The independent project is your chance to work on some topic relating to the themes of the program that interests you. The purpose of this project is to give you a chance to explore mathematics as it relates to real world problems, to learn how to read the scientific literature, to learn how to write a mathematics paper that adequately explains the topic you have studied and to practice presenting your work to the class.

Choice of Topic

You have freedom to work on any topic you want, with the proviso that it relates to the themes of the program and that it incorporates mathematics at the level we are covering in class. You are not expected to conduct *original* research, rather you should learn about and understand how mathematics has been used to model problems in biology. Your idea should have scope for exploring some mathematical model in detail.

Here are some suggestions:

- Behavior ecology - behavior games, foraging theory
- Dynamic models in medicine - chemotherapy, circulation, HIV
- Excitable systems - nerve conduction, circadian rhythms
- Pattern formation - slime molds, zebra stripes
- Ecosystem modeling - stability vs. complexity
- Statistical models in population dynamics

I have placed some books on closed reserve in the library, which contain ideas that you might find useful. I also have links in the reference section of the program website.

You should submit a one-page project proposal by the end of week two. This proposal should be typed and contain a title and a paragraph explaining the topic you wish to study and why it is interesting. You should briefly mention the type of mathematical model you will use and give references to books or journal articles you wish to use.

Project Presentations

Project presentations will be during week ten. A sign up list will go up by the end of week two. Your presentation should be twenty minutes long with five or ten minutes for questions. In your presentation you should start with some background information about the problem you are modeling, carefully explain how the model is constructed, and then explain how the model is solved. Your objective is to teach the class, so make sure you explain all terms clearly and check that your audience follows your explanations. You are encouraged to make use of visual aids to help explain your results. Here are some tips.

Tips for Successful Presentations

Start every talk with a title and a brief overview of what the talk will be about.

- Motivate the talk by connecting it with what we have learned in the class or relating it to some interesting natural phenomena.
- Show enthusiasm for what you are presenting and engage your audience with questions.

- Have a logical and interconnected progression from more general questions or topics to a more focused discussion of specific details.
- Make good use of the technology to illustrate your talk. Audiences need tangible images and equations to facilitate their understanding.
- Define all terms that you use – do not assume your audience knows the terminology you have learned in preparing your talk.
- Tie together all the main points at the end of the talk, answer any questions you posed at the beginning the talk.
- Rehearse your talk ahead of time and finish it on time.

Project Paper

I would like you to submit a ten-page, double spaced, paper by the beginning of week ten. You should hand in rough drafts of your paper at beginning of week nine. Your paper should start with a general introduction giving a motivation for the topic you are studying. You should carefully present the model you have examine and any supporting experimental or computer modeling work that you have done, taking care to define all terms and symbols and explain the assumptions being made. You should clearly specify a research question you want to answer. The body of your paper should outline what methods you used to analyze the problem and what inferences you are able to make. Your concluding paragraph should answer your research question, state the limitations of your model and allude to possible generalizations or improvements that could be made to the model. Your paper should include a title and bibliography. Your paper must be double-spaced and carefully typeset – including embedded graphs and equations where appropriate. A useful program for typesetting mathematics is LaTeX.

Credits

Two credits will be given for your project work. Those credits will be based on your presentation and final paper. I would also like you to keep a logbook accounting for the number of hours of work you do each week, and detailing what work you did. You should spend twenty-twenty five hours on this project. Upper division credit is possible for upper division work. Typically upper division work will involve extensive use of mathematics beyond first year level, will include reference to current scientific literature – such as preprints, professional journals and textbooks, will contain evidence that you have conducted significant independent work (which may include experimental support for your mathematical model, a computer simulation, or derivation of some mathematical result.), and finally will be presented in both written and oral form in a professional manner.