design
- Introduction to Bioengineering
- Introduction to Computers and Engineering Problem Solving
- Introduction to Computer Science and Programming

No registration is required, and you get access to free lecture notes, exams, and videos from MIT. Visit the MIT OpenCourseWare website given above to browse the course catalog and get started.



Digital media design students at Texas State

TEXAS

Technical College in Waco (www.waco.tstc.edu) earn an associate’s degree while learning how to design multimedia products with 2-D and 3-D animations.

NASA INSPIRE

www.nasa.gov/education/INSPIRE

Through the Interdisciplinary National Science Project Incorporating Research and Education Experience, or INSPIRE, ninth to 12 graders interested in STEM education and careers can join a NASA online learning community, or OLC. The OLC lets INSPIRE students interact with their peers, NASA experts, and STEM education specialists, as well as participate in STEM educational activities and explore NASA careers and opportunities. Students who qualify for the National School Lunch Program are eligible to receive a free laptop to be able to take part in OLC. INSPIRE students can also apply to attend free summer STEM learning experiences hosted at NASA facilities.



NATIONAL SCIENCE RESOURCES CENTER (NSRC) INTERNSHIP PROGRAM AT THE SMITHSONIAN INSTITUTION

www.nsrconline.org/about_the_nsrc/Internship_program.html

The NSRC offers unpaid internships to high school students who are at least 16 years of age. Interns serve in one of seven program areas, including the Center for Building Awareness of Science Education. Students selected for this center can create their own research project or choose from a variety of ongoing projects. Past internship opportunities have included organizing conferences and seminars to help change the course of science education throughout the United States and the world.

PRE-FRESHMAN ENGINEERING PROGRAM (PREP)

www.prep-usa.org

The Pre-freshman Engineering Program (PREP) provides a challenging eight-week summer academic program to get middle and high school students ready for success in advanced studies leading to careers in STEM fields. This national program was created to increase the number of women and under-represented minorities in STEM college programs and careers.



PREP sessions are held at colleges and universities throughout the United States and Puerto Rico. Most host schools are either Hispanic-serving institutions or historically black colleges and universities.

DUPONT CHALLENGE SCIENCE ESSAY COMPETITION

thechallenge.dupont.com

Created to honor the *Challenger* astronauts and promote excellence in science writing, the DuPont contest challenges students to research and write a 700- to 1,000-word essay about a scientific discovery, theory, event, or technological application. Essays are judged on mechanics and conventions, ideas and content, organization, style and creativity, and voice. Winners receive savings bonds of up to \$5,000 and expenses-paid trips to Walt Disney World and the Kennedy Space Center.



The “3-2” program at Westminster College

UTAH

(www.westminstercollege.edu) in Salt Lake City lets students earn two degrees in five years—a bachelor’s from Westminster and an engineering degree from the University of Southern California or Washington University in St. Louis.



University of Vermont (www.uvm.edu) mechanical

VERMONT

engineering student Jimmy Cochran is a world-class slalom skier and U.S. Olympian who juggles UVM in Burlington classes with competitions around the world.

An overview of the costs you will need to consider when planning life on your own.

Reality Check

AS YOU START DREAMING about your future life and career, you'll need to consider what it will cost to live on your own. Use the estimated living expenses below to get a better idea of the amount of money you'll need to earn each month. Then, look back at the wages* information in the 25 STEM Careers section (pages 14–23) to find jobs that pay more than enough to meet your basic expenses.

**Subtract 30 percent from the salaries shown for each career to get a more accurate idea of the amount that will actually be on your paycheck. Called "take-home pay," this total is your earnings minus what is taken out by the government and your employer to cover taxes, retirement, and insurance.*



WHAT IT COSTS TO LIVE WHERE YOU WANT TO LIVE

Actual basic living expenses can vary considerably from the estimates on the opposite page, depending on where you decide to live. Big cities on the east and west coasts, including New York, Boston, San Francisco, and Los Angeles, are among the priciest places in the nation to call home, while smaller cities in the South and Midwest (such as Omaha, Birmingham, and Cincinnati) tend to be more affordable for young workers.

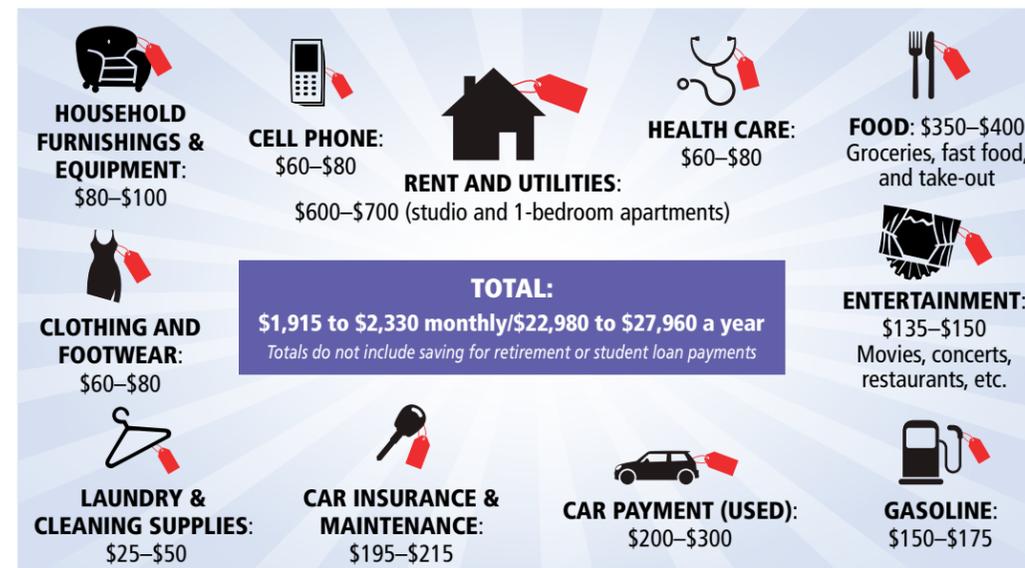
To get a better idea about what it would actually cost to live on your own in a certain city or state, use one of these free, online cost-of-living calculators:

- Best Places to Live & Retire, www.bestplaces.net/col
- Bankrate.com, www.bankrate.com/calculators/savings/moving-cost-of-living-calculator.aspx
- CNN/Money.com, cgi.money.cnn.com/tools/costofliving/costofliving.html



WHAT IT COSTS TO LIVE ON YOUR OWN

Estimated basic monthly expenses for a 22-year-old living in the United States



Source: 2008 Expenditure Survey, United States Department of Labor/Bureau of Labor Statistics adjusted for 2010 based on the Consumer Price Index Inflation Calculator (www.bls.gov/bls/inflation.htm)

REPAYING STUDENT LOANS

When deciding what college to attend and career path to pursue, remember to figure in repaying student loans. Whether you go to a public or private school after high school, chances are good that you will take out student loans to help pay the tuition bill. According to the government's National Postsecondary Student Aid Study, two-thirds of today's college students borrow to pay for college, and their average debt load is \$23,186 by the time they graduate. You'll be required to start paying back student loans after you graduate, leave school, or drop below half-time enrollment. Review the loan terms carefully with your lender and your parents to figure out exactly what you will owe and when. Once the payback period begins, you have to pay in full each month until the loan is paid off (which could take several years). If you don't pay on time, you could rack up serious penalties and expensive fees, and have a hard time getting a loan in the future to buy a car or a home. As your salary grows, increase your monthly contribution so you can pay off the loan faster.



Jim Buckmaster, a biochemistry graduate of

VIRGINIA

Virginia Tech (www.vt.edu) in Blacksburg, is CEO of Craigslist (www.craigslist.org), a series of websites that feature free classified ads and forums on multiple topics.



The innovative digital technology and culture program at Washington

WASHINGTON

State University Vancouver (www.vancouver.wsu.edu) integrates critical thinking, creativity, and computing skills with coursework in the arts, humanities, and social sciences.



Listen to what employers say about the need for STEM employees.

Bosses Speak

“When I am hiring, I always look for creativity and a knack for problem solving. I also look for diligence and decisiveness. In the current marketplace, we are thrown so much information and so many tasks that it’s critical to be a hard worker and to be able to quickly ferret out the kernels of important information and act on them.

“Verbal skills also make a huge difference. It’s important to be able to read, write, and speak English effectively. If you’re the only one who understands your ideas, they won’t go anywhere.”

—JEFF MOEHLENBRUCK, director of research and development, Zimmer Orthobiologics, Austin, Texas

Source: AchieveTexas in Action: Science, Technology, Engineering & Mathematics

“Our customers are constantly demanding that we improve our products; add more technological content; and enhance safety, comfort, and performance. To accomplish that, we need today’s and tomorrow’s engineers to be armed with the technologically complex knowledge that they need.”

—JAMAL JENKINS, manager, diversity recruiting and relationship management, Chrysler, Detroit

Source: NACME Post-Symposium Report 2008

“A strong background in science, technology, engineering, or math is required to be successful in any field. Having a strong background in all of these areas gives someone the ability to succeed and advance to the highest levels in the field of their choice.

“In years past, someone could earn a good living by simply being strong and working hard at manual labor. Today, every industry from farming to space exploration uses technology that did not even exist when your parents were your age.

“You have to understand that learning can never stop. Getting a high school diploma or a college degree is not the end to your education; it is only the beginning. New technologies affect every industry every day. You must always be willing and eager to learn new things.”

—BYRON DUNN, president, Gulf State Shipbuilders Consortium, Mobile, Alabama

Source: Alabama SUCCESS STEM Guide

“Today, graduation rates for our high school students and their level of achievement in math and science rank at the bottom among industrialized nations. Thirty percent of ninth graders and nearly half of African Americans and Hispanic ninth graders do not graduate on time. Fewer than 40 percent of high school students graduate ready to attend college. As a nation, we must have a fundamental goal that every child in the United States should graduate from high school prepared for college, career, and life.”



—BILL GATES, founder, Microsoft, Redmond, Washington

Source: Testimony before the Committee on Science and Technology, U.S. House of Representatives, March 12, 2008

“Diversity is good for business. We want to make sure that we have individuals who represent the population we sell our vehicles to, and we believe that diverse perspectives create a superior product. Diversity is more than just race and sex—it is diversity of thought, which is one of our priority areas in selecting young engineering talent.”

—MEL STEWART, manager, academic relations for talent acquisition, General Motors, Detroit

Source: NACME Post-Symposium Report 2008

“The number of students entering STEM disciplines is too low to meet future U.S. needs. Industry can play a critical role in helping address this shortfall. Not only does SAIC rely on a STEM-educated workforce, our customers and our nation do, as well. It is what drives our economy.”

—WALT HAVENSTEIN, chief executive officer, SAIC, McLean, Virginia

Source: SAIC website (www.saic.com)

MEET A STEM STUDENT

NAME: **Jessica Mayberry**

MAJOR/MINOR: Electrical Engineering; Mathematics

SCHOOL: Tennessee Technological University, Cookeville, Tennessee

MAJORING IN ELECTRICAL ENGINEERING has given Jessica Mayberry the chance to use her lifelong passions for math and science to solve real-world problems.

“Each day and each class presents a different puzzle that demands not only the laws set down by my idols—Newton, Einstein, and Edison—but also everyday common sense and real-world knowledge,” she explains. “Engineering is a profession where a problem is never solved just once and in just one way. I enjoy being part of that; the idea that every day, past discoveries are improved to become bigger—or in the case of electrical engineering, smaller—faster, and better.”

Throughout her college career, Mayberry has looked for additional opportunities for discovery. Her adventurous spirit and good grades took her to Houston, Texas, for 15 weeks while she worked as a paid NASA Johnson Space Center (JSC) intern. As a JSC intern, Mayberry learned from NASA mentors who patiently taught her what it took to do their jobs. “I can’t pretend that it wasn’t intimidating,” Mayberry recalls. “[But] I soon realized that all of them had been in my place before. It’s important to realize that no one expects you to achieve great things overnight, and that most of the phenomenal things that NASA—or any other high-tech organization—produces are the products of dozens, if not hundreds or thousands, of minds working together.”

During her internship, Mayberry focused on the communication aspect of the International Space Station (ISS). Although this meant she had to log 11 p.m. to 6 a.m. shifts supporting Mission Control, she says she wouldn’t have traded sleep for the once-in-a-lifetime opportunity. “I felt like I had moved beyond the hypothetical problems of my textbooks into something meaningful. Besides, who would miss the chance to see a massive rocket dock with a tin can floating 2,000 kilometers above the earth’s surface?”

Other memorable moments from the internship, Mayberry says, included crawling through the tiny crevices of the full-sized ISS mock-up to plan the most efficient way to run wires for new equipment. She also witnessed the Space Center crew work around the clock to figure out how to steer the ISS when the new navigation software malfunctioned. And as if her on-the-job, real-world learning experiences weren’t enough, Mayberry was chased out of town by Hurricane Ike and became part of the community that pulled together to rebuild itself.

Adds Mayberry, “My experience at NASA makes me excited about my chosen profession and the endless opportunities it offers. All engineers have the potential to be the builders of bridges, the artisans of planes, the magicians behind skyscrapers, the inventors of the next great technological platform, and so much more.”



STEM SCOOP:
“STEM fields are male-dominated. This is just a fact every girl who decides to pursue technology-, math-, or science-based professions will discover the first day she walks through the door. However, if you are interested in a technological area of study, I strongly encourage you to break social mores and pursue it. Follow your passions.”
— JESSICA MAYBERRY

The Laboratory for Neuroanatomy at George

WASHINGTON, D.C.

Washington University (www.gwu.edu) in the District of Columbia is one of only a small number of laboratories in the world to directly investigate brain evolution in mammals. Students use high-tech tools to collect data from the brains of monkeys, tigers, elephants, and other animals.



The safety technology bachelor’s degree program

WEST VIRGINIA

at Marshall University (www.marshall.edu) in Huntington prepares students for careers in “safety science,” preventing accidents, illnesses, fires, explosions, and catastrophic events.



Students in the paper science and engineering

WISCONSIN

department at the University of Wisconsin–Stevens Point (www.uwsp.edu) prepare for technical careers in the pulp and paper industry by using the first paper-manufacturing machine in the United States designed specifically for teaching.

Take a look inside this high-tech house to see some of the current and future innovations designed, built, and installed by professionals with a wide variety of STEM skills. What kind of new home could you create?

The House That STEM Built

ENERGY-SAVING SOLAR PANELS

Solar panels or photovoltaic systems are solar cells that capture light energy from the sun and convert it directly into electricity. A wide variety of solar panels are available, including traditional solar panels, a new type of thin solar panel, and ground-mounted tracking systems that move with the sun. In addition, solar panels generate power for the home's solar water heater. Combining a collector and storage tank, the solar water heater uses the sun's thermal energy to heat water for showers, baths, dishwashing, laundering, and cooking.

TRANSFORMER BED

This futuristic four-poster bed transforms from a mere sleeping platform to an electronic media system with the touch of a button. Tap the remote to lower the bed's three blinds, one of which doubles as a screen for the built-in HD projector. The system is tricked out with high-end audio components, including speakers, amplifiers, and an Xbox. Use the remote to dim the lights and adjust the angle of the mattress.

ECO-FRIENDLY TOILET

Save space and the environment at the same time with an eco-friendly toilet that recycles the water you've previously used for washing your hands in the bathroom sink to fill its cistern. Reused water is rinsed over disinfectant tablets and filtered through a screen that blocks large particles such as hair and toothpaste. A small hose connects the reused water reservoir to the toilet cistern. The reused water then becomes the primary water source for flushing. Using an eco-friendly toilet can reduce water consumption by up to 25 percent.

ENERGY-SAVING WINDOWS

Spectrally selective window glazing or glass lets visible light through, but keeps the solar heat gain out. This lowers the cooling load during the summer and reduces the fading of furniture color caused by sunlight. Computer simulations have shown that window glazing with spectrally selective coatings can reduce the electric space cooling requirements of new homes in hot climates by more than 40 percent.

THREE-DIMENSIONAL TELEVISIONS

Full LED 3-D flat-panel televisions transform any home media room into a state-of-the-art movie theater. Electronics giant LG has developed 47-inch and 55-inch models, both featuring a set of comfortable 3-D glasses specially engineered for longer use than the traditional disposable versions.

RAINWATER COLLECTION, FILTRATION, AND STORAGE SYSTEM

Specially engineered gutter tubes collect and pre-filter rainwater before it is funneled into a narrow, space-saving tank. Harvesting rainwater allows the homeowner to store and reuse water in personal water storage chambers—saving energy, water, and water usage fees. The debris-rejecting design of the gutter tubes reduces the load on the filter and helps prevent water from splashing or spilling out. The 2,000-square-foot roof can provide more than 1,125 gallons of water from one inch of rainfall. Clean, collected rainwater can be used for drinking, cooking, gardening, and cleaning.

CELLULOSE INSULATION

Cellulose insulation made from recycled newsprint and other paper sources helps keep the house warmer in the winter and cooler in the summer. The paper used to make this insulation might otherwise end up in landfills, where it would release harmful greenhouse gases as it decomposed. According to the Cellulose Insulation Manufacturers Association, if all the paper being put into landfills were converted to cellulose insulation, it would save approximately 8 million tons of CO₂ emissions each year. That's the equivalent of taking every car off the road in New Mexico and Nevada.

FACIAL RECOGNITION TECHNOLOGY

Cutting-edge facial recognition technology is being engineered that will let future homes identify and interact with specific residents. For example, wall-mounted sensors could identify the homeowner as he enters his bathroom in the morning. The bathroom mirror would then transform into a daily calendar, reminding the homeowner of important events, instructing him to take his morning medication, and delivering the day's forecast so he knows how to dress for the weather. Facial recognition sensors at exterior doors would identify people allowed inside the house, eliminating the need for keys and preventing intruders from entering unnoticed.

FOOD PREP PLATFORM

This transparent platform is packed with sensors that can analyze the ingredients of any food or liquid and list them on its attached screen. Dieters, allergy sufferers, or people on restricted diets can see exactly what's in each food item to make more informed dining choices. Want to re-create restaurant takeout? Place the meal on the platform and get a complete list of what's inside.

SMART FRIDGE/PANTRY

Engineers are developing refrigerators and pantries that use radio frequency identification (RFID) to tag and track goods, and order items from the local grocery store. Sensors use radio waves to monitor food inventory. When the stock gets low, they alert the grocery store to have the food replaced. An order is sent via wireless communication and the items are delivered directly to the home or prepared for customer pickup.

SMART METER TECHNOLOGY

User-friendly displays provide up-to-the-minute tallies of household utility consumption. Homeowners can easily track electricity, gas, and water usage, giving them greater control over what they use and how much they spend each month on utilities. In addition, the displays will alert homeowners to changes in energy prices. Homeowners can also control home temperature remotely from a laptop or smart phone. So if you forget to turn off the heat when you leave for the day or want to turn on the air conditioner before you get home, send instructions to your smart meter.

BATHOMATIC

Bathomatic is an add-on for any existing tub that allows for remote filling via mobile phone. In addition to adding water, the Bathomatic application allows bathers to choose the depth and temperature of the water, as well as add fragrances or bubble bath.



Explore More

Use these websites and other STEM career and education resources available from your school counselor or online to help you design the future of your dreams.

AMERICA'S CAREER INFONET | www.acinet.org/acinet

Use this CareerOneStop site sponsored by the U.S. Department of Labor to watch videos about different STEM careers and take online quizzes to see what jobs might fit you best.

ENGINEER YOUR LIFE | www.engineeryourlife.org

To encourage high school girls to explore engineering careers, the National Academy of Engineering designed this website just for them. Visit the site to read about female engineers and learn about cool new opportunities for women in engineering.

NACME BACKS ME | www.nacmebacksme.org

The National Action Council for Minorities in Engineering has created a special website for students, parents, and teachers featuring helpful information about engineering careers, becoming an engineer, and paying for college. Learn about the many ways NACME helps students who want to pursue engineering.

NASA JOBS | nasajobs.nasa.gov

Discover the world of STEM career opportunities available to students and graduates at the National Aeronautics and Space Administration (NASA); includes a special section for students on education, employment, and research and development.

O*NET (OCCUPATIONAL INFORMATION NETWORK) | online.onetcenter.org

O*NET provides full information on careers, including state-by-state salary information and skill matching for students.

SEA GRANT MARINE CAREERS | www.marinecareers.net

Explore marine-related careers such as oceanography, ocean engineering, and marine biology by viewing profiles of people working in these fields; includes salary and education information.

SOCIETY OF WOMEN ENGINEERS | societyofwomenengineers.swe.org

Learn about the career opportunities available to women in engineering, as well as special scholarships and programs available to women engineering students.

TRY ENGINEERING | www.tryengineering.org

Find out if engineering is right for you by participating in hands-on experiments and online games, getting answers to your STEM career and education questions from current engineering students and professionals, and researching summer engineering and college programs.

U.S. DEPARTMENT OF LABOR OCCUPATIONAL OUTLOOK HANDBOOK | www.bls.gov/oco

This electronic version of the venerable *Occupational Outlook Handbook (OOH)* features updated information on what people in nearly every career in the world do, the wages they are paid, the conditions in which they work, the education requirements they have to meet, and other aspects of choosing a profession. (The descriptions of the 25 career ideas featured on pages 14 to 23 are excerpted from the public information in the *OOH* and O*NET Online [see above]).



The Wyoming NASA Space Grant Consortium

WYOMING

wyomingspacegrant.uwyo.edu offers community college STEM scholarships to students at these Wyoming Space Grant-affiliated community colleges: Casper, Central Wyoming, Eastern Wyoming, Laramie County, Northern Wyoming Community College at Sheridan and Gillette, and Western Wyoming College. Science, technology, engineering, math, and some health science majors are eligible to apply.

STEM Stories

The press is filled with stories about the need for more STEM workers.

ALARM OVER SHORTAGE OF NUCLEAR EXPERTS

BY BRYAN BENDER, GLOBE STAFF

WASHINGTON—The United States is facing a critical shortage of nuclear scientists and engineers, even as demand rises for their expertise in managing an aging U.S. arsenal, monitoring dangerous weapons stockpiles around the world, and operating new nuclear power plants, according to the latest government figures and independent studies.

—*The Boston Globe*, April 3, 2010

DEMAND KEEPS GROWING FOR CYBER-SECURITY WORKERS

BY ALEJANDRO MARTÍNEZ-CABRERA, CHRONICLE STAFF WRITER

Several federal agencies are redoubling their hiring of security specialists as high-level security breaches, successful take-downs of government Web sites and discouraging military simulations of coordinated cyberattacks have underscored the nation's digital vulnerabilities.

...San Francisco's Market Research Media estimates that the federal government will spend \$55 billion in cyber-security investments in the next five years, including the recruitment of thousands of security professionals.

—*The San Francisco Chronicle*, April 2, 2010

WANTED: MORE SCIENCE AND MATH TEACHERS IN THE U.S.

School officials hope financial and training incentives will help fill the need for 200,000 new teachers

BY STACY TEICHER KHADAROO, STAFF WRITER

...Over the next decade, schools will need 200,000 or more new teachers in science and math, according to estimates by such groups as the Business-Higher Education Forum in Washington. Already, many districts face shortages: In at least 10 states, fewer than six out of 10 middle-school science teachers were certified when the Council of Chief State School Officers compiled a report last year.

"We desperately need more qualified...science and math teachers, because of retirement...overcrowded classrooms...and people teaching out of [their] field," says Angelo Collins, executive director of the Knowles Science Teaching Foundation (KSTF) in Moorestown, N.J., which offers fellowships for teachers in these fields.

—*The Christian Science Monitor*, December 29, 2008

U.S. ENERGY INDUSTRY IS HAMPERED BY LABOR SHORTAGE

BY REBEKAH KEBEDE

[The] U.S. energy industry is flush with cash after oil prices quintupled and natural gas prices tripled over the past six years, but the sector is still short on workers as hefty salaries fail to draw enough new talent...The labor crunch has slowed the pace of new drilling and refining projects and added to already escalating costs...Adding to the problem is the industry's aging workforce. A majority of U.S. energy workers will be eligible to retire by 2017, according to a 2007 study by the National Petroleum Council, an advisory committee to the U.S. secretary of energy.

—*The New York Times*, May 1, 2008

SHORTAGE OF SKILLED WORKERS WORRIES ENERGY INDUSTRY

BY KEVIN MCCULLEN, HERALD STAFF WRITER

KENNEWICK—Energy producers and suppliers are optimistic about their long-term future in Washington, but are concerned about shortages of skilled workers and developing adequate training programs for them, according to a survey of energy employers.

Growth in the clean energy industry depends on the state's ability to train workers who need to be a "jack of all trades" to build, operate and maintain plants and equipment, said Alan Hardcastle. He's senior research associate with Washington State University's Extension Energy Program and author of a 2009 report on renewable energy and workforce development in the state.

—*Tri-City Herald* (Kennewick, Wash.), February 10, 2010

AMERICA'S NEW DEFICIT: A SHORTAGE OF TECHNOLOGY SPECIALISTS

BY HEIDI SHYU, VICE PRESIDENT, CORPORATE TECHNOLOGY AND RESEARCH AT RAYTHEON COMPANY

The labor market for scientists and engineers is expanding at warp speed, driven by the unrelenting advancement of technology. Yet thousands of engineering jobs remain unfilled because of a shortage of qualified workers.

Where are these workers, and more important—where are the women who can fill these vital roles?

The formal, four-year education system is producing only a small proportion of the scientists and engineers needed in the United States. As a result of this severe shortage of science and engineering students, future U.S. innovation, productivity, and competitiveness in world markets could be undermined. India and China are producing far more scientists and engineers than the United States. In China alone, 60 percent of all bachelor's degrees are in sciences and engineering and many of [those earning] them are women.

—*IMDiversity.com*, August 2007



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