Teaching Undergraduate (Students) Biomechanics

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Five Key Questions?

- How do we define biomechanics?
- What are the frontiers of biomechanics?
- Where will our students be employed?
- What should they know?
- Where/how should these students be educated?

1. How Do We Define Biomechanics?

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Discrete, Continuum, Statistical,…, Mechanics

2. Frontiers of Continuum Biomechanics?

- Molecular & Cellular Biomechanics
- Developmental Biomechanics
- Biomechanics of Growth & Remodeling
- Injury Biomechanics & Rehabilitation
- Functional Tissue Engineering
- Muscle Mechanics
- Solid-Fluid Interactions
- Biothermomechanics
- *Biochemomechanics*
- *Multiscale Mechanics*

Humphrey (2002) Proc Roy Soc Lond A

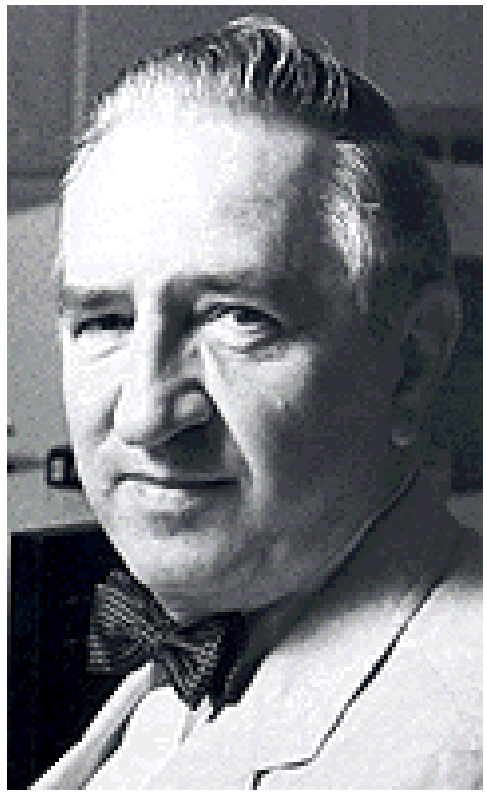
3. Where will they be employed?

- Medical Device Industry
- Tissue Engineering / Biologicals
- Government (FDA, NIH,…)
- Academia (Mechanical Engineering)
- Academia (Biomedical Engineering)

4. What should a student know?

(So they make an impact?)

Y.C. Fung



R. Skalak

Common “Mechanical” Engineering Courses

- Statics & Dynamics
- Strength Materials
- Fluid Mechanics
- Mechanical Vibrations
- Materials Science
- Composites
- Plates & Shells
- Advanced Dynamics
- Advanced Strength
- Advanced Fluids
- Elasticity
- Plasticity
- Viscoelasticity
- Finite Elements

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Caveat: **“The main difficulty lies in the customary use of infinitesimal theory of elasticity to the media which normally exhibit finite deformations.”** (Y.C. Fung, 1967)

5. Where will these students be educated?

- Mechanical Engineering Departments

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  - Standard ME Curriculum
  - Senior Electives in Biomechanics

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- Biomedical Engineering Departments
  - Foundations Courses (sophomore)
  - Applications Courses (junior)
  - Specialty Electives (senior)

A First Course in Biomechanics & Biotransport

- (patho) Physiology
- Cell & Matrix Biology
- Kinematics & Forces
- 5 Basic Postulates
  - Mass
  - Linear Momentum
  - Energy
  - Angular Momentum
  - Entropy
- Isothermal Material Behavior
- Thermomechanics
- Chemomechanics
- Summary of 3-D Relations
- Experimental Methods
- Computational Methods

Humphrey (20xx)…cf. Bowen (1989)

5. How should students be educated?

- Tell them the truth, nothing but the truth, but not the whole truth…

- Help them develop Creative, Critical Thinking Skills
  - To develop and extend, not just apply


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References

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Humphrey JD, Delange SL (2004) *An Introduction to Biomechanics: Solids and Fluids, Analysis and Design.* Springer, NY.

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