Physics 280: Physical Models of Biological Systems

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"The beauty of Nature lies in detail; the message, in generality. Optimal appreciation demands both." — Stephen Jay Gould

"Nature uses only the longest threads to weave her patterns, so each small piece of her fabric reveals the organization of the entire tapestry." — Richard Feynman

"Seek simplicity, and distrust it." — Alfred North Whitehead

Classic case studies of successful reductionistic models of complex phenomena, emphasizing the key steps of (1) making estimates, often based on dimensional analysis, (2) using them to figure out which physical variables and phenomena will be most relevant to a given system, and which may be disregarded, and (3) finding analogies to purely physical systems whose behavior is already known. The cases studied involve basic biological processes, mainly at the molecular and cellular level, in the light of ideas from physics.

The past decade or two has seen a revolution in physical techniques to get inside the nanoworld of cells, tweak them in physical ways, and measure quantitatively the results. Finally, a lot of physical theories are getting the precise tests needed to confirm or reject them. At the same time, even some mechanisms not necessarily used by Nature, for example in neural computing, have proven to be of immense technological value.

In short, you'll be hearing a lot about biological physics in the 21^{st} century. This course attempts an introduction to just one corner of the field, using as its unifying thread the physics and biology of random walks.

Announcements: `http://courseweb.library.upenn.edu/`
Time: MWF 2:00–3:00pm.
Office Hours: We'll arrange these to suit the class.
Assignments: Biweekly problem sets, midterm, final. Students also write a 10pp paper.
General Policies: see "Course Info" handout.

General prerequisites:
PHYS 101 (or higher), MATH 140-141 or MATH 150-151. Recommended: previous or concurrent PHYS 102; basic background in chemistry and biology.