

APh162: Physical Biology Laboratory

Winter 2006

When: W, 3:00 PM.

Who: You and me (Rob Phillips, x 3374, phillips@pboc.caltech.edu, 159 Broad). The TAs for the course are Hernan Garcia, x3106, hgarcia@caltech.edu 157 Broad and Tristan Ursell x 8889, natsirt@caltech.edu 71 Broad. Joanne Ramirez (joannear@caltech.edu) is the Lab Manager and will be helping us with many different aspects of the course. I am always happy to see you, but with certainty, the best way to contact me is by email. After that, the best approach is to schedule a time to see me through my assistant, Katie Miller (x6337, kmiller@caltech.edu, 138 Broad).

Where: 040 Keck, subbasement

What: See below!

How: We will meet once per week in the lab and once per week as a group. You will have weekly presentations as well as hand in a CD each week with your "write up". The particular due dates will be worked out as we go along. Probably there will only be a total of 4 times when you hand in your work.

Course Philosophy: This course is the experimental counterpart of APh161: Physical Biology of the Cell. The basic idea of both courses is to pursue the exciting opportunities that exist at the interface between biology and more traditional quantitative sciences. In particular, the ambition of these courses is to use quantitative tools to investigate biological systems. The idea of almost all of the experiments is that there will be a core part of the experi-

ment where we suggest a concrete measurement or procedure. However, once you have accomplished that, almost all of the labs will permit (and we will STRONGLY encourage) open ended exploration on your part - in some ways, this is the most serious aspect of the course – you need to take the ball and run with it. We are expecting you to talk to us and to think and explore.

In all cases, the experiments will culminate in *measurements*. This means that when you report the outcome of your experiment, you should have quantified the results. We will be using Matlab repeatedly as the basis of our analysis and we will conduct some tutorials as a group on how to do image analysis and data manipulation.

1 Tentative Course Outline

The course outline given below is intended to provide an overall sense of the topics we will cover and the general flow of the course. Certain individual topics might be added or deleted as I see fit.

1. Weeks 1 and 2: Biology - A Feeling for the Numbers

- *Spatial scales*. The size of things - molecules, macromolecular assemblies, organelles, cells, tissues, organisms. Using microscopy to examine the sizes of biological structures.
- *Temporal scales in cells*. How fast? Measurements of the rate of processes such as enzyme action, the cell cycle and embryonic development.

2. Weeks 3-6: DNA Science

- *Manipulating DNA*. restriction enzymes, gel electrophoresis, bacterial transformation.
- *Fluorescence in E. coli*. Bioinformatics. Putting genes for fluorescent proteins into bacteria and observing the resulting response.

3. Weeks 7-10: Advanced Projects

- *Cytoskeletal Polymerization*. Single molecule and bulk measurements of the rate of polymerization of cytoskeletal polymers.

- *Quantification of Gene Expression.* Single cell and bulk measurement of the level of gene expression in cells.
- *Optical Tweezers or TIRF.* Build your own optical tweezers set up and measure the trap stiffness. Build your own TIRF microscope.
- *Lipid Bilayer Mechanics* Measurement of the mechanical properties of lipid bilayers. Examination of the segregation properties of multicomponent lipid bilayers.