This course explores the fundamental concepts of biological physics. The main objective is to learn how to apply the principles of physics, methods of mathematical analysis and computational modeling to complex biological systems and develop a better understanding. Our approach will be truly interdisciplinary, bringing concepts from statistical physics, classical mechanics, cell biology, chemistry and biochemistry. This course will serve as an introduction to this wide area, providing you with necessary general concepts, as well as selected topics from current literature.

Instructor: Prof. Erkan Tuzel
Class time and place: TTh 4:00-5:20 PM in Olin Hall 223
Office: Olin Hall 220
Office phone: (508) 831-5391
Office hours: TBA
E-mail: etuzel@wpi.edu (best way to reach me)
Webpage: http://tuzelgroup.wpi.edu
Class site: http://my.wpi.edu

Topics to be covered

- Biology by the numbers: time and length scales
- Mechanical and chemical equilibrium in the living cell
- Entropy in biology
- Two-state systems and cooperative binding
- Random walks and the structure of macromolecules
- Architecture of the cytoskeleton
- Biological membranes: life in two dimensions
- The mathematics of water
- Statistical view of biological dynamics
- Life in crowded environments
- Rate equations and dynamics in the cell
- Dynamics of molecular motors

Course Logistics

Attendance: Your class attendance is expected, although not required. Research shows that there is a high correlation between students who miss class and students who perform poorly in classes.

Homework: There will be one homework set per week. The homework will be assigned on Tuesdays and will be due beginning of class the following week. Solutions will be posted on Blackboard. Late homework will not be accepted.

Project: Each student will complete a project and submit a journal style written report, followed by a presentation to the class. Details will be discussed in class.

Final Course Grade: 50% Homework, 40% Project report, 10% Project presentation.
**Supplemental Reading:** Additional reading materials (such as papers, reviews) will be posted on the Blackboard site of the course. Furthermore, the following books can be used as supplements:

- Random Walks in Biology by Howard C. Berg.
- Biological Physics by Phillip Nelson.
- Mechanics of the Cell by David Boal.
- Cell Movements from Molecules to Motility by Dennis Bray.
- An Introduction to Biophysics by Thomas M. Nordlund.

**Active Learning:** Learning is not simply the acquisition of correct information. Learning requires integrating new information with your own knowledge and experiences, and delivery of information by itself doesn’t help you develop your own understanding of the material. What this means is that I cannot simply transmit knowledge to you—you will have to take an active role in the learning process. Educational research has shown that most learning occurs in an active classroom environment where students take responsibility for learning rather than being passive receptors of the professors knowledge.

The course text is very clear and easy to read, and we will follow the text closely in class. For me to present all that information in class would be a poor use of your time given the fast pace of our course. If you prepare for class by reading the material, we can make better use of the class time by working together to develop a better understanding of the material.

**Strategy for Success:** The most learning occurs in an environment characterized by high expectations and respect and care for individual students, and where the value of collaboration is stressed over competition. Advanced reading, consistent active participation throughout the term, collaboration, and timely completion of assignments are key to success. If you work regularly and allocate enough time each week to keep up with the course, you will get the most out of the course both intellectually and grade-wise.

**Academic Dishonesty:** Individual integrity is vital to the academic environment because education involves the search for and acquisition of knowledge and understanding, which are, in themselves, intangible. Evaluation of each student’s level of knowledge and understanding is a vital part of the teaching process, and requires tangible measures such as reports, examinations, and homework. Any act that interferes with the process of evaluation by misrepresentation of the relation between the work being evaluated (or the resulting evaluation) and the student’s actual state of knowledge is an act of academic dishonesty. The moral equivalent of academic dishonesty in larger society is treason.