

**PHOL 476 Cell Biophysics**  
 Wednesdays and Fridays 3:30 to 5:00 pm  
 E614 School of Medicine

**2011 Schedule**

Date	Topic	Instructor
Jan 12 (W)	Introduction	Jones
Jan 14 (F)	Modeling with SCoP	Jones
Jan 19 (W)	Phase behavior of lipids and membranes	Hopfer
Jan 21 (F)	Equilibrium thermodynamics of transport	Hopfer
Jan 26 (W)	Non-equilibrium thermodynamics	Hopfer
Jan 28 (F)	Molecular machines and thermodynamics	Hopfer
Feb 2 (W)	Interfaces and electrostatics	Hopfer
Feb 4 (F)	Diffusion and electrodiffusion	Hopfer
Feb 9 (W)	Mediated catalysis and transport kinetics	Hopfer
Feb 11 (F)	System analysis of steady-state kinetics	Hopfer
Feb 16 (W)	Osmosis and Donnan effects	Hopfer
Feb 18 (F)	Network analysis and cable theory I	Smith
Feb 23 (W)	Network analysis and cable theory II	Smith
Feb 25 (F)	[class canceled]	
Mar 2 (W)	Single channel kinetics	Jones
Mar 4 (F)	Voltage-dependent gating	Jones
Mar 7 – 11	Midterm exam (take-home)	
Mar 16 (W)	Hodgkin-Huxley papers I	Jones
Mar 18 (F)	Hodgkin-Huxley papers II	Jones
Mar 23 (W)	Hodgkin-Huxley papers III	Jones
Mar 25 (F)	Potassium channel inactivation	Jones
Mar 30 (W)	Calcium channel permeation	Jones
Apr 1 (F)	Channel modeling	Jones
Apr 6 (W)	Ligand-gated ion channels: from ligand binding to channel gating	Mu
Apr 8 (F)	(to be announced)	Ford
Apr 13 (W)	Spectroscopy and fluorescence	Smith
Apr 15 (F)	Specialized modalities in imaging (DIC, structured illumination)	Smith
Apr 20 (W)	Advanced microscopy topics: FCS, FLIM, OCT	Ramachandran
Apr 22 (F)	Advanced microscopy topics: FCS, FLIM, OCT	Ramachandran
Apr 28- May 5	Final exam	

Course director: Steve Jones, Department of Physiology & Biophysics, School of Medicine, E514, [swj@case.edu](mailto:swj@case.edu). 368-5527

## Course description and general organization

The course focuses on three general areas of physics that provide important theoretical frameworks and methodologies for biology: 1) Thermodynamics and kinetics; 2) Electrophysiology; 3) Optics and microscopy.

### General format

The course relies on reading of the relevant material, problem sets, laboratory exercises and in-class discussions. During the last 20 min of each session, the instructor for the next session will explain/illustrate biological observations and/or problems that require physics concepts and approaches. The lecturer will provide students with the learning objectives for the next session, reading assignments or some starting literature references, and a problem set. At the next session, the students will discuss the new concepts and principles, as well as solutions to the problem set.

### Evaluation and Grading

The grade will be based on oral participation and preparedness (30%), home work (20%), and 2 exams (25% each).

### Participating faculty

Name	Office	Telephone	E-mail
Hopfer, Ulrich	E515	368-2878	ulrich.hopfer@case.edu
Jones, Stephen	E514	368-5527	swj@po.cwru.edu
Smith, Corey	E510	368-3487	corey.smith@case.edu
Ramachandran, Rajesh	E511	368-2513	rajesh.ramachandran@case.edu

### **Math and modeling**

Matlab will be used as general calculation/visualization language.

It is available from the Case Software Center.

There are many built-in and web-based tutorials. In addition, there is a useful tutorial at:

<http://web.ew.usna.edu/~mecheng/DESIGN/CAD/MATLAB/matlab/matlab11.html>

In addition, there are plenty of books, e.g.,

Matlab An introduction with applications. Amos Gilat 2<sup>nd</sup> ed. Wiley, 2004, ISBN 0-471-69420-7  
ISBN 13: 978-0-471-69420-5

Introduction to MATLAB 7 for Engineers by William J Palm III, William Palm (Paperback)  
Buy new: \$39.32 Used & new from \$35.00

Getting Started With Matlab 7: A Quick Introduction For Scientists And Engineers (The Oxford Series in Electrical and Computer Engineering) by Rudra Pratap (Paperback)  
Buy new: \$29.95 Used & new from \$26.00

SCoP is a modeling package for which the Department has several licenses. It has a very convenient enzyme/transport kinetics section that will be used in the course. The modeling package will be distributed.

**Text book for thermodynamics and kinetics:**

Ken A. Dill and Sarina Bromberg Molecular Driving Forces – Statistical Thermodynamics in Chemistry and Biology, Garland 2003 QC 311.5 D578m 2003

**Other texts on reserve in HSC library**

Philip C. Nelson, Biological Physics, Energy, Information, Life, W.H.Freeman and Co. 2004  
Hille, Bertil, Ion channels of excitable membranes Sunderland, Mass. : Sinauer, 2001 3rd ed QH 601 H651i3 2001  
Cell physiology sourcebook : a molecular approach / edited by Nicholas Sperelakis  
Academic Press, c2001 Edition 3rd ed QH 631 C393ce3 2001  
Equations of membrane biophysics / N. Lakshminarayanaiah Orlando : Academic Press, 1984,  
HCL Stacks, QH 509 L192e 1984

**Other texts**

Nonequilibrium thermodynamics in biophysics [by] A. Katchalsky [and] Peter F. Curran,  
Cambridge, Harvard University Press, 1965, Kelvin Smith Stacks, QC311.K33  
Palsson, Bernhard Systems biology [electronic resource] : properties of reconstructed networks Cambridge ; New York : Cambridge University Press, 2006  
Entropy Demystified : The Second Law Reduced To Plain Common Sense / Arieh Ben-Naim Ben-Naim, Arieh, 1934- Hackensack, N.J. : World Scientific, c2007  
A Farewell To Entropy : Statistical Thermodynamics Based On Information : S=LogW / Arieh Ben-Naim Ben-Naim, Arieh, 1934- Hackensack, N.J. : World Scientific, c2008