



*The Biophysical Society
2008 Summer Course in Biophysics:
Case Studies in the Physics of Life*

**University of North Carolina at Chapel Hill
May 25, 2008 – August 9, 2008**

UNC Campus & Summer Course Program Information

Week of May 25-May 31

May 25: Sunday

- 2:00 p.m. Arrive at UNC
4:30 p.m. Barry Lentz, Julianna Wittig, and the TAs (Jenn Cable, Jon Edwards, Ron Jacak) will meet you in the lobby of Granville Towers East.

May 26: Monday (Memorial Day)

- 10:00 a.m. Students will be met by course TAs in the lobby of Granville Towers East. Activities include touring Chapel Hill and Carrboro, becoming familiar with bus service if needed, and meeting with Elizabeth Russell-McKenzie (Course Evaluator). Schedule TBA.

May 27: Tuesday

- 8:30 a.m. TAs will meet you at Granville Towers East to get UNC One Cards.
~11:00 a.m. Orientation in 408 Mary Ellen Jones Building
12:30 p.m. Luncheon with Mentoring Faculty to establish mentoring relationships.

Lab Research will begin on May 28.



Week of June 1-June 7

Lab Research

Week of June 8-June 14

Lab Research

June 9: Monday

4:30-6:30 p.m. Poster session for Post-docs sponsored by NIH's Institutional Research and Academic Career Development Awards Program. This program provides training support for young scientists learning to do research and teach. The Fellows generally do their teaching apprenticeships in minority colleges and universities. We will compile a list of posters applications of the physical sciences to biology. Upper and lower atria of Sitterson Hall (computer science).

June 13: Friday

11:30 a.m. Professional Careers Panel Discussion (408 Mary Ellen Jones Building)

June 14: Saturday

Biophysics Summer Course Reunion: Registration & Finger Food (11:30-12:30); Symposium (1:00-3:00); Luncheon.

Week of June 15-June 21

I. Life and Energy: 3 lectures

June 15: Sunday

Meet with Elizabeth Russell-McKenzie (Course Evaluator). Time TBA

June 16: Monday

8:30 a.m. Classes Begin (408 Mary Ellen Jones Building)
Lecture 1. LEC A: What is life? An attempt at definition.
Energy, heat, and work: Temperature and thermal equilibrium. The First Law.
Why do organisms need energy? ([B Lentz](#))

10:00 a.m. Lecture 2. LEC B: Mother Nature plays dice: the Boltzmann distribution, partition functions and entropy. ([B Lentz](#))

2:00 p.m. Computer Lab 1 (124 Taylor Hall)
Simple mathematical tools in biophysics: plotting, and simple regression analysis using Sigma Plot. ([G Weinreb](#))



June 19: Thursday

8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 3. LEC A: Thermodynamic states and state functions. Reversible and real processes. The Second Law and free energy. (B Lentz).

II. The Cell: A Survey and Preview: 2 lectures

10:00 a.m. Lecture 4. LEC B: The cell as a basic unit of life's organization. (K Jacobson)
The components: membranes, cytoskeleton, organelles.
The central role of macromolecules: proteins, nucleic acid, carbohydrates.

11:30 a.m. **Discussion:** (D Erie) How much energy (work) is needed to pull RNA into a viral capsid? Ref: Acc Chem Res. 2001 June; 34(6):412-20 (408 Mary Ellen Jones Building).

12:30 p.m. Lunch with Dr. Erie (408 Mary Ellen Jones Building).

2-3:15p.m. Lecture 5. LEC C: The cell interior as a tough neighborhood: Brownian motion and viscosity and their influence on particle motion in the cell. (K Jacobson) (408 Mary Ellen Jones Building)

4:00 p.m. **Seminar** (408 Mary Ellen Jones Building)
Dr Richard Superfine, UNC-CH Physics Department "Pushing and Pulling Molecules in Real Time: Applications to Cell Biophysics"

III. Proteins: Structure and Function: 7 lectures

June 20: Friday

8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 6. LEC A: From linear polymers to functioning molecular machines: the role of weak interactions in limiting "conformational space". (N Dokholyan)

10:00 a.m. Lecture 7. LEC B: The structural organization within proteins: primary, secondary, tertiary, and quaternary levels of organization; varieties of proteins: globular and fibrous. (K Slep)

11:30 a.m. **Seminar** (408 Mary Ellen Jones Building)
Dr. Ishita Mukerji, Wesleyan University Dept. of Molecular Biology & Biochemistry. "The Mechanics of Fiber Formation in Sickle Cell Anemia, Alzheimer's Disease and Prion Diseases"

12:30 p.m. Lunch with Dr. Mukerji (408 Mary Ellen Jones Building)

4:00 p.m. **Help Session:** Go over Computer Lab 1 (TAs & Weinreb) and **Problems.** (TAs) (329, 312, AND 425 MARY ELLEN JONES BUILDING)

June 21: Saturday

9:00 a.m. Lab Demonstration 1: Viewing motions and organization in the cell membrane. (Jacobson Lab); Meet Jenn Cable in the lobby of Granville Towers East at 8:30.

Week of June 22-June 28

June 22: Sunday



9:45 a.m. Wafting on the Eno: Meet vans in the lobby of Granville Towers East.

June 23: Monday

- 10:00 a.m. Class (408 Mary Ellen Jones Building)
Lecture 8. LEC A: Proteins are binding machines: How to detect and analyze binding and allostereism. ([A. Baerga-Ortiz](#))
- 11:30 a.m. **Seminar** (408 Mary Ellen Jones Building)
[Dr. Baerga-Ortiz](#), Univ of Puerto Rico Medical Sciences Campus, Department of Biochemistry.
“The interaction between thrombin and thrombomodulin: kinetics, solvation and flexibility”
- 12:30 p.m. Lunch with Dr. Baerga-Ortiz (408 Mary Ellen Jones Building)
- 2:00 p.m. Computer Lab 2 (408 Mary Ellen Jones Building)
Analysis of binding isotherms. ([A. Baerga-Ortiz](#))
- 5:00p.m. Lecture 9. LEC B (408 Mary Ellen Jones Building): The stability of proteins as measured by free energy and denaturation. ([E Collins](#))

June 26: Thursday

- 8:30 a.m. Class (124 Taylor Hall)
Lecture 10. LEC A: Proteins are not rigid structures: Protein dynamics/conformational variability/drug design. ([A Lee](#))
- 10:00 a.m. Lecture 11. LEC B: Speeding things up: how enzymes work. ([C Carter](#))
- 11:30 a.m. **Seminar** (305 Mary Ellen Jones Building)
[Dr Charles Carter](#), Biochemistry & Biophysics Department, UNC-CH. “X-ray Analysis of Enzyme Function: t-RNA Synthase”
- 12:30 p.m. Lunch with Dr. Carter (305 Mary Ellen Jones Building)
- 2-3:15p.m. Lecture 12. LEC C: Protein folding and protein design. ([B Kuhlman](#))
- 4:00 p.m. *Help Session: Go over **Problems**. (TAs)*
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IV. The Cell Membrane: 5 lectures

June 27: Friday

- 8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 13. LEC A: The Lipid Bilayer: A Dynamic Self-Assembled Structure of Multiple Lipid Classes. ([M Berkowitz](#))
- 10:00 a.m. Lecture 14. LEC B: Membrane Proteins. ([BR Lentz](#))
- 11:30 a.m. **Seminar** (305 Mary Ellen Jones Building)
[Dr Barry Lentz](#), Department of Biochemistry & Biophysics, Univ. of North Carolina at Chapel Hill. “Why Did Nature Design Membranes with So Many Lipid Species?”
- 12:30 p.m. Lunch with Dr. Lentz (305 Mary Ellen Jones Building)
- 2:00p.m. **Workshop: (Lentz)** How to Prepare & Deliver a Good Seminar. (305 Mary Ellen Jones Building)
- 4:00 p.m. *Help Session: Go over Computer Lab 2 (TAs & Baerga-Ortiz) and **Problems**. (TAs)*



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June 28: Saturday

- 9:30 a.m. Lab Demonstration 2: Examining protein structure and folding using mass spectrometry. (Mike Fitzgerald, Duke University): Meet Jon Edwards in the lobby of Granville Towers East at 8:30.
Visit Duke Gardens
Lunch at Bullocks

Week of June 29-July 5

June 30: Monday

- 8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 15. LEC A: Principles of Membrane Transport. (G. Meissner)
10:00 a.m. Lecture 16. LEC B: Bioenergetics: The ATP Synthase and the Chemiosmotic Hypothesis. (G. Meissner)
2:00 p.m. Computer Lab 3 Programming and fitting to user-defined functions in SigmaPlot. (G Weinreb) (408 Mary Ellen Jones Building)

July 1: Tuesday

- 8:30 a.m. Lecture 17. LEC A: Membranes & Signal Transduction: Small GTPases & membrane anchoring. (S Campbell) (408 Mary Ellen Jones Building)

V. The Neuron: 5 lectures

- 10:00 a.m. Lecture 18. LEC B: Generation and propagation of the action potential: experimental observations and the Hodgkin-Huxley analysis. (RL Rosenberg)
11:30 a.m. Seminar (305 Mary Ellen Jones Building)
Dr John Sondek, Pharmacology Dept. UNC-CH, "Hetero-trimeric G-Proteins and the Role of Lipids in Signaling"
12:30 p.m. Lunch with Dr. Sondek (305 Mary Ellen Jones Building)
2:30P.m. Lecture 19. LEC C: The Action Potential (continued) (RL Rosenberg) (408 Mary Ellen Jones Building)

July 2: Wednesday

- 8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 20. LEC A: Membranes & Signal Transduction: Ca²⁺ Signaling (G. Meissner)
10:00 a.m. Lecture 21. LEC B: Neural Networks of the Visual System (P. Tiesinga)
11:30 a.m. Help Session: Go over Computer Lab 3 (TAs & Weinreb) and Problems. (TAs) (408 Mary Ellen Jones Building)
2:00 p.m. Computer Lab 4 (P. Tiesinga): Modeling Neural Networks. (408 Mary Ellen Jones Building)

July 3-July 5



July 4 Break and Lab Time

Week of July 6-July 12

July 7: Monday

8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 22. LEC A: The biophysics of the neuromuscular junction. ([G Meissner](#))

VI. Motility: 3 lectures

10:00 a.m. Lecture 23. LEC B: Molecular Motors and The Cytoskeleton: The Cell's AMTRAK ([D. Jacobs](#)).

11:30 a.m. **Seminar** (408 Mary Ellen Jones Building)
[Jose Rizo-Rey](#), UT Southwestern Medical Center Dept. of Biochemistry & Physiology, "Mechanisms of Neurotransmitter Release and Trafficking between and across Membranes"

12:30 p.m. Lunch with Dr. Rizo-Rey (408 Mary Ellen Jones Building)

July 10: Thursday

8:30 a.m. Class (124 Taylor Hall)
Lecture 24. LEC A: Muscle: many actin-myosin motors at work ([M Reedy, Duke](#)).

10:00 a.m. Lecture 25. LEC B: How Biological Motors Work: The Enzymology of Mechano-Chemical Energy Transduction ([C Carter](#)).

11:30 a.m. **Seminar** (305 Mary Ellen Jones Building)
[Robert Bourret](#), Immunology & Microbiology Department, University of North Carolina; "Molecular Machines: How Bacteria Sense and Respond to Their Environment"

12:30 p.m. Lunch with Dr. Bourret (305 Mary Ellen Jones Building)

4:00 p.m. *Help Session: Go over [Problems](#). (TAs)*
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VII. Nucleic Acids and Genetic Information: 6 lectures

July 11: Friday

8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 27. LEC A: Information Depository: Why a double helix? DNA Damage & Repair ([S Matson](#))

10:00 a.m. Lecture 28. LEC B: DNA Supercoiling Stores Energy ([J Griffith](#))

11:30 a.m. **Seminar** (408 Mary Ellen Jones Building)
[Tom Kunkel](#), Director, Environmental Biophysics Program, NIEHS, Research Triangle Park, NC; "Proofreading of DNA: There are no absolutes, but how good is good enough?"

12:30 p.m. Lunch with Dr. Kunkel (408 Mary Ellen Jones Building)

2:00 p.m. *Help Session: Go over Computer Lab 4 (TAs & Tiesinga) and Problems. (TAs)*
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July 12: Saturday

- 9:00 a.m. Lab Demonstration 3: Biomaterials and implantable sensor. ([L Averett](#)) Meet Ron Jacak in the lobby of Granville Towers East at 8:30.
- 12:00 p.m. Lecture 26. (305 Mary Ellen Jones Building)
Stochastic Modeling of Molecular Motors ([D Tsygankov](#)). (329, 312, AND 425 MARY ELLEN JONES BUILDING)

Week of July 13-July 19

July 14: Monday

- 8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 29. LEC A: How DNA Is Packed in The Cell Nucleus: Chromosomes, Genes, Nucleosomes. ([W Marzluff](#))
- 10:00 a.m. Lecture 30. LEC B: Other Nucleic Acid Structures and Functions: Ribozymes ([W Marzluff](#))

July 17: Thursday

- 8:30 a.m. Class (408 Mary Ellen Jones Building)
Lecture 31. LEC A: The Organization of Information: Genes, Introns, Exons, and Molecular Theories of Evolution. ([H. Fried](#))
- 10:00 a.m. Lecture 32. LEC B: The End of the Chromosome: Aging, Cancer, and Drug Development. ([M Jarstfer](#))
- 11:30 a.m. **Seminar** (305 Mary Ellen Jones Building)
[Wilma K. Olson](#), Chemistry Dept., Rutgers University: "DNA Mechanics and Gene Regulation"
- 12:30 p.m. Lunch with Dr. Olson (305 Mary Ellen Jones Building)

VIII. Polysaccharides: The Other Polymers: 2 lectures

- 2:30 p.m. Class (408 Mary Ellen Jones Building)
Lecture 33. LEC A: Structure/Function Relationships in Carbohydrate/Protein Complexes. ([Jian Liu](#))
- 4:00p.m. Lecture 34. LEC B: Regulation of Heparan Sulfate Synthesis/ Blood Coagulation, Cancer And Viral Infections. ([Jian Liu](#))

July 18: Friday

- 4:30 p.m. *Help Session:* Go over [Problems](#). ([TAs](#)) (329, 312, AND 425 MEJB)

Week of July 20-July 26

Lab Research

Week of July 27-August 2

Lab Research

Week of August 3-August 9



Lab Research

August 7

1:00 p.m. Final Student Presentations and Closing Ceremony (408 Mary Ellen Jones Building)

August 8

10:00 p.m. Evaluation Interviews (305 Mary Ellen Jones Building)

August 9 Check out of dorms by 12:00 Noon and departure

