BME Careers: An Overview
A Mix of Engineering and Biology

Prof Bruce Wheeler
BME Careers
Some Perspectives
And Reality Checks
Lots of Data for Engineers
BME Data – not so much
Simple Observations

- The field has exploded
- Huge Opportunity for All of Society -- Globally
- Involves all forms of engineering and biology
- Huge challenge for academics, employers, students, professionals
Curricula

We are Preparing Students for
”MED TECH”
(devices)
“BTECH”
Molecular, pharma, tissue, …
“BINFORMATICS
Genomic data
”BSYSTEMS”
Analysis of complex systems
BioE Job Market (BS/MS Level)

- Growing percentage-wise very quickly
- Smaller than other engineering fields especially CS
- Growing need for cross trained in BioE & Other Engineering
  - design, quality control, software, manufacturing …
- There are also good jobs in: clinical engineering, marketing, field support, business operations, …
- Think about Law, MBA, regulatory (FDA)
- Traditional engineering majors with biology minors
  - Compete with BME majors
- Biologists – especially molecular
  - Compete with some molecular oriented BME majors
- Helps to have a strength in a more engineering traditional area
- MS helps significantly
BME Enrollment and Employment

Source: AIMBE http://navigate.aimbe.org

Good News

- 20,100 BME jobs in US (estimates up to 27,000)
- 7% growth rate to 2026
- $92,970 annual salary average (Bureau of Labor Statistics)
- 1008 PhDs in 2017
BME Enrollment and Employment

Sources: American Institute of Medical and Biological Engineering [http://navigate.aimbe.org], Bureau of Labor Statistics, American Society for Engineering Education

Good News

- 20,100 BME jobs in US (AIMBE: 21,300 in 2016; others up to 27,000)
- 7% growth rate to 2026
- $92,970 annual salary average (Bureau of Labor Statistics)
- 1008 PhDs in 2017

Not So Good News (ASEE and Bureau Labor Statistics)

- 6,725 grads/yr = 33% of current total BME job market
- 34,060 current BME BS students = 70% greater than total BME job market
- 4,025 current BME MS students = 20% of total BME job market
- 6,730 current BME PhD students = 33% of total BME job market
<table>
<thead>
<tr>
<th>Engr Field</th>
<th>2012</th>
<th>2017</th>
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<tbody>
<tr>
<td>AgE</td>
<td>3.0</td>
<td>1.3</td>
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<tr>
<td>BME</td>
<td>4.5</td>
<td>3.0</td>
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<tr>
<td>ChemE</td>
<td>4.6</td>
<td>3.1</td>
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<td>MechE</td>
<td>12.7</td>
<td>9.7</td>
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<td>Materials</td>
<td>18.9</td>
<td>13.4</td>
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<td>Aero</td>
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<td>16.2</td>
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<td>EE</td>
<td>23.5</td>
<td>17.0</td>
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<td>Petroleum</td>
<td>34.8</td>
<td>18.3</td>
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<tr>
<td>Mining</td>
<td>33.9</td>
<td>20.9</td>
</tr>
<tr>
<td>Environ.</td>
<td>32.0</td>
<td>22.8</td>
</tr>
<tr>
<td>Civil</td>
<td>21.3</td>
<td>25.1</td>
</tr>
<tr>
<td>Nuclear</td>
<td>29.0</td>
<td>29.5</td>
</tr>
<tr>
<td>CS</td>
<td>256.0</td>
<td>133.0</td>
</tr>
</tbody>
</table>

**Not So Good News:**

**Ratios:**

**Total USA Jobs**

**Current BS Grads**

**Notes:**
- Job totals for all who are working, not new openings;
- BS grads are those graduating in 2017

Enrollments are increasing faster than jobs

STEM recruitment in middle/high school increases number of BS grads

Limits of STEM – it’s Really TE

- 2013 starting salary data for BS grads:
  - English majors - $32k
  - TE: Engineering/CS - $50k
  - S: Biology - $25k
  - S: Chemistry – a little better than English majors
  - M: Math – between Chem and Engineering

- Associate’s Level
  - Bio and Chem majors ~ barista
  - Eng / CS tech – twice as much

- NIH recognizes oversupply of biology PhD’s
  - (still happening today)

STEM Employment by type of STEM occupation, May 2015

STEM is really CS and Engineering
Important Data Points

Unemployment among BS Engineering Grads is lowest of all major employment groups

2013: Engineers: 2.9% vs All BS degrees: 4.3%

(2013 was not a good year)
Biomedical Engineers
By far the fastest growing engineering field
The more like an engineer …
- Higher pay, more jobs, but … is it as interesting?

The more like a biologist …
- Lower pay, fewer jobs, but … is it as interesting?

But … *the Big But* …

Life is more than calculating odds for getting a job

The exciting stuff is “right down the middle” -- both bio and engineering

Where are you going to bet your life?
Caveat

There exist ZERO Reliable Statistics on Employment Of BME Majors
<table>
<thead>
<tr>
<th>NSF categories used for engineering occupations</th>
<th>Number employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeronautical/aerospace/astronautical engineers</td>
<td>96,000</td>
</tr>
<tr>
<td>Agricultural engineers</td>
<td>7,000</td>
</tr>
<tr>
<td>Bioengineers/biomedical engineers</td>
<td>26,000</td>
</tr>
<tr>
<td>Chemical engineers</td>
<td>80,000</td>
</tr>
<tr>
<td>Civil, including architectural/sanitary engineers</td>
<td>251,000</td>
</tr>
<tr>
<td>Computer engineers – hardware</td>
<td>70,000</td>
</tr>
<tr>
<td>Electrical and electronics engineers</td>
<td>290,000</td>
</tr>
<tr>
<td>Environmental engineers</td>
<td>66,000</td>
</tr>
<tr>
<td>Industrial engineers</td>
<td>82,000</td>
</tr>
<tr>
<td>Marine engineers and naval architects</td>
<td>12,000</td>
</tr>
<tr>
<td>Materials and metallurgical engineers</td>
<td>31,000</td>
</tr>
<tr>
<td>Mechanical engineers</td>
<td>337,000</td>
</tr>
<tr>
<td>Mining and geological engineers</td>
<td>5,000</td>
</tr>
<tr>
<td>Nuclear engineers</td>
<td>25,000</td>
</tr>
<tr>
<td>Petroleum engineers</td>
<td>19,000</td>
</tr>
<tr>
<td>Sales engineers</td>
<td>90,000</td>
</tr>
<tr>
<td>Engineers – all others</td>
<td>178,000</td>
</tr>
<tr>
<td>Postsecondary teachers: Engineering</td>
<td>53,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,718,000</strong></td>
</tr>
</tbody>
</table>

*Computer Science Not Included*
BS Graduates 2000-2013
Rapid Growth After Recession
Rapid Growth in All Engineering Degrees

**Figure A-3** Growth in Bachelor’s, Master’s and PhD Degrees in Engineering 2000-2012. Source: Bachelor’s & Master’s—IPEDS Completion Survey; PhD—Survey of Earned Doctorates.
Career Paths for BS Engineers

FIGURE C-17 Post-College Pathways of Engineering Degree Holders (N=1,956)
Source: 2011 Post-baccalaureate Survey, Higher Education Research Institute, UCLA.
Many engineers move to other areas but they don’t come back

FIGURE 1-18 Median lifetime earnings for the top-paying 15 majors, in millions of dollars, 2014. Source: Hershbein and Kearney 2014, complete chart is available at www.hamiltonproject.org/assets/legacy/files/downloads_and_links/MajorDecisions-Figure_2a.pdf.
Annual Pay (BS) is better than other STEM Fields
## 2019 Starting and Mean Salaries for Engineers

<table>
<thead>
<tr>
<th>Field</th>
<th>Starting</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME</td>
<td>$61k</td>
<td>$95k</td>
</tr>
<tr>
<td>Aero</td>
<td>$</td>
<td>$115k</td>
</tr>
<tr>
<td>AgE</td>
<td>$</td>
<td>$77k</td>
</tr>
<tr>
<td>Civil</td>
<td>$56k</td>
<td>$93k</td>
</tr>
<tr>
<td>CompE hardware</td>
<td>$71k</td>
<td>$118k</td>
</tr>
<tr>
<td>CompE software</td>
<td>$68k</td>
<td>$114k</td>
</tr>
<tr>
<td>ChemE</td>
<td>$65k</td>
<td>$114k</td>
</tr>
<tr>
<td>EE</td>
<td>$65k</td>
<td>$101k</td>
</tr>
<tr>
<td>Environmental</td>
<td>$56k</td>
<td>$92k</td>
</tr>
<tr>
<td>Geo/Mining</td>
<td>$62k</td>
<td>$98k</td>
</tr>
<tr>
<td>Materials</td>
<td>$66k</td>
<td>$97k</td>
</tr>
<tr>
<td>MechE</td>
<td>$62k</td>
<td>$93k</td>
</tr>
<tr>
<td>Petroleum</td>
<td>$</td>
<td>$137k</td>
</tr>
</tbody>
</table>

Source: Michigan Tech: [https://www.mtu.edu/engineering/outreach/welcome/salary/](https://www.mtu.edu/engineering/outreach/welcome/salary/)
Will You Use Your Major?

Twice as Many Engineers Work Outside Engineering than Within

But: >80% say science or engrg is needed for job

BS Eng, but Job Not Eng

BS Eng and Job Eng

BS Not Eng but Job Eng

FIGURE 1-11 The engineering workforce in 2013: Degreed engineers in engineering and non-engineering occupations, and workers without an engineering degree in engineering occupations.
Source: NSCG 2013.
20% Chance You Will Become a Manager Independent of Degree

Figure A-12 Likelihood of holding a management job (for those with highest degree a bachelor’s or master’s), by field of highest degree.
You will likely work for a For-Profit Company that has at least 1000 employees.
Can you choose a great job in an idyllic place that you can afford?
Entrepreneurship as a Career

- Rapid Increase in Engineering Curricula
- 6% of BS Engineers work in new company (< 5 yrs)

Conclusion: Entrepreneurship lessons are more often used for promoting ideas within companies
Diversity

Statistics haven’t changed a lot in 15 years

BS/MS/PhD Engineering

- Women: ~20% (BME: ~44% -- this stat has increased)
- Under-represented minorities: ~10%
- Foreign Born fractions of degrees granted
  - 10% BS, 40% MS, 55% PhD
- Differences in promotion/stress/pay persist
- You can create change!

- Biology: >50% women PhDs for ~30 years?
- MD Grads: >50% women for ~15 years?
Reasons Engineers Leave Engineering

- Job in engineering field not available (44%)
- Change in interests (13%)
- Promotion or pay increase (4%)
- Location (women: 12%; men 2%)
- Working conditions (4%)
- Family (3%)
- Other (20%)

Men/Women the same except location
Satisfaction is high

Unemployment is Low
Lowest of all major employment groups

FIGURE 3-2 Percent somewhat or very satisfied with their job by engineering degree and occupation. (N=15,189)
Source: SESTAT 2010.
Summary

- Engineering is a Great Career – lots of choices
- Biology is a Great Career – not so many choices
- Bioengineering is in between biology and engineering

Next up – more on Bioengineering