

VANDERBILT

SCHOOL OF ENGINEERING



engineering.vanderbilt.edu

Vanderbilt appeals to engineering students who want to put their careers and lives into a rich context. You will learn to be a creative thinker and problem solver, skills that will be valuable throughout your life.

Our curriculum allows you to examine various engineering majors from multiple perspectives before you declare a specific major. As an engineering student, you will explore engineering fundamentals and the responsible use of technology.

All of our students study in state-of-the-art classrooms and laboratories, and you may choose to conduct original research by working with outstanding faculty members. Professors and students collaborate on projects that span the spectrum of engineering from robotics and computer animation to biomedical optics and environmental engineering. Our engineering graduates are valued for their expertise, intellectual independence, communication skills, and

leadership ability. Professional demand for graduates with this background is intense. Graduates are actively recruited, not only for engineering careers but also for careers as diverse as consulting, medicine, law, and finance.

Vanderbilt's School of Engineering offers the depth and breadth of education required to solve real-world problems. Understanding how to solve these problems will give you an edge in any endeavor.

Front cover: Mechanical engineering assistant professor Robert Webster and student Jenna Gorlewicz use an app created by Gorlewicz to help visually impaired students comprehend algebra, geometry, and graphing. She used haptic technology—technology that takes advantage of a user's sense of touch by applying vibrations or motions to enhance remote control of machines, devices, or virtual objects.

Chemical and biomolecular engineering student Lara Jazmin checks the cyanobacteria study while researching how metabolic fluxes in bacteria that obtain energy through photosynthesis could be mapped.



The School of Engineering offers the bachelor of engineering degree in biomedical, chemical, civil, computer, electrical, and mechanical engineering and the bachelor of science degree in computer science and engineering science. The school also confers master of engineering, master of science, and doctoral degrees.

All full-time faculty members hold doctorates and teach undergraduate students. Our research centers and labs investigate topics from nanoscale materials, technology-guided surgery, and robotics to environmental management, intracellular engineering, and combustion diagnostics.

Many engineering students choose double majors, minors, or concentrations in complementary disciplines. In addition to training in engineering science, mathematics, physics, and chemistry, you will take liberal arts courses in the College of Arts and Science. You may also choose selected courses from Vanderbilt's other undergraduate or graduate schools or round out your academic experience with an honors program, internship, engineering-based study abroad, or accelerated degree program.

Our multimillion-dollar engineering complex combines advanced technologies in a student-centered environment. Featheringill Hall features a three-story atrium for student interactions and contains more than 50 teaching and research laboratories brimming with the latest equipment. The design studio, model shop, and project room showcase student ideas from concept to prototype to final product.

All programs leading to the bachelor of engineering degree at Vanderbilt are accredited by the Engineering Accreditation Commission of ABET, Inc. Vanderbilt also encourages stu-

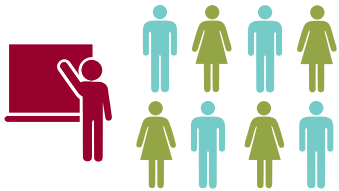


Featheringill Hall, one of five buildings housing Vanderbilt's School of Engineering, serves as a focal point for teaching, research, and engineering events.

dents to take the Fundamentals of Engineering examinations, coordinated by the Tennessee State Board of Architecture and Engineering Examiners. Vanderbilt University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools and is a member of the Association of American Universities.

School of Engineering Academic Departments

- Biomedical Engineering
- Chemical and Biomolecular Engineering
- Civil and Environmental Engineering
- Electrical Engineering and Computer Science
- General Engineering
- Mechanical Engineering



96

% of seniors graduating from Vanderbilt were satisfied with the quality of teaching

Circuit board for shooter location system—developed by engineers at Vanderbilt's Institute for Software Integrated Systems with the support of the Defense Advanced Research Project Agency—that displays enemy shooters' positions in three dimensions and identifies the caliber and type of weapon they are firing.

“In the biomedical engineering department at Vanderbilt, we put a very strong emphasis on the importance of teaching in research.”

Anita Mahadevan-Jansen,
Orrin H. Ingram Professor of Engineering,
Professor of Biomedical Engineering,
Professor of Neurological Surgery



One-On-One With Anita Mahadevan-Jansen

She may not fit the traditional ideas of pioneer, but Professor Anita Mahadevan-Jansen continues to prove herself worthy of the title. As part of a small group of biomedical engineers exploring biophotonics, she researches the applications of light for tissue physiology and pathology, especially cancer detection.

Currently, Professor Mahadevan-Jansen, along with her husband, Professor Duco Jansen, are part of a nationwide collaboration exploring how a low-power infrared laser beam can stimulate peripheral nerves and allow amputees not only to control but also to feel the movement of prosthetic limbs. Yet she still has a true passion for teaching.

“In the biomedical engineering department at Vanderbilt, we put a very strong emphasis on the importance of teaching. We encourage our students, especially those interested in academia, to get some experience in the art of teaching—most notably through the Biomedical Education Research REU (Research Experience for Undergraduates) program and undergraduate projects in biomedical engineering education.”

As Professor Mahadevan-Jansen has found, the collaborative nature of both teaching and research often leads to surprising breakthroughs.

“Two or three years ago, a surgery resident who was doing an endocrine surgery rotation noticed that all the surgeons were having a tough time finding the parathyroid. It’s a very small gland, about the size of a grain of rice, and if you remove it accidentally, there are a lot of long-term effects.

“She and I looked at all available technologies and started off using a Raman spectrometry system, but we kept saturating the detector. At first, we thought it was an artifact. It turned



Professor Anita Mahadevan-Jansen sets up a system for the non-invasive detection of the parathyroid gland using near infrared autofluorescence.

out that the parathyroid actually has a strong infrared fluorescence signal. It glows ten, twelve times stronger than everything else around it, so you can use some very simple infrared light sources to find it.

“Ultimately, there are two kinds of scientists. There are scientists who build new technologies and then look for an application to use it for, medical or otherwise. Then there are some of us who are more problem solvers. Light can do a lot of things but you need to find the right matches for it. Don’t use a hammer to look for a nail to hit.”

In addition to foundations in math, chemistry, physics, and the liberal arts, our eight academic majors provide depth of study in a wide variety of traditional engineering disciplines and some that can be customized based on individual interests. Minors as well as electives should be selected carefully to fulfill a specific purpose and in consultation with your academic adviser.

Biomedical Engineering

Bachelor of Engineering

Biomedical engineering applies engineering concepts to specific and practical problems in biology, medicine, and health care. It attempts to quantify biological events for the purpose of creating and improving upon diagnostic practices and treatment protocols. The main areas of study in our biomedical engineering program

include biophotonics, biomaterials, medical imaging, gene therapy, and technology-guided surgical devices.

Chemical Engineering

Bachelor of Engineering

Chemical and biomolecular engineering plays a key role in the development and production of pharmaceuticals and bioengineered materials for medical applications. Chemical engineers are also concerned with process control techniques and production in the development of high-strength composites and specialty polymers, semiconductors and microelectronic devices, and a variety of other products.

Civil Engineering

Bachelor of Engineering

Civil and environmental engineering prepares professionals to repair our nation's decaying infrastructure and in the use of engineered materials for stronger, lighter, more reliable buildings, bridges and transportation systems. Civil and environmental engineers address problems with land-use, sustainability, risk management, increasing population, nuclear waste management, environmental quality, and construction management.

Computer Engineering

Bachelor of Engineering

Computer engineering acts at the interface of software and hardware and deals with problems related to the organization, design and application of digital processing systems as general purpose computers or as components of information processing, control and communications. Computer engineering allows students to specialize in embedded systems, computing systems and networks, or intelligent systems and robotics.

Computer Science

Bachelor of Science

Computer science blends scientific and engineering principles, theoretical analysis, and computing experience. Program emphasis is on computing activities of both practical and intellectual interest, and on theoretical studies of efficient algorithms and the limits of computation. Students may major or minor in computer science. A finance track prepares students for a career in finance through a five-year program ending with a Master of Science in Finance from the Owen Graduate School of Management.

Electrical Engineering

Bachelor of Engineering

Electrical engineering focuses on hardware involved in electrical and electronic systems and how electrical components interact with each other. Students study mathematics, physics, and computer science and develop a foundation in circuit analysis and electronics. Students choose an area of further study in computer engineering, microelectronics, signal and image processing, robotics, and networking and communications.

Engineering Science

Bachelor of Science

Engineering science combines engineering with specialized knowledge from a concentration in applied physics; engineering management; communication of science, engineering, and technology; or materials science and engineering. Individual programs can be created within this interdisciplinary offering in areas such as engineering mathematics, environmental engineering, business administration, teaching, technical communications, and entrepreneurship, among many others.

Mechanical Engineering

Bachelor of Engineering

Mechanical engineering prepares students to become practicing engineers who design systems to control engineered products and solve problems through manufacturing processes, energy management, and hardware design. Strengths of the department include robotics, intelligent mechatronics, combustion and propulsion, nanostructures, fluid physics, and laser diagnostics of combustion and space experimentation.

Minors

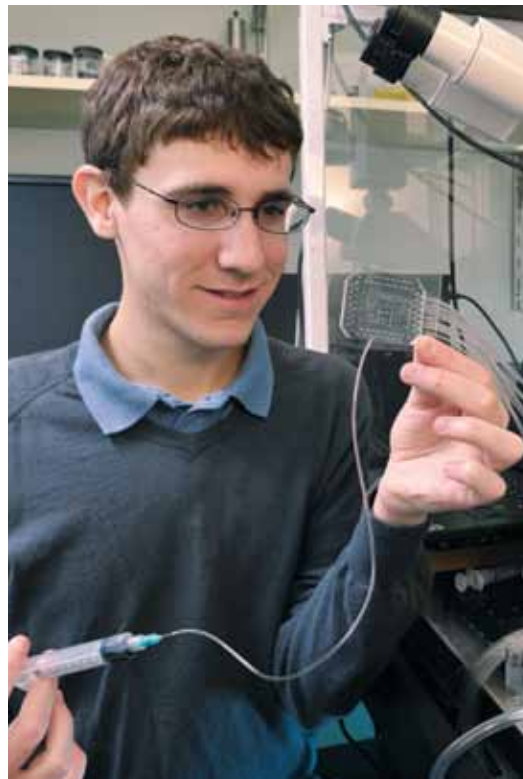
Minors in computer science, scientific computing, environmental engineering, and energy and environmental systems may be combined with various majors, as can minors offered through the College of Arts and Science. Students may also choose a minor or concentration in engineering management or materials science and engineering.

Engineering Management Minor

This interdisciplinary program links engineering, science, and management. Students study entrepreneurship, management of high-tech enterprises, engineering economics, technology strategy, business psychology, finance, communications, and supply chain management.

Materials Science Minor

High-performance materials are in demand throughout the engineering world, and there is equal demand for specialists who understand the relationship between properties and structure, the thermodynamics of materials, and the physics and chemistry of solids and liquids. In specialized laboratories you'll test the properties of materials and consider new applications of derived information.



Will Matloff (School of Engineering '13) displays the 16-channel microformulator he has been developing in SyBBURE Searle, one of only a handful of multi-year, year-round undergraduate research programs in the nation. SyBBURE Searle alumni can be found in labs and medical schools ranging from Stanford, Berkeley and Rice to Northwestern, MIT, Cambridge, and Vanderbilt.



% of engineering undergraduates are female—nearly twice the national average of 18%



Our engineering professors, all dedicated teachers, are also committed to ongoing scholarship and research. Faculty and students collaborate across disciplines to address critical research initiatives that characterize the school's commitment to developing technological solutions with real-world impact.

Energy and Environment

The School of Engineering at Vanderbilt is recognized as an international research leader in areas of structural reliability and risk, nuclear waste management, and teaching assessment approaches to environmental decision making.

Health Care

Critical research initiatives are ongoing in cellular dynamics in immunology, cardiology, cancer, as well as MRI and imaging systems to guide surgery. Other research efforts include laser-tissue interaction, biomedical optics, and bionanotechnology.

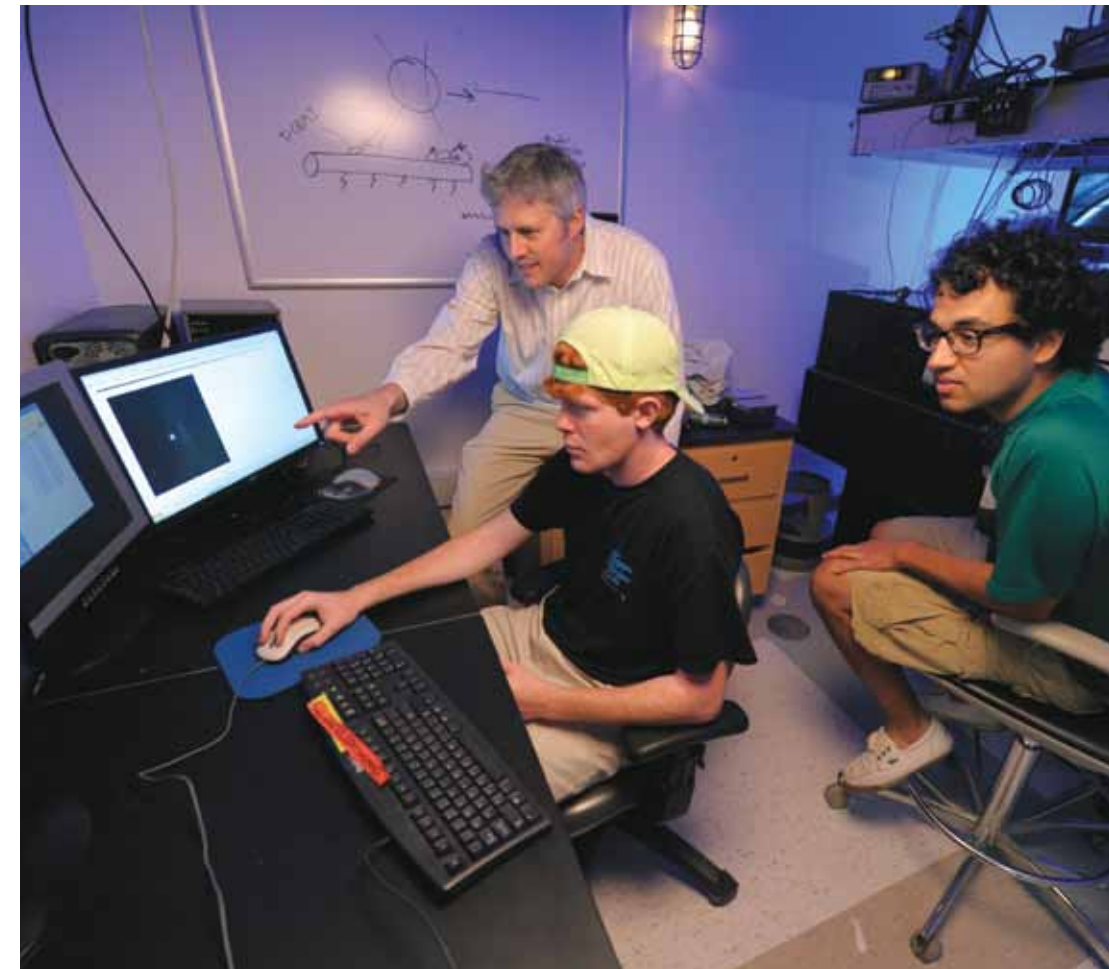
Security

A large number of faculty and students engage in leading-edge research of significant importance to critical commercial and government systems, including model-based design of trustworthy information systems, diagnostics of complex systems and tools for the design of embedded systems.

Information Technology

Research focus includes computer networking and network security, human-machine teaming, machine learning, and software engineering.

Mechanical engineering professor Michael Goldfarb walks with middle Tennessee resident Craig Hutto outside Olin Hall as Goldfarb tests a new prosthetic leg that has been developed in his lab.



Richard Stroder (School of Engineering '12) tracks motility of a biological motor using a microscope capable of visualizing a single molecule while graduate student Juan Carlos Cordova and chemical and biomolecular associate professor Matthew Lang observe.

Multidisciplinary capability is a particular strength of the school. Through programs funded by the National Institutes of Health, the National Science Foundation, the Department of Defense, the Department of Energy, and others, the School of Engineering participates in multidisciplinary collaborations with many top 25 universities and national laboratories.

The school plays a leading role in transinstitutional collaborations in nanoscience, nano-engineering, environmental, and integrative biosystems research. Additional transinstitutional

centers in which the school plays an important role include learning sciences, environmental management, and cognitive neuroscience.

Engineering faculty members are engaged in a diverse collection of research projects, such as embedded information systems and smart materials, robotics, laser surgery equipment, intelligent transportation systems, genetic therapy techniques, thin films, integrated computer systems, machine learning, renewable energy systems, and power conversion.

20

% of the School of Engineering Class of 2012 studied abroad at more than 25 universities in 12 countries/regions

Mechanical engineering senior design team presents a model of their energy-savings exhaust stack to Denso Manufacturing manager. Denso filed a provisional patent application for the team's innovative design work.



Research Internships

Students have the opportunity to perform independent research with engineering faculty as well as with other professors from across the entire university. Research interests may be identified by utilizing the school's website, working with academic advisers, or talking to course instructors. You may choose to do research for up to six hours of course credit.

You may also apply to participate in one of two paid summer research programs at Vanderbilt: the university-wide summer research program (VUSRP) or the engineering school-sponsored summer research program. Students also may wish to take advantage of National Science Foundation-sponsored Research Experiences for Undergraduates (REU) that are available across the United States.

Internships teach invaluable lessons. Graduating senior survey data indicates that **more than 69% of students typically have had at least one summer internship experience during their time at Vanderbilt.** Our students take advantage of internship opportunities posted in the Office of Student Professional Development

as well as utilizing their own networks and those of their professors.

Centers and Institutes

Center for Intelligent Mechatronics
Consortium for Risk Evaluation with Stakeholder Participation (CRESP)
Institute for Software Integrated Systems (ISIS)
Institute for Space and Defense Electronics (ISDE)
Vanderbilt Center for Environmental Management Studies (VCEMS)
Vanderbilt Engineering Center for Transportation Operations and Research (VECTOR)
Vanderbilt Initiative in Surgery and Engineering (ViSE)
Vanderbilt Institute for Energy and Environment (VIEE)
Vanderbilt Institute for Integrative Biosystems Research and Education (VIIBRE)
Vanderbilt Institute of Nanoscale Science and Engineering (VINSE)
Vanderbilt University Institute for Imaging Science (VUIIS)

Other Academic Opportunities



Led by Associate Professor Cynthia Paschal, 12 biomedical engineering students repaired medical equipment in Guatemala while participating in a service learning trip over spring break. Students hiked the Pacaya volcano, seen behind the group.

Merit Scholarships

Each year, the School of Engineering awards honor scholarships to incoming freshmen through the Cornelius Vanderbilt Scholarship Program, one of Vanderbilt's three signature scholarship opportunities. Awards are made on the basis of leadership and merit. Cornelius Vanderbilt Scholars receive full tuition, plus a one-time stipend to be used towards a summer study abroad or research experience. Scholarships are renewed each year as long as the recipient maintains at least a 3.0 GPA. Students may also apply for scholarships awarded through Vanderbilt's two other signature scholarship programs: the Ingram Scholarship and the Chancellor's Scholarship Programs. To be considered for any of our three signature scholarship programs, students must submit the appropriate forms from the Vanderbilt Application Packet for Merit-Based Scholarships.

First-Year Seminars

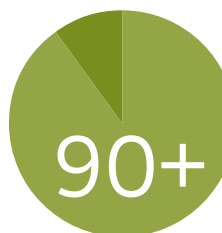
First-year seminars introduce students to the expectations of the university—a high level of scholarship and a participatory style of learning. Optional seminars through the School of Engineering or through The Ingram Commons offer freshmen opportunities to work in small groups with seasoned engineering professors. By creatively applying engineering concepts to real-world problems, students improve their communication skills and become more certain in their selection of a specific engineering major.

Honors Programs

Qualified engineering juniors and seniors may participate in departmental honors programs that emphasize independent study and research. Honors students may also take selected graduate courses in Vanderbilt's graduate and professional schools.

\$63
MILLION

in annual research expenditures by the School of Engineering from sponsored research grants



% of engineering students entering the workforce have a job within six months of graduation



Internships

Undergraduate students often choose to apply their knowledge and skills in an internship, testing levels of competence and clarifying career choices. Vanderbilt's Office of Student Professional Development places high priority on helping students find rewarding internships. A recent student, for example, served as a biomedical industrial intern for Lockheed-Martin at the Johnson Space Center in Houston, writing user guides for medical test hardware for the International Space Station Alpha. An intern majoring in computer science, math, and economics developed web applications for UnumProvident, Inc., in Chattanooga. Another intern created a website and a customer kit for medical applications for National Instruments in Austin. In addition to valuable experience beyond technical application, many internships provide an entrée into professional engineering positions.

Study Abroad

Qualified engineering students may study abroad during the summer or academic year at universities in England, France, Germany, Scotland, Mexico, South Africa, Ireland, Australia, and New Zealand, among others.

A growing number of exchange programs exist and currently include National University of Singapore, City University of Hong Kong, Hong Kong University of Science and Technology, Budapest University of Technology, and Politecnico di Torino.

Integrated Bachelor of Science/ Master of Business Administration

Selected engineering undergraduates may be accepted into an integrated engineering program through which both bachelor's and master's degrees are earned. You may earn a bachelor of science in engineering science and an MBA through Vanderbilt's Owen School of Management.

Integrated Bachelor/ Master of Engineering

Selected engineering undergraduates who have completed at least 75 hours with a B average or higher may be accepted into an integrated engineering program through which both bachelor's and master's degrees are earned. The last two years, generally of five, are planned as a unit. You may earn bachelor's and master's degrees in engineering through this program.

impact

Financial Engineering— B.S. Engineering/M.S. Finance

Computer science students interested in a career in business and finance may opt for this track. With judicious planning, computer science majors are able within four years to earn a B.S. in computer science, an optional minor in engineering management or math, and participate (optionally) in a study abroad experience and/or a senior design experience. During the fifth year, students take all courses in the Owen Graduate School of Management and may obtain an M.S. in finance after the fifth year.

Dual Degree with Fisk University

Students may earn an A.B. degree in biology, chemistry, physics, or mathematics from Fisk and a B.E. or B.S. in engineering from Vanderbilt, generally within five years.

Academic Advising

Each student is assigned a faculty adviser in his or her major department. This adviser remains with the student all four years as long as he or she does not change majors. These advisers guide course selection, direct students toward academic and research opportunities, and provide information on careers after graduation. Advisers meet with students throughout each semester and are readily available for consultation.

PAVE

PAVE, or Preparatory Academics for Vanderbilt Engineering, is a six-week summer engineering program for high school students who have completed eleventh grade. With a multidisciplinary approach, the program involves problem solving, computer skills, laboratory experiments, and technical writing in an engineering/science environment. Participants have access to all campus academic and recreational facilities.

Teacher Licensure

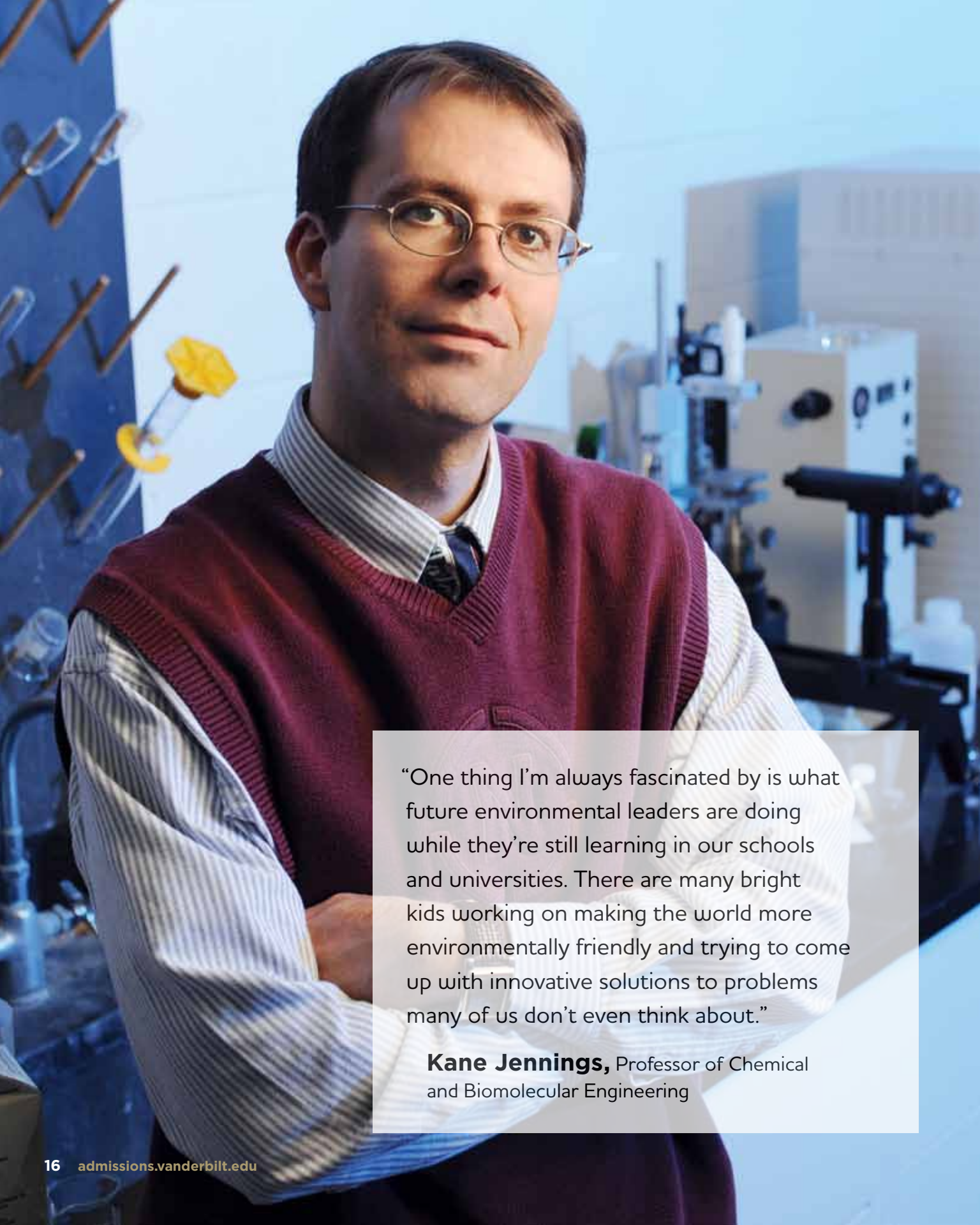
The School of Engineering and Vanderbilt's Peabody College offer a teacher education program that leads to licensure as a secondary school teacher in physics or computer technology. Students major in engineering science in the School of Engineering and complete a second major in education at Peabody. The Office of Teacher Licensure at Peabody provides guidance and information on this option.

Accelerated Graduate Program

Students who enter with 20 to 30 hours of credit—earned through Advanced Placement tests or in college courses taken during high school—may be eligible for the Accelerated Graduate Program in Engineering. A student may earn a bachelor's degree in four years and an M.S. by completing a master's thesis the following summer.

Student Steve Boronyak holds a stretch bioreactor, which is used to apply cyclic stretching to growing heart valve tissues in vitro. Boronyak works in the lab of David Merryman (right), assistant professor of biomedical engineering, who employs undergraduates in his research.





“One thing I’m always fascinated by is what future environmental leaders are doing while they’re still learning in our schools and universities. There are many bright kids working on making the world more environmentally friendly and trying to come up with innovative solutions to problems many of us don’t even think about.”

Kane Jennings, Professor of Chemical and Biomolecular Engineering

One-On-One with Kane Jennings

Chemical engineers are stereotypically seen as lab-coated introverts with Erlenmeyer flasks in hand, and while Professor Kane Jennings certainly knows his way around a lab, he’s just as comfortable in front of a class. Perhaps it’s part of his own chemistry; his father was a high school chemistry teacher after all. But according to Jennings, “During my undergraduate career, I loved the positive impact that many of my professors had on students’ lives, so I decided to go to graduate school to prepare for a career in academia.”

After earning his master’s and doctoral degrees from MIT, where he also won a Department of Energy Electrochemical Summer Fellowship, he joined Vanderbilt’s Department of Chemical Engineering, publishing over 55 papers in the area of organic thin film and interfacial science/engineering while mentoring and inspiring undergraduates, graduate students, and even pre-college students at Vanderbilt.

“One thing I’m always fascinated by is what future environmental leaders are doing while they’re still learning in our schools and universities. There are many bright kids working on making the world more environmentally friendly and trying to come up with innovative solutions to problems many of us don’t even think about.”

A good example is the recent Environmental Protection Agency’s 2012 People, Prosperity and the Planet competition, where more than 45 university teams aimed to turn an initial \$15,000 grant into a new \$90,000 grant. Vanderbilt’s team entered a biohybrid solar panel that substitutes a protein from spinach for expensive, and intensive-to-produce, silicon wafers. The team won the most awards at the event; received the Student Choice Award, voted on by students from the other teams; and won the Marketplace Award for Innovation, given out by



Chemical and biomolecular engineering professor Kane Jennings (left) and David Cliffl, associate professor of chemistry, investigate the light activity of photosynthetic proteins.

the Paladin Capital Group. In addition, the School of Engineering won the \$90,000 EPA grant.

“We’ve been looking at solar energy in the last five years and what we could do with it. Plant proteins don’t capture as much light as silicon, which is what most people use, but our photosystem is much more efficient with the energy it does capture. So we developed these two-by-two-foot solar panels that developing countries or small countries can use with their natural resources.”

Jennings said his group of students already have results that would give a thousand-fold more power per area than using silicon panels. And while he admitted that he is “two or three years away” from knowing if the project will work long term, one thing is for sure, his impact on the lives of students certainly continues to have a long-term effect.

For More Information

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Web: www.vanderbilt.edu/financialaid


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Dates to Remember 2012/2013

- August** Part I Supplement and Common Application available at www.commonapp.org
- October 1** Earliest deadline to submit the College Scholarship Service (CSS)/Financial Aid PROFILE
- November 1** Application deadline for Early Decision I
- December 15** Early Decision I notification
- January 1** Earliest deadline to submit the Free Application for Federal Student Aid (FAFSA)
- January 3** Application deadline for Early Decision II and Regular Decision
- February 5** CSS PROFILE and FAFSA due to addresses indicated
- February 15** Early Decision II Notification
- April 1** Regular Decision Notification
- May 1** Postmark deadline for matriculation deposit

admissions.vanderbilt.edu/visit
Come Visit



Senior Design Day at Vanderbilt:

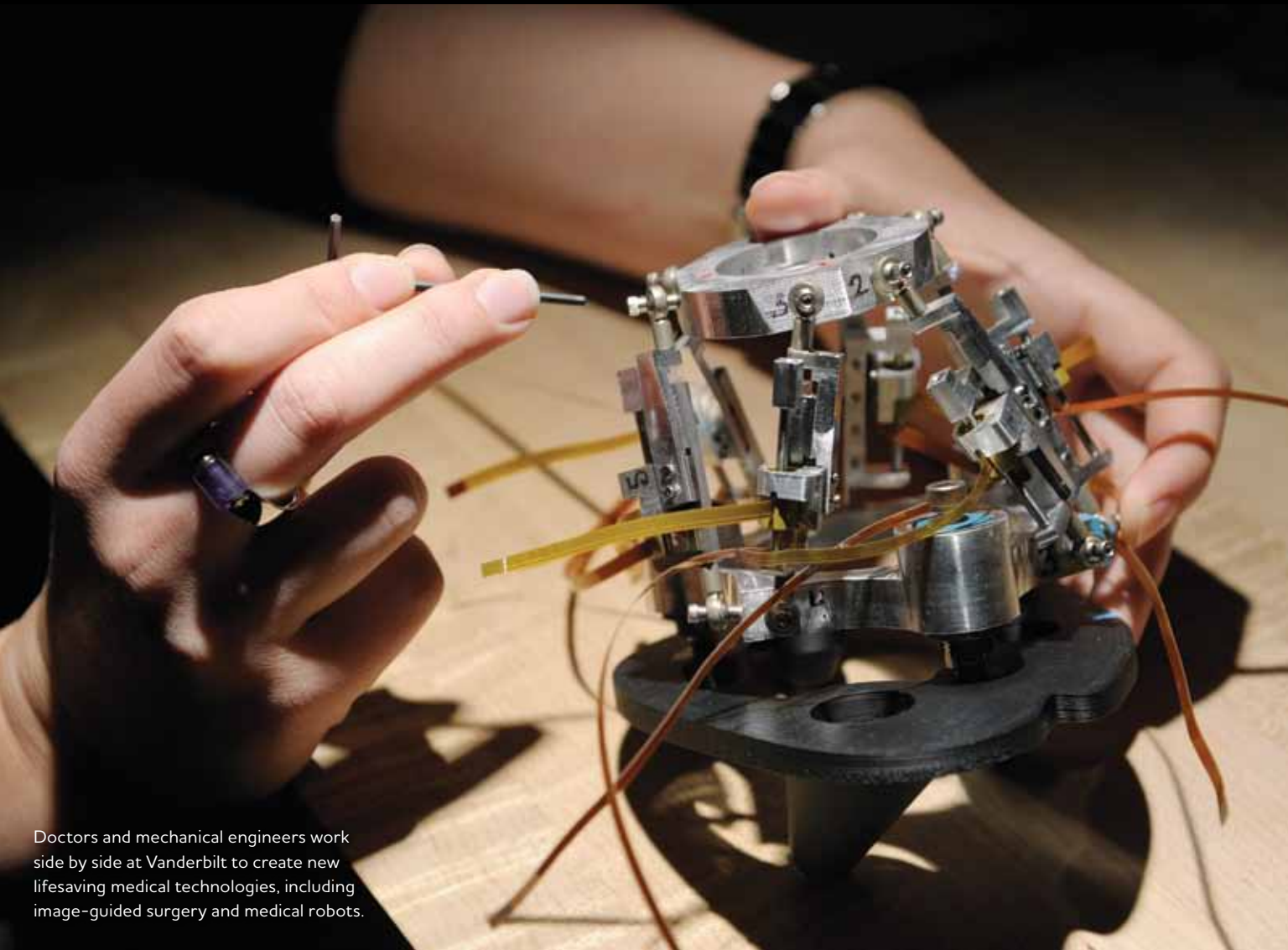
Serving as the culmination of every engineering student's year-long senior design course, Senior Design Day at Vanderbilt is held every April and is always met with campuswide excitement. Most recently, sponsors included Northrop Grumman, the Environmental Protection Agency, NASA, Nissan, Roche Diagnostics and various medical departments on Vanderbilt's campus. Projects included solutions to a wide variety of design problems: limited wheelchair functioning, the unstable foundation of a medical office building, inefficient traffic flow, the need for a noninvasive way to measure a child's internal brain temperature and much more. One student team received a \$90,000 award from the Environmental Protection Agency to further develop a spinach-powdered solar cell, and earned both the Marketplace Innovation Award from Paladin Capital, a private equity firm, and the Student Choice Award from their peers.



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Doctors and mechanical engineers work side by side at Vanderbilt to create new lifesaving medical technologies, including image-guided surgery and medical robots.