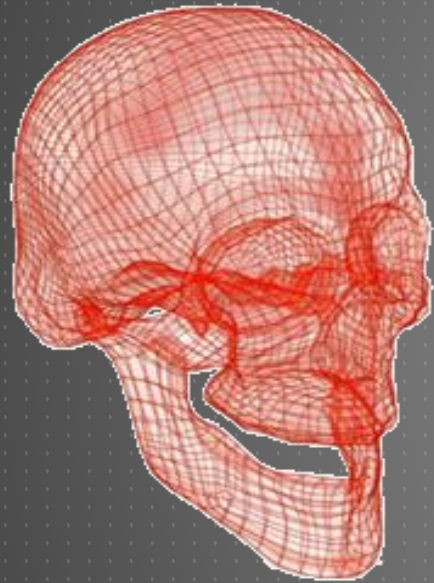


# BIOMEDICAL ENGINEERING

HPA Career of the Month  
Oct. 2020

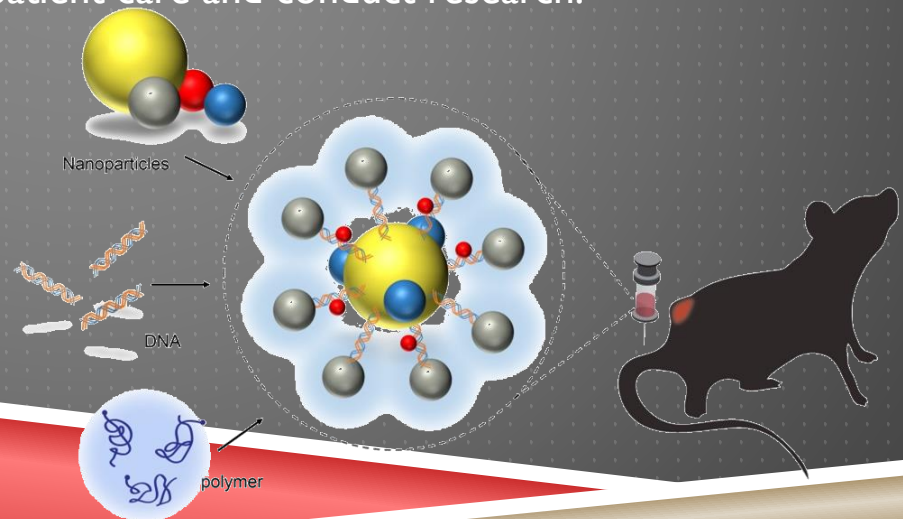
# WHAT IS BIOMEDICAL ENGINEERING?



- ▶ Biomedical engineers apply the concepts of engineering – mathematical modeling, analysis, design – to living systems, improving lives by solving problems in biology and medicine. The field is rapidly expanding to include many exciting research areas:
  - ▶ Bioinstrumentation: developing tools for biological research
  - ▶ Biomaterials: creating synthetic materials intended to interact with living systems
  - ▶ Biomechanics: analyzing the mechanics of living organisms
  - ▶ Cell and tissue engineering: repairing or replacing living cells with synthetic cells
  - ▶ Drug delivery: improving the way medications are administered
  - ▶ Medical imaging: creating images of the body using light, sound, radiation, electrodes, etc.

# WHAT DO BIOMEDICAL ENGINEERS DO?

- ▶ Biomedical engineers' work may include designing surgical robots and artificial organs, making synthetic lubricants for aging joints, improving techniques for DNA sequencing and making MRI machines smaller and more powerful.
- ▶ New job opportunities for biomedical engineering are constantly emerging – [U.S. News & World Report](#) ranks biomedical engineering among the top ten engineering jobs and the [US Bureau of Labor Statistics](#) predicts faster than average job growth.
- ▶ Many graduates work in the biotechnology industry, in pharmaceutical and medical device companies. Others work in hospitals, medical research facilities and government regulatory agencies. Many of our students go on to medical school and then use their knowledge of technology to improve patient care and conduct research.



# BIOMEDICAL ENGINEERING SPECIALTIES

- ▶ **Bioinstrumentation** uses electronics, computer science, and measurement principles to develop instruments used in the diagnosis and treatment of medical problems.
- ▶ **Biomaterials** is the study of naturally occurring or laboratory-designed materials that are used in medical devices or as implantation materials.
- ▶ **Biomechanics** involves the study of mechanics, such as thermodynamics, to solve biological or medical problems.
- ▶ **Clinical engineering** applies medical technology to optimize healthcare delivery.
- ▶ **Rehabilitation engineering** is the study of engineering and computer science to develop devices that assist individuals recovering from or adapting to physical and cognitive impairments.
- ▶ **Systems physiology** uses engineering tools to understand how systems within living organisms, from bacteria to humans, function and respond to changes in their environment.

# DEGREE OPTIONS

- ▶ Careers in BME are diverse and may be pursued with a variety of educational backgrounds.
- ▶ Students with bachelor's degrees in Biology, Engineering, or related fields may pursue BME after graduation and then decide on an advanced degree based on their career trajectory.
- ▶ To advance in the field, a few degrees are common, including a Master of Engineering (M Eng), a Master of Science (MS), or a doctoral degree (PhD).
- ▶ Some students opt to combine biomedical engineering and medical training in MD/PhD or MD/Masters dual degree programs.



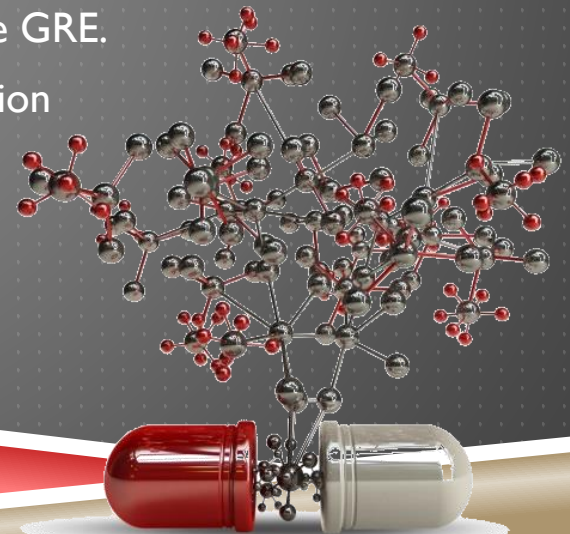
# SAMPLE DEGREE OPTIONS

*THE PRATT SCHOOL OF ENGINEERING AT DUKE UNIVERSITY*

	<b>PhD</b>	<b>MS</b>	<b>M Eng</b>
Curriculum:	Research degree with advanced technical course work and a dissertation	Research degree with advanced technical course work and a thesis	Non-thesis degree comprised of technical and business coursework with internship and applied research experience
Professional Interests	Research/technology development in academia, industry, or government	Research/technology development in academia, industry, or government	Product design, product development, and innovation in industry
Duration	6 years	1.5-2 years	1.5-2 years
Ideal for	Those interested in leading specialized research efforts, contributing new knowledge in an interdisciplinary, highly collaborative environment.	Those interested in participating in research efforts, or who are preparing for a doctoral program.	Those who seek practice-oriented training through both course work and real world training.
Learn More	<a href="https://BME.Duke.edu/Grad/PhD">BME.Duke.edu/Grad/PhD</a>	<a href="https://BME.Duke.edu/Master-Science">BME.Duke.edu/Master-Science</a>	<a href="https://BME.Duke.edu/Grad/MEng">BME.Duke.edu/Grad/MEng</a>

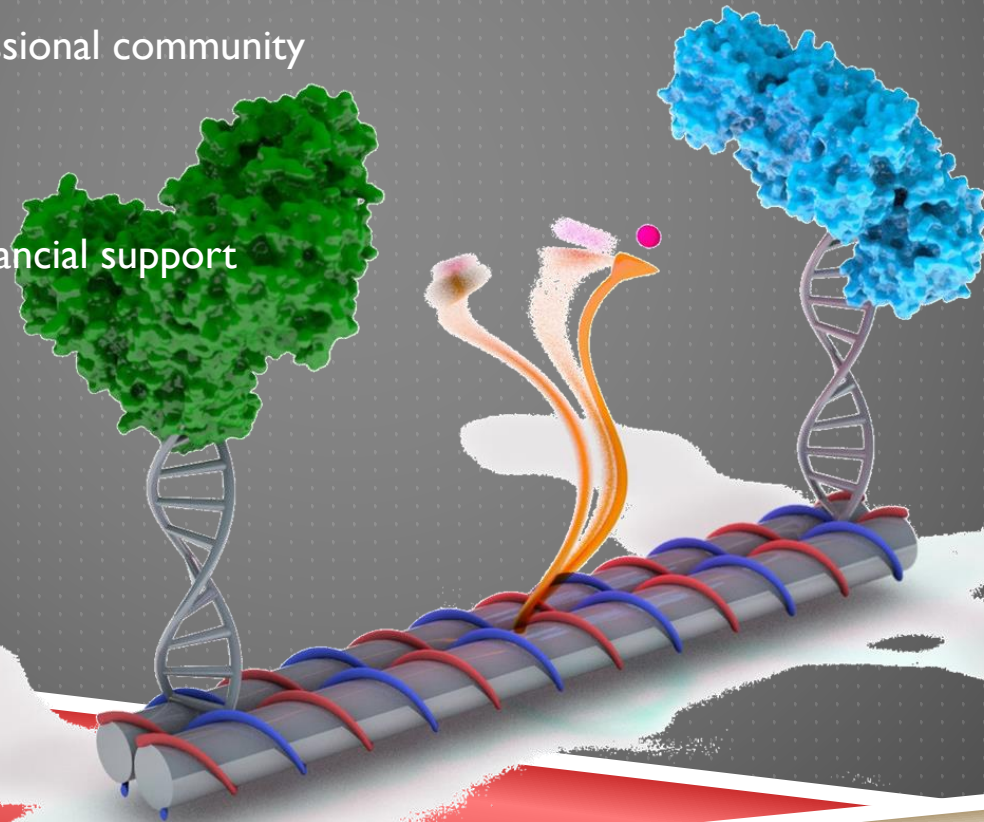
# ADMISSIONS REQUIREMENTS

- ▶ Will vary depending on the program, but will likely include:
  - ▶ Degree in engineering or a science discipline, or course work in physics, chemistry, advanced mathematics, and biology
  - ▶ Graduate Record Exam
  - ▶ Personal statement
  - ▶ Letters of recommendation
  - ▶ Application deadlines generally in the academic year prior to matriculation
- ▶ Students applying for the MD/PhD will follow regular medical school admissions requirements and may have additional requirements set by the PhD program.
  - ▶ Most MD/PhD programs accept the MCAT in lieu of the GRE.
  - ▶ Students will apply about 15 months prior to matriculation



# FACTORS IN SELECTING SCHOOLS

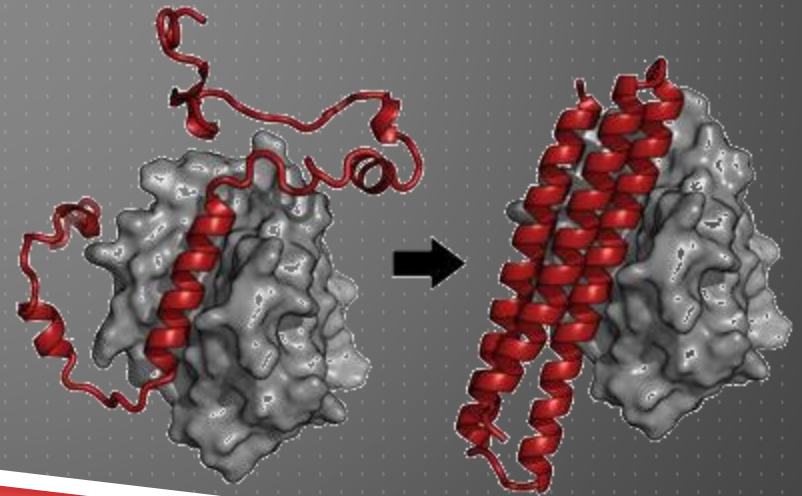
- ▶ Availability of specialty area(s) of interest. BME encompasses diverse areas of study, from Computational Biology to Systems Neuroscience to Tissue Engineering, to name a few. Different programs specialize in different areas.
- ▶ Research opportunities
- ▶ The student and professional community
- ▶ Curriculum
- ▶ Location
- ▶ Cost / availability of financial support





# SAMPLE SCHOOLS FOR BME

- ▶ [The Whiting School of Engineering at Johns Hopkins University](#)
- ▶ [The College of Engineering at Georgia Institute of Technology](#)
- ▶ [The School of Engineering at Massachusetts Institute of Technology](#)
- ▶ [University of California – San Diego Jacobs School of Engineering](#)
- ▶ [The School of Engineering at Stanford University](#)
- ▶ [The Pratt School of Engineering at Duke University](#)
- ▶ [The College of Engineering at University of California-Berkeley](#)
- ▶ [Boston University College of Engineering](#)
- ▶ [Columbia University](#)



# SCHOOLS WITH MD/PhD IN BME

*This is not an exhaustive list. See [AAMC.ORG](https://www.aamc.org) MD/PhD Policies for more.*

- ▶ [Perelman School of Medicine at the University of Pennsylvania](#)
- ▶ [Stanford University School of Medicine](#)
- ▶ [Boston University School of Medicine](#)
- ▶ [Yale School of Medicine](#)
- ▶ [Case Western Reserve University School of Medicine](#)
- ▶ [Northwestern University Feinberg School of Medicine](#)
- ▶ [Vanderbilt University School of Medicine](#)
- ▶ [University of Pittsburgh School of Medicine / Carnegie Mellon University](#)
- ▶ [Mayo Clinic](#)

# SAMPLE CURRICULUM

## MS AND PHD IN BIOMEDICAL ENGINEERING AT VANDERBILT SCHOOL OF ENGINEERING

### **Master of Science- 30 hours of grad-level credit**

12 credit hours, Biomedical Engineering

3 or more approved credit hour courses in life sciences at/above 6000 level

9 credit hours of Advanced Engineering/Science

At least 6 of the BME hours and 3 of the advanced science or engineering hours must be 6000+ level courses. One (1) hour of BME seminar and 6 hours of thesis research credit hours can count toward the total of 30 hours necessary for the M.S. degree. In addition, the candidate must submit a research thesis for faculty approval and give a final oral presentation.

### **Doctor of Philosophy- min 27 semester hours of grad-level didactic courses**

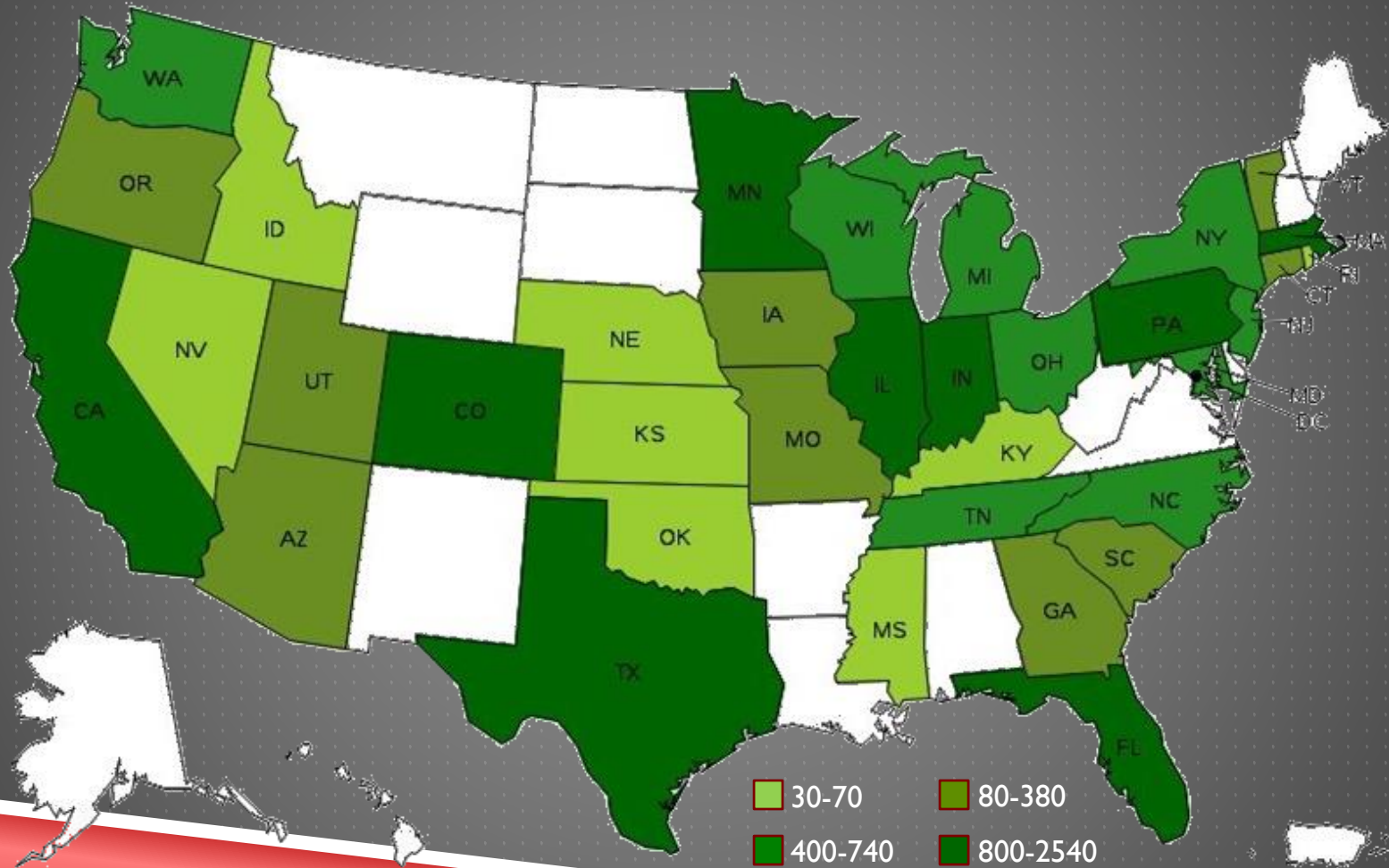
15 credit hours, Biomedical Engineering

3 or more approved credit hour courses in life sciences at/above 6000 level

9 credit hours of Advanced Engineering/Science

Of the 27 required didactic credits, at least one course is required to be strongly quantitative. It must either come from the list provided by the department or be approved by your mentoring committee.

# EMPLOYMENT OF BME BY STATE, MAY 2019



# VIDEOS AND ARTICLES OF INTEREST

- ▶ The [IEEE Engineering in Medicine & Biology Society \(EMBS\)](#) boasts over 9000 members. They have a [career guide](#) for students considering careers in Biomedical Engineering.
- ▶ [Designing a Career in Biomedical Engineering](#): an IEEE YouTube playlist for those considering a career in BME.
- ▶ [Columbia University BME Webinar Series 2020-21](#)
- ▶ Articles of Interest
  - [Day in the Life of a Biomedical Engineer](#)
  - [Research and Life](#)
  - [Engineer the Future of Human Health with a PhD in Biomedical Engineering](#)
  - [A War Made Me Realize: The World Needs More Biomedical Engineers](#)
  - [Biomedical Engineering Ranks in Top Five in NIH Funding for Fourth Straight Year](#)
  - [Biomedical Engineering Spotlight: Mallory Gullett](#)
  - [How to Get Grad School Funding in STEM](#)

# FOR MORE INFORMATION

- ▶ Bioengineering at Princeton: [Princeton.edu/CBE/Research/Bio/](https://Princeton.edu/CBE/Research/Bio/)
- ▶ Career Development Grad School Guide: [careerdevelopment.princeton.edu/sites/careerdevelopment/files/graduate\\_school\\_guide\\_2020.pdf](https://careerdevelopment.princeton.edu/sites/careerdevelopment/files/graduate_school_guide_2020.pdf)
- ▶ [AIMBE.org](https://AIMBE.org) American Institute for Medical and Biological Engineering
- ▶ [BMES.org](https://BMES.org) Biomedical Engineering Society, Advancing Human Health and Well Being
- ▶ [IEEE.org](https://IEEE.org) The Institute of Electrical and Electronics Engineers is the world's largest professional association for the advancement of technology.
- ▶ [EMBS.org](https://EMBS.org) The Engineering in Medicine and Biology Society is your global connection to the biomedical engineering community.
  
- ▶ Publications of Interest
  - ▶ [Designing a Career in Biomedical Engineering](#)
  - ▶ [IEEE PULSE](#)

