

# VANDERBILT

## SCHOOL OF ENGINEERING



[engineering.vanderbilt.edu](http://engineering.vanderbilt.edu)



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: A computer science undergraduate takes a closer look at his drone model.

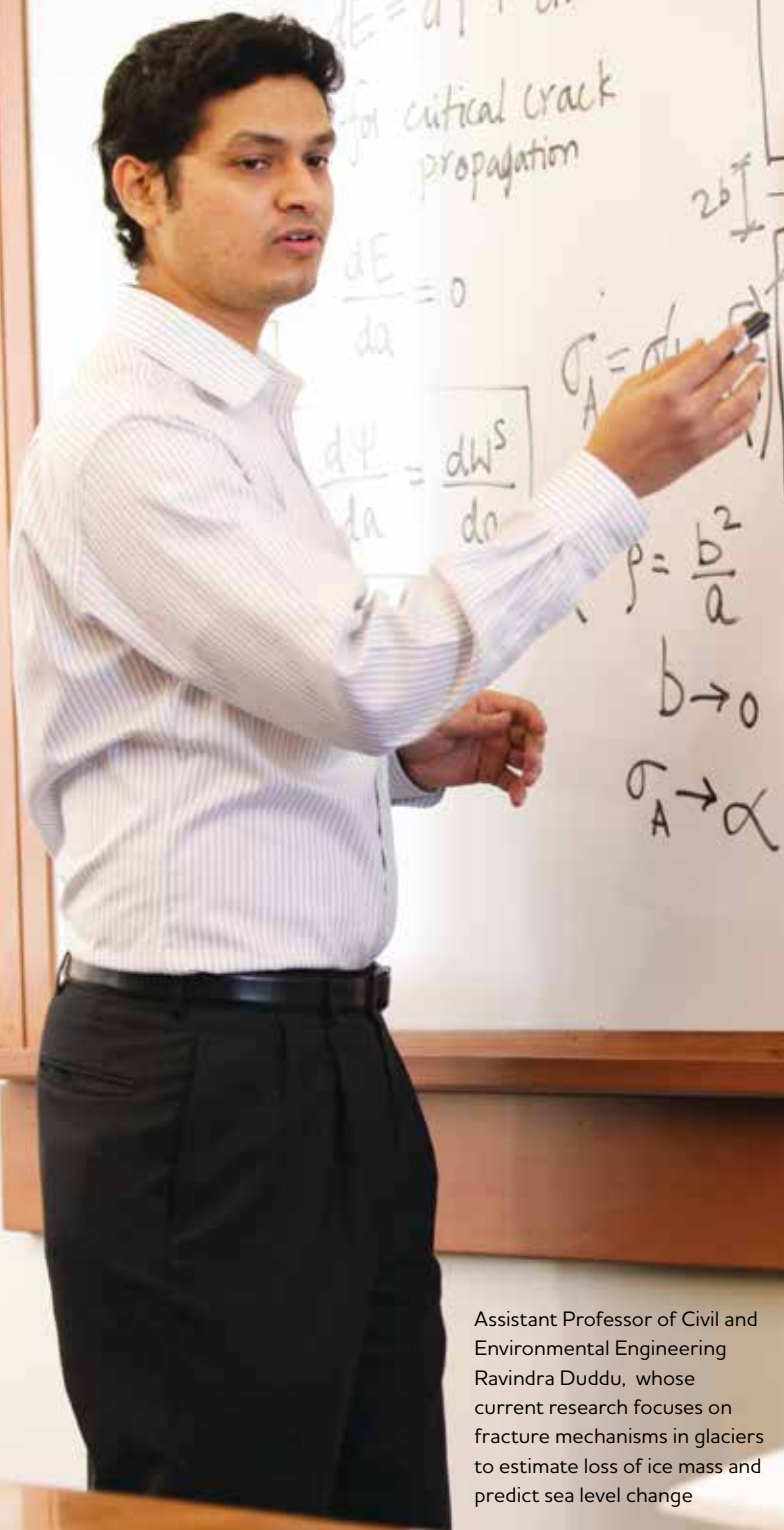
Vanderbilt appeals to engineering students who want to put their careers and lives into a rich context. You will learn creative thinking and problem solving skills that will be valuable throughout your life.

Edwin McAlister, director of Air & Missile Defense Programs for Northrop Grumman, speaks to engineering students as part of National Engineers Week.





# Insight. Innovation. Impact.®



Assistant Professor of Civil and Environmental Engineering Ravindra Duddu, whose current research focuses on fracture mechanisms in glaciers to estimate loss of ice mass and predict sea level change

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 students 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



# 97

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

William Robinson, an associate professor of electrical engineering and associate professor of computer engineering, collaborates with students to address the reliability and security of computing systems.





“Robots will transition to everyday usage, but many complex research questions must be addressed before every household owns a robot.”

**Julie Adams,**

Associate Professor of Computer  
Science and Computer Engineering

## One-on-One with Julie Adams

Watch a Hollywood movie, and you will believe that robots are infinitely intelligent and able to perform tasks with very little human assistance. As a professor and researcher, Julie Adams works year-round with Vanderbilt students in order to make such fictional robots a reality.

Professor Adams' Human-Machine Teaming Laboratory challenges students to identify complex, human-machine interaction issues and develop artificially intelligent algorithms that improve communications and coordination between humans and robots. Specifically, Adams and her students focus on developing capabilities that allow robots to work with first responders during large-scale incidents.

Adams is also passionate about developing systems that equip robots with better interaction and visualization capabilities. Designing advanced human-robotic interaction capabilities will allow a single human to interact with a large number of unmanned vehicles that are operating on the ground or in the air.

In addition to teaching undergraduate and graduate courses at Vanderbilt in artificial intelligence, mobile robotics, and human-computer interaction, Adams routinely involves both undergraduate and high school students in robotic research projects and participates in events to encourage K–12 students to pursue engineering and science careers. “Robots will transition to everyday usage, but many complex research questions must be addressed before every household owns a robot,” says Adams.

The interdisciplinary spirit that is integral to Vanderbilt led Adams to partner with Vanderbilt archaeologist Steven Wernke on the develop-



ment of a system that uses an unmanned aerial vehicle to map large archeological sites in 3-D. The system will permit archiving of archaeological sites around the world.

Adams says that the unmanned aerial vehicle system can be applied to other real-world problems, including the manner in which first responders react at a disaster site. “The device will be an excellent tool for evaluating the site of a major crisis such as September 11 in order to decide how to deploy lifesaving resources more effectively. The only way for this system to be cost-effective is for it to be easy enough to operate that you don’t need an engineer to use it. It has to be useable without on-site technical help.”

# Engineering Programs

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*

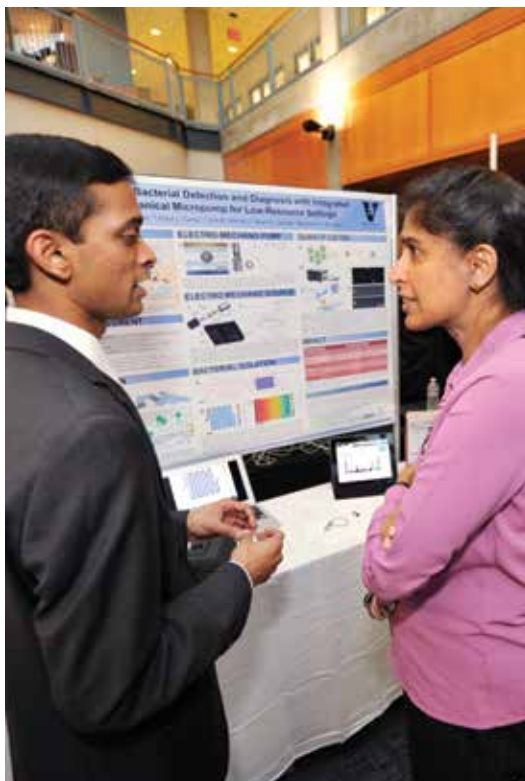
Civil and environmental engineering prepares professionals to repair our nation's decaying infrastructure with the use of engineered materials for stronger, lighter, and more reliable buildings, bridges, and transportation systems. Civil and environmental engineers address problems with land-use, sustainability,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

For more than 25 years, Vanderbilt engineering students have analyzed, experimented, and designed innovative solutions for clients ranging from the EPA, Nissan, and Oak Ridge National Laboratories to Northrop Grumman and Oreck before presenting their work as part of Senior Design Day.





## 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, or 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, energy and environmental systems, and nanoscience and nanotechnology 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.

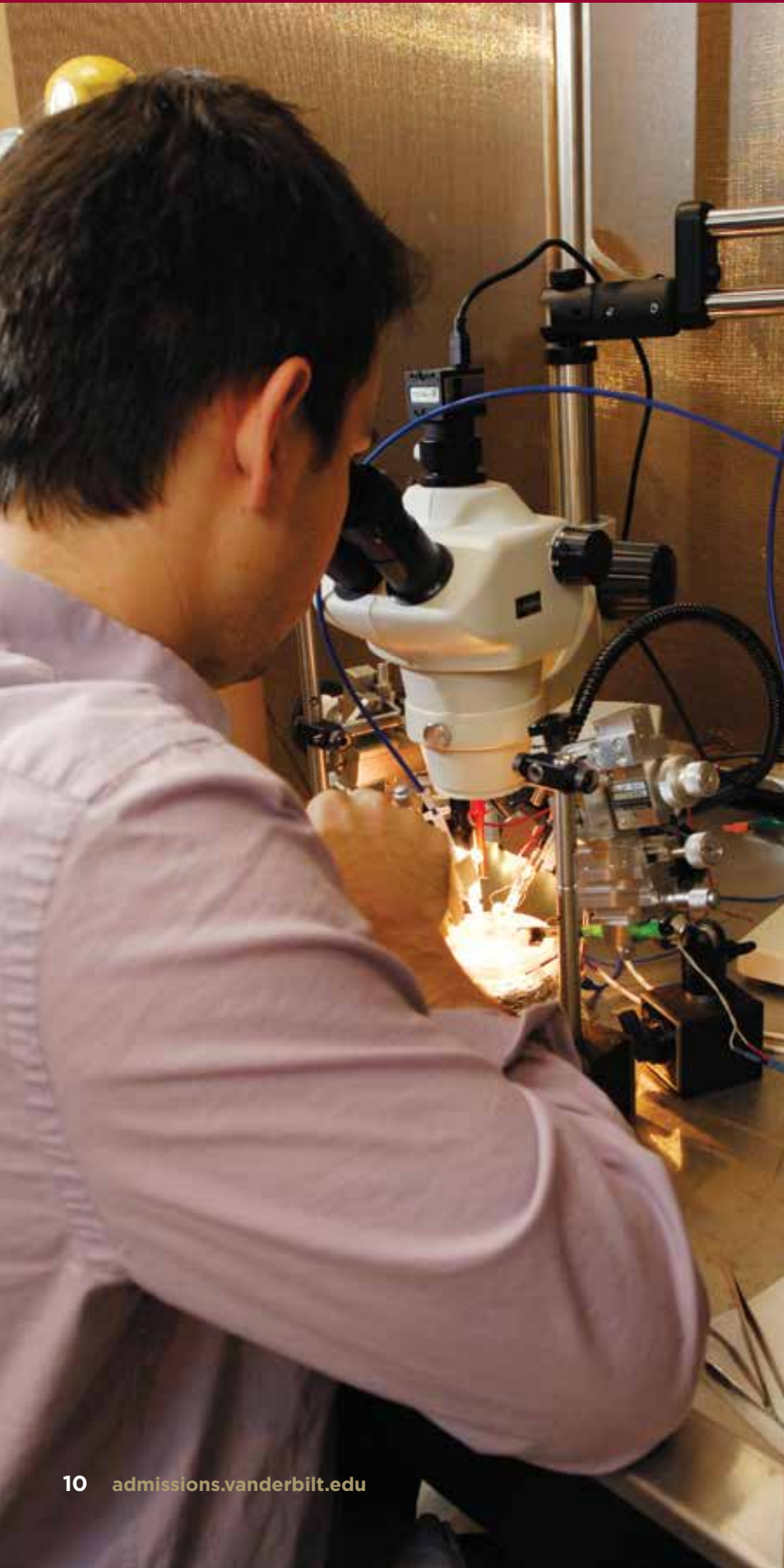
### *Materials Science Minor*

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.



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

# Engineering Research



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 Natural Resources

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 and Medicine

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 cutting-edge research that involves systems security and privacy for critical commercial and governmental agencies. Research efforts include privacy-aware health information systems, foundations of resilient systems design, system security co-design, and secure control systems for industry and society.

## Entertainment

The research in this burgeoning area focuses on computer networking and network security, human-machine teaming, machine learning, and software engineering.

Biomedical engineering students work alongside post-doctoral researchers and faculty as part of the Biomedical Photonics Research Group.



20

% of the School of Engineering Class of 2013 studied abroad at more than 40 programs in 19 countries

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.



Members of the Vanderbilt Aerospace Club showcase their bio-hybrid, ramjet engine rocket that uses carbon-neutral, 100 percent renewable, bio-hybrid fuels for combustion, the first-place winner of the 2013 NASA Student Launch Project Challenge.



### Research and 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 (VUSR) 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 **73% of students typically have had at least one 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)

**\$73**  
MILLION

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

# 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 in 2012. Students hiked the Pacaya volcano, seen behind the group.

## Merit Scholarships

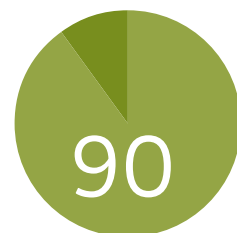
Each year, the School of Engineering awards honor scholarships to incoming freshmen through the Cornelius Vanderbilt Scholarship Program, one of Vanderbilt's three signature scholarship opportunities. Awards are made on the basis of leadership and merit. Cornelius Vanderbilt Scholars receive full tuition, 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 Martha Rivers 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.



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

Engineering students and professors listen to an address by Thomas Zacharia, deputy director for science and technology at Oak Ridge National Laboratory, and one of many guest speakers to share their insights throughout the year.



### 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, Israel, Scotland, Spain, 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.

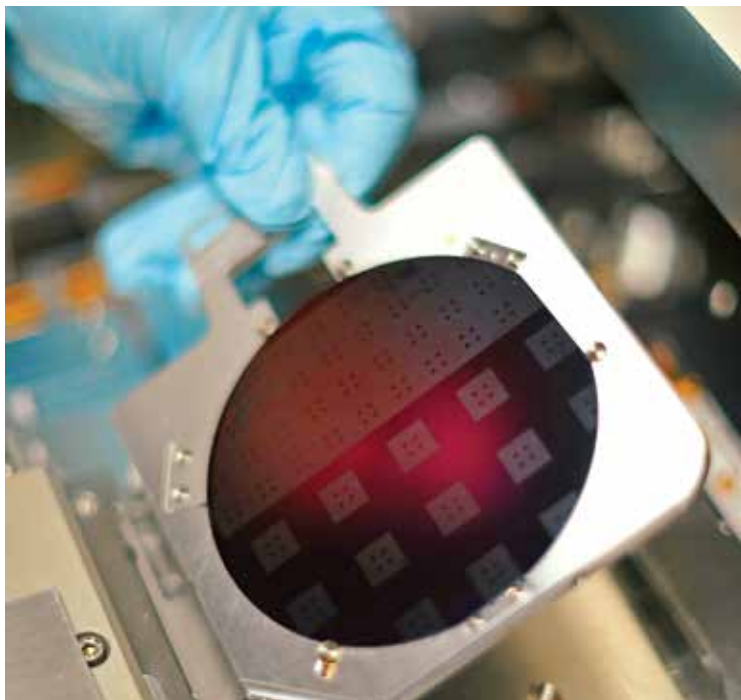
## Teacher Licensure

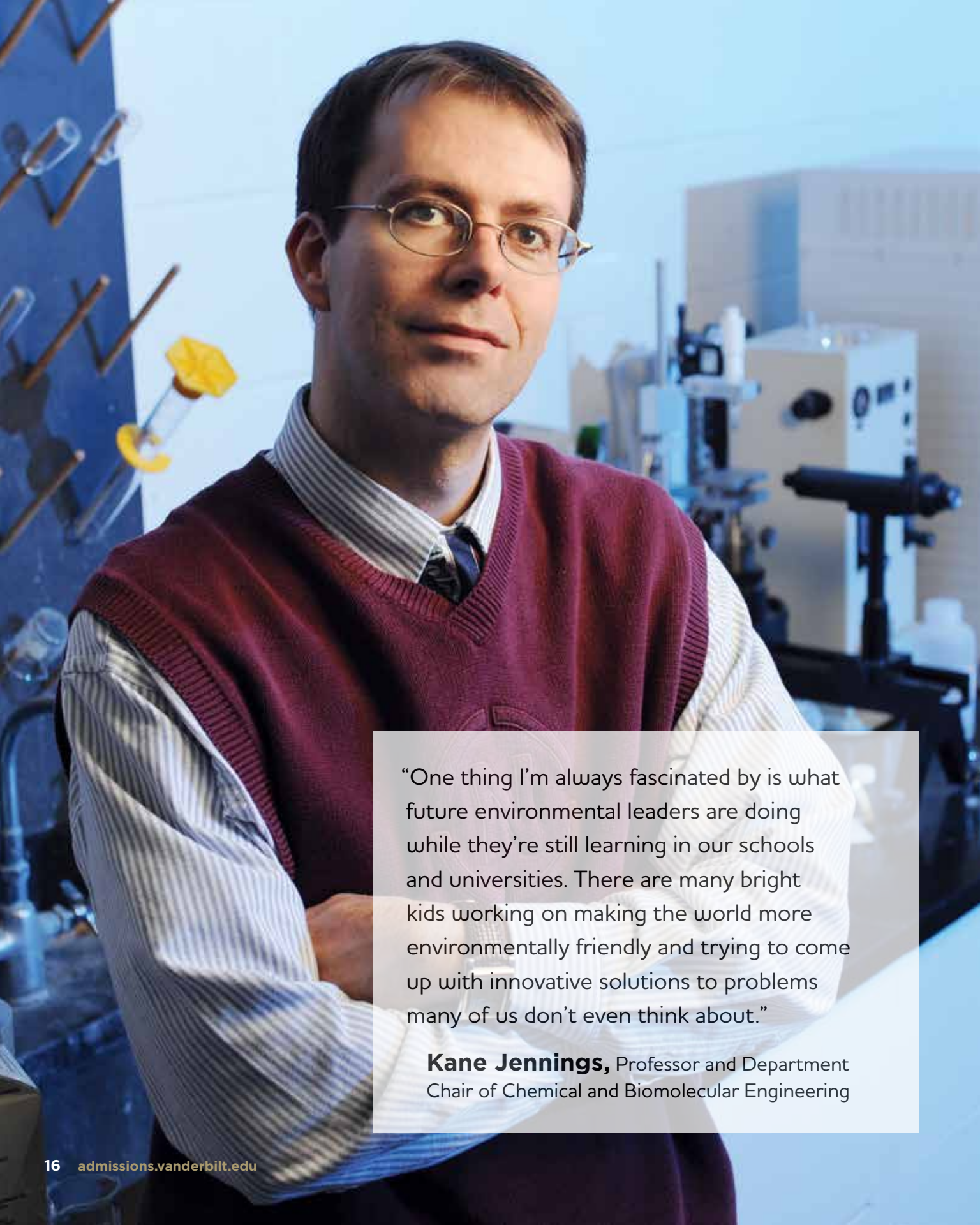
The School of Engineering and Vanderbilt's Peabody College offer a teacher education program that leads to licensure as a secondary school teacher in physics. Students major in engineering science in the School of Engineering and complete a second major in education at Peabody. The Office of Teacher 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.

Silicon dioxide patterns held by Tony Hmelo, research associate professor of materials science and engineering and director of VINSE Core Laboratories





“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 and Department Chair 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, but 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



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

Marketplace Award for Innovation, given out by 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 has 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


Vanderbilt University  
School of Engineering  
PMB 351826  
2301 Vanderbilt Place  
Nashville, Tennessee 37235-1826  
(615) 322-2762  
Web: [engineering.vanderbilt.edu](http://engineering.vanderbilt.edu)

Office of Undergraduate Admissions  
Vanderbilt University  
2305 West End Avenue  
Nashville, Tennessee 37203-1727  
(615) 322-2561 or (800) 288-0432  
Email: [admissions@vanderbilt.edu](mailto:admissions@vanderbilt.edu)  
Web: [admissions.vanderbilt.edu](http://admissions.vanderbilt.edu)

Office of Student Financial Aid and  
Undergraduate Scholarships  
Vanderbilt University  
2309 West End Avenue  
Nashville, Tennessee 37203-1725  
(615) 322-3591 or (800) 288-0204  
Email: [finaid@vanderbilt.edu](mailto:finaid@vanderbilt.edu)  
Web: [vanderbilt.edu/financialaid](http://vanderbilt.edu/financialaid)

**Accreditation** All programs leading to the Bachelor of Engineering degree are accredited by the Engineering Accreditation Commission of ABET, Inc. ([www.abet.org](http://www.abet.org)). Vanderbilt University is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools to award bachelor's, master's, education specialist's, professional, and doctoral degrees and is a member of the Association of American Universities. Vanderbilt University is an equal opportunity/affirmative action institution.

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## Dates to Remember 2013/2014

- August Common Application available at [commonapp.org](http://commonapp.org)
- November 1 Application deadline for Early Decision I
- November 5 Priority filing deadline for College Scholarship Service (CSS) PROFILE for Early Decision I
- December 15 Decision response for Early Decision I
- January 1 Application deadline for Early Decision II and Regular Decision
- January 5 Priority filing deadline for CSS PROFILE for Early Decision II
- February 3\* Priority filing deadline for CSS PROFILE for Regular Decision
- February 3 Priority filing deadline for FAFSA for Early Decision I, Early Decision II, and Regular Decision
- February 15 Decision response for Early Decision II
- April 1 Decision response for Regular Decision
- May 1 Deadline for matriculation deposit

\*For international students, priority filing deadline for CSS PROFILE is January 5, 2014.



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[admissions.vanderbilt.edu/visit](http://admissions.vanderbilt.edu/visit)  
**Come Visit**



## Senior Design Day at Vanderbilt

Serving as the culmination of a student's design experience, Senior Design Day at Vanderbilt is held every April and is always met with campus-wide excitement. Most recently, sponsors included Northrop Grumman, NASA, Nissan North America, Trane Corporation, and various medical departments on Vanderbilt's campus. Projects included solutions to a wide variety of design problems: optimization of aircraft fuselage components, a test board for a cube satellite that will launch from a NASA rocket, a master plan for Nashville's iconic Centennial Park, a smart car seat that could prevent a child from being left alone in a hot car, and much more. One student team received a \$90,000 award from the Environmental Protection Agency to further develop a spinach-powered solar cell, and the results have piqued the curiosity of a Fortune 500 company.





**VANDERBILT**  
**UNIVERSITY**

Office of Undergraduate Admissions  
2305 West End Avenue  
Nashville, TN 37203-1727

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Outside Featheringill Hall, one of  
six buildings housing the School of  
Engineering and home to more than  
50 teaching and research laboratories