

APh161: Physical Biology of the Cell

Possible Poster Topics: Winter 2006

Poster Session Project Philosophy

Each year one of the most important parts of the course is the student projects in which you imitate the overall style we have used to attack problems in the course, but now to a problem of your own choosing. The poster session is taken very seriously and this is NOT something that you can do in the final week before the poster session. To eliminate the urge to procrastinate, there are several milestones for the project during the term. The first milestone is to obtain a title and to write an abstract of your intended project. These abstracts will be due on Thursday, Jan. 26, 2006 and must be submitted by email to Eric Peterson, Jen Barnet and me by the beginning of class on Thursday morning. Below I give you some suggestions for possible projects - the list is very limited and you should feel free to do something completely different. I can help out with suggested readings and also with what calculations to try.

- *Statistical Mechanics of Hemoglobin.* Examination of the status of different models of oxygen binding in hemoglobin. Relation to physiology.
- *Statistical Mechanics of Signaling.* Experimental backdrop. Modeling a simple signaling problem using statistical mechanics.
- *Kinetic Proofreading.* Phenomenology of proofreading (could be in translation, replication or other contexts). The theory and related experiments.

- *Chromosome Segregation.* Phenomenology of chromosome segregation. How microtubules and motors make it all happen.
- *Connectivity of Neurons.* The neuronal network in the worm *C. elegans*. Models of network connectivity.
- *Hydrolysis in Polymerization.* How is hydrolysis used during polymerization.
- *Molecular Motors.* Phenomenology of motors *in vivo*. Examine the recent experiment from the Selvin group. Life on microtubules.
- *Transcription Factors in Embryos.* Recent PNAS paper by Gregor *et al.* on bicoid gradients in *Drosophila*. Simple reaction-diffusion models of transcription factor gradients.
- *Vesicle Budding.* The role of vesicles in biological systems (Golgi, synapses, etc.). The cost to make vesicles. Simple models of the mechanisms.
- *Biological electricity.* The action potential. Energetics associated with action potentials and estimates for the whole brain.
- *The Physics of Viruses.* The numbers associated with viruses like HIV or influenza. The mechanism of RNA packing in viruses. Other processes in viral life cycles.
- *The Physics and Biology of Macromolecular Crowding.* Simple estimates about the role of crowding. How equilibria are altered by crowding. How dynamics is altered by crowding.