CIB 565: Essentials of Biophysics

Rutgers University - Camden

Instructor: Dr. Eric Klein, JHSC 215B

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Hours and Location: Classes will be held online on Wednesday evenings from 6:00 - 8:50.
Zoom link: https://rutgers.zoom.us/j/95387486313?pwd=ZzF3bnhGMzhqSzBzOUZ4VWhHYlNaZz09

Text: No text is required, but for further reading I would recommend: Physics of the Life Sciences by Jay Newman. I will post recorded lectures for a review of basic physics to prepare you to read the papers for class discussion. Lectures can be watched any time before class and the links are on the Sakai site.

Learning Objectives: Students will

a) Become comfortable with physics concepts fundamental to classical biophysics, including the ability to use such concepts in basic problems
b) Develop familiarity with how such concepts are used and understood in biophysics research
c) Develop appreciation for the number of systems and problems that have been addressed using biophysical methods
d) Improve ability to effectively read for and/or present the "big picture" of a research manuscript.

Academic Integrity. Each student in this course is expected to abide by the University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work. Please see the academic integrity policy at

https://fas.camden.rutgers.edu/faculty/facultyresources/academic-integrity-policy/

Homework:

For each week's paper, submit two questions by Wednesday at noon to the Sakai site (in the forums section) to stimulate discussion.

There will be 2 problems sets due on the following dates:

Wednesday, October 21, 6:00 PM
Wednesday, December 9, 6:00 PM

News and Views: Each student will prepare a 5-minute presentation (twice per semester) based on a News and Views item from *Science, Nature, Biophysical Journal,* etc.

Grading:

Participation: 33% (Includes the submission of paper questions as well as in class participation)
News and Views: 33%
Homework: 33%

Class	Theme	Physics Concepts	Math Review
1 (9/2)	Description of a single particle	Displacement; velocity; acceleration	
2 (9/9)	Fluid Flow	Reynold's number; viscosity; surface tension	Derivatives
	Chemotaxis in *E. coli* analyzed by 3-dimensional tracking		
3 (9/16)	Diffusion	Random walk; Brownian motion	Averages and distributions
	Resistance to Blood Flow in Microvessels in vivo		
4 (9/23)	Mechanics	Kinetic/potential energy; work; force	Trigonometry
	Protein mobility in the cytoplasm of *E. coli*		
5 (9/30)	Particle interactions	Force; momentum; interaction potential	Vectors
	The hydrodynamics of water strider locomotion		
6 (10/7)	Elasticity	Springs; compressibility; oscillations	
	Fire ants self-assemble into waterproof rafts to survive floods		
7 (10/14)	Molecular dynamics	Systems of particles	
	Elastic behavior of crosslinked and bundles actin networks		
	Mechanism of shape determination in motile cells		
8 (10/21)	Electrostatics	Coulomb potential; dipole-dipole interactions	
	How fast-folding proteins fold		
	How membrane chain-melting phase-transition temperature is affected by the lipid chain asymmetry and degree of unsaturation		
10/28	No Class		
9 (11/4)	Surface forces	Friction; adhesion	
	Counterion atmosphere and hydration patterns near a nucleosome core particle		
	Intracellular anions as the voltage sensor of prestin, the outer hair cell motor protein		
10 (11/11)	Rotation	Angular kinematics and momentum; torque	
	Adhesive force of a single gecko foot-hair		
	Strike forces of the peacock mantis shrimp		
11 (12/4)	High-speed atomic force microscopy reveals rotary catalysis of rotorless F1-ATPase		
	The stall torque of the bacterial flagellar motor		
11/25	Thanksgiving- No Class		
12 (12/2)	Statistical Mechanics and molecular crowding		
	Molecular crowding limits translation and cell growth		
13 (12/9)	Bridging experimental and computational approaches		