The Role of Tissue Mechanics in Biological Responses to Mechanical Loading

Sponsored by:

The University of Notre Dame Center for the Study of Biocomplexity

and

Indiana University School of Medicine

November 8, 9 and 10th 2002
The University of Notre Dame McKenna Center for Continuing Education

Co-organizers:
Glen L. Niebur (University of Notre Dame), Charles H. Turner (Indiana University) and James Glazier (University of Notre Dame)

The mechanical properties of biological tissues have been studied by mathematicians and mechanicians for centuries. Biological tissues are of interest from an applied perspective, as they form the structural components that allow organisms to interact with their environment. From a theoretical standpoint, the mechanics of biological materials range from simple linear elasticity to complex coupled fluid-solid-electrochemical models, providing ample challenges for mathematicians, physicists and engineers.

Perhaps the most interesting characteristic of biological tissues is that cells on the surface, embedded within, or in close proximity to the tissue cause active or passive responses of the tissue to mechanical loading. Thus, tissues are not only structural components, but also act as transmitters and modulators of mechanical stimuli from the environment to cells. The cells in turn respond to these stimuli, resulting in altered mechanical properties or structure of the tissue.

This symposium will explore the function of biological tissues as modulators of mechanical stimuli applied to cells and as transducers of mechanical forces. A wide variety of lectures will be presented, ranging from tissue formation and remodeling, to methodologies for probing the mechanical properties of tissues and cells.

Support for Junior Researchers: Funds are available through a grant from the Whitaker Foundation to support the attendance of junior researchers (graduate student to assistant professor). Please mark the appropriate boxes on the registration form to be considered.

Submitted Abstracts: A limited number of openings are available for short research talks (10 minutes). Submit a short abstract to gniebur@nd.edu to be considered.

Thursday, November 7

4:00-5:00	*The Biomechanics of Ancient Tasks*	Steven Vogel

Friday, November 8

8:00 – 8:40	*Nanobiotechnology: The convergence of engineering with modern biology*	Carlo Montemagno
8:40 – 9:20	*TBA*	Charles Pell
9:20 – 9:30	*Break*	
9:30 – 10:10	*Torsional versus flexural stiffness in natural structures*	Steven Vogel
10:10 – 10:50	*Tissue Liquidity and Organogenesis*	Malcolm Steinberg
10:50 – 11:00	*Break*	
11:00 – 12:00	*Submitted talks*	TBA
12:00 – 1:00	*Lunch*	
1:00 – 1:40	*Mechanical Interactions and Mechanosensing during Fibroblast Migration*	Yu-Li Wang
1:40 – 2:20	*Mechanotransduction in hair cells*	Rob Rafael
2:20 – 2:35	*Break*	
2:35 – 3:15	*Membrane Free Volume Theory for Mechanochemical Transduction*	John Frangos
3:15 – 3:55	*Mechanobiology*	Marjolein van der Muellen
4:10 – 5:00	*How does nature build tissues?*	Stephen Cowin
6:00 – 8:00	*Reception*	

Saturday, November 9

8:00 – 8:40	*TBA*	Elliot Rosen
8:40 – 9:20	*Probing polymerization forces using actin-propelled lipid vesicles*	Arpita Upadhyaya
9:20 – 9:30	*Break*	
9:30 – 10:10	*Biomechanics of the intracellular environment studied with magnetic tweezers*	Gabor Forgacs
10:10 – 10:50	*MEMS devices for measuring mechanical properties of cells*	Wes Jackson
10:50 – 11:00	*Break*	
11:00 – 11:40	*Atomic Force Microscopy in Cells*	Agnes Ostafin
11:40 – 11:55	*TBA*	TBA
12:00 – 1:00	*Lunch*	
1:00 – 1:40	*The Plasticity of Skeletal Muscle: Mechanical Consequences*	Vince Caiozzo
1:40 – 2:20	*Micromechanics of heart valve tissues.*	Michael Sacks
2:20 – 2:30	*Break*	
2:30 – 3:10	*Mechanics of Cardiovascular Development*	Larry Taber
3:10 – 3:50	*Negative Diffusion and Aggregation of Blood Cells due to Elastic Deformation in Shear Flow*	Chia Chang
3:50 – 4:00	*Break*	
4:00 – 4:40	*Cartilage Mechanics and Tissue Engineering*	Gerard Ateshian
4:40 – 5:20	*Contractile response of fibroblasts on a collagen-based matrix used in tissue engineering*	Lorna Gibson

Sunday, November 10

8:00 – 8:40	*Matricellular proteins: Extracellular modulators of bone cell biology*	Kurt Hankenson
8:40 – 9:20	*Modulation of Cell Adhesion during Migration*	William Parks
9:20 – 9:30	*Break*	
9:30 – 10:10	*Nonlinearities in bone remodeling*	Charles Turner
10:10 – 10:50	*Implications of Fluid Flow for Bone Function, from an Organ to a Cellular Level*	Melissa Knothe Tate
10:50 – 11:00	*Break*	
11:00 – 11:40	*Bone Adaptation after Joint Replacement*	Rick Sumner
11:40 – 11:55	*TBA*	TBA
12:00 – 1:00	*Lunch*	
1:00 – 2:00	*Submitted talks*	TBA
2:10 – 2:50	*Matricellular proteins: Extracellular modulators of bone cell biology*	Subrata Saha
2:50 – 3:30	*Mechanistic models of the human spine - the effects of scale*	Eric Nauman