Biomedical Engineering

Dr. Kevin Lear, Director, Undergraduate Program
Ms. Brett Eppich Beal, Adviser

5280 CSU Engineering Showcase
January 29, 2011
SBME – Who are We?

Director – Stuart Tobet
   Professor of Biomedical Sciences

Associate Director – Kevin Lear
   Professor of Electrical & Computer Engineering
   Also Director of Undergraduate Program

Staff
   Brett Eppich Beal – Industry Relations, Grant Facilitation
     and Undergraduate Program Advisor
   Sara Neys – Adviser, Graduate Students, Undergrad Minor
   Deanna Scott – Director, Regulatory Affairs
     Interdisciplinary Program
Biomedical Engineering at CSU

Interdepartmental school with over 50 faculty
SBME – What do we do?

Officially became a school in 2007

Academic Areas of Emphasis:
• Molecular, Cellular, Tissue Engineering
• Biomechanics and Biomaterials
• Medical Devices, Diagnostics, Imaging

Students

NEW DUAL DEGREE UNDERGRADUATE PROGRAM
So What’s the difference between BME and BMS?

Biomedical Sciences
- What, Why, How something happens
- Investigation oriented
- “Research”
- Career Paths
  - Further education
  - Medicine
  - Teaching
  - Research
  - Research/Teaching

Biomedical Engineering
- So What? What can we do? How can we make something?
- Problem-solving oriented
- “Development”
- Career Paths
  - Further education
  - Medicine
  - Teaching
  - Research
  - Research/Teaching
  - Design
  - Research/Design
  - CTO/CEO
What’s *Biomedical Engineering*?

Engineering with a focus on improving health care and performance

Biomedical engineering is a discipline that advances knowledge in engineering, biology and medicine, and improves human health through cross-disciplinary activities that integrate the engineering sciences with the biomedical sciences and clinical practice.

*The Whitaker Foundation, 2003*
What’s a **Biomedical Engineer**?
What do Biomedical Engineers DO?

- Medical Devices, Diagnostics, Imaging
- Biomechanics and Biomaterials
- Molecular, Cellular, Tissue Engineering
More Detail, Please...

• **Design** biomedical materials and/or medical device equipment
  • Artificial heart valves, bio-compatible wheelchairs, exercise equipment for astronauts, create/improve materials for joint replacements

• **Develop or improve** therapies for fighting cancer, tuberculosis, or other illnesses and diseases
  • Nanoscaffolding for localized chemotherapy delivery, telemetric sensors to determine healing rates in bone fractures

• **Find** better ways to image and/or diagnose illnesses
  • Use lasers to detect viruses, develop ways to increase electrical signals to detect threats to food safety and security, design a biosensor to diagnose cancer cells, or develop software to determine toxicity levels in people exposed to pesticides
What do Biomedical Engineers need?

- Broad background in engineering and science
- Expertise in a well-established engineering discipline, e.g. chemical engineering
- To understand applications in a rapidly developing, high impact area – medicine
- To learn to solve problems at the interface of multiple interesting disciplines
- To work productively on interdisciplinary teams
What does that mean at CSU?

BME interfaces with Engineering:
* Chemical & Biological Engineering
* Electrical Engineering
* Mechanical Engineering

And Science:
* Health & Exercise Science
* Chemistry
* Computer Science
* Math
* Physics
* Biology, Microbiology, Biochemistry, Neurobiology
Starting Fall 2011, CSU will offer the *only* biomedical engineering bachelor’s degree program in Colorado.

5-year Dual Degree with:
- Chemical & Biological Engineering
- Electrical Engineering
  - Laser/Optics Concentration
- Mechanical Engineering
Biomedical Engineering

Applications of Chemical Engineering

New Descriptions of Cell Biology
Biomedical Engineering
Applications of Chemical Engineering

Pharmaceutical and/or Biologic Drug Development, Production, Delivery, etc.

GLIADEL WAFER
(polifeprosan 20 with carmustine implant)

PROZAC Weekly
fluoxetine hydrochloride

Claritin-D 24Hour
(10 mg loratadine/240 mg pseudoephedrine sulfate, USP)
Extended Release Tablets
Biomedical Engineering

Applications of Electrical Engineering

Biomedical Imaging

Instrumentation and Signal Processing
Computer Modeling, Orthopedic Implants, Biomaterials

Biomedical Engineering

Applications of Mechanical Engineering

UHMWPE BioPoly™

Water drops on DRY surfaces

Biomedical Engineering at Colorado State University
Biomedical Engineering
Applications of Mechanical Engineering

Biomechanics
Biomedical Devices

1982-Jarvik total heart replacement used as a bridge until patients could receive a heart transplant.

Drug eluting coronary artery stents.

Biosensors—glucose monitor and insulin pump.

Tissue engineering to repair bone defects.
Countless other applications...

- Stable, single-dose vaccines
- Membrane filtration units
  - Dialysis -- kidney failure
  - Blood oxygenation -- open heart surgery
  - Remove viruses or other harmful compounds from blood
- Life support systems for long-term space flight

NEW IDEAS...
Why a Dual Degree?

- “One cannot underestimate the flexibility of a dual degree. The dual degree provides the depth of a traditional major with the breadth and specialty in biomedical engineering, and allows students to be better prepared for their careers, qualify for more internships, graduate programs, and job opportunities upon graduation. What student wouldn’t want as many opportunities as possible?”
  - Tara M. Ruttley, PhD, Associate Program Scientist – NASA

- “This dual degree program will shorten the learning curve, or ramp-up time, when a young engineer joins the ranks of industry, giving the graduating student a leg up both in terms of getting the job, and early success within that job.”
  - Rick Jory, President & CEO, Sandhill Scientific;
  Chair, Board of Directors, Colorado Bioscience Association

BLS predicts ↑72% job growth for BME by 2018.
More opportunities, higher pay with dual degree.
BME Dual Bachelor’s Degree Curriculum with Electrical Engineering

FIRST YEAR (31 credits)
BIOM 101, Intro to BME
CHEM 111,112, 113 Chem I,II & Lab
ECE 102, Digital Circuit Logic
ECE 103, DC Circuit Analysis
MATH 160 & 161, Calculus I & II
PH 141, Physics I

SECOND YEAR (31 credits)
LIFE 102, Living Systems
ECE 202, Circuit Theory Appl.
CIVE 262, Eng. Mechanics
CO 150, College Composition
CS 155, 156, 157, Comp. Prog.
MATH 261, Calculus III
MATH 34x, Differential Eq’ns
PH 142, Physics II

THIRD YEAR (30 credits)
LIFE 210, Cell Biology
CHEM 245, Organic Chemistry
BMS 300, Human Physiology
ECE 303, Communications
ECE 311 & 312, Linear Systems
ECE 341 & 342, Elec’magnetics
MECH 337, Thermodynamics

FOURTH YEAR (33 credits)
BIOM 300, Biomed. Engr. Lab
BIOM/ECE 4XX, Gateway
BIOM/ECE Tech. Electives (8 cr.)
ECE 331 & 332, Electronics
ECE 251, Microprocessors
ECON 202, Economics
University Core (3 cr)

FIFTH YEAR (29 credits)
BIOM 486, Design Practicum (8 cr.)
BIOM/ECE Tech. Electives (12 cr.)
CO 301/JTC 300, Tech. Writing
Univ Core (9 cr.)

Colorado State Univ.
Bachelor of Science in Biomedical Engineering
and
Bachelor of Science in Electrical Engineering

2 Degrees for 157 credits vs.
1 (EE) Degree for 125 credits
Gain Practical Experience

- Laboratory opportunities in and out of the classroom.
- Assist faculty in their research activities.
- Strong internship program throughout the College of Engineering.
- Synergistic senior design project (practicum) that combines Biomedical Engineering with other engineering majors for interdisciplinary, real-world experience.

- Local & global collaborations
  - CSU Vet school allows easy access to animal models.
  - Many faculty work w/ UCD HSC
  - International connections in New Zealand, Germany, Slovenia ...
Biomedical Engineering Minor

- 21 Credits
  - 12 in upper division coursework
- Great combination with other engineering, science, business or liberal arts degrees
Minor or Dual Degree?

- Minor requires less coursework
- Minor a definite plus, but carries less weight than a second degree
- If you are primarily interested in biomedical engineering, the dual degree is the best choice.
- If you are primarily interested in another engineering discipline or even a non-engineering major, then the BME minor is an option to consider.
- You don’t have to decide now – take BIOM 101 and figure out how much you like it.
Biomedical engineers are naturally interested in other people – both their health and their lives.

- Diverse student population
- Organizations help you interact with others
  - Biomedical Engineering Society (BMES) student chapter
    - fun activities: speakers, site visits, BBQs, recreation ...
  - Academic Village
  - Society of Women Engineers
  - ... many more
Why be a Biomedical Engineer?

- **Flexibility**
  - Industry
    - Technical
    - Management
    - Sales
    - Patent Law
    - Public Policy
  - Education
    - Medical/Vet School
    - Graduate School
- **High Demand** – Well paying jobs

**Help people and have FUN!**
Find Out More

• School of Biomedical Engineering at CSU
  www.engr.colostate.edu/sbme

• Contact us
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    Undergraduate Advisor
Thank you

Questions?