BE 549: Structure-function relations of the extracellular matrix

Fall Semester, 2016

Classes: Monday & Wednesday 2-4 pm.

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Office hours: Friday 1-2 and by individual appointments.

TA: TBA

Detailed powerpoint presentations will contain sufficient information for most lectures.

Additional papers from literature will be covered and distributed.

Goals: 1. To provide an introduction to the properties of the extracellular matrix components
2. To introduce quantitative models of the matrix and predict the functional properties

Main Topics:
- Introduction to course and overview of the extracellular matrix and its relation to cells
- Building blocks and organization of collagen from amino acids to fibrous tissue
- Mechanical properties of collagen from molecules to tissue in normal and diseased states
- Building blocks and organization of elastin from amino acids to fibrous tissue
- Mechanical properties of elastin from molecules to tissue in normal and diseased states
- Building blocks and organization of microfibrils
- Mechanical properties of microfibrils and their roles in development and disease
- Building blocks and organization of proteoglycans
- Mechanical and electrical properties of proteoglycans and their relation to other extracellular proteins
- Relation of the extracellular matrix components to each other and cells
- Modeling the mechanical properties of single molecules, fibrils and fibers
- Modeling the mechanical properties of network of fibrils and fibers embedded in proteoglycans
- Basic concepts in multiscale modeling: examples of vessels, lung and cartilage
- Modeling the repair and digestion of fibers and networks
- General multiscale modeling of tissue failure: implications for aneurysm and emphysema
- Application of mathematical modeling to tissue engineering

Laboratory: 6-8 projects involving computational modeling of various extracellular matrix properties. The projects are 1-3 week long and several of them are open ended. Class mates are encouraged to discuss their project. However, directly copying a classmate’s work or allowing a classmate to knowingly copy your work is not allowed. A good rule to follow is to never share written versions of lab reports or computer code.

Homework: Occasional homework throughout the semester.

Grading: Laboratory project 40%, Homework 10%, Midterm exam 25%, Final presentation 25%.

Incomplete & withdrawal: Incomplete will be given to students demonstrating good progress (C or better) with acceptable reason for being unable to complete the course. Students may withdraw from course prior to the University deadline. Having taken the final exam, students will not be able to receive an incomplete or withdraw.