STEM occupations

by Nicholas Terrell

Faster aircraft, bolder video games, better medicines—technology moves forward every day. And tech-savvy workers make those advances happen. Without the work of scientists, technicians, engineers, mathematicians, and other skilled workers, most new products and discoveries would never be developed.

The need for technical work continues to grow. Technical occupations are often defined as those related to science, technology, engineering, and mathematics (STEM). Workers in STEM occupations use science and math to solve problems. Educational requirements for STEM occupations range from a high school diploma and on-the-job training to a Ph.D. But all require the ability to think logically.

There are several ways to identify and count STEM occupations. Some researchers, for example, count social scientists and science managers; others include any occupation that uses science and technology. Adopting a more focused definition, this article describes the occupations that most clearly concentrate on STEM.

On the pages that follow, you'll find information about STEM occupations, earnings, educational requirements, and job prospects. There are also suggestions on how to prepare for a STEM career and where to find more information.

STEM jobs

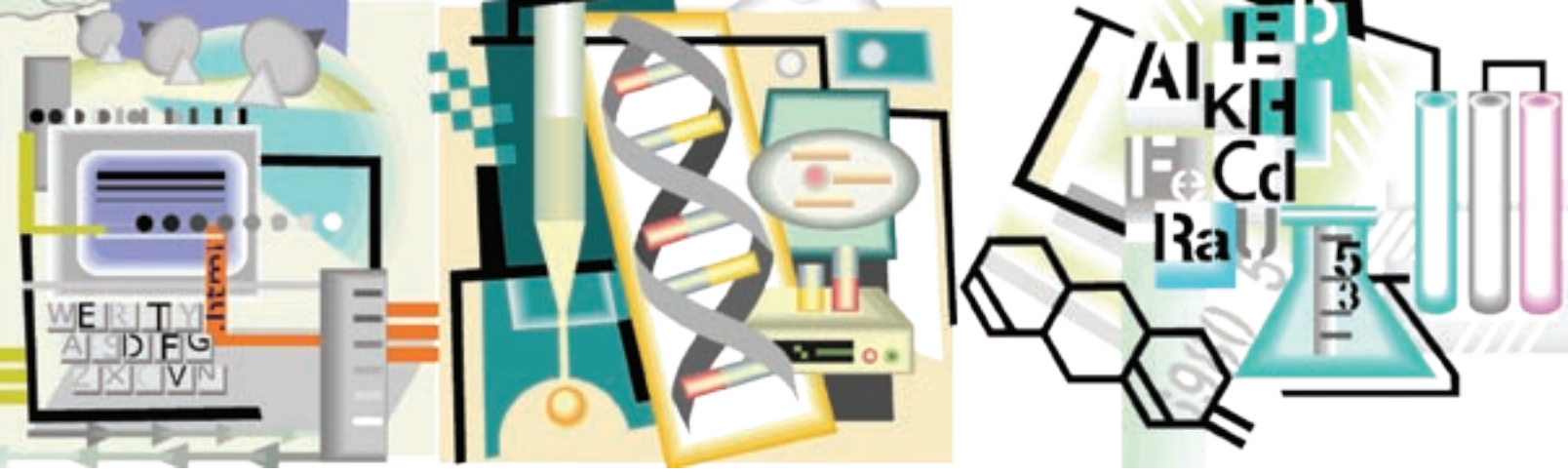
There are many kinds of work within STEM's divisions of science, technology, engineering, and mathematics.

Science

When you think of science workers, you might picture a chemist in a white lab coat running experiments—and you'd be right. But science goes beyond the laboratory. Scientists are also involved in teamwork, communication, and data analysis. And although many scientists spend time in laboratories, they work in offices, too. Some work outdoors, as when wildlife biologists observe animals in their habitats or geoscientists measure movements in the Earth's crust.

Scientists design experiments to find out how things

Nicholas Terrell is an economist in the Office of Occupational Statistics and Employment Projections, BLS, (202) 691-5711.



High-tech jobs for a high-tech economy

work. They conduct or oversee those experiments, analyze the results, and explain what the results mean. They use scientific methods to learn about the world. In 2005, according to the U.S. Bureau of Labor Statistics (BLS), 13 percent of STEM jobs as defined here were in natural science occupations. (See chart 1.)

Natural science occupations fall into three broad groups: life scientists, physical scientists, and natural science technicians.

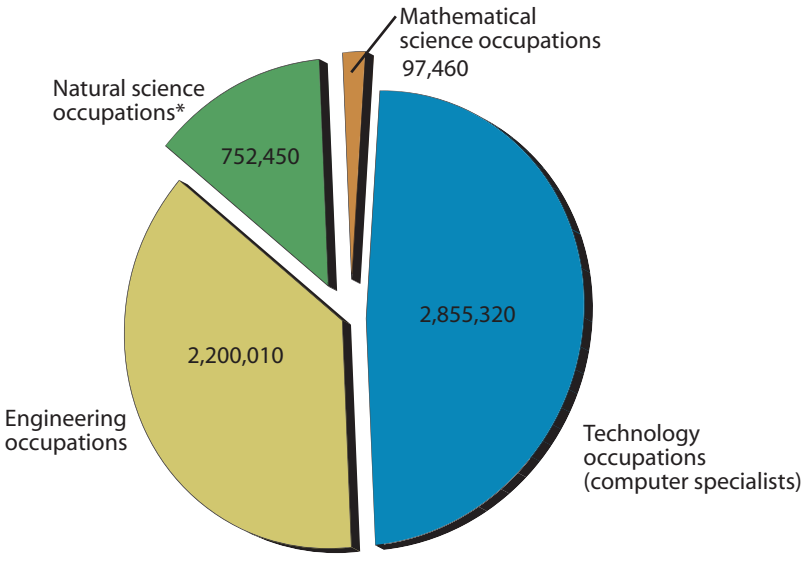
Life scientists. Life scientists study living systems, from organisms to ecosystems. Agricultural and food scientists, for example, study the production and distribution of food. They work to increase food quantity, quality, and safety.

Biological scientists study animals, plants, and bacteria. They also analyze metabolic processes and other life elements.

Conservation scientists and foresters manage natural resources to maximize their long-term economic, recreational, and conservation value; for example, they might decide when and how to plant trees or chop them down. And medical scientists look for both causes of and treatments for human diseases.

Physical scientists. Physical scientists study the parts of nature that are not alive. They might ponder the motion of distant suns or the bonds between nuclear

Chart 1
Wage-and-salary employment in STEM occupations, May 2005



*This group may include a small number of social science technicians.

particles. Atmospheric scientists, for example, monitor weather conditions to understand trends and to forecast atmospheric changes.

Chemists and materials scientists conduct research to create new chemicals and other materials for use in many products.

Environmental scientists and hydrologists investigate environmental hazards and pollutants and the circulation of underground and surface waters. Geoscientists study the composition and structure of the earth, often in search of available supplies of natural resources.

Physicists and astronomers explore the fundamental laws governing matter and energy in the universe, mathematically modeling the forces of nature.

Natural science technicians. These technicians assist scientists in conducting experiments and analyzing the results. They might prepare experimental apparatus, collect samples or readings, and summarize the results.

Biological technicians generally work as laboratory assistants engaged in biological and medical research. Chemical technicians in research and development also work as laboratory assistants, and those involved in manufacturing typically monitor industrial processes.

Technology

This category could include any occupation that requires technical skill, but it usually refers to information technology or computer-related occupations. Workers in these occupations use logic, mathematics, and computer science to make computers function.

Some technology workers create new software, design computer systems, and develop databases. Others focus on helping people use computers and on keeping computers running well.

Designing and developing. Many computer workers find ways to make computers more useful. Computer software engineers, for example, create new computer programs or systems. They develop an overall plan for how the program works. They design algorithms that tell the computer how to complete tasks. And they figure out how to make software work faster.

Computer programmers often help software engineers implement their plans. They write code to tell the computer to do specific tasks.

Computer systems analysts help organizations to use computers effectively. They choose computer hardware and software that meet an organization's needs and oversee its computer-related policies and plans.

Computer research scientists study advanced computer technology. Database analysts design methods of organizing and storing data for quick retrieval.

Helping users. Other information technology workers focus on helping people with computer problems and on keeping computers running smoothly. These workers, called computer support specialists or systems administrators, provide administrative and technical assistance to computer users.

Engineering

Almost every product, from cars to carrots, is the result of engineering. Engineers use science to solve practical problems. They design, develop, and test new products, such as computers, machines, and chemical fertilizers; they also design, develop, and maintain systems, including assembly lines and electric power grids. Drafters, engineering, and mapping technicians help in those efforts.

Specialties. Most engineers specialize. Agricultural engineers, for example, design farming equipment, irrigation systems, and food processing systems. Biomedical engineers develop medical devices and instruments. Civil engineers, the largest specialty, design bridges, dams, and other public works projects; some plan highways and solve traffic problems.

Electrical and electronics engineers design consumer electronics, electrical robotics, and other electrical equipment. Mechanical engineers design, manufacture, and test tools and other mechanical devices.

Among the other engineering specialties are aerospace, chemical, environmental, and petroleum.

Drafters and technicians. Drafters, engineering, and mapping technicians assist in the development of new products. Drafters use computers to make detailed tech-

nical drawings of products or construction projects. They sometimes suggest what type of components to use in a product or structure.

Engineering technicians build models, do calculations, and perform other engineering tasks. Mapping technicians aid surveyors, cartographers, and photogrammetrists in measuring and mapping the Earth's surface.

Mathematics

Many occupations use mathematics. But some occupations focus on mathematics almost exclusively.

Actuaries, for example, analyze statistical information to determine the risk of uncertain future events, such as hurricanes or automobile collisions. They use these calculations to decide what kinds of insurance a company should offer and how much that insurance should cost.

Mathematicians develop new mathematical theories and tools to solve problems. Some devise or decipher encryption methods to protect confidential information.

Operations research analysts use math to model complex logistical chains to determine the most efficient way to move materials or meet other management objectives.

Statisticians collect, analyze, and interpret data. Some write surveys.

Earnings

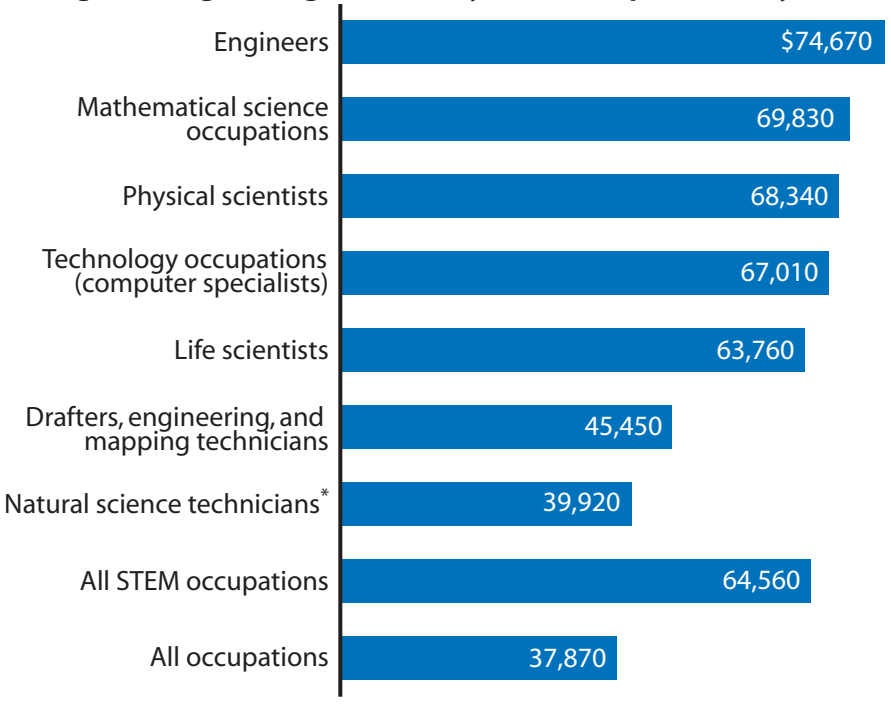
As a group, STEM workers earned about 70 percent more than the national average in 2005, according to BLS. Every major group of STEM occupations enjoys overall median earnings that are above the national average. (See chart 2.) Higher than average earnings are often an indicator of strong demand for workers.

Like occupations in other disciplines, STEM occupations that require more education usually pay more than those that need less.

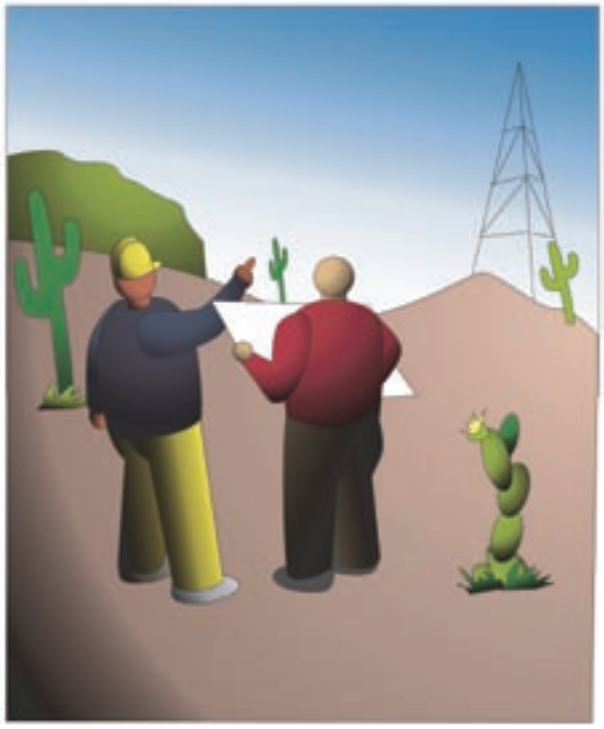
For example, biochemists and biophysicists, who often have a Ph.D., had median earnings of $71,000 in 2005; biological technicians, who often have an associate degree or less education, earned a median of $34,270.

Earnings vary by subject matter for the highest paid occupations within each STEM group. The highest earning scientists were astronomers, with median earnings

Chart 2
Average earnings in wage-and-salary STEM occupations, May 2005



*This group may include a small number of social science technicians, who are counted among life, physical, and social science technicians, all other.



of $104,670. Among technicians, nuclear technicians had the highest median earnings, at $61,120. The highest earning engineering specialty was petroleum engineering, with median earnings of $93,000. And actuaries, with median earnings of $81,640, made more than other mathematical specialists did.

In addition, starting salaries are higher for STEM workers than for workers in many other disciplines. According to a fall 2006 survey by the National Association of Colleges and Employers, students with a bachelor's degree in engineering had the highest starting salary offers, on average, compared with students who have bachelor's degrees in other subjects. (See table 1.)

Learning STEM

Success in STEM requires both technical and nontechnical skills and attributes. Curiosity, the ability to think logically, and creative problem-solving are highly valuable. Communication skills and teamwork are helpful, too.

All STEM workers need a firm grasp of mathematics; science knowledge is also important for many of the occupations. Preparation should begin in high school, with coursework and extracurricular activities focusing on honing problem-solving skills. After high school, STEM career requirements are more specific to the occupations.

High school preparation

Students interested in a STEM career should get started in high school by taking as much math and science as they can. Even those who struggle in these subjects during school can succeed on the job; with perseverance, many people who may have had difficulty with early math or science classes can later thrive in a STEM career.

There are many ways to build skills in math and science. Teachers may be available to give students extra help or to provide information about tutoring. School counselors might also have advice.

Associations sometimes provide educational assistance over the Internet. To learn more, see the sources of information at the end of this article.

Students might also be able to take courses at 2- and 4-year colleges during the summer. The more math and science students learn in high school, the easier it is to tackle advanced subjects later.

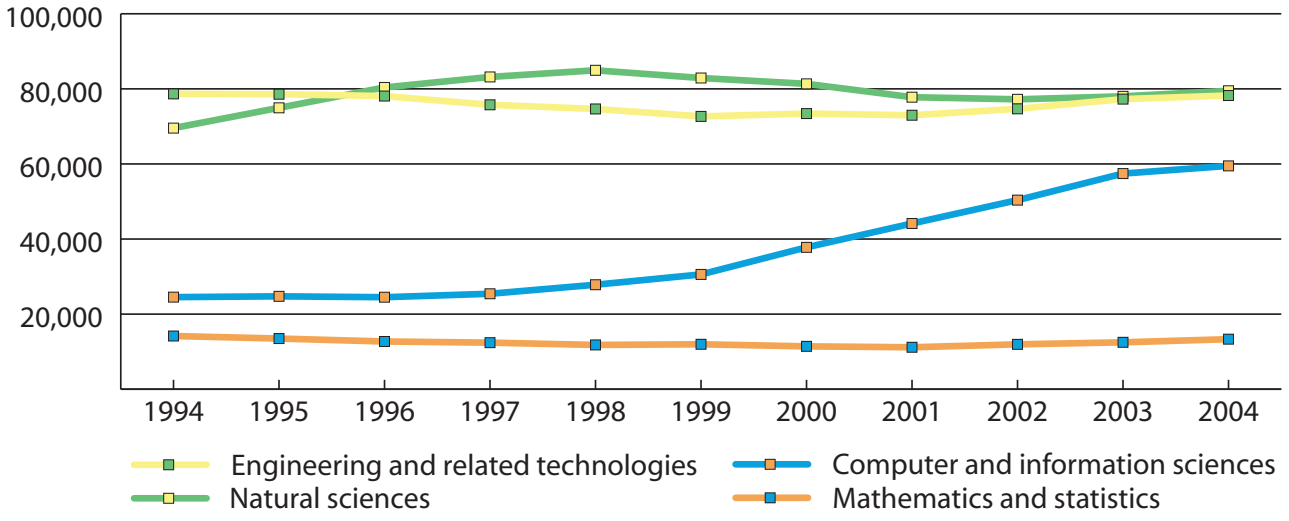
To further sharpen skills and explore career options, students might consider joining a math, science, engineering, or computer club at school. Starting a club at schools that don't already have one might not be difficult; ask a teacher or counselor for help. Club members often take field trips to science museums, go to math and

Table 1
Average starting salary offers for college graduates by bachelor's degree category, 2005-06

Degree field	Average salary offer
Engineering	$51,313
Computer science	50,744
Engineering technology	48,514
Information sciences and systems	47,182
Construction science/management	45,516
Management information systems/business data processing	45,391
Nursing	45,347
Geological and related sciences	45,091
Accounting	44,928
Logistics/materials management	44,810
Mathematics, including statistics	44,672

Source: Fall 2006 Salary Survey, National Association of Colleges and Employers

Chart 3
Bachelor's degrees in STEM subjects, 1994-2004



Source: U.S. Department of Education

science competitions, and help each other study.

Students can also participate in summer camps that are related to math, science, and computers. Campers take part in games and challenges and learn what it's like to have a STEM career. Depending on the type of camp, students might design and create their own computer programs or secret codes. Or they might build robots, motors, or architectural models.

Preparation after high school

As noted previously, the knowledge and abilities needed differ for specific STEM occupations. Education, certification, and experience are of varied importance. Changes in the number of degrees granted in STEM fields show how educational requirements are shifting and how the demand for these workers is increasing.

Specific requirements. Many scientists have a bachelor's degree; often, these scientists work as research assistants or in applied sciences. But for those who focus on research, a doctorate and, possibly, years of postdoctoral training are usually the minimum requirements.

Science technicians often need an associate degree or experience in building and using scientific equipment, in helping with data collection and analysis, or in other technical tasks. Some of these workers have a bachelor's degree.

Computer-related jobs usually require a degree, certification, or both. A bachelor's degree is the usual requirement for software engineers, systems analysts, and database administrators, but a master's degree is becoming more common for workers doing higher level development. Computer support workers and network analysts often have an associate degree, certifications, or both. Computer scientists, like other scientists, often have a Ph.D.

Engineers need at least a bachelor's degree, and a master's degree is becoming common. Engineering technicians and drafters often have an associate degree or experience in building models, helping with calculations, or doing other tasks.

Mathematical occupations usually require a master's or doctoral degree. A notable exception is actuaries, who usually need at least a bachelor's degree and a passing score on an actuarial exam.

Degree trends. The number of bachelor's degrees awarded in STEM subjects has been increasing in the past few years after several years of slight decline, according to the U.S. Department of Education. (See chart 3.) But the number of degrees in computer and information science has grown dramatically, reflecting increases both in the number of computer jobs available and in employers' preference for workers who have formal education in computer sciences.

Increases in degree awards for some STEM subjects are also apparent at the associate and master's degree levels. For example, the number of associate degrees awarded in computer fields more than tripled in a decade, growing from about 12,600 degrees in 1994 to about 41,800 in 2004.

In that same decade, the number of master's degrees granted in engineering declined before increasing from more than 30,000 in 1994 to more than 35,000 in 2004. Because more engineers are taking on managerial responsibilities, more schools are offering master's

degree programs that focus on the application of engineering principles to industry rather than on basic research. These programs include coursework in finance, project management, and other areas of business. They may increase workers' chances for advancement.

Job prospects

STEM workers hold jobs in every State. But six States—California, Texas, New York, Florida, Virginia, and Illinois—accounted for 40 percent of these jobs in 2005.

Growing demand for technological advances means more jobs for STEM workers. BLS projects job growth for STEM occupations as a whole between 2004 and 2014.

Nearly all the major STEM groups are expected to have about the same rate of growth as the national average. The exception is computer specialist occupations, which are expected to grow much faster than the average. (See table 2.)

Projected job growth varies widely by specific occupation, from a 55-percent projected growth for network systems and data communications analysts to about a 2-percent decline for mining and geological engineers.

More STEM workers also will be needed to replace those who are leaving these occupations. Many highly skilled workers will retire, change careers, or move to management positions over the next decade. Between 2004 and 2014, employers are expected to hire about 2.5 million STEM workers who are entering their occupation for the first time.

For more information

Although this article describes STEM occupations generally, there are important distinctions among the occupations. Detailed information about these occupations is in the *Occupational Outlook Handbook*. The *Handbook* is available in many libraries and career counseling offices and is online at **www.bls.gov/oco**.

Detailed earnings and employment information is also available from the BLS Occupational Employment Statistics survey. The information is online at **www.bls.gov/oes**. Specific projections of job growth in occupations and industries are available from the BLS Office of Occupational Statistics and Employment Projections. This information is also available online at **www.bls.gov/emp**.

To receive BLS information by phone or in another format, call (202) 691-5200.

Table 2
Employment growth and job openings in STEM occupations, projected 2004-14

Occupational group	Employment		2004-14 change		Job openings due to growth and net replacement, 2004-14
	2004	2014	Numeric	Percent	
Science occupations, natural*	**806,330**	**931,027**	**124,697**	**15%**	**315,000**
Life scientists	231,723	279,890	48,166	21	103,000
Physical scientists	250,417	280,913	30,496	12	94,000
Natural science technicians	324,190	370,224	46,034	14	118,000
Technology occupations (computer specialists)	**3,045,836**	**4,002,547**	**956,711**	**31**	**1,350,000**
Engineering occupations	**2,299,778**	**2,576,906**	**277,128**	**12**	**798,000**
Engineers	1,448,871	1,643,500	194,629	13	507,000
Drafters, engineering, and mapping technicians	850,906	933,406	82,500	10	291,000
Mathematical science occupations	**106,965**	**117,297**	**10,332**	**10**	**39,000**
STEM occupations, total	**6,258,909**	**7,627,777**	**1,368,867**	**22**	**2,503,000**

* This group may include a small number of social science technicians, who are counted among life, physical, and social science technicians, all other.

More information about careers in STEM occupations is available from professional associations. In addition to the associations listed below, the *Handbook* lists some associations for each occupation it describes.

To learn about engineering careers and activities, contact:
American Design Drafting Association
105 E. Main St.
Newbern, TN 38059
(731) 627-0802
www.adda.org

American Society for Engineering Education
1818 N St. NW., Suite 600
Washington, DC 20036
(202) 331-3500
www.asee.org

Junior Engineering Technical Society
1420 King St., Suite 405
Alexandria, VA 22314
(703) 548-5387
www.jets.org

To learn more about mathematics careers and for help learning math, contact:
American Mathematical Society
201 Charles St.
Providence, RI 02904
Toll-free: 1 (800) 321-4267
www.ams.org/employment

Mathematical Association of America
1529 18th St. NW.
Washington, DC 20036
Toll-free: 1 (800) 741-9415
www.maa.org

Society for Industrial and Applied Mathematics
3600 University City Science Center
Philadelphia, PA 19104
(215) 382-9800
www.siam.org/students

For more information about the STEM workforce, contact:
Commission on Professionals in Science and Technology
1200 New York Ave. NW., Suite 113
Washington, DC 20005
202-326-7080
www.cpst.org

To learn more about summer camps, tutoring, and other special STEM programs, check with school counselors, school district offices, and professional associations.