My intent in this class is to give you practical experience in molecular systems biology. You will learn a combination of computational methods and experimental methods surrounding biochemical states of eukaryotic cells with the intent of understanding how these molecules impact normal and diseased physiology of mammalian cells. Although we will cover a small subset of the methods possible, you will ideally have a solid foundation and be able, in the future, to easily learn new measurement modalities or computational methods. Coursework and lectures revolve around the following goals of learning:

1) To broaden your perspective on how mammalian cells are regulated and controlled at the biochemical level
2) To understand the measurement modalities for measuring molecules on a systems-level, including understanding the limitations, linearity and noise
3) To understand the breadth of computational tools available for deriving meaning from such biochemical data
4) To choose the best combination of measurements, experimental conditions, and computational methods to optimally answer a question of interest

In addition to practical skills, coursework is also designed with professional development in mind. These are the main goals considered regarding professional development:

1) Improve critical thinking regarding current literature
2) Gain experience in summarizing and presenting research ideas.

The attached schedule is a tentative plan for topics and assignments. Professor Naegle reserves the right to make changes to the schedule throughout the course as needed.

References (on reserve at Olin library, except where noted):
Lodish, “Molecular Cell Biology” 2004 or 2012 (Chemistry Library Permanent Reserve)
Find other references and tutorials in “Course Documents” on Blackboard

Grade
10% Participation 18% Final Proposal*
10% Literature presentation 17% Preliminary Data*
35% Homework
* Are the final project

Participation
I expect every member of the class to participate equally in the process of learning. This process includes active discussion within the class and proper preparation for class discussions. Along with participation comes respect for your peers by offering them an equal opportunity to participate. There will be active discussion throughout the course.
and it is important to recognize there may often be many possibly correct answers. I fully expect all class interactions to remain cordial and respectful. Acting consistently outside of any of these expectations will lead to a decrease in this portion of your grade.

**Homework**
Homework will often consist of implementations from primary literature. Hard copy results of the homeworks will be due by the end of class on the indicated due date (Never include printed Matlab code). Matlab code must be submitted via blackboard before the class begins. Code must be submitted as a zipped folder with all required dependencies directly in that folder. Name the script that produces the results as main.m and the folder name as LASTNAME_HW<X>.zip. Make sure this code works as a stand-alone before submitting it. Specific directions for code submission may vary by homework.

**Literature Presentation**
In the second week of the semester students will sign up for one of several primary research papers to present to the class. Likely 2 to 3 students will be responsible for introducing the paper, highlighting the key points, leading a discussion, and concluding the paper.

**Final Project**
The final project will consist of defining a biological question of interest that involves the measurement of systems-level data, the experimental design for how you would collect the data and how you will use this data, specifically what computational techniques will be needed in combination with the experiments to help answer the initial exploratory questions or hypotheses. To gauge the size of this project, should someone take your project proposal and successfully yield results, it would be publishable in a journal article on order of the articles we will read in PNAS or Molecular Systems Biology. A proposal will be due **four weeks before the end of the semester** for which comments will be returned a week later with the project grade. The biological question could be open-ended or hypothesis-driven, but in either event the choice of question must be novel and the reasoning for the experimental design and computational plans must be sound. In the final weeks you will generate preliminary data to demonstrate that the combination of computational techniques and experimental data will potentially yield fruitful results when applied to your particular proposed experiments (you may choose to generate your question directly around existing data and use this for preliminary results or choose existing data that will be similar in nature to your proposed experiments).

**Proposal Report:**
These are approximate page lengths. You will not be graded on exact page numbers, but whether each of the sections is complete regarding detail, these page numbers reflect the average length of such sections. Abstract and Aims (1 page): Brief summary of the problem and proposed project. Background and significance (2-4 pages). Experimental Methods (1-3 pages). This should be detailed and include plans for cell lines or tissues, conditions, proper controls, instrumentation, data normalization etc. Computational Methods (1-3 pages). This section should include Anticipated problems and alternate solutions (1 page)
Proposed data for generating preliminary results (1 page)
Citations (1-2 pages): Use Author-Date style for referencing and listing citations.

Proposal Grading:
Novelty and significance (20%): How novel and significant is the work proposed, either from the standpoint of new techniques applied to a previously researched problem or standard techniques for a completely new problem? This will require motivating the work properly through ample research.
Experimental plan (20%): Does the plan include proper controls? Does it indicate you understand the best measurement methods for the problem you are trying to tackle?
Computational plan (20%): Does this demonstrate you understand the proposed computational tools and the proper selection of computational methods for answering a direct biological question?
Writing (20%): General flow, grammar, and style.
Anticipated problems/alternate solutions (10%): Does this indicate you have thought about the caveats of the experiments or the limitations of the proposed techniques?
Can you propose something that could salvage time and effort in the experimental side of things?
Bibliography (10%): How appropriate and complete is the bibliography? There is no number of required citations, but citations should be accurate and sufficient.

Preliminary Data grading:
Your final project will be your proposal along with preliminary results that demonstrate your proposed techniques, in combination with example data, will potentially answer the question as outlined in your proposal. You may rewrite the proposal for final submission and your proposal grade will then be the weighted combination of the two proposals (one-third from the lowest score and two-thirds from the highest score).
Final report grade (20% of final project):
30% Choice of data
50% Implementation and results.
20% Representation of the results. This includes useful choice of graphs and interpretation of results.
Should your attempts prove to be unfruitful, attach an addendum to describe an alternate strategy for answering your initial question and a detailed explanation of why you think this method failed to work. The 50% assigned to implementation and results may be scaled according to the risk of the project. A riskier project could have fewer results than a “safe” project, but be graded the same to reflect the difficulty and novelty of the attempt.

Final project presentation
In the last full week of the semester, we will have 20-minute project presentations (15 minute presentation, 5 minute Q&A) for each project. The grade will be assessed based on how effectively you motivate and introduce your biological problem of interest (20%), explain the experimental design (20%) and the computational design (20%), stay on time (20%) and answer questions from the audience (20%).
Access to Readings
All course readings are available on the course reserves section of Blackboard.

Late Assignment Policy:
Assignments should be turned in by the end of class on the date listed on the syllabus. Permission to turn in late assignments should be requested in advance of class on the date the assignment is due. It is the responsibility of the student to ensure that their request for permission to turn in late assignments has been approved before the start of class. Late assignments will be reduced by 1 letter grade for each day they are late and no late assignments shall be accepted after the assignment has been returned to other students.

Independence and collaboration:
As in most work areas of research and work, you will find collaboration enhances your own understanding and improves the final outcome of a homework. Homeworks are individual assignments and as such, are expected to represent your own work. However, collaboration regarding development of code and ideas is expected. There is a line that I hope you can easily decipher between generating important ideas and direct copying of another person's work. If I see evidence of direct copying I will treat these incidents as plagiarism for both parties involved (see below).

Plagiarism:
Copying phrases or sentences from sources other than one's own writing without proper citation is plagiarism. This includes textbooks, classnotes and papers distributed for the course. Plagiarism is considered cheating. The first incident will result in a warning and loss of credit for the portion of the assignment where plagiarism is found, the second incident will result in zero points for the assignment. The third incident of plagiarism will result in notification of the School of Engineering Judicial Board and a failing grade in the course.