Department of Biomedical Engineering

Spring Open House

Kristen Billiar, Ph.D.
Professor and Department Head
kbilliar@wpi.edu

Karen L. Troy, Ph.D.
Professor and Associate Head
ktroy@wpi.edu

wpi.edu/academics/bme
@WPI_BME
What is Biomedical Engineering?

“What is Biomedical Engineering?

“The application of engineering principles to the solution of problems in biology and medicine for the enhancement of health care”

To prepare students for rewarding careers in the health care industry or professional programs in biomedical research or medicine applying critical systems thinking and engineering rigor to create value at the challenging interface of engineering and medicine, through multidisciplinary student-centered project-based experiences.

The WPI community and the BME Department value diversity. We are a community that stands for civility and respect. We stand for acceptance of others and champion those who may need compassion and understanding. We are an inclusive community that respects peaceful discord and upholds a fundamental belief that all members of our community deserve to feel safe.

For more on WPI’s values statement, please see: https://www.wpi.edu/about/diversity-inclusion
Biomedical Engineering Faculty

**Kristen Billiar***
*Dept. Head & Professor*
Research Interests:
- Mechanobiology and Tissue Mechanics
- Functional Tissue Engineering
- Wound Healing & Regeneration
- Biomaterials Characterization

**Songbai Ji***
*Professor*
Research Interests:
- Biomechanics
- Orthopedics
- Finite Element Modeling
- Osteoporosis
- Musculoskeletal Injury
- Biomechanics and Computational Modeling
- Sports-related Modeling
- Medical Imaging
- Surgical Image Guidance

**Karen Troy***
*Professor & Assoc. Dept. Head*
Research Interests:
- Biomechanics
- Orthopedics
- Finite Element Modeling
- Osteoporosis
- Musculoskeletal Injury

**George Pins***
*Professor*
Research Interests:
- Mechanobiology and Tissue Mechanics
- Functional Tissue Engineering
- Wound Healing & Regeneration
- Biomaterials Characterization

**Raymond Page***
*Professor of Practice*
Research Interests:
- Tissue Regeneration
- Cell Dedifferentiation and Differentiation
- Natural Biopolymers
- Cell Therapy

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- Natural Biopolymers
- Cell Therapy

**Dirk Albrecht***
*Associate Professor*
Research Interests:
- BioMEMS/Microfluidics
- Neural Dynamics and Behavior
- Automated Microscopy
- High-throughput Screening

**Jeannine Coburn***
*Associate Professor*
Research Interests:
- Biomaterials
- Tissue Engineering
- In vitro Disease Models
- Drug Delivery

**Brenton Faber***
*Professor of Writing*
Research Interests:
- Social Determinants of Health
- Scientific and Medical Writing
- Health Systems and Pre-hospital Medicine
- Ethics and Biomedical Technologies

**Dirk Albrecht***
*Associate Professor*
Research Interests:
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- Automated Microscopy
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**Jeannine Coburn***
*Associate Professor*
Research Interests:
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- Tissue Engineering
- In vitro Disease Models
- Drug Delivery

**Diana Alatalo***
*Assistant Professor*
Research Interests:
- Biomechanics
- Women’s Health and Maternal-Child Health
- Rheology
- Biofluids/BioTransport

*Research faculty*
**Biomedical Engineering Faculty**

**Adam Lammert**  
*Assistant Professor*  
Research Interests:  
- Neuroengineering and Brain Health  
- Computational Modeling  
- Signal Processing  
- Sensorimotor Control

**Solomon Mensah**  
*Assistant Professor*  
Research Interests:  
- Vascular Engineering  
- Mechanobiology  
- Medical Device Development  
- Global Health

**Catherine Whittington**  
*Assistant Professor*  
Research Interests:  
- In vitro disease models  
- Pancreatic cancer and Fibrosis  
- Lymphatic Growth and Function  
- Vascularization and Tissue Engineering

**Haichong “Kai” Zhang**  
*Assistant Professor*  
Research Interests:  
- Bioinstrumentation and Signal Processing  
- Medical Robotics  
- Medical Ultrasound and Photoacoustic Imaging  
- Brain and Cancer Imaging

**Sakthikumar Ambady**  
*Assoc. Teaching Professor*  
Research Interests:  
- Regenerative Medicine  
- Cell and Tissue Engineering  
- DNA and Protein Transfers  
- Molecular Biology

**Zoe Reidinger**  
*Assoc. Teaching Professor*  
Research Interests:  
- Tissue Engineering  
- Biomaterials  
- Design

**Taimoor Afzal**  
*Assistant Teaching Professor*  
Research Interests:  
- Neural Engineering  
- Machine Learning  
- Pattern Recognition  
- Movement Control

**Funmi Ayobami**  
*Assistant Teaching Professor*  
Research Interests:  
- Biomechanics  
- Orthopedics  
- Engineering Education  
- Diversity, Equity, and Inclusion

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*Research faculty*
BME Research/Teaching Clusters

Biomechanics and Mechanobiology
- Computational Biomech
- Tissue Biomechanics
- Image-guided surgery
- Rehabilitative Engineering

Bioinstrumentation & Quantitative Imaging
- Wearable Sensors
- Signal Analysis
- Neurobiology
- Cellular imaging
- Machine learning/bioinformatics

Biomaterials and Tissue Engineering
- Regenerative Medicine
- Drug Delivery
- Biomanufacturing
- In vitro Tissue Models
- Cell Delivery

Worcester Polytechnic Institute
Biomaterials and Tissue Engineering

Kristen Billiar
Jeannine Coburn
Solomon Mensah
Raymond Page
George Pins
Zoe Reidinger
Marsha Rolle
Catherine Whittington
Biomechanics and Medical Robotics

Diana Alatalo
Funmi Ayobami
Kristen Billiar
Songbai Ji
Adam Lammert
Karen Troy
Haichong (Kai) Zhang

Worcester Polytechnic Institute
Bioinstrumentation and Signal Processing

Taimoor Afzal
Dirk Albrecht
Songbai Ji
Adam Lammert
Solomon Mensah
Karen Troy

Worcester Polytechnic Institute
BME Curriculum

Freshman Courses

Sophomore Level Bridge Courses
(Transition to Specialization)

Upper-Level Courses in Specialization
BME Curriculum (Courses)

**Balanced, Multidisciplinary, Focused**

✓ **Fundamental Freshman Courses:**
  - Mathematics, Physics, Chemistry, Biology

✓ **Sophomore Bridge Courses:**
  - Foundations in Bioprocess Engineering
  - Foundations of Bioinstrumentation, Signals, Data Analysis
  - Foundations of Biomechanics & Biotransport
  - Foundations of Biomaterials & Tissue Engineering

✓ **Junior Year – (4) Challenge-based Labs in Core Areas:**
  - Skeletal Biomechanics Lab
  - Biomaterials Lab
  - Cellular Engineering Lab
  - Bioinstrumentation Lab

✓ **Biomedical Engineering Specialization Areas:**
  - Bioinstrumentation, Biosignals & Image Processing
  - Biomechanics
  - Biomaterials & Tissue Engineering
Strong emphasis on Professional Skills

- Students work in diverse, multidisciplinary groups and address open-ended problems

- Projects teach and promote:
  - Critical thinking
  - Research methodologies

- Communications Skills:
  - Writing intensive
  - Requires oral presentations

- Teaches students to:
  - Set goals/priorities
  - Manage time
  - Work within practical constraints

- Entrepreneurial minded learning (EML) / Value Creation
BME Teaching and Project Labs

Instrumentation and Design Lab

Mechanical Testing Lab

Surgical Training Lab

Cell Culture Lab

Chemical Wet Lab

Imaging Lab
WPI/BME Curriculum (Projects)

“Lehr und Kunst”, Theory and Practice

Great Problems Seminar: Team-based research and project work focused on global importance

Project-Enriched Hands-On Learning:

▪ Humanities and Arts
  
  (Project in a non-technical discipline)

▪ Interactive Qualifying Project (IQP)
  
  (Project relating science and technology to society)

▪ Major Qualifying Project (MQP)
  
  (Technical capstone project and design experience in the student’s major)

Entrepreneurial Mindset Learning and Value Creation – across curriculum
WPI/BME Curriculum

“Lehr und Kunst”, Theory and Practice - Design
MQP: Optimization of a Sternal Fixation Technique

Experimental Set-Up (published in ATS)

FEA (published in ABME)

Students - Erin Dupak, Najmuddin Gunja, Nicole McMahon, Shruti Pai

Advisors - Professors Kristen Billiar, George Pins, Raymond Dunn
FAQs
Job Prospects in Biomedical Engineering

BME 2021 Post-Graduation Survey of UG Class:

<table>
<thead>
<tr>
<th>Status</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed</td>
<td>67%</td>
</tr>
<tr>
<td>Graduate School</td>
<td>21%</td>
</tr>
<tr>
<td>Other</td>
<td>9%</td>
</tr>
<tr>
<td>Unknown</td>
<td>3%</td>
</tr>
</tbody>
</table>

BME Average Starting Salaries with BS:

2020: $65,006

(WPI, CDC Survey; #10 Princeton Review)
Job Prospects in Biomedical Engineering

- **BME ranked #1 for Best Engineering jobs** (US News 2023)

**Employment in Biomedical Engineering**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Care</td>
<td>1460</td>
</tr>
<tr>
<td>Colleges and Universities</td>
<td>680</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>4840</td>
</tr>
<tr>
<td>Medical Equipment Manufacturing</td>
<td>2480</td>
</tr>
<tr>
<td>Instrument Manufacturing</td>
<td>1270</td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td>1300</td>
</tr>
</tbody>
</table>

**Biomedical Engineering Salaries**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Care</td>
<td>85,920</td>
</tr>
<tr>
<td>Colleges and Universities</td>
<td>62,650</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>79,400</td>
</tr>
<tr>
<td>Medical Equipment Manufacturing</td>
<td>97,090</td>
</tr>
<tr>
<td>Instrument Manufacturing</td>
<td>98,610</td>
</tr>
<tr>
<td>Pharmaceutical</td>
<td>108,690</td>
</tr>
</tbody>
</table>

https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm
Where are WPI BMEs Employed?

- **Medical Device Development**
  - Research and Development
  - Engineering Design and Analysis
  - Manufacturing
  - Regulatory Affairs

- **Biomedical Research**

- **Corporate Management**
  - Project Management
  - New Business Development
Biomedical engineers work in a variety of settings, depending on what they do:

- Hospitals where therapy occurs
- Laboratories conducting research
- Manufacturing settings where they design and test medical products
- Commercial enterprises where they make or support business decisions
- Entrepreneurs / start-up companies
- Federal government agencies (e.g. FDA, NIH, EPA, PTO).
Continuing Graduate Education

• MS/ME Programs in BME
• PhD Programs in BME
• Professional Programs
  ➢ Medical Schools
  ➢ Dental Schools
  ➢ Veterinary Schools
  ➢ Law Schools
Continuing Graduate Education

Graduate schools attended by our BME graduates (*Partial List*):

- Brown University
- Rutgers University
- Rice University
- University of California (Berkeley/SF)
- Boston University
- Tufts University
- Clemson University
- Georgia Tech
- Harvard University
- Cornell University
- MIT
- Columbia University
- Johns Hopkins University
- University of Pittsburgh
- WPI
- Imperial College (UK)
- University of London (UK)
- University of Cambridge (UK)
Award-winning students:
- 5 Goldwater Scholars
- 6 Tau Beta Pi Scholarships,
- 7 NSF GRFPs (13 NSF GRFP Hon. Mentions)
- 2 AHA Summer Fellowships
- Marshall Scholar
- 2 NIH-Oxford/Cambridge Biomedical Scholar
- Rotary Ambassadorial Scholarship
- SWE Scholarship
The BME Department is AWESOME!

Faculty vs. student athletic events!
The faculty/grad students always win 😊

Pie eating is an “athletic” event