The research project and the accompanying presentation are an important part of the coursework. You will be expected to write a journal style "article" and talk about your results in a short presentation. The purpose of this brief note is to give you some general guidelines about how to choose a topic, organize your paper, and prepare your presentation.

While you work on your project, you will get feedback from the staff at the Writing Center, fellow students and myself. However, you will benefit from this feedback only if you turn in your work on time, and show up to all the meetings.

There are two general approaches to choosing a topic for your presentation:

- You can start with a published model of a biological system or phenomenon. You will need to demonstrate a thorough understanding of the model and the mathematical techniques used to develop and study it. In your project you will also have to go beyond the published results, ask your own questions and try to answer them using further simulations and mathematical analysis of extensions of the model.

- You can try to develop your own model of a biological system or phenomenon using the mathematical technique developed in the course. In this case you should start with a book or article that provides a description of the phenomenon you wish to model. While this will not be a mathematically precise description, it should provide sufficient information to constrain the model. In this case your presentation should provide a precise account of how you have developed your model to capture different features of the biological system you are studying.

I will describe what I expect from you in terms of the deadlines for the different stages in the development of the project. Writing Center studio meeting dates are given in parentheses – these are approximate, so please make sure that you get the correct date, time and location.

September 17 (9/8) – Topic Proposal At this time you will need to choose a general topic for your project that involves a nontrivial model of a biological system or phenomenon. Keep in mind that in your final submission you will need to present the model using precise, mathematical terminology. Moreover, you will need to also do some computer simulations. Therefore, look for a model that is not trivial, but also not so complex as to be intractable.

Your proposal should consist of about one paragraph and several references. You should briefly describe the biological system you wish to model, and the mathematical and numerical methods you intend to employ.

To choose a topic start with a general area that you find interesting (neuroscience, gene networks, sequence analysis, ...). There are a number of introductory texts, as well as website, on mathematical biology that you can look at to give you an overview of the subfield. Follow up on some of the references to find a specific topic that is of interest to you.

Please feel free to email me with questions or if you need suggestions. Be prepared to receive suggestions on modifying your topic, if it is too far removed from what we will be doing in the course, or it is too ambitious.

October 6 (9/22) – One page synopsis At this time you will have chosen your topic, and now it is time to think about what you will do with it. Think of the synopsis as a roadmap for the development of your project during the rest of the semester. Briefly describe the model you intend to study, and what has been done so far. Then present the questions that you intend to ask, and give an outline of how you intend to answer them.

October 27 (10/13) – First draft of paper At this time all the parts of your paper will start taking shape, although you may still be working on completing some of the analysis, programing and simulations. In particular, your paper should consist of the following

- **Abstract.** Here you will tell the reader in a few sentences about the problem you are considering, and about your main conclusions. In the first draft, the abstract can be very short.
- **Introduction.** This part of the paper serves to motivate the rest. Don't use it to dump a bunch of references, and don't use it to cite extensively from previous work. Use it to discuss where the question you are considering comes from, why it is interesting, and what people have done to answer it so far.
- **Methods.** Here you will describe the methods that you are using. Be as complete as you can. Writing a paper is frequently a process of trimming, rather than adding more text. It is easiest to start with an overly detailed description and then streamlining it, than with an incomplete description and trying to fill in the details after some of the may be forgotten.
- **Results.** This is the main section of the paper. Here you present what you actually did. Again, don't worry about being concise at this stage, but try to be complete.
- **Discussion.** Here you will put your results into context. Perhaps start by revisiting the main conclusions of your work. Then discuss how you extended what other people did, and how your conclusions compare to those in previous work. Also, talk about limitations and possible extensions of your work.

The first draft should have the general structure of the finished product. However, all parts may not be fully fleshed out at this point.

November 17 (11/10) – Second draft of the paper At this point the paper needs to be nearly complete. This draft should contain all your results and a full discussion. Think of this draft as the version of the manuscript that you would send out for review. After you receive reviewer comments you will be ready to revise your manuscript and submit a final version.

The final version of the document will be due on the final day of classes.

Final presentations (TBA) You will have 15–20 minutes for your final presentation. I will provide separate guidelines on how to prepare these.

There are many potential areas from which you can choose your project. One approach is to start with a book on mathematical models in biology and find a topic that is of interest to you. You can follow the references in the book, or go online to look for papers on a similar subject. The following is a list of more general reference books on mathematical biology:

- J. Murray. *Mathematical biology.*
- Sneyd and Keener. *Mathematical Physiology.*
- C. Fall. *Computational Cell Biology.*
- de Vries, et al. *A course in mathematical biology: quantitative modeling*
- Edelstein-Keshet. *Mathematical Models in Biology*
- Otto and Day. *A Biologists Guide to Mathematical Modeling.*

As I mentioned in class, there are particular topics you may wish to consider. Here is a partial list

- Signaling and gene networks. (Szallasi, et al. *Systems Modeling in Cellular Biology*, and Wilkinson. *Stochastic Modelling for Systems Biology*).
- Spread of infectuous diseases.
- Stochastic models of neuronal networks. (Gerstner and Kissler. *Spiking Neuron Models*).
- Models of cancer. (Wodarz and Komarova. *Computational biology of cancer*).
- Stochastic models in evolution, including evolutionary game theory. (Nowak. *Evolutionary Dynamics*).
- Models of swarming behavior, and dynamics of groups. (papers by Ian Couzin, and www.swarm.org)

If you still cannot think of everything, please see me and I would be happy to discuss.