Biophysics 607 Syllabus
Literature-based Course
Winter 2016
Prof. Sabrina Leslie
Enrollment: 7 students

Syllabus
- Participation (15%)
- Oral presentations in a ‘journal club format’, top 2 (25%)
- Written report (60%)

Format
- Include at least one peer-reviewed article per week in the list below, to read and learn (with your name)
- Discuss your articles with others and participate in class
- Present a 20-min formal synopsis at least twice to the class (denoted as when you are “leading” below)
- Prepare a literature review report for end of semester (6-8 pages) due to Prof. Leslie by Monday, April 25, 2016


Background reading: Biophysical Chemistry Part I: The conformation of biological macromolecules.
- Ch. 1: An Introduction to the Strategy and Tactics of Biophysical Chemistry
- Ch. 3: Structure of Nucleic Acids
- Ch. 6: Conformational Analysis and Forces That Determine Nucleic Acid Structure

Week 2: (Shane leads)

- Benham 1979 PNAS. Torsional stress and local denaturation in supercoiled DNA. (Shane)
- Li 2013 ACS Nano. Nanoparticles Inhibit DNA Replication by Binding to DNA: Modeling and Experimental Validation. (Gil)
- Reinhart 2015 J. Chem. Phys. Distribution of distances between DNA barcode labels in nanochannels close to the persistence length. (Dan, Frank)
- Introduction to Optical Microscopy. (Simon, John)
- Ch. 7: Intensity Fluctuations
- Ch. 8: Detection Noise
Week 3: (Dan leads)

- Kowalski 1988 PNAS. Stable DNA unwinding, not “breathing,” accounts for single-strand-specific nuclease hypersensitivity of specific A+T-rich sequences. (Shane)
- Das 2015 ACS Nano. Mechanistic Influence of Nanometer Length-Scale Surface Chemistry on DNA Hybridization. (Gil)
- Schadt 2010 Human Molecular Genetics. A window into third-generation sequencing. (Dan, Albert, Frank)
  - Ch. 6: Reaction Kinetics

Week 4: (Gil leads)

- Fye 1999 Phys. Rev. E. Exact method for numerically analyzing a model of denaturation in superhelically stressed DNA. (Shane)
- Payne 2013 PLOS One. Molecular Threading: Mechanical Extraction, Stretching and Placement of DNA Molecules from a Liquid-Air Interface. (Dan, Frank)
- Venkatesan, B. M.; Bashir, R. Nat. Nanotechnol. 2011, 6 (10), 615-624 (Nanopore sensors for nucleic acid analysis.) (Albert)
  - Ch. 7: Biological Oscillators and Switches

Week 5: (Albert leads)

- Biophysical Chemistry Part II: The behavior of biological macromolecules.
  - Ch. 7: Absorption Spectroscopy
    - Section 7-1: Basic Principles (Shane)
- Bell 2012 Microsc. Microanal. DNA Base Identification by Electron Microscopy. (Dan)
- Douville, et al. DNA linearization through confinement in nanofluidic channels. Analytical and Bioanalytical Chemistry 2008 (Gil, Frank, Albert)
  - Ch. 8: BZ Oscillating Reactions

Week 6: (Simon, John lead)

- Biophysical Chemistry Part II: The behavior of biological macromolecules. (Shane)
- Elson, & Magde - 1974 - Fluorescence Correlation Microscopy - Conceptual Basis and theory (John)
- Beer 1962 PNAS. Determination of Base Sequence of Nucleic Acids with the Electron Microscope: Visibility of a Marker. (Dan, Gil)
  - Ch. 9: Perturbed and Coupled Oscillators

**Week 7: (No class. At APS conference. Keep up reading but no presentations)**
- Biophysical Chemistry Part II: The behavior of biological macromolecules. (Shane)
- Comprehensive Biophysics
  - Volume 2: Biophysical Techniques for Characterization of Cells
    - Section 2.12: Image Correlation Spectroscopy (John)
  - Ch. 11: Reaction Diffusion, Chemotaxis, and Nonlocal Mechanisms

**Week 8 (Shane leads):**
- Biophysical Chemistry Part II: The behavior of biological macromolecules. (Shane)
  - Ch. 8: Other Optical Techniques
    - Section 8-2: Fluorescence Spectroscopy p. 433 – 448
- Rodolphe Marie and Anders Kristensen. Nanofluidic devices towards single DNA molecule sequence mapping. Journal of Biophotonics 2012 (Frank, Gil)
- Mathematical Biology: II. Spatial Models and Biomedical Applications (Simon, John)
  - Ch. 2: Spatial Pattern Formation with Reaction Diffusion Systems

**Week 9 (Albert & Frank both lead):**
- Biophysical Chemistry Part II: The behavior of biological macromolecules. (Shane)
  - Ch. 8: Other Optical Techniques
    - Section 8-2: Fluorescence Spectroscopy p. 448 - 465
- Medina, & Schwille - 2002 - Fluorescence Correlation Spectroscopy for the detection and study of single molecules in biology (John)
- Mathematical Biophysics (J. D. Murray) (Simon)
  - Direct Multiparticle Models of Processes in Subcellular Systems
    - Method of Direct Multiparticle Simulation of Protein Interactions
    - Modeling of Protein Complex Formation in Solution with Diffusion and Electrostatic Interactions
- Tegenfeldt et al. Micro- and Nanofluidics for DNA Analysis. Analytical and Bioanalytical Chemistry. March 2004 (Gil)
- B N. Anderson et al. pH Tuning of DNA Translocation Time through Organically Functionalized Nanopores. ACS Nano. 2013 (Albert)
Week 10 (John & Simon lead):

• Vetcher, et al - 2010 - Gel mobilities of linking-number topoisomers and their dependence on DNA helical repeat and elasticity (Shane)
• Carson, S.; Wanunu, M. Nanotechnology 2015, 26 (7), 074004 (Challenges in DNA motion control and sequence readout using nanopore devices) (Albert, Gil, Dan, Frank)
• Mathematical Biophysics (J. D. Murray) (Simon, John)

Direct Multiparticle Models of Processes in Subcellular Systems
– Modeling of Protein Interactions in Photosynthetic Membrane
– Spatiotemporal Evolution of Electrochemical Potential $\Delta \mu$ H+ in Photosynthetic Membrane
• The nonequilibrium mechanism for ultrasensitivity in a biological switch: Sensing by Maxwell’s demons (John)

Week 11 (Shane & Frank lead):

• Schwille, & Haustein - Fluorescence Correlation Microscopy - An Introduction to its Concepts and Applications - Experimental Biophysics Group University of Gottingen (John)
• Stephen L. Levy and Harold G Craighead. DNA Manipulation, Sorting, and Mapping in Nanofluidic Systems. Chemical Society Reviews 2010 (Frank, Gil, Albert)
• Introduction to Optical Microscopy. (Simon)
  – Ch. 13: Fluorescence

Week 12: (Dan & Albert lead)

• Opel 2004 Ann. Rev. Genet. Activation of transcription initiation from a stable RNA promoter by a Fis protein-mediated DNA structural transmission mechanism. (Shane)
• Introduction to Optical Microscopy. (Simon, John)
  – Ch. 14: Confocal Microscopy

Week 13: (Gil leads)

• Sabanayagam 2005 J. Chem. Phys.. Using fluorescence resonance energy transfer to measure distances along individual DNA molecules: corrections due to nonideal transfer. (Shane)
• Levy et al. Entropic Unfolding of DNA Molecules in Nanofluidic Channels. Nano Letters 2008 (Frank, Gil, Dan, Albert)
• Introduction to Optical Microscopy. (Simon, John)
  – Ch. 18: Superresolution

Reports are due by April 25 2016 to Prof Leslie. A few extensions up until Thursday April 29 2016 can be requested in advance, at no penalty. This allows Prof Leslie to finish the marking during this last week of April.