

Invent Create Discover





"My research allows me to directly apply my bioengineering education, to think critically and develop and test new methods to answer questions that, I am hopeful, can save lives." *—Kristi Chakrabarti,* rising junior Explore Innovate Build Foundations Integrate Collaborate Serve



Come to Penn and change someone's life

As a Penn student you join some of the most talented faculty and students in the world. You are part of a cosmopolitan lvy League university and a top international research and medical community. In bioengineering, you collaborate and create knowledge in engineering, medicine, business, and the arts and sciences.

That means if you want to work in a world-famous biomedical research lab, all you have to do is ask. If you want to design a new medical device or build a start-up company, all the entrepreneurial skill and expertise is right here. And if you want to become fluent in Spanish or Chinese, fire pots in a fine arts studio, or make an animated film, you can.

What are faculty and students doing? How are they making news? They are:

- · creating tissue to rebuild torn ligaments and cartilage
- decoding the brain's signals for treating epilepsy
- · detecting disease with molecular beacons
- protecting children by understanding brain injuries
- building new polymer gels for precise delivery of potent drugs
- safeguarding implants with bacteria-resistant coatings
- discovering how cells regenerate in the brain
- modeling how cells "talk" to each other and learning why this goes wrong in cancer
- · fitting children with prosthetics or orthotics in China
- bringing clean water to villages in Latin America and Africa
- teaching science after-school in West Philadelphia and in programs on campus







Creating Knowledge





Professor Susan Margulies studies the mechanisms of traumatic brain and lung injury in children and adults.



Kristi Chakrabarti is currently doing research in the lab of Dr. Lewis Chodosh, at the Abramson Family Cancer Research Institute. She studies the role of a protein kinase in breast cancer development and metastasis.



"I feel that in the last three years bioengineering and Penn have made me break down problems and rationally arrive at solutions. In a sense, they have given me the confidence to really attack any issue, not just in engineering or academics."

—Joan José Martínez, rising senior

Explore Innovate Build Foundations Integrate Collaborate Serve



What will you learn?

Our capstone experience is the senior design project.

While completing research—independent study or senior design—you may apply for a patent, launch a business, or help treat disease.

Undergraduates have conceived, designed, created:

• The SmartSock–a "sock" with a microprocessor designed by Chrysta Irolla, graduating senior, that would allow amputees to walk in greater comfort by adjusting for pressure at the juncture of prosthesis and limb.

• The Metacarpal Exoskeleton (patent pending for Jonathan Tzou, senior)—a splint that helps metacarpal fractures heal by stabilizing the joint under the cast as edema changes.

• First Flavor, Inc.-a company that is developing a patent-pending edible marketing technology called Peel 'n Taste, founded by alumni Adnan Aziz (dual degree in political science).

• An enhanced method for detection of HIV-a virus which can remain hidden within cells for a long time, researched by Megan Liszewski, Danielle Friedman, and Sarah Casey, graduating seniors.







Invent | Create | Discover

Learn the skills to:

• Start your own company as Jonathan Danoff did while an undergraduate. He cofounded IntelliStem Orthopaedic Innovations, Inc., with then-fellow Bioengineering/Wharton student Jared Bernheim. Their discovery: implants coated with piezoelectric ceramics cause electrical impulses to stimulate bone growth.

• Realize your ideas as undergraduates Alex Mittal and Priyanka Agarwal did when they returned from Honduras. They had helped build a village water system with Penn's chapter of Engineers Without Borders but were troubled about bacterial contamination. What they needed was to discover a cheap way to treat permanently the inside of plastic pipes against dangerous microbes. They teamed up with others to create Innova Materials based on their research.

• Publish your research-as many as 20% of the Class of 2008 did while they were undergraduates.

- Go to medical school.
- Pursue biomedical research in graduate school.
- Enter law school.
- · Become a management consultant with world-wide firms.
- Take your expertise to the F.D.A., the U.S. Patent Office, or the National Institutes of Health.

IFYOU COME TO PENN ASKING-and we hope you ask- "WHAT DO I WANT TO DO WITH MY LIFE?" four transformative years here will help you decide.





"The relationships you make during the lab experience, both with professors and friends, are some of the strongest I have at Penn."

---Robert Mozia, rising senior, with Sevile Mannickarottu (left), undergraduate lab coordinator

Explore Innovate Build Foundations

Integrate Collaborate Serve





You will be taught by bioengineering faculty beginning your freshman year. You will get to know your professors, like Department Chair David Meaney, who offer undergraduates many research opportunities in their labs.

How do you start?

Getting Your Bearings – Year I

Learn the fundamentals. Writing, physics, math-the building blocks, taught by preeminent professors. Team-taught chemistry from an engineering perspective.

Hear guest lecturers from across the university.

In your Introduction to Bioengineering, you experience hands-on labs and learn how bioengineering cuts across disciplines.





Build Foundations



"Thinking Like an Engineer" – Year 2

Explore biomechanics, biomaterials, biomedical instrumentation, and biology. In the sophomore bioengineering labs, face a problem you may have never seen: the challenge of designing your own experiment.

- Formulate important questions.
- Anticipate what problems could occur.
- Solve problems; design solutions.
- Learn to analyze and interpret the data.
- Research the literature.
- Support your conclusions.
- Work in teams.

You are encouraged to discover on your own, and your work is original. Faculty promote innovation and creativity through laboratory discovery, while peers become labmates, colleagues, and friends.





"After participating in Penn's Global Biomedical Research Program in China and Hong Kong, I fell in love with the field of prosthetics and orthotics." (Inspired by her experience, Chrysta designed the SmartSock above, a prosthetic device that senses pressure and allows amputees to walk in greater comfort.) "I am using PennVention and Wharton Business Plan Competition money to pay for prototyping components and the full patent."

---Chrysta Irolla, graduating senior

Explore Innovate Build Foundations Integrate Collaborate Serve



For the first two years, classes are the same. Then, you begin to chart your own career.



"The Global Biomedical Service program (in Shunde, China) allowed me to apply my technical and analytical skills in ways that I had not previously imagined. This exposure to orthopedic biomechanics, patient assessment, and product manufacturing confirmed my aspirations of becoming an orthopedic surgeon. I've never been involved in a project with such profound magnitude and impact."

-Elana Cooper, rising senior

Deciding on a path-two degree choices

Bachelor of Applied Science (BAS)

This choice gives you flexibility to choose more courses outside the engineering school than a traditional curriculum does. For example, you may:

- · Pursue a dual degree
- Learn Turkish, Hebrew, Hindi, or Swahili
- Spend time in an art studio
- Explore the ethical impact of research
- Design a Senior Thesis.

or

Bachelor of Science in Engineering (BSE)

This path leads to a fully accredited professional engineering degree, with courses that enable you to:

- Understand human physiology's engineering principles
- Wrestle with the ethics of gene therapy
- Learn about the body's signals and systems
- · Master more chemistry from a bioengineering point of view
- Create a Senior Design Project
- Tailor your degree to fit your interests with upper-level engineering classes.

and...



Integrate



BAS and BSE

Both programs give you the chance to:

- Shadow a clinician at a Penn hospital for ten weeks
- Take organic chemistry for pre-med
- Minor in nanotechnology, economics, engineering entrepreneurship, chemistry, math, or...
- Spend a summer-or every summer-in a lab
- Take social science and humanities electives
- Travel to a developing country with Engineers Without Borders
- Study in Hong Kong and China learning and fitting prostheses or orthotics with the Global Biomedical Service program...

and you can change from one degree program to the other!







"I want to be not just a researcher but also an inventor. After talking to a good friend of mine, I finally saw the support and resources around me in the engineering school to delve into inventing devices, products, and programs."

—Osama Ahmed, far right, rising senior

Explore Innovate Build Foundations Integrate Collaborate Serve



"…a greater group effort."





"I remember once standing in the operating room, watching a patient being operated on by the da Vinci Robotic Surgery system, when I realized that I was in the OR with the world's expert on head and neck cancer using a stateof-the-art robot to remove a cancer from the patient's tongue base. I was in the same room with two physicians from Belgium and a professor from Egypt, all of whom had flown to the United States to see Dr. Weinstein use the da Vinci Robot—a technique invented at the Hospital of the University of Pennsylvania."

-Alex Yen, rising junior

Apply your knowledge in a research lab with faculty across the university who more than willingly train and support you. You can begin researching even as a freshman and continue, often with financial support, throughout your Penn career.

Plunging into Research, Extending Medicine's Reach – Years 3 and 4

Choose research opportunities in the medical, veterinary, dental, and nursing schools and among the hundreds of cross-disciplinary institutes at Penn–from the McKay Orthopaedic Lab to the Penn Institute for Research in Cognitive Science.

Clinical preceptorship-the chance of a lifetime

Do you want to know how a neurosurgeon collaborates with a bioengineer or an interventional cardiologist uses the latest imaging technology? World-renowned physicians will give you an experience few undergraduates in the U.S. ever receive: ten weeks shadowing them as they treat patients, perform surgery, diagnose, teach you.



Collaborate

Find research opportunities everywhere you look: it's as easy as an e-mail or a question after class.

• "My research experience has been enlightening! It has really taught me how science is done, but more so if a research career is for me. I started research the summer after sophomore year, having never worked at a research lab. The researchers reminded me that my work was always part of a greater group effort." —Joan José Martínez

(The hydrogel study, for which Joan José performed immunohistochemical staining to measure limits of pain, was accepted for publication by the *Journal of Orthopaedic Research*. Joan José is continuing research in chronic neck pain and immune response by studying how pain responses are processed in the brain stem and thalamus.)

• "I started working with Dr. McDonough during my junior year and studied proton therapy.... Doing so exposed me to all aspects of the treatment planning process and the daily routines of a radiation oncologist. The breadth of my research experiences in this one field showed me how much freedom and room for research there is in radiation oncology." —Bari Dane, graduating senior

(Penn will begin treating cancer patients integrating conventional radiology with a new cyclotron for proton beam therapy which targets tumors, leaving healthy tissue unharmed.)









"I traveled abroad four times with Penn Engineers Without Borders to communities in Honduras and Cameroon to bring clean drinking water and sanitation facilities to underserved communities."

—Sarah Casey, graduating senior

Explore Innovate Build Foundations Integrate Collaborate Serve



How have you changed?

A swift four years have passed, and you are about to do something you probably could not have imagined before coming to Penn. Your interdisciplinary experiences have changed the kinds of questions you will ask for the rest of your life.

For those of you who have fitted prostheses in China or worked on water systems in Honduras, you will know how important your expertise is to the lives of many others. The entrepreneurs among you will be taking the seed money you won in the PennVention competition or the know-how you gained in your courses to launch new businesses. The engineers among you will develop new devices to treat and diagnose disease, while your consultant counterparts will put together the venture capital to bring your discoveries to market.



How will you change the world?







Wherever you go, you will bring with you the confidence, knowledge, and partnerships you have gained at Penn, just as these stories of recent alumni and upper-classmen show:

"Having the opportunity to apply what I was learning in the classroom in a way that actually improves lives opened my eyes I plan to do similar work as a Peace Corps volunteer. A career in international health is my ultimate goal." —Sarah Casey

"As a new field, BE demands a creative yet diligent problem-solving skill set, and Penn does a great job teaching exactly that. At the same time, my professors and advisors helped me be creative with the direction I wanted to take my education, which allowed me to work on entrepreneurial ideas I had."

—Adnan Aziz

"When I first came to Penn, I thought I would become a consultant. After working a summer of 9-to-5 jobs, I realized I wanted something more, and the professors in the BE department really helped me find my passion in doing research."

—Robert Mozia

"The analytical mindset that I learned in BE was especially helpful in my first job after college as a management consultant. Even though I wasn't functioning as an engineer or designing new technology, I knew enough about the technologies and engineering lingo that my clients used to be able to build a rapport with them and really understand my clients' entire business."

—Leo Chang, Management and Technology program alumni



Come to Penn and change someone's life.



"When I first came to Penn, I did not know what I wanted to do. The BE curriculum is flexible enough that I was able to get independent study credit for doing developmental biology research. I am currently doing HIV research and like the challenge of trying to find out something that's never been known before." —*Megan Liszewski,* graduating senior

Come to Penn and change your life.

Invent | Create | Discover

Department of Bioengineering







$\overline{Invent} \mid Create \mid Discover$

Department of Bioengineering 240 Skirkanich Hall 210 S. 33rd Street Philadelphia, PA 19104-6321 Tel 215.898.8501 Fax 215.573.2071

www.seas.upenn.edu/be www.seas.upenn.edu/be/undergrad/prospective

University of Pennsylvania Nondiscrimination Statement The University of Pennsylvania values diversity and seeks talented students, faculty and staff from diverse backgrounds. The University of Pennsylvania does not discriminate on the basis of race, sex, sexual orientation, gender identity, religion, color, national or ethnic origin, age, disability, or veteran status in the administration of educational policies, programs or activities; admissions policies; scholarship and loan awards; athletic, or other University administered programs or employment. Questions or complaints regarding this policy should be directed to: Executive Director, Office of Affirmative Action and Equal Opportunity Programs, Sansom Place East, 3600 Chestnut Street, Suite 228, Philadelphia, PA 19104-6106 or by phone at (215) 898-6993 (Voice) or (215) 898-7803 (TDD).

