Program in Computational Biology & Bioinformatics

Graduate Program Guide
2006 - 2007

Northwestern University

September 25, 2006 DMG

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WELCOME

August 15, 2006

Greetings New Students!

Congratulations to all of you on your past accomplishments and on your decision to attend Northwestern University. I know that you will find our Master's Program in Computational Biology & Bioinformatics (CBB) both challenging and gratifying. Many of you have concentrated on the life sciences or computer sciences up until this point in your academic careers; you will now expand your horizons by delving into complementary areas of study. As you are our second group of incoming students, you will see our first group of students graduate from our program, and as a result have a group of mentors the previous class did not; we are still young. This is therefore a momentous time for both our program and Northwestern University as we enter a new era and a new direction in our education and research missions. Our Program continues to grow weekly, not only with increased student interest but with rising faculty and administration interest as well. This is an exciting junction for all us and we welcome you into our community to share our enthusiasm. This will be a symbiotic relationship; our program grows through your experiences as we expect you to grow through your experiences with our program.

The program would not have been possible without the vision and support of Dr. Richard Morimoto. Professor Morimoto was Dean of The Graduate School four years ago when he asked Dr. Ming-Yang Kao (Computer Science), Dr. Vassily Hatzimanikatis (Chemical & Biological Engineering) and Dr. Ishwar Radhakrishnan (Biochemistry, Molecular Biology, and Cell Biology) to propose an interdepartmental program focusing on computational biology and bioinformatics. Between then and now, we have come a long way. We have received broad support for the program from the University administration at all levels which is one of the reasons why we are all here today.

Our goal is to provide training in computational and life sciences, as broadly defined, and prepare you for careers in academia or industry by building upon and complementing your current skill sets. Our program should be viewed as an opportunity to expand the breadth of your academic training. The program is much more than didactic coursework, employing participation in a seminar series and the completion of guided independent research projects which will assure students successful and rewarding graduate careers and provide you with the tools necessary for a successful career in science. Students will also participate in a summer research internship program, gaining paid work experience in an industrial setting.

This handbook will be a valuable resource for you, ***please retain this handbook for the duration of your study at Northwestern.*** This handbook outlines the main features of our program by describing the requirements for earning the Master's of Science degree in Computational Biology & Bioinformatics, and it outlines the four available concentration areas of study. We have also included information regarding the research interests of participating CBB faculty members. The program is unique in that it brings together 50+ outstanding faculty members from an unprecedented 12 departments spanning 3 schools: the Feinberg School of Medicine, the McCormick School of Engineering, and the Weinberg College of Arts & Sciences.

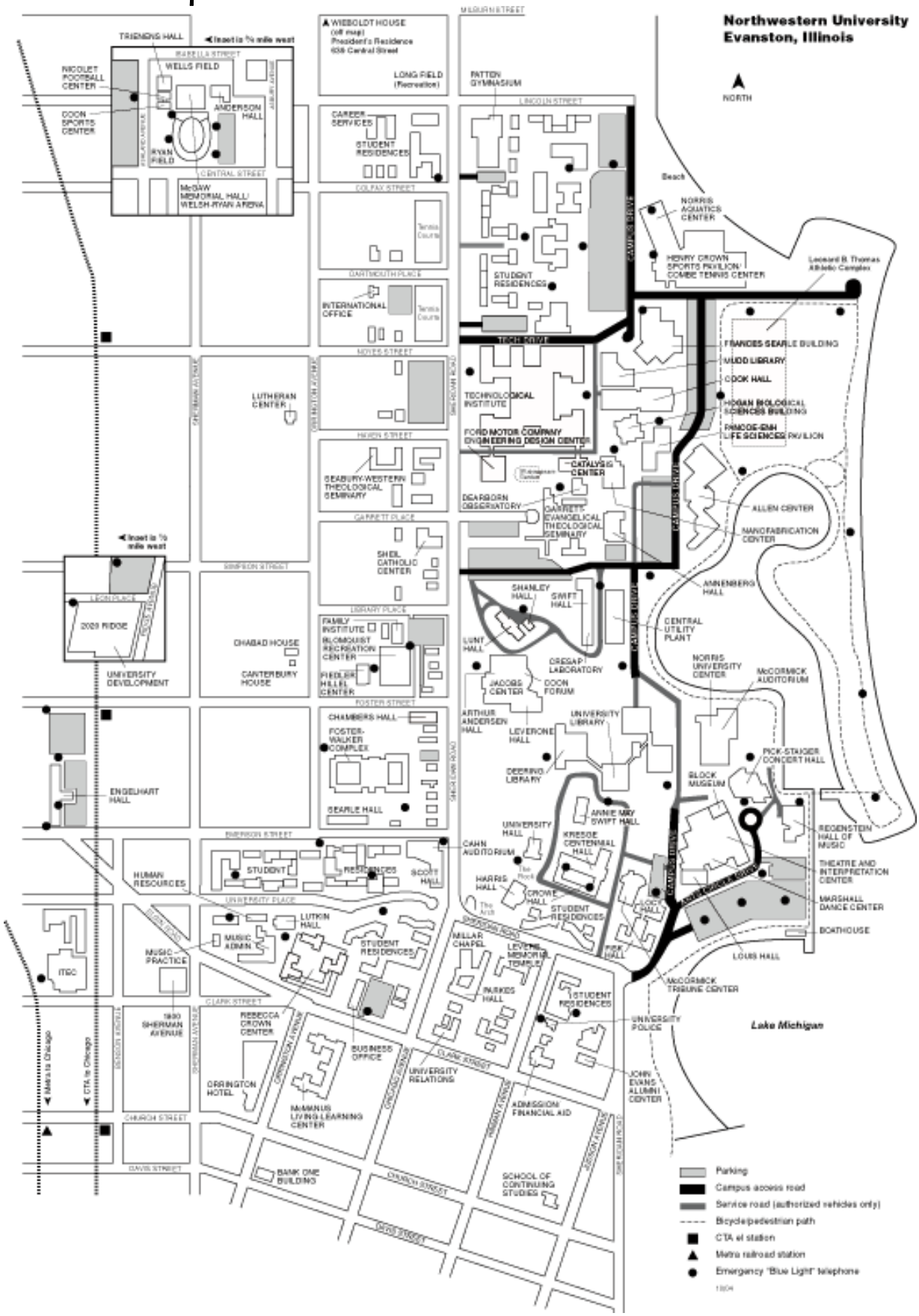
Opportunities for developing enabling technologies and making exciting discoveries at the interface of computational and life sciences abound. Our Program places a strong emphasis on independent research as we believe there is no better way to learn than to actually do something, and to enjoy the process. You are all both pioneers and catalysts for collaboration between faculty members.

Again, welcome to Northwestern University; I look forward to working with all of you.

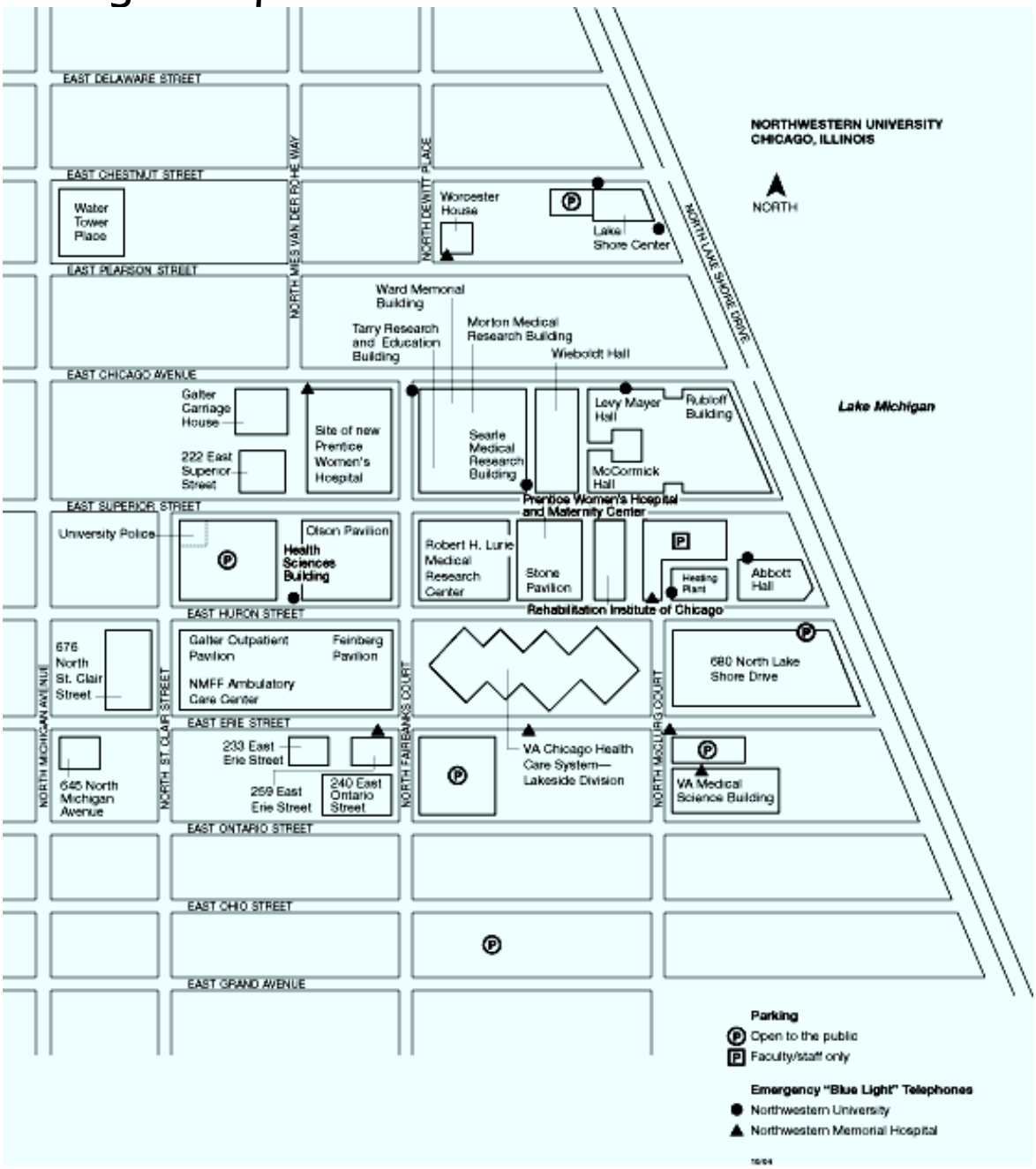
Sincerely,

Dawn M. Graunke, PhD
Associate Director
Computational Biology & Bioinformatics

Evanston Campus



Chicago Campus



CBB - 2006/2007 ACADEMIC CALENDAR

- FALL QUARTER 2006 -

September 11	Graduate School Orientation 1-4 pm, Norris University Center
September 13	**CBB Program Orientation 8:30am – 4pm, Ford Building**
September 15	New Student Registration begins at 8:30am (www.registrar.northwestern.edu)
September 19	Fall Quarter classes begin at 8 am – *Change of registration begins 9 am*
September 25	Last day for changing fall registration without being charged a late fee
October 27	Last day to drop a course without receiving an "F" (you will be charged)
November 3	Application for a degree due to TGS for December 2006 graduation
November 13	Advance registration for Winter Quarter begins
November 23-24	**Thanksgiving holiday break**
December 1	**Laboratory Research Agreements (winter) due in Program Office by 5:00 pm**
December 2	Last day of Fall Quarter classes
December 4-8	Final examinations
December 15	Advance registration for Winter Quarter ends at 5:00 pm
December 25-26	**Legal holiday – TGS and CBB offices closed**

- WINTER QUARTER 2007 -

January 1	Winter Quarter tuition due for continuing students
January 1	**Legal Holiday – TGS and CBB offices closed**
January 3	Winter Quarter classes and independent research begins at 8am
January 3	Late registration/Change of Registration/New student registration begins
January 9	Last day for changing winter registration without being charged for tuition
January 15	Suspension of classes in observance of Martin Luther King Jr. Day 11am -2pm
February 9	Last day to drop a course without receiving an "F" (you will still be charged)
February 19	Advance registration for Spring Quarter begins at 8am
March 5-9	**Spring Quarter independent research arrangements formalized**
March 9	**Laboratory Research Agreements (spring) due in Program Office by 5:00 pm**
March 10	Last day of Winter Quarter classes
March 12-16	Final examinations
March 16	**Winter Quarter research reports due in Program Office by 5:00 pm**
March 16	Advance registration for Spring Quarter ends at 5:00 pm

- SPRING QUARTER 2007 -

March 26	Spring Quarter classes and independent research begins at 8am
March 26	Late registration/Change of registration/New student registration begins
March 30	Last day for changing spring registration without being charged
April1	Spring Quarter tuition due for continuing students
April 9	Advance registration for Summer Quarter
May 4	Last day to drop a course without receiving an "F" (you will still be charged)
May 14	Advance registration for fall 2007 begins
May 18	Master's Degree Candidate Certification forms/Change of Grade forms due to TGS for June Master's Degrees
May 28	**Memorial Day Observed**
June 1	**Laboratory Research Agreements (fall '07) due in Program Office by 5:00 pm**
June 2	Last day of Spring Quarter classes
June 4-8	Final examinations
June 8	**Spring Quarter research reports due in Program Office by 5:00 pm**
June 15	Last Day to submit a Recommendation for the Thesis Examination Committee to the Program Office by 5:00 pm
June 17	Advance Registration for Summer Qtr. ends at 5:00 pm

- SUMMER QUARTER - (*Note: Except for CBB 590, students are not required to register for summer)

June 18	Summer Quarter tuition due
June 18	Summer Quarter classes and independent research begin at 8am
June 18	Late registration/Change of registration/New student registration begins
June 22	Last day to drop a course without receiving an "F" (you will still be charged)
July 4	**Independence Day Observed**
July 27/August 11	Last day of 6 week/8 week summer session classes
August 11	**CBB 590 Research Reports due in CBB Program office by 5pm**

YOU WILL FIND THE OFFICIAL ACADEMIC CALENDAR ON THE GRADUATE SCHOOL'S WEBSITE:
http://www.tgs.northwestern.edu/studentlife/newsevents/calendar/

REQUIREMENTS FOR THE M.S. DEGREE

OVERVIEW

The following pages list the requirements for being awarded a Master's of Science Degree in Computational Biology and Bioinformatics, along with a summary of the most significant general requirements of The Graduate School (TGS). Please note that these requirement details are specifically for full-time students although part-time students will still find this information useful, they will not necessarily follow the same schedule. Additional details on TGS requirements may be found online at http://www.tgs.northwestern.edu/.

PROGRAM SUMMARY

1st Year:	fall	- 3 to 4 courses, seminar (0 units)
2006-07	winter	- 2 to 3 courses, 1 independent research (I), seminar (0 units)
	spring	- 2 to 3 courses, 1 independent research (II), seminar (0 units)
	summer	- Summer research internship (0 units) *OR* 1 independent research (III)
2nd Year:	fall	- 1 to 3 courses (as needed), 1 independent research (III)
2007-08		(if needed), seminar (0 units)
	winter	- 1 to 3 courses (as needed), TGS 588 if needed (in order to maintain full-time status with TGS), seminar (0 units)

ACADEMIC REQUIREMENTS

All Degrees:

All Northwestern University graduate students, regardless of the degree they seek, must fulfill requirements regarding residency (put simply, the number of courses required to complete the degree), approved courses, grades, and filing for graduation.

In addition to requirements directly related to the awarding of a degree, all students are required to maintain standards of academic integrity and adhere to a code of academic ethics (see http://www.tgs.northwestern.edu/studentsvcs/ethics/). Regulations concerning registration and changes of academic program also apply to all students across degree programs and disciplines.

I. The Graduate School - Master's Degree Requirements

A. Minimum of three quarters full-time residency, or equivalent (minimum 3 courses/quarter or 9 courses total)
B. Continuous residency for three quarters prior to completing the program
C. Eleven (11) formal graduate level courses taken for a grade; a maximum 1/3 of courses independent study (i.e. CBB 499); note: TGS does not award 'D' grades, therefore anything lower than a 'C-' will be an 'F' and you will not receive credit for that course toward your degree
D. Time to complete degree is limited to 5 years post initial registration plus maximum one- year extension
E. Final examination according to the Graduate School standards
F. Approval of thesis by Program or Department

II. CBB Program Requirements – Academic Requirements

A. Satisfactory performance (Grade B or better, on time documentation [LRAs, Research Reports, seminars, etc]) in all CBB 499 independent research
B. Average grade of B or higher in all courses; students may not receive more than two grades of 'C' or *any* grade of 'F' in CBB-approved coursework toward their degree; minimum cumulative GPA of 3.5
C. Submission of Laboratory Research Agreements (LRAs) */which include a research project title and summary of proposed research/* for each quarter of independent research
D. Registration in the CBB 460 seminar series; attendance and participation is required
E. 3 quarters of registration in CBB 499: students are required to attend laboratory meetings in mentor's laboratories and participate in presentations and discussions. Students will submit a research rotation report at the end of final examination week to both the mentor and the CBB Program Office. Students will present their research during the following term's seminar series for each quarter of research.
F. One quarter of CBB 560 Summer Research Internship (paid)
G. Approval of final thesis and presentation/examination by Thesis Committee
H. Public seminar presentation of thesis research
I. Satisfactory performance in all required work; quarterly research presentations/ research reports, participation in the CBB seminar series, the summer research internship, the written thesis, oral presentation/examination before the Thesis Examination Committee, and the public seminar presentation of thesis research

III. Miscellaneous CBB Program Requirements

A. Research Group Seminars (while enrolled in Independent Research Projects)
B. CBB Retreat
C. Special Interest Group Seminars (i.e., Molecular Biology Club, Biophysics Club, Joint Biostatistics/Bioinformatics Meetings) or any seminars recommended by the student's advisor, mentor and/or the Associate Director
D. Participation in recruiting weekends/Open Houses

CURRICULUM & STUDENT ADVISORY COMMITTEE

Upon your arrival at Northwestern you will meet with the Associate Director to discuss your fall coursework, you will also be assigned to a faculty advisor from the Curriculum and Advisory (CSA) committee. Your advisor will help you with additional questions regarding coursework during your first term and will support you in the important task of choosing your independent research mentors. Your advisor, mentor, or the Associate Director must approve all electives that you choose to take each term. You should feel free to consult your advisor or the Associate Director as the need arises during the course of the year. It is of particular importance that you contact your advisor or the Associate Director if you are experiencing problems with any of your courses or with an independent research project.

The CSA committee is responsible for approving the appointment of your thesis examination committee. Documents in need of approval will be presented to the

Chairperson of the CSA committee; all Laboratory Research Agreements and the Recommendation for the Thesis Examination Committee must be approved in this manner.

COURSEWORK REQUIREMENTS - CORE COURSES

- ***All students must take a combination of CBB graduate core courses and elective classes. The four core courses described below are graduate-level courses that explore the most up-to-date topics in Computational Biology & Bioinformatics. All students must complete three of these four courses. Students are required to earn a B grade or better in each of these courses.***

BIOL SCI 323 Bioinformatics - An introductory course exploring the principles and applications of computational tools to research problems in biology. Prerequisites: introductory-level biochemistry, protein structure and function, and some background in discrete mathematics, statistics and probability. Prerequisites: BIOL SCI 301 or equivalent, BIOL SCI 361 or equivalent, and permission of instructor.

CHEM ENG 395 Special Topics in Chemical Engineering: Networks - *" What do metabolic pathways and ecosystems, the Internet, and propagation of HIV infection have in common?" Until a few years ago, the answer would have been very little. The first two examples are biological and shaped by evolution, the third is a human creation, and the fourth is an unwieldy mixture of biology and sociological components. However, in the last few years the answer that has emerged is that they all share similar network architectures.*

In this course, I will define a graph. I will then define a number of quantities that can be used to quantitatively characterize the structure of any graph. I will also briefly discuss the implications of the values of some of those quantities fore the dynamics of processes taking place of the graph. An example would be to investigate whether the emergence of an epidemic on a given population depends on the structure of the graph of contacts among individuals.

I will then introduce the most fundamental network models proposed in the literature. In the second part of the course, I will demonstrate the application of network analysis to complex systems in a number of disciplines, including "Systems biology and the characterization of cellular networks," "The spread of infections," "The structure of natural ecosystems," and "Technological networks."

EECS 336 Design and Analysis of Algorithms – Discussion of fundamental concepts and techniques for designing efficient algorithms and analyzing their performance. Topics include recurrences; sorting and order statistics; dynamic programming; greedy strategies; amortized analysis; advanced data structures; linear programming; efficient reductions and computational hardness.

STAT 465 Statistical Methods in Bioinformatics and Computational Biology - The goal of this course is to provide an introduction of statistical methodologies in important topics in bioinformatics and computational biology. The major topics covered in this course include microarray gene expression data analysis; biological sequence analysis; EST and SAGE data analysis. Statistical theory or methods to be introduced in this course include Z-test, t-test, regression, ANOVA, multivariate data analysis, Bayesian statistics, bootstrap, Monte-Carlo simulation, clustering algorithms, Markov Chain, Hidden Markov Chain, mixture model, etc. The students will be trained to apply the learned tools to solve real problems in the term projects or their own research.

COURSEWORK REQUIREMENTS - ELECTIVE COURSES

- ***Students complete 5 elective courses and 3 quarters of CBB 499. Students may choose from the following list of electives. 3 of the 5 electives must be advanced electives (denoted by an asterisk). 4 of the 5 electives must fall outside of the***

student's original area of specialization. Prerequisites may or may not apply (and are listed in capital letters at the end of the listing).

BIOL SCI 301 Biochemistry - Intermediate biochemistry course with an emphasis on the structure/function of macromolecules and understanding the principles and concepts that have broad application throughout the area of life sciences. Topics will include protein and nucleic acid structure, enzymology, intermediary metabolism, membrane structure, bioenergetics, and control mechanisms. BIOL SCI 110-1,2,3 OR BIOL SCI 210-1,2,3; CHEM 210-2.

BIOL SCI 302 Fundamentals of Neurobiology I - Cellular and biochemical approaches to the nervous system, focusing on neuron structure and function; will provide a strong background for nearly any speacialty within neuroscience; focuses upon molecular, cellular and systems neuroscience. BIOL SCI 210, PHYSICS 130 or 135.

BIOL SCI 306 Fundamentals of Neurobiology II - Integrative approach toward understanding functioning of mammalian central nervous system. Prerequisite: BIOL SCI 302-0.

*BIOL SCI 361 Protein Structure and Function - Structure and function of proteins; X-ray crystallography and NMR. BIOL SCI 301 or 309; PHYSICS 130 or 135.

*BIOL SCI 378 Functional Genomics - Gene expression patterns and their causes. BIOL SCI 210.

*BIOL SCI 395 Molecular Genetics – Course will explore recent advances through the primary research literature, which will be provided to the student and will consist of several classic papers as well as a larger number of recent papers from the most highly respected research journals. Representative topics will include: how genes are manipulated, how gene expression is regulated *in vivo*, how bacteria "talk" to each other, how yeast genetics is used to advance understanding in higher organisms, how human disease genes are discovered, and a bit on genomics. We will also delve deeply into two of the hottest fields in molecular genetics today: epigenetics (chromatin modification and its consequences) and non-coding RNA (RNAi and microRNAs).

EECS 310 Mathematical Foundations of Computer Science - An introduction to the mathematical tools needed for later Computer Science and Mathematics courses; familiarizes students with formalism and practice writing and reading proofs. Focuses on sets, functions, relations, propositional and predicate calculi, and graph theory. EECS 110 or EECS 111.

EECS 311 Data Structures and Data Management - Design, implementation, and analysis of abstract data types, data structures and their algorithms. Topics include: data and procedural abstraction, linked lists, stacks, queues, binary trees, searching, and sorting. CS 211 or permission of instructor; students need to be reasonably competent in C++ programming.

EECS 317 Data Management and Information Processing - Data models and database design. Modeling the real world: structures, constraints, and operations. Entity relationship to data modeling (including network hierarchical and object-oriented), emphasis on the relational model. Uses existing database systems for the implementation of information systems. EECS 110, EECS 111, or programming experience.

EECS 325 Artificial Intelligence Programming – Introduction to LISP and the basic elements of AI programming (semantic networks, frames, and partial matching). Advanced AI programming techniques (rule-based reasoning [deductive systems and production systems] and case-based reasoning [frames, discrimination trees]). EECS 110, EECS 111, or programming experience.

EECS 328 Numerical Methods for Engineers – Introduction to numerical methods; numerical differentiation, numerical integration, solution of ordinary and partial differential equations. Students write programs in FORTRAN, C, or Pascal using methods presented in class. GEN ENG 205- and MATH 220, 224, 230.

EECS 330 Human Computer Interaction - Introduction to human-computer interaction and the design of systems that work for people and their organizations. The goal is to understand the manner in which humans interact with, and use, their computers for productive work. The course focuses on the interface as designed artifact, a design problem without a single "correct" solution but with many "good" solutions and a plethora of "bad" solutions. Prior programming experience.

*EECS 339 Introduction to Database Systems - Data models and database design. Modeling real world structures, constraints, and operations. The entity relationship to data modeling (network hierarchical and object-oriented), with an emphasis on the relational model. Use of existing database systems for the implementation of information systems. EECS 213 & EECS 311.

*EECS 348 Introduction to Artificial Intelligence – Core techniques and applications. Representing, retrieving, and applying knowledge for problem solving. Hypothesis exploration; theorem proving; vision and neural networks. EECS 111, EECS 325, or LISP programming experience.

*EECS 351 Introduction to Computer Graphics – Fundamental concepts in computer graphics; graphics devices, rendering images, ray tracking, image processing, etc. CS 311.

*EECS 358 Introduction to Parallel Computing - Introduction to parallel computing for scientists and engineers. Shared memory parallel architectures and programming, concepts using shared address space programming, locks, events, barriers, loop scheduling, compiler directives such as DOALL, portable shared memory parallel programming such as PTHREADS. Distributed memory message-passing parallel architectures and programming, concepts including message sends and receives, global communicative promitives, single-program multiple data (SPMD) programs, portable parallel message programming using MPI. Data parallel architectures and programming concepts: array sections and operations, data distribution and alignment, languages (i.e. High Performance Fortran [HPF]). Parallel algorithms for engineering applications i.e. matrix and search algorithms.

*EECS 394 (1,2) Software Project Management and Development - Software development methodologies, object-oriented analysis and design, CASE tools, software life cycle. Project management tools, programming teams. Executable specifications, automatic test generation. EECS 343 or equivalent programming experience.

ES APPM 311 (1,2) Methods of Applied Mathematics - Ordinary differential equations: Sturm-Liouville theory, properties of special functions, solution methods including LaPlace transforms. Fourier series: eigenvalue problems and expansions in orthogonal functions. Partial differential equations: classification, separation of variables, solution by series and transform methods. Permission of instructor.

*ES APPM 420 Models in Applied Mathematics - Applications illustrating typical problems and methods of applied mathematics. Formulation of models for phenomena in science and engineering, problem solution, and interpretation of results. Examples: solid and fluid mechanics, combustion, diffusion phenomena, chemical and nuclear reactors, and biological processes.

*ES APPM 448 Numerical Methods for Random Processes - Applications illustrating typical problems and methods of applied mathematics; formulation of models for phenomena in science and engineering, problem solution and interpretation of results. Examples: solid and fluid mechanics, combustion, diffusion phenomena, chemical/nuclear reactors, and biological processes.

*ES APPM 495 Computational Neuroscience – Computational models of neurons: passive properties, models of ionic conductances, and the effect of a cell's morphology. Model synapses: behavior of small networks of neurons. Integrate-and-fire neuron models, spike train statistics and information theory. Conclude with computational models of plasticity and learning.
*IBIS 401 Molecular Biophysics – Includes protein/nucleic acid structure; transport and diffusion; macromolecular assemblies; molecular machines and single molecule studies; x-ray crystallography; electron microscopy and image reconstruction; nuclear magnetic resonance; spectroscopy.

*IBIS 402 Eukaryotic Molecular Biology - Genome and gene structure and organization; transcription and its control, aspects of signaling and developmental control of gene expression; RNA processing, translation and their regulation; DNA replication and its control; molecular analysis of disease; applications of molecular biology in biotechnology.

*IBIS 403 Eukaryotic Genetics – Genetic analysis and genetic mechanisms, structural and functional genomics, gene and genome evolution.

*IBIS 407 Genome Scale Science – Contemporary large scale approaches to biological research problems; including whole-genome transcriptional profiling, proteomic analysis, and high-throughput phenotypic screening.

IEMS 303 Statistics I - Summary statistics, plotting for electrical measurements, paired comparison for natural frequency measurements, regression for predicting the volume of a non-regular shape

IEMS 304 Statistics II - Advanced statistical methods: multiple regression; analysis of variance; design/analysis of single-factor & multifactor experiments; categorical data; nonparametric methods

*IEMS 450 (1,2) Mathematical Programming – (I) First of a two-course sequence; primarily designed for graduate students who intend to design studies and analyze data; stand alone course or background for further statistics courses. Topics include design of experiments, descriptive statistics, correlation and regression, probability, sampling, estimation and testing. (II) The second of a two-course sequence. Constrained and unconstrained nonlinear optimization, networks, discrete optimization, applications, and case studies. IEMS 450-I.

*IEMS 460 Stochastic Models - First of a two-course sequence. Bernoulli processes, Poisson processes, Markov chains, and applications to reliability and quality control.

*NUIN 485 Genes, the Brain, and Behavior - A literature-based seminar course that deals with genetic approaches to the nervous system, with particular emphasis on the role genes play in determining behavior. As the nature of genetic approaches varies dramatically between systems, invertebrate (especially Drosophila) and vertebrate systems, including humans will be discussed. Each week, two students will lead a discussion of the papers in which all students are expected to participate; students present papers as well as the background information necessary to understand them. Grading based on student presentations, classroom discussion and a final exam focused on data analysis. No assigned text. Background in genetics/molecular biology is highly recommended.

STAT 320 (1,2) Statistical Theory and Methods - (I) Distribution functions, densities, measurement of location and scale, random sampling, random variables, sampling statistics, hypothesis tests, confidence intervals, parameter estimation, and nonparametric methods. MATH 310-1 or IEMS 202. (II) Correlation and regression, contingency tables, analysis of variance, design and analysis of experiments. MATH 310-1 or IEMS 202.

STAT 330 (1,2) - Applied Statistics for Research - (I) Design of experiments and surveys, numerical summaries of data, graphical summaries of data, correlation and regression, probability, sample

mean, sample proportion, confidence intervals and tests of significance, one and two sample problems, ANOVA. (II) Simple linear regression, inference, diagnostics, multiple regression, diagnostics, autocorrelation, one-way ANOVA, power and sample size determination, two-way ANOVA, ANCOVA, randomized block designs. STAT 330-1.
*STAT 359 – Data Mining – The objective of this course is to provide an introduction to the methods of modern time series analysis. The main focus will be on modeling and forecasting time series using linear models. Some nonlinear forecasting techniques will also be discussed.

*STAT 420 (1,2,3) – Advanced Statistics: Introduction to Statistical Theory and Methodology - The goal of this course is to provide a comprehensive introduction to statistical theory and methodology at a level not requiring advanced probability theory (i.e. measure theory). The course will cover all major areas of statistical theory including distribution theory, theory of estimation and hypothesis testing, large-sample theory, Bayesian methods, and decision theory. The emphasis will be on those theoretical topics that are used in the development of statistical methods and the application of theoretical ideas to models used in practice, such as normal-theory linear model, will be considered in detail. The course is intended to be useful to students in areas such as engineering and economics as well as students in statistics. **Prerequisites:** Probability Theory (e.g., Math 330), calculus (e.g., Math 215), linear algebra (e.g., Math 217) and Statistics 320-1.

*STAT 461 – Multiple Testing Procedures and Their Applications – Special topics course in statistics.

- *Any variation from these requirements, or others described below, requires the approval of the Graduate Advisory Committee. See Appendix A for a complete outline of registration requirements.*

SEMINARS AND RELATED REQUIREMENTS

CBB Program Seminar Series (CBB 460)
Students must register for a CBB Program Seminar Series (CBB 460; 0 units) each quarter of enrollment with the exception of summer. Students are required to attend and participate in presentations and discussions. Fall 2006 will focus on writing and presentation skills.

Informal Seminar Programs
In addition to the formal seminar series, numerous informal seminar programs are offered within the university. These include special departmental seminars, symposia, laboratory group meetings, various journal clubs, and meetings of special interest groups, such as the Molecular Biology Club, the Biophysics Club, and the Joint Biostatistics/Bioinformatics Group on the Chicago campus. You will be contacted directly by the CBB Program if there is a seminar outside of the CBB Seminar Series that is of special interest to CBB students. Participation in such activities is considered an important part of graduate training.

RESEARCH INTERNSHIP: CBB 560 (0 units) – Required course
The Research Internship is traditionally completed during the summer term, although in special cases a student may enroll during other terms. Students work with an industry partner on a research project. As with the Independent Research Projects, at the beginning of the term students will be expected to submit a short description of the research planned for the term. Also, if the industry partner allows it, students will be expected to submit a

research report and present a seminar describing the project and significant results at the end of the term.

CBB COURSES & ELECTIVES

The following lists selected courses typically offered during the academic year. These are subject to change at any time, the most up-to-date information can be found in the NU class schedule on-line at http://www.registrar.northwestern.edu/index.html prior to each quarter. Additional classes either on the Evanston Campus or at the Medical School may be appropriate as electives. All electives must be approved by the Chair of the Graduate Advisory Committee before CBB credit will be awarded. Courses denoted by an asterisk (*) may only be offered every other year.

Fall

BIOL SCI 301	Biochemistry	Loach	Elective
BIOL SCI 302	Fundamentals of Neurobiology I	Spruston	Elective
IBIS 402	Eukaryotic Molecular Biology	Morimoto	Adv Elective
IBIS 403	Eukaryotic Genetics	Pinto	Adv Elective
CHEM ENG 395	**Special Topics: Networks**	**Amaral**	**CBB Core**
EECS 310	Mathematical Foundations of CS	Kao	Elective
EECS 311	Data Structure and Management	Scheuermann	Elective
EECS 339	Introduction to Database Systems	Dinda	Adv Elective
EECS 351	Introduction to Computer Graphics	Tumblin	Adv Elective
ES APPM 311	Methods of Applied Mathematics I	Olmstead	Elective
ES APPM 420	Models in Applied Mathematics	Golovin	Adv Elective
IEMS 304	Statistics II	Apley	Elective
IEMS 450	Mathematical Programming I	Fourer	Adv Elective
STAT 330	Applied Statistics for Research I	Tanner	Elective
STAT 420	Statistical Theory & Methodology I	Severini	Adv Elective
STAT 465	**Statistical Methods in Bioinformatics and Computational Biology**	**Wang**	**CBB Core**

Winter

BIOL SCI 306	Fundamentals of Neurobiology II	Segraves	Elective
BIOL SCI 361	Proteins and Nucleic Acids	Rosenzweig	Elective
BIOL SCI 395	Molecular Genetics	Gaber	Adv Elective
EECS 330	Human Computer Interaction	Gomez	Elective
EECS 336	**Design and Analysis of Algorithms**	**Zhou**	**CBB Core**
ES APPM 311	Methods of Applied Mathematics II	Olmstead	Elective
ES APPM 448*	Numerical Methods for Random Processes	Chopp	Adv Elective
ES APPM 495*	Computational Neuroscience	Kath	Adv Elective
IBIS 401	Biochemistry and Biophysics	Mondragon	Adv Elective
IBIS 407	Genome Scale Science	Weiss	Adv Elective
IEMS 450	Mathematical Programming II	Nocedal	Adv Elective
STAT 320	Statistical Theory and Methods	Andrews	Elective
STAT 330	Applied Statistics for Research II	Tanner	Elective

Spring

BIOL SCI 323	**Bioinformatics: Biological Sequence & Structure Analysis I**	**Radhakrishnan**	**CBB Core**
BIOL SCI 378	Functional Genomics	Takahashi	Adv Elective
EECS 311	Data Structure and Management	Pardo	Elective
EECS 317	Data Mgmt. & Information Processing	Trajcevski	Elective
EECS 328	Numerical Methods for Engineers	Nocedal	Elective
EECS 394	Software Project Mgmt & Development	Hammond	Adv Elective
EECS 457	Advanced Algorithms	Zhou	Adv Elective
ES APPM 311	Methods of Applied Mathematics III	Silber	Elective
IEMS 303	Statistics I	Apley	Elective
IEMS 460	Stochastic Models	Staum	Adv Elective
STAT 320	Statistical Theory and Methods	Spencer	Elective
STAT 461	Multiple Testing Procedures/Applications	Jiang	Adv Elective

Department codes: **BIOL SCI** = Biological Sciences, **CHEM ENG** = Chemical and Biological Engineering; **EECS** = Electrical Engineering and Computer Science; **ES APPM** = Engineering Sciences and Applied Mathematics; **IBIS** = Interdepartmental Biological Sciences; **IEMS** = Industrial Engineering and Management Sciences; **NUIN =** Northwestern University Institute for Neuroscience; **STAT** = Statistics;

***** = Course Approval is pending; ****** = Course may not be offered every year.

Course Schedule and Specialization Areas of Study for CBB students (Academic Year 2006-2007)

All CBB students are required to take 3 of the following 4 core courses: **BIOL SCI 323** Bioinformatics: Biological Sequence and Structure Analysis I (S06 -> W07), **CHEM ENG 395** Networks, **EECS 336** Design and Analysis of Algorithms, or **STAT 465** Statistical Methods in Bioinformatics and Computational Biology [Listed below in bold type]

All CBB students are required to perform Independent Research (CBB 499) for 3 quarters, and register for CBB seminar series (CBB 460) each quarter they are enrolled in the program with the exception of summer quarter.

fall	winter	spring	summer**
BIOL SCI 301 Biochemistry	BIOL SCI 306 Fundamentals of Neurobiology II	**BIOL SCI 323 Bioinformatics: Biological Sequence and Structure Analysis I**	CBB 590 Summer Research Internship (with Industry Partner)
BIOL SCI 302 Fundamentals of Neurobiology I	BIOL SCI 361 Proteins and Nucleic Acids	BIOL SCI 378 Functional Genomics	
CHEM ENG 395 Special Topics: Networks	BIOL SCI 395 Molecular Genetics	EECS 311 Data Structure and Management	
EECS 310 Mathematical Foundations of Computer Science	EECS 330 Human Computer Interaction	EECS 317 Data Management and Information Processing	
EECS 311 Data Structure and Management	**EECS 336 Design and Analysis of Algorithms**	EECS 328 Numerical Methods for Engineers	
EECS 339 Introduction to Database Systems	ES APPM 311 Methods of Applied Mathematics II	EECS 394 Software Project Management and Development	
EECS 351 Introduction to Computer Graphics	ES APPM 448 Numerical Methods for Random Processes	EECS 457 Advanced Algorithms	
ES APPM 311 Methods of Applied Mathematics I	ES APPM 495 Computational Neuroscience	ES APPM 311 Methods of Applied Mathematics III	
ES APPM 421 Models in Applied Mathematics I	IBIS 401 Molecular Biophysics	IEMS 303 Statistics I	
IBIS 402 Eukaryotic Molecular Biology	IBIS 407 Genome Scale Science	IEMS 460 Stochastic Models	
IBIS 403 Eukaryotic Genetics	IEMS 450 Mathematical Programming II	STAT 320 Statistical Theory and Methods II	
IEMS 304 Statistics II	STAT 320 Statistical Theory and Methods I	STAT 359 Data Mining	
IEMS 450 Mathematical Programming I	STAT 330 Applied Statistics for Research II	STAT 420 (3) Advanced Statistics: Introduction to Statistical Theory and Methodology III	
STAT 330 Applied Statistics for Research I	STAT 420 (2) Advanced Statistics: Introduction to Statistical Theory and Methodology II		
STAT 420 (1) Advanced Statistics: Introduction to Statistical Theory and Methodology I			
STAT 465 Statistical Methods in Bioinformatics and Computational Biology			
		* Courses designated as Advanced Electives are shown in red type [core courses in bold] ** F=fall, W=winter, S=spring, Su=summer	

	Structural Biology & Biostatistics	Computational Neuroscience
Required Specialization Advanced Electives - Choose a minimum of 2 courses per curriculum specialization	BIOL SCI 361 Proteins and Nucleic Acids (W)	BIOL SCI 378 Functional Genomics (F, S)
	BIOL SCI 401 Biochemistry and Biophysics (W)	ES APPM 495 Computational Neuroscience (F,W)
	BIOL SCI 407 Large Scale Approaches to Biological Problems (W)	NUIN 485 Genes, the Brain, and Behavior
	STAT 420 (1,2) Advanced Statistics: Introduction to Statistical Theory and Methodology (F, W)	

Biological Informatics	Systems Biology	
COMP SCI 336 Design and Analysis of Algorithms (S -> W)	BIOL SCI 361 Proteins and Nucleic Acids (W)	Required Specialization Advanced Electives - Choose a minimum of 2 courses per curriculum specialization
COMP SCI 339 Introduction to Database Systems (W)	BIOL SCI 401 Molecular Biophysics (W)	
COMP SCI 394 Software Project Management and Development (W)	BIOL SCI 378 Functional Genomics (S)	
COMP SCI 395 Algorithmic Techniques in Bioinformatics (F)	BIOL SCI 407 Large Scale Approaches to Biological Problems/Genome-Scale Science (W)	
ECE 457 Advanced Algorithms (S)	STAT 420 (1,2,3) Advanced Statistics: Introduction to Statistical Theory and Methodology I, II, III (F, W, S)	

FALL QUARTER REGISTRATION

SELECTION OF FALL TERM COURSES AND LABORATORY RESEARCH

During the 2nd week of September 2006, you will meet with the Associate Director to determine your course work and to discuss topics of interest for your independent research rotations. During this time, you should familiarize yourself with faculty interests either via seminars, the CBB website, or through information provided to you in this Program Guide document.

REGISTRATION REQUIREMENTS

Courses usually carry one unit of credit except for the seminar series and summer internship which carry 0 units. Full-time registration consists of either three or four units per quarter. During the first quarter in the CBB program, full-time students will register for 3-4 classes; and unless the student has extensive research experience, it is suggested that students *not* enroll for research during their first term. Beginning in the winter (or during the student's second quarter), students will register for one unit of CBB 499 (Independent Research) for each of 3 quarters. See **Appendix A** for a complete outline of registration requirements.

All students receiving financial aid of any kind from any source must register as full-time students. A full-time student is one registered for 3-4 units of credit or one registered for TGS 588, TGS 598, or TGS 503.

ONLINE REGISTRATION

ALL NEW STUDENTS SHOULD COMPLETE REGISTRATION BY SEPTEMBER 18th, 2006 (Drop/Add period begins @ 9am September 19th, 2006 – Change of Registration period ends September 25th, 2006, no full tuition refunds will be awarded after this date).

1. **Go to www.registrar.northwestern.edu.**
   Click **"Online registration on CAESAR",** then Click **"Register online through CAESAR**", the next screen will prompt you to enter your NETID and password and Click "Login". If you would like a demonstration of how to register, click **"CAESAR walk through".** If you have any log-on/access problems, please contact registration technical help at 1-HELP (they can walk you through registering on-line), and if you have course questions contact the CBB Program Office at (847) 467-1972.

2. **Clear any holds.**
   Holds are indicated once you log on to CAESAR. You are responsible for clearing any holds before attempting to register. You will NOT be able to register with a hold on your student account. Holds may come from the Bursar, International Office, etc.

3. **Obtain permission from the department for any restricted courses.**
   Courses requiring permission are footnoted in the Class Schedule. Permissions can be obtained from the appropriate department via a course authorization number. Obtaining permission before attempting to register will facilitate the process for you.
   NOTE: TGS 588 cannot be accessed through CAESAR but you may enroll in the class by emailing The Graduate School and requesting enrollment.

REGISTRATION PROCEDURES FOLLOWING FALL QUARTER

REGISTRATION PROCESS AFTER FALL QUARTER – "PRE-REGISTRATION"

During each quarter there is a designated time period for "pre-registration". All graduate students need to register during this time period or be charged a late registration fee. Notices will be sent to you via e-mail reminding you of the dates of pre-registration.

Following the selection of your mentor(s) and the completion of all 11 required units of coursework, you may register for TGS 588 Research if additional time is necessary in order to complete your thesis work.

The Seminar in Computational Biology & Bioinformatics (CBB 460) is taken every quarter until graduation. CBB 460 is not offered during the summer quarters.

Consult **Appendix A** for detailed registration requirements.

INDEPENDENT RESEARCH REQUIREMENTS

OVERVIEW OF INDIVIDUAL RESEARCH ROTATIONS

Each student conducts independent research on different aspects of a research project in two separate laboratories over the course of their 3 quarters of independent research.

The most important function of the research project is to aid students and faculty in establishing mutually agreeable student/thesis advisor partnerships. Faculty members and students discuss available research projects in the lab and decide on a research project. Research projects generally form the basis for the final thesis and provide valuable hands-on laboratory experience. By participating in the daily routine of the laboratory, students are able to judge how comfortable he/she feels in that laboratory environment. Meanwhile, faculty members use several criteria to judge whether a student will prove to be an asset to their laboratory, these include:

1. ***Commitment:*** Scientific research is not a 9-to-5 job. Projects often require students to work in the evening and on weekends.

2. ***Execution and documentation of experiments:*** A research career depends on the clear and reliable execution of often complicated experiments. These experiments have to be fully and concisely documented in protocols and lab books.

3. ***Interest:*** A hallmark of independent investigators is that they are motivated by curiosity, driven by the "need to know". Students are encouraged to seek out published information relating to their projects and to think critically about how their project relates to the overall scientific enterprise.

4. ***Maturity:*** Scientific research depends on effective communication among laboratory workers. Common sense, cooperation, and courtesy are essential qualities for the proper functioning of a research laboratory.

Mastery of these skills benefit the student's career regardless as to whether the student decides to pursue an academic or an industry-related career post-graduation.

Program in Computational Biology & Bioinformatics
Student Independent Research Guidelines

The independent research component of the Master's Program in CBB is intended to provide training to and enhance the learning experience of students in the broad areas of computational biology and bioinformatics. Ideally, this will also lead to greater interaction among CBB faculty, students, and staff as well as foster collaborations between research faculty in the life sciences and mathematical and computational sciences.

- Minimum of 10-16 hours/week
  - work is performed at home, in the laboratory, or elsewhere on campus; the location where work is performed can be negotiated between mentor and student

- During the first quarter of a student's enrollment, they are encouraged to engage in appropriate coursework that enriches their future research experience by strengthening their background and understanding of the cross-disciplinary nature of computational biology and bioinformatics. It is suggested that the student does not enroll in research during their first quarter of study.

- Projects
  i. will be of a cross-disciplinary nature and focused on addressing a real-world computational biological problem
  ii. must be approved each quarter by the Curriculum and Advisory Committee
    a. deadlines (December 1, 2006 – W07; March 9, 2007 – S07)
    b. ***Laboratory Research Agreement*** between student and mentor will be completed quarterly (up to 3 quarters) and filed with the CBB Program office. **The agreement will include a project title, summary and goals, as well as the mentor's and student's signatures**

- Presentations
  i. students will give short presentations at the end of each quarter to students/faculty/staff as part of the CBB Seminar Series
  ii. final thesis must be turned in for review by the thesis committee a *minimum* of 2 weeks prior to the oral presentation/examination with the thesis committee
  iii. students will present a public seminar after the successful completion of their presentation/examination – it can only be scheduled after the thesis committee grants their approval, and then can only be scheduled 2 weeks or later from the date of approval
  iv. both the written thesis & oral presentation/examination must be approved by the Thesis Committee and *must* be completed before the Master's degree will be awarded

- Additional research requirements include the summer research internship

SELECTION OF RESEARCH ADVISORS FOR WINTER/SPRING QUARTERS

All arrangements for independent research are made directly between the student and the research faculty member. The Curriculum and Student Advisory committee helps students with this important task prior to the student's first quarter of independent research. Faculty members may accommodate as many CBB students as he or she has resources for supporting. The obligation of approaching individual faculty members lies with the student, the Associate Director or your faculty advisor may also be able to help. Each faculty member accepts the student for independent research on the basis of direct discussions with the student. Students should approach as many faculty members as necessary to select a research advisor. The *Laboratory Research Agreement (LRA)* between the faculty member and student is sent to the Curriculum and Student Advisory Committee for final approval; completed forms are turned in to the Program Office prior to 5:00pm on deadline dates. Independent research rotations with mentors outside of the CBB faculty are permitted but require the approval of the Chair of the Curriculum and Student Advisory Committee and the Co-Directors of the CBB program.

******Arrangements for independent research during the Winter Quarter must be made by Friday, December 1st, 2006. For the Spring Quarter (2007), arrangements must be made by March 9th, 2007. On these dates, students will submit a completed LRA form and a short summary of their research plan to the Program Office for approval by the CSA Committee. Students and the proposed mentor will be contacted prior to the first day of classes if the form is not approved.******

Advice for choosing a research project/mentor:

1. Discussions with Individual Faculty Members. Meeting multiple faculty members is essential in selecting a research advisor and provides an opportunity to discuss research projects available in the laboratory in detail. The new student orientation will provide your first introduction to CBB-related research. Students should meet with all faculty members whose research programs are of potential interest to them. Such meetings do not constitute a formal agreement, only the submission of an approved LRA does.

2. Reading the Literature. A great deal can be learned by reading recent papers describing the research interests of faculty members; many of the CBB faculty members are just beginning CBB-related research, so a meeting would be very helpful as they may not yet have published in the field.

3. Discussion with Graduate Students and Postdoctoral Fellows. Incoming graduate students can learn a great deal from the students and post-docs in laboratories of interest. They are usually eager to talk about their research and experiences.

4. Annual Scientific Retreat. The 1st Annual Retreat will be held on the Evanston campus during fall 2006. Students will be introduced to faculty and their research programs through short seminars, poster presentations and informal discussions.

5. Research Group Seminars. Most laboratories hold regular group meetings. You may want to inquire about attending these meetings if you are interested in doing your research with them during a future Quarter. Some research groups also participate in joint research seminars, such as the Wednesday Evening Molecular Biology Club and the Biochemistry and Biophysics Club, which provide excellent opportunities to gather information.

RESEARCH ROTATION REPORTS

The research advisor assigns a letter grade based upon the student's investigative performance during the quarter, partially based on a written research report submitted by the student at the end of the quarter. The written research report and the research advisor's critique of the report will be placed in the student's file and will contribute to the evaluation of the student's academic progress. The research report (single spaced) should consist of the following:

a. **Title Page:** The title of the research project and the student's name printed on a separate cover page.
b. **Specific Aims:** Provide a clear, concise point-by-point summary of the aims of the research project. Do not exceed one-half page.
c. **Background and Significance:** Briefly explain the background of the research project. Indicate how this project relates to the long-term objective of the advisor's research. Include relevant references. Do not exceed two pages (not including references).
d. **Research Design and Methods:** Describe the procedures and biological materials (if applicable) used in the project. Clearly indicate the contributions of others currently involved in the project. Do not exceed two pages.
e. **Results:** Describe the results of all experiments and calculations performed. Use images, tables and figures to present data, include figure legends.
f. **Conclusions/discussion:** Discuss the interpretation of results, significance of findings, problems and limitations of the procedures used, and future research directions. Do not exceed two pages.
g. **References:** List all references cited in the text; use reference format of the journal Cell.

Research rotation reports are to be turned in to the advisor and a copy submitted to the Program Office no later than 5:00 pm Friday of the week of final examinations for each term (March 16th, 2007 and June 8th, 2007).

SELECTION OF A THESIS EXAMINATION COMMITTEE

The selection of a research project and thesis examination committee is the joint responsibility of the student and faculty members. Students are encouraged to perform research in more than one laboratory, students should meet with faculty members in person, and students should explore all laboratories in the CBB Program that are of interest to them. A preliminary commitment must be initiated by sending the signed *Recommendation for the Thesis Examination Committee* form to the Program Office. Final approval for all arrangements rests with the CBB Program Co-Directors and the Chair of the department in which the selected thesis advisor holds his or her primary appointment. It is expected that each student will have made the arrangements necessary for designation of the thesis advisor(s) by Thursday, June 15th, 2007.

In special circumstances, a student in good standing may be granted permission by the Curriculum and Student Advisory Committee to pursue a fourth term of independent research. This requires the permission of the fourth rotation faculty member.

QUARTERLY REVIEWS

A quarterly review of the student may be performed if the student's grades are not satisfactory for a given term (minimum average grade of 'B' with no 'F' grades) and there is a cause for concern. The meetings will include discussion of the student's work, the student's progress towards the master's degree, and any action required to increase the student's performance and success in the program.

ACADEMIC HONESTY

Both the University and the CBB graduate program take academic honesty very seriously. Cases of suspected academic dishonesty, including suspected plagiarism, will be referred directly to The Graduate School for follow-up, and may result in expulsion from the CBB program. Among the most important goals of graduate education are maintaining an environment of academic integrity and instilling in students a lifelong commitment to the academic honesty that is fundamental to good scholarship. Standards of academic honesty are violated whenever a student engages in any action that jeopardizes the integrity of scholarly work. Such actions include, without limitation, cheating in the classroom or on examinations, including master's final examinations and PhD qualifying examinations; the intentional and deliberate misuse of data in order to draw conclusions that may not be warranted by the evidence; fabrication of data; omission or concealment of conflicting data for the purpose of misleading other scholars; use of another's words, ideas or creative productions without citation in either the text or in footnotes; paraphrasing or summarizing another's material in such a way as to misrepresent the author's intentions; and use of privileged material or unpublished work without permission. See The Graduate School Bulletin or http://www.northwestern.edu/graduate/current/csethics.html for more information.

PETITIONS AND APPEALS

The CBB faculty members recognize that deviations from the established requirements may be required. Students may submit petitions requesting a variation in the requirements whenever they believe that they can adequately justify their request. Minor variances from the requirements may be requested in writing from the Chairperson of the Curriculum and Student Advisory Committee. Substantial variances require a written petition to the Co-Director(s) of the CBB Program.

Similarly, decisions made by the CBB faculty or administration may be appealed by the student. Such appeals should be justified in writing to the CBB Program Office. The Associate Director will establish an appropriate impartial committee to make a recommendation to the CBB Co-Directors, who will vote on the appeal.

THESIS COMMITTEE AND THESIS EXAMINATION

THESIS COMMITTEE

The Thesis Committee consists of 3 members, two research mentors and one additional CBB faculty member. One member is designated as the Chair of the committee. The third member of the Thesis Committee may be non-CBB faculty with the approval of one of the Program Co-Directors. Changes to the Thesis Committee membership can be made with approval of the Chair of the Curriculum and Student Advisory Committee.

THESIS AND THESIS PRESENTATIONS

The advisor and the student together determine the appropriate timeframe in which to write and submit the thesis. Each student must complete an original research project and produce a thesis report acceptable to the research advisor and the Thesis Committee. All requirements for the M.S. degree must be met within five (5) years of initial enrollment. Under exceptional circumstances, this deadline can be extended by petitioning The Graduate School. The deadline extension must propose a reasonable timetable for completion, be based upon a meeting between the student and the Thesis Committee, and be approved by all members of said committee (signatures required). The maximum extension is for one (1) year.

It is recommended that the student establish and meet informally with the Thesis Committee at least 3 months prior to the time that completion of the M.S. degree is anticipated. This meeting serves to review the progress of the student's research and to identify areas that require additional work. Students are encouraged to meet with all Thesis Committee members on a regular basis to discuss their work.

The thesis examination consists of three components: the written thesis document, the oral presentation/examination before the Thesis Committee, and a public seminar.

It is expected that the written thesis provided to the committee represents a final, edited version that has been read and critiqued by the advisor(s). This will allow other committee members to receive a polished document, enabling readers to concentrate on the science rather than on grammatical or typographical errors. The written thesis should be distributed to the Thesis Committee at least 2 weeks prior to the oral defense. The 'closed' oral presentation/examination may not be scheduled until the written dissertation has been delivered to the Committee, and it cannot be scheduled earlier than 2 weeks from the date the written thesis is delivered to the Committee. During the oral presentation, Thesis Committee members will question the student about the content of their research and may also include general questions. Criticisms of the thesis document that arise during the oral presentation/examination must be addressed by the student, and the revisions must be incorporated into the thesis before final submission to the Program Office.

If the advisor agrees that the thesis is generally acceptable, the public thesis seminar can be scheduled in consultation with the committee. This is a formal, public seminar presented to CBB Program members, invited guests, and the general public. The thesis seminar must be arranged through the CBB Program Office. Program staff will assist in making the necessary room reservations and in advertising the public presentation. These arrangements must be made a minimum of 14 days prior to the presentation.

CBB PROGRAM INFORMATION/POLICIES

PROGRAM OFFICE

Dawn Graunke, Associate Director, and Suzana Han, Program Coordinator, are available to help you with questions related to the CBB program.

The CBB Program Office is located in The Ford Motor Company Engineering and Design Center (FMEDC) – Room 2.323 [2nd floor on the west side of the building].

2133 Sheridan Road
Evanston, IL 60208
CBB office telephone – 847.467.1972 Email - cbb@eecs.northwestern.edu
CBB FAX machine – 847.491.5258 Website - http://cbb.cs.northwestern.edu

ID CARD/WILDCARD

The Wildcard gives you access to all University facilities (e.g. the libraries, the Sports and Aquatic Center, etc.) and identifies you as a member of the Northwestern University community. The Wildcard Office is located in the Norris University Center (across from the University Library) on the Underground Level. The Office is open from 8:30 a.m. - 5:00 p.m., Monday through Friday.

Wait at least one day after registration before signing up for your Wildcard. This will insure that you will be in the University's computer system. Take some form of photo identification with you. Once you are there, complete the application, have your photograph taken and they will create your new Wildcard while you wait. The Wildcard office number is x 7-6843.

E-MAIL/COMPUTING CENTER FACILITIES

Your e-mail address should have been set up for you before your arrival at Northwestern. You should have received a letter from Information Technology giving you your email address, NetID and NetID password. If you did not receive a letter, please contact x 1-HELP line (847-491-4357), or visit the NUIT Information Center, Kresge 57, Evanston Campus.

It is very important to make sure that the CBB Program Office has your current e-mail address as much essential information is disseminated by e-mail. Please be sure to change your NU e-mail mailbox since your email accounts will be delivered to your summer e-mail address. To receive e-mail at the NU e-mail mailbox, you must redirect the NU e-mail address to your NU e-mail mailbox at: https://snap.it.northwestern.edu/newstudent/

STUDENT COUNSELING SERVICES

Free and confidential counseling services are available to all students through Student Health Services. To use the services, a student needs to call Student Health Services at x 1-8100 and select the option for Counseling and Psychological Services. A student can make a formal appointment or use the walk-in hours between12:00-2:00pm M-F if the problem is serious, volatile, or urgent and can't wait for an appointment. After hours or weekends, a student can call x 1-8100 and use the paging system to be connected to a counselor who will speak with them over the phone.

Faculty members who are concerned about a student can contact Counseling Services to receive advice on how to work with the student.

STUDENT LEAVE POLICY

The following is a minimum leave policy available to all CBB students in good standing:

1. Extended medical leave of absence – Up to one year (Graduate School Policy)
2. Additional leave may be negotiated between a student and his/her advisor

OUTSIDE EMPLOYMENT

Outside employment of any type is not allowed for full-time CBB students unless the employment is through the CBB 590 course. Exceptions can be made by the Program Co-Directors for advanced students only when the employment directly helps the professional development of the student.

OTHER DEGREE PROGRAMS OR FOR-CREDIT COURSEWORK

Enrollment in any formal degree program (J.D., M.B.A., etc.) or participation in for-credit coursework outside of the CBB curriculum requires prior approval from the Program Co-Directors. Requests will be considered on an individual basis and are not automatically granted.

DOCTORAL DEGREE

CBB is primarily a master's program. A CBB doctoral degree program may be established as early as 2008/2009.

PARKING PERMITS

If you plan to park on-campus you will need a parking permit which can be obtained through the University Police Parking Office. It is located at 1819 Hinman Avenue and is open between 9 a.m.-5 p.m. Monday through Friday. You will need your Wildcard, your car's make/model and license plate number, and your driver's license. Fees for the 2006/2007 academic year are $438; reduced rates are available for part time students. Parking is also available at Ryan Field for $25 per year; a free shuttle is available to campus.

SOCIAL SECURITY CARD

If you are an international student, you will need to get a social security card as soon as possible. The Evanston Illinois Social Security Office is located at 2116 Green Bay Road, Evanston. Office hours are 9:00am to 4:00pm, Monday through Friday. To apply for a card, you need to bring at least two pieces of identification to verify the following:

-Age
-Identity
-Citizenship
-Current address (lease/utility bill)

HEALTH INSURANCE AND DENTAL PLAN

BENEFIT OVERVIEW

A health and insurance benefit through Northwestern University Student Hospitalization and Tuition Credit Plan is provided to each student. You should have received a Health Insurance form to fill out from Health Services, indicating your preference for the Comprehensive or Basic Plan. **Please make sure to fill out and submit the Health Insurance form to the Graduate School. New students may enroll in dental/health coverage between August 15th – October 15th, 2006.**

If you are covered under a parent or spouse's insurance policy, you must provide proof of that coverage and may be exempted from the plan requirement. Part-time students are also exempted from the health plan requirement. In order to meet University standards, alternative coverage must do the following: provide a minimum of $250,000 in coverage per year, have a maximum $2,000 deductible, provide mental health benefits including 24 outpatient visits and $25,000 for inpatient care per year, and NOT exclude pre-existing conditions

Please review your Health Insurance options and coverage details here:

- *NU Student Health Plan* (Out-Patient Health Care):

  http://www.nuhs.northwestern.edu/eligible.html

- *Hospitalization Insurance Details*: http://www.northwestern.edu/risk/studhosp.htm

- *Hospitalization Sign-up*: http://www.northwestern.edu/risk/CSF2006-07.pdf

Please review your Dental Insurance options and coverage details here:

- *Chickering Insurance Site:* www.chickering.com

- Chickering Dental Insurance Info:

  http://www.chickering.com/schools/northwestern/AdvDentalBrochure.pdf

- Chickering Dental Enrollment Form:

  http://www.chickering.com/schools/northwestern/DentalApplication.pdf

In order to avoid taxation on any reimbursement for Health or Dental plans, whenever possible DO NOT choose payroll deduction or payment by check or credit card, instead ask for direct billing to your University Student Account.

The NU Student health plan has two options, the Basic/High Deductible option costs $1896 for the 2006-2007 academic year while the second, Comprehensive/No Deductible option costs $2664 for 2006-2007 academic year. Both plans afford coverage to a limit of $500,000 per policy year.

The Chickering Dental plan costs $150.82 for the 2006-2007 academic year.

2006-2007 HEALTH INSURANCE DEADLINE:

If you do not select your Hospitalization premium prior to October 15th, 2006 you will automatically be signed up for the High Deductible Plan and will not be able to change plans for the year.

CBB is not responsible for your enrollment in an insurance plan. You are responsible for ensuring you are properly enrolled in a health and dental insurance plan and pay any premiums in a timely manner.

CAREER AND PROFESSIONAL DEVELOPMENT PROGRAMS

The CBB Program is committed to providing its graduate students with the tools they need to embark on rewarding science careers after completing their Master's training. To that end, life sciences programs at NU have developed the most comprehensive set of career and professional development programs for life scientist trainees in the country. Seven separate yet interconnected programs focus on career opportunities, skill building, and trainee preparation in the competition for top positions in all areas of the life sciences. Many programs are tailored for PhD students although they may still be of interest to you.

BioOpportunities Career Seminars - One element of this commitment is a program called BioOpportunities. Its primary goal is to introduce graduate students and postdoctoral fellows to diverse life sciences career options, thus helping them identify career paths that maximize their individual skills, training, talents and interests. The core activity of the BioOpportunities program is a seminar series featuring speakers from a wide range of professions, unified by the fact that they all have a Ph.D. in the life sciences. Whenever possible, Northwestern alumni are invited to so as to provide tangible evidence of what can be accomplished with training from Northwestern. Most seminars have a panel of two to three speakers, providing the trainees with a diverse range of opinions and pathways in each field. Most recently, a database of alumni and former speakers has been developed by BioOpportunities to serve as a career resource for our trainees and to provide essential networking contacts. An extensive career resource library is maintained in the IBiS Program office (Hogan 2-100) to supplement BioOpportunities Seminars.

BioOpportunities seminar topics: (*Topics rotate on an annual or bi-annual basis*)

- Tenure-track careers
- Teaching
- Industry Research- biotechnology and pharmaceutical
- Science/Medical Writing
- Intellectual Property: Patent Agents, Lawyers, and Technology Transfer
- Regulatory Affairs
- Computers and Science- Bioinformatics
- Development and Fundraising
- University Administration
- Museum Science: Laboratory and Outreach
- Science and Public Policy
- Forensic Science
- Management Consulting
- Public Relations
- Clinical Research Careers

BioSurvival Skills Workshops - The BioSurvival Skills workshop series (based in part on that of other Universities' skills programs) helps trainees develop specific skills needed to achieve maximum success while progressing through their training, making them more competitive in the career of their choice. The series consists of 5 interactive workshops, each lasting 2 to 4 hours.

BioSurvival Skills workshop topics: (*Topics are repeated on an annual or bi-annual basis*)

- Science Writing
- CV and Cover Letter Writing; Interviewing Skills
- Writing and Publishing Scientific Articles
- Job Search and Self-Marketing
- Identifying Funding and Grantsmanship
- Presentation Skills
- Job Negotiation Skills

Chicago Science Career Forum - The life sciences doctoral programs, in conjunction with NU Career Services, The University of Chicago, and Science magazine, sponsor the annual Chicago Science Career Forum—a research exposition and employer job fair for PhD-level scientists and engineers.

Two important features of the Chicago Science Career Forum make it a valuable event specifically for doctoral students and fellows. The day begins with a poster session attended by employers. Here, the students and fellows have the opportunity to showcase their research and achievements and to talk extensively with employers. Additionally, employers bring PhD-level scientists and engineers to the job fair in addition to human resources personnel. This provides students and fellows with resources on specific jobs as well as broader career opportunities. Employers participate in this event from all areas of science and engineering: biotechnology, pharmaceutical, business development, management consulting, intellectual property, government, bioengineering and academia.

University Career Services - University Career Services (UCS) provides comprehensive career services to all life sciences graduate students and postdoctoral fellows considering non-academic as well as academic careers. Career counselors assist students and fellows with career decision making by helping them explore and re-clarify interests, values, and skills through one-on-one counseling meetings and career assessments.

Life sciences trainees also utilize the Career Resource Center and other online materials to research employers and careers of interest to them. Employment counselors work closely with students and fellows to help them develop individualized job search strategies and refine job search skills (resumes, CVs, interviewing). UCS also coordinates on- campus recruiting and interviews with employers interested in PhD-level scientists and engineer applicants and coordinates special events such as the Career Expo and the Annual Chicago Science Career Forum.

Pathway to the Professoriate - The Pathway to the Professoriate program focuses on academic career paths, especially the professoriate. This program insures that our trainees are enlightened and demystified about the process of becoming a faculty member and provides valuable insight into the effort required to be successful. Two faculty members meet monthly with students and fellows over lunch to discuss specific topics. Although this program is targeted toward pre-doctoral candidates, a number of highlighted topics below may be of interest to the master's level graduate student.

Pathway to the Professoriate program topics: (*Topics are repeated on an annual or bi-annual basis*)

- Grants: Funding During the Post-doc and Faculty Years
- Selecting the Right Post-doc
- Research and Publishing
- Technology Transfer
- Faculty Job Search and Start-up Packages
- Medical School versus Undergraduate Institution
- Lab Management, Mentoring, and Leadership
- Teaching
- University Service
- The Tenure Process
- Balancing a Faculty Career and Family
- Non-Tenure-Track Faculty Careers
- Lessons from Emeritus Faculty
- Lessons from HHMI Investigators

Searle Center for Teaching Excellence - The Searle Center for Teaching Excellence engages in a broad range of services and programs in order to promote and enhance university learning and teaching. Through its many programs, services, research, discussions, and consultations, the Searle Center helps faculty members and graduate student teaching assistants collect, analyze, and evaluate information about their own teaching skills. Research and evaluation projects contribute to the knowledge base and literature on university learning.

Searle Center for Teaching Excellence graduate student workshop topics:
Topics are repeated on an annual or bi-annual basis

- Marketing Your Teaching
- Building a Distinctive Portfolio
- Helping Students Think Critically
- The Grueling Task of Grading: Approaches for Assessing Students
- Unpacking "Pedagogy"
- Designing Courses to Advance Learning
- Stop Sleeping in Class!: Creating a Challenging Classroom
- Generating Feedback: How Students Can Improve Your Teaching
- Solving Problems: Helping Students Think for Themselves
- Directing Discussions
- Managing Multiple Roles: Timing is Everything
- Teaching "Hot" Topics
- Learning in Labs
- Student Affairs
- Negotiating Boundaries
- Motivating Majors versus Non-Majors
- The First Day and Beyond
- Professor Politics
- Dealing with Difference
- Web-Enhanced Instruction for Northwestern Graduate Students
- Graduate Teaching Certification Program
- Teaching Assistant Fellow Program and Workshop

Beyond Books - Beyond Books is a series of professional development workshops for all Northwestern graduate students, professional students, and post-doctoral fellows. Sessions focus on career development, from job searches to career tips for academic and non-academic employment. Workshops feature success stories as well as tips and advice on pitfalls to avoid during your graduate career and beyond.

Beyond Books program topics: (*Topics are repeated on an annual or bi-annual basis*)

- Being a Successful Graduate Student: Working with Mentors and Tormentors
- Effective Research, Conference, and Classroom Presentations
- The Academic Job Search from Start to Finish
- The Non-Academic Job Search: Industry, Government, and Consulting- Writing Skills and Strategies
- Surviving Your Dissertation and Publishing Your Research
- Reason and Responsibility: Ways to Incorporate Ethics in the Teaching of Engineering, Education, Science, Humanities, Art, and Social Science
- Ethical and Legal Issues in Teaching and Research
- How to Get a Job: Advice from Start to Finish
- How to Write a Distinctive Teaching Philosophy
- Developing an Effective Teaching Portfolio
- How to Write a Winning Vita
- Interviewing and the Job Talk
- Labor Relations and Negotiating Your Salary
- Transitioning from Graduate Student to Faculty

Preparing Future Faculty Program - The Preparing Future Faculty (PFF) Program offers Northwestern graduate students the opportunity to augment their disciplinary training with preparation in the issues and responsibilities that shape professional life in the academy. Through monthly colloquia on pedagogy, faculty obligations, and academic governance, to year-long faculty mentorship at four diverse regional institutions, PFF prepares graduate students for the multiple roles and responsibilities they will assume as faculty members.

The core experience of Northwestern's PFF program is the year-long graduate course, On the Academic Profession. Through monthly colloquia on pedagogy, professional responsibilities, and the issues that uniquely affect academic careers, graduate students are helped to both assess and realize their pedagogical and professional goals. Colloquia have included seminars on ethical issues in the academy, collective bargaining, and teaching minority students, as well as workshops on interactive teaching strategies, distance learning, and assembling a teaching portfolio.

In addition to the core experience, students who become PFF Fellows work throughout the year with a faculty mentor at one of the four area cluster institutions collaborating with Northwestern in the PFF program. Under the guidance of the mentor, Fellows engage in a variety of activities that encompass the three major areas of faculty responsibility: teaching, research and service.
By the end of the course, all students will have critically examined their teaching skills; developed an enhanced understanding of how faculty members balance teaching, research, and service; and learned about the challenges and rewards of working in diverse academic environments.

Preparing Future Faculty program topics: (*Topics are repeated on an annual or bi-annual basis*)

- Getting Started: Setting Professional Goals and Considering the Teaching Philosophy
- Faculty Firsts: Untenured Faculty Life and Work at a Liberal Arts College
- Power, Plagiarism, and Professional Dilemmas: Ethics in Academia
- Free Speech or Censorship?: Balancing Personal Politics and Professional Responsibilities
- Innovations and Techniques for Teaching Success
- Landing Your First Job: The Interview in the Academic Profession
- Teaching at a Minority Institution: The Politics and Poetics of Dealing With Difference
- Teaching Portfolios

WAYNE ANDERSON *- Molecular Pharmacology and Biological Chemistry*
As genome sequencing projects produce large databases of sequence information, the next logical step is to determine the biochemical functions and structures of the encoded proteins. For many proteins, sequence comparisons can identify a family of related proteins and allow tentative assignment of function. Our aim is to determine the structures of selected proteins that are conserved in a wide range of species but belong to protein sequence families that have no structurally characterized members in order to help complete the catalog of protein structures and provide important information for functional studies.

LUIS A. N. AMARAL - *Chemical and Biological Engineering*
The goal of Dr. Amaral's research is to develop and validate models that provide insight into the emergence, evolution, and stability of complex systems and that can be studied using computational experiments. This approach identifies the mechanisms determining the dynamics of a given system, which are then translated into a parsimonious set of rules that can be implemented and investigated using computational methods.

ANNELISE E. BARRON - *Chemical and Biological Engineering*
The primary focus of the Barron group is to offer significant conceptual and technological contributions to the engineering design of polymeric materials for applications in biotechnology and medicine. Ongoing research involves the design, synthesis, physical/chemical characterization, and testing of novel polymeric materials for a variety of biotechnological and biomedical applications.

GREGORY BEITEL *- Biochemistry, Molecular Biology, and Cell Biology*
Dr. Beitel's research group uses molecular, biochemical, and genetic approaches to understanding organ morphogenesis and development in *Drosophila* and has recently begun using robotic high-throughput screening to investigate the protein interaction networks that underlie these processes. The data generated by these screens is analyzed using bioinformatics and computational approaches, and predictions tested *in vivo* using the powerful genetic tools available for *Drosophila.*

RAYMOND C. BERGAN *- The Robert H. Lurie Comprehensive Cancer Center*
Gene expression of specific cell populations present within otherwise complex prostate tissue is profiled using microarray experiments.

REX L. CHISHOLM - *Department of Cell and Molecular Biology*
Dr. Chisholm's research projects include Dictybase, an online informatics resource for *Dictyostelium*, and the Disease Ontology, a comprehensive hierarchical controlled vocabulary for human disease representation (development and maintenance).

DAVID CHOPP - *Engineering Sciences and Applied Mathematics*
Research includes the experimental and computational study of microcircuits composed of principal neurons and interneurons in the CA1 region of the hippocampus, including computational models for patch-clamp experiments measuring ionic conductances, calcium imaging, and fell-cell morphological reconstructions.

ALOK CHOUDHARY - *Electrical Engineering and Computer Science*
Dr. Choudhary's research interests are in high-performance computing and communication systems, power aware systems, computer architecture, high-performance I/O systems and software and their applications in many domains including information processing (e.g., data mining, CRM, BI) and scientific computing (e.g., scientific discoveries). Furthermore, his interests lie in the design and evaluation of architectures and software systems (from system software such as runtime systems to compilers), high-performance servers, high-performance databases and input-output, and software protection/security.

DOUGLAS FREYMANN *- Molecular Pharmacology and Biological Chemistry*
Dr. Freymann characterizes the structural biology of the heterodimeric GTPase core complex. This complex mediates the assembly of the co-translational protein targeting apparatus of the Signal Recognition Particle at the membrane. The laboratory exploits high resolution X-ray crystallography to understand the mechanisms by which interactions with ligands (GTP in this case) regulate protein function.

ALEXANDER A. GOLOVIN *- Engineering Sciences and Applied Mathematics*
The Golovin group is interested in designing mathematical models for controlled drug delivery and of biological cells during cryopreservation.

KASTURI HALDAR *- Pathology*
Dr. Haldar's laboratory studies the regulation of pathogenic vacuoles using pathogens including *Salmonella*, *Mycobacteria, Chlamydia, and Toxoplasma*, by employing emerging genetic techniques to develop functional assays and regularly mines databases for functional organelle protein motifs.

GORDON B. HAZEN *- Industrial Engineering and Management Sciences*
Dr. Hazen's interests include decision analysis methodology, utility and preference theory, medical decision analysis, cost-effectiveness analysis of medical treatment decisions, normative expert systems in artificial intelligence, multiple criteria decision making.

MARK C. HERSAM - *Materials Science and Engineering*
Involvement in the development of scanning probe microscopy (SPM) techniques that enable the sensing, characterization, and actuation at the single molecule level has enabled Dr. Hersam's group to isolate individual organic, biologic, and inorganic molecules on semiconductor surfaces. The group is also working with nanoscale gene chips.

LINDA HICKE *- Biochemistry, Molecular Biology, and Cell Biology*
Dr. Hicke's research group is interested in the down regulation of signal transducing receptors.

ROBERT A. HOLMGREN *- Biochemistry, Molecular Biology, and Cell Biology*
Dr. Holmgren's research combines genetic and structure-function studies to examine the activities of various Ci protein domains (transcription factor and downstream target of the Hedgehog [Hh] signaling pathway).

THEODORE S. JARDETZKY *- Biochemistry, Molecular Biology, and Cell Biology*
The research in the Jardetzky laboratory concerns molecular mechanisms involved in human immunity and disease. By studying the three-dimensional structures of key proteins involved in immunity and viral pathogenicity, these studies provide both fundamental insights into underlying molecular mechanisms as well as information for the development of new structure-based therapeutic treatments for disease.

JOSEPH J. JEROME *- Mathematics*
Nonlinear analysis, approximation theory, partial differential equations, modeling and computation in science and engineering (e.g., charge transport) are some of the areas of Dr. Jerome's research.

HONGMEI JIANG - *Statistics*
Recent works include events analysis in biostatistics and theoretical aspects of mixtures and hierarchical mixtures in the area of statistical learning. Other interests include mathematical statistics; biostatistics; statistical and computational learning theory.

WENXIN JIANG - *Statistics*
Dr. Jiang is interested in developing statistical and computational methodologies, developing multiple testing procedures for a large number hypothesis test (i.e. whole genome microarray investigations).

BORKO D. JOVANOVIC *- Preventive Medicine*
Dr. Jovanovic studies classical statistical methods and new computational and informatics realities in research and teaching.

GEOFFREY S. KANSAS - *Microbiology and Immunology*
One current research direction in the Kansas laboratory involves leukocyte adhesion and migration, particularly the biology of selectins. Our main focus is on identification of enzymes (glycosyltransferases) which play a role in biosynthesis of carbohydrate ligands for selectins, and on how their expression is controlled in T cells. We and other investigators have identified the T Cell Receptor (TCR) and specific cytokine receptors as important in controlling expression of specific enzymes. We are now deciphering the signaling and transcriptional pathways downstream of these receptors, with a focus on Ras and two transcription factors, Stat4 and T-bet, to understand how T cell migration is controlled at the transcriptional level.

MING-YANG KAO *- Electrical Engineering and Computer Science*
Current research interests include the design, analysis, and implementation of algorithms pertaining to computational biology and computational finance.

WILLIAM L. KATH - *Engineering Sciences and Applied Mathematics*
Research includes the experimental and computational study of microcircuits composed of principal neurons and interneurons in the CA1 region of the hippocampus, including computational models for patch-clamp experiments measuring ionic conductances, calcium imaging, and fell-cell morphological reconstructions.

WARREN A. KIBBE - *The Robert H. Lurie Comprehensive Cancer Center*
Dr. Kibbe is developing a database on the research activities and how computer resources and technologies are used in the Basic Sciences Department. Interests also include biological data representations, biological ontologies, and the application of basic science technologies to clinical practice through IT systems.

ROGER A. KROES - *Biomedical Engineering*
As a member of the Falk Institute, Dr. Kroes uses innovative molecular biology techniques to identify and evaluate genes responsible for neurological disorders such as brain tumors, learning and memory disorders, and depression and epilepsy. The group is also interested in drug development using a number of approaches including bioinformatics.

TIMOTHY M. KUZEL - *The Robert H. Lurie Comprehensive Cancer Center*
Research group developed Northwestern University's clinical trial informatics systems and expanded the same; also interested in biological and experimental therapies of cancer.

DAVID M. LEIBOVITZ - *General Internal Medicine*
Dr. Liebovitz is interested in understanding the benefits of clinical decision support at the point of care and optimizing the use of electronic heath information for patient care, research and education.

SIMON LIN - *The Robert H. Lurie Comprehensive Cancer Center*
Dr. Lin extracts biomedical knowledge from high-throughput data collections using databases, data mining, and statistical methods. He also uses computational systems to analyze mass spectrometry data and is testing the hypothesis that a wavelet-based framework is more effective than traditional analyses.

JERILYN A. LOGEMANN - *Neurology*
Combinations of videofluoroscopic, manometric, videoendoscopic and electromyographic data collection techniques are used to study swallowing in normal subjects and patients with swallowing disorders.

RICHARD M. LONGNECKER *- Microbiology-Immunology*
The Longnecker laboratory focuses on Epstein-Barr virus (EBV) transformation, latency, and entry by using animal models of EBV latent infections.

ANDREAS MATOUSCHEK *- Biochemistry, Molecular Biology, and Cell Biology*
This laboratory has shown that proteins are unfolded by translocases and proteases via a mechanism that unravels them from their targeting signals. Three areas of investigation are now begin pursued: 1) identify the components of the mitochondrial import machinery that unravel the protein during import using yeast cell biology and biochemistry; 2) determine the properties of the import motor using biophysical techniques; 3) investigate how the ability of a protein to be unfolded by ATP-dependent proteases depends on its 3D structure, and how partial degradation of transcription factors by the proteasome is regulated.

SANJAY MEHROTRA - *Industrial Engineering and Management Sciences*
Optimization methods and applications, linear and nonlinear integer programming, stochastic programming, large scale optimization, and optimization applications applied to finance and biological science

GOKHAN MEMIK *- Electrical Engineering and Computer Science*
Dr. Memik develops embedded systems, high performance architectures, code optimizations for networking applications, application-specific programmable processor design, and performance evaluations of embedded systems.

ALFONSO MONDRAGON *- Biochemistry, Molecular Biology, and Cell Biology*
The Mondragon laboratory focuses upon crystallographic studies of DNA topoisomerases and protein-nucleic acid interactions, and since topoisomerases are the targets of several antimicrobial and cancer drugs, the work will affect the design of more effective therapeutic agents.

RICHARD I. MORIMOTO - *Biochemistry, Molecular Biology, and Cell Biology*
The Morimoto Laboratory studies the regulation and function of molecular chaperone molecules using genetic and biochemical approaches. The group is particularly interested in the eukaryotic response to environmental and physiological stress, and the impact of stress upon molecular and cellular events (i.e. reprogramming gene expression, dynamic reorganization of the nucleus, or inhibition of biosynthetic events).

JOSEPH R. MOSKAL - *Biomedical Engineering*
As a member of the Falk Institute, Dr. Moskal uses innovative molecular biology techniques to identify and evaluate genes responsible for neurological disorders such as brain tumors, learning and memory disorders, and depression and epilepsy. The group also researches drug development using bioinformatics techniques.

BARRY L. NELSON *- Industrial Engineering and Management Sciences*
Dr. Nelson designs and analyzes computer simulation experiments; issues of statistical efficiency, multivariate output analysis, mutivariate input modeling, and metamodeling.

JORGE NOCEDAL *- Electrical Engineering and Computer Science*
Dr. Nocedal's research interests include optimization, scientific computing, numerical analysis, internet computing, software, optimization in VLSI design, atmospheric sciences, networks, and management sciences.

E. TERRY PAPOUTSAKIS *- Chemical and Biological Engineering*
Dr. Papoutsakis uses the advanced strategies of regulatory genes, gene inactivation, and antisense RNA to construct cells with altered enzymatic pathways.

ISHWAR RADHAKRISHNAN - *Biochemistry, Molecular Biology, and Cell Biology*
The laboratory develops methods for automated analysis of macromolecular interactions; one of their web applications named MONSTER detects stabilizing intermolecular interactions in macromolecular complexes using atomic coordinate data by validating atomic coordinate files, identifying interacting residues, and assigning the nature of these interactions. Results are integrated and presented in an intuitive and interactive graphical format. The laboratory also studies the structure, function, dynamics, and informatics of macromolecular complexes as well as the molecular mechanisms of ubiquitin recognition during endocytosis. (http://monster.northwestern.edu)

AMY C. ROWENZWEIG - *Biochemistry, Molecular Biology, and Cell Biology*
Dr. Rowenzweig studies metal trafficking, including the molecular mechanisms of metal ion homeostasis in atomic detail; the chemical mechanisms of di-oxygen activation at multinuclear metal centers; and how the protein complex structures, including the substrate and cofactors, are involved in antibiotic synthesis to provide a starting point for protein engineering experiments to construct modified *B*-lactam antibiotics.

DENISE M. SCHOLTENS - *Preventive Medicine*
Development of methodology for the analysis of high-dimensional data; analysis of factorial designed microarray experiments and local modeling of protein complexes; development of measurement error models for graph theoretic data and efficient sampling schemes for network data collection

HANK S. SEIFERT *- Microbiology-Immunology*
We are defining the molecular mechanisms used to produce pilus antigenic variation in *Neisseria gonorrhoeae* by identifying the gene products required, their biochemical activities, and the DNA sequences used in this homologous recombination process. These studies have allowed us to develop novel models for gene conversion and uncover new mechanisms by which recombination can occur.

LONNIE B. SHEA - *Chemical and Biological Engineering*
The Shea laboratory develops and employs biomaterials and controlled delivery systems (protein, DNA) to create synthetic environments for directing and analyzing cellular functions, which have applications to tissue regeneration and development, and diagnostics assays.

HANS-GEORG SIMON - *Pediatrics*
Genes were identified that are active during the regeneration of limbs and/or hearts, the goal is to understand them further to determine genetic pathways that are operational in regenerating animals but not in mammals. The group is also interested in identifying how the same transcription factors (genes) orchestrate different functional activities.

***HALCYON G. SKINNER** - Preventive Medicine*
The two-stage clonal expansion models of carcinogenesis are applied to statistical models of risk for cancer in human populations for the development of statistical and informatics tools for analyzing data generated using multiple microarrys (i.e. SNP, expression and methylation) that can be applied in an epidemiologic context.

***MARCELO BENTO SOARES** - Pediatrics*
Dr. Soares' research includes uncovering the molecular mechanisms underlying genomic instability, aberrant transcription, and splicing in tumorigenesis and cancer metastasis; the genome wide identification and epigenomic analysis of Natural Antisense Transcripts and transcriptionally active repetitive elements in cancer, their potential role in promoting tumor heterogeneity, and their value as molecular markers for diagnosis, prognosis and early detection in cancer.

***NELSON SPRUSTON** - Neurobiology and Physiology*
Sensory information is integrated in the hippocampus, providing a contextual map of experience with a strong spatial component. In addition, the hippocampus is a crucial structure for the formation of new declarative memories (including spatial memory). The Spruston lab studies the cellular processes that allow hippocampal neurons to carry out these functions and to adapt as a consequence of experience. Research focuses on the excitable properties of CA1 dendrites and their role in synaptic integration.

***JOSEPH S. TAKAHASHI** - Neurobiology and Physiology*
The long-term objective of the research in the Takahashi laboratory is to understand the cellular and molecular mechanisms that regulate circadian rhythms, a genetic approach has been initiated to study the mechanism of circadian rhythms in mammals using the mouse as a model organism.

***JI-PING WANG** - Statistics*
Dr. Wang's research is motivated by problems in bioinformatics and genetics. He recently developed a statistical model and diagnosing tool for expressed sequence tag (EST) data.

***D. MARTIN WATTERSON** - Molecular Pharmacology and Biological Chemistry*
Dr. Watterson's research group uses an interdisciplinary approach to study fundamental biological processes and mechanisms of pathophysiology to identify new approaches to therapeutic intervention in areas of unmet medical need. The approach centers around integrative chemical biology, medicinal chemistry, and computational biology interdigitated with molecular genetics and animal models of disease.

***ERIC WEISS** - Biochemistry, Molecular Biology, and Cell Biology*
Dr. Weiss performs phenotypic analysis and proteome-scale investigations of potential phosphorylation targets. He is also interested in protein kinase signaling pathway coordination of cytoskeleton organization, membrane traffic, and gene expression in defining cell architecture.

***JONATHAN WIDOM** - Biochemistry, Molecular Biology, and Cell Biology*
Research in Dr. Widom's laboratory focuses on the structure and function of chromosomes and related protein-DNA complexes. The long-term aims are to elucidate the molecular architecture of chromosomes, the mechanisms whereby cells regulate their chromosome structure during the cell cycle, and the relationships of the chromosome structure to its function. The laboratory is also working to answer fundamental questions concerning the physico-chemical basis of gene regulation through quantitative studies on single living cells.

***SANDY L. ZABELL** - Statistics*
Dr. Zabell's principal research interests revolve around mathematical probability (large deviation theory) and Bayesian statistics (the study of exchangeability), as well as the history, philosophical foundations, and legal applications of probability and statistics. Dr. Zabell also studies issues arising in the statistical analysis of the frequency of DNA match profiles and collaborates with medical faculty on the design and analysis of a methodology to accurately and efficiently detect gastric disease.

***HAI ZHOU** - Electrical Engineering and Computer Science*
Hardware design, which includes design methodology, specification design tools, and design correctness; VLSI (very large scale integration) design automation, algorithm design and formal methods

RESEARCH CENTERS

CENTER FOR CELL AND DEVELOPMENTAL BIOLOGY (http://www.biochem.northwestern.edu/cdbcenter/)

Linda Hicke, Director
Biochemistry, Molecular Biology, and Cell Biology

The goal of the recently established Center for Cell and Developmental Biology is to provide support and infrastructure for the Evanston campus' strong and growing research programs in Cell Biology and Developmental Biology, as well as to help strengthen the training of future research scientists in these important areas of biomedical research.

CENTER FOR DRUG DISCOVERY & CHEMICAL BIOLOGY (http://www.northwestern.edu/research/cddcb/)

D. Martin Watterson, Director
Molecular Pharmacology & Biological Chemistry

The Center for Drug Discovery and Chemical Biology evolved from the faculty-initiated Drug Discovery Program that was established in 1996 to facilitate interdisciplinary research and educational activities. The core group of faculty from two schools and three departments has since grown to include more than thirty clinical and basic science faculty who have expanded the research and educational infrastructure through acquisition of peer reviewed funds for major instrumentation, training, and collaborative research projects. The Center's mission, focus and operations reflect this history as it seeks to broaden its impact on the interface between molecular and integrative basic sciences and facilitate the translation of preclinical discoveries into clinical applications.

CENTER FOR FUNCTIONAL GENOMICS (http://www.genome.northwestern.edu/)

Joseph S. Takahashi, Director
Neurobiology & Physiology

The Center for Functional Genomics has as its mission to unify basic research efforts at Northwestern University focused on understanding gene function. Research within the Center has the following goals:
- use phenotype-driven, forward genetic approaches to identify genetic pathways and understand gene function
- use functional, expression-driven approaches to elucidate gene function
- use and develop informatics tools for analysis of complex phenotypic data as well as gene expression and sequence information
- develop and implement new approaches to study gene functions on a genome-wide scale

CENTER FOR GENETIC MEDICINE (http://www.cgm.northwestern.edu/index.htm)

Rex L. Chisholm, Director
Cell & Molecular Biology

The Center for Genetic Medicine (CGM) was established to expand genetics-based research at Northwestern University and the Feinberg School of Medicine and to foster the development of genetically-based diagnostic tools and therapies at Northwestern Memorial Hospital, Evanston Northwestern Healthcare, and Children's Memorial Hospital. This collaboration between the university, the medical school, and the affiliated hospitals aims to increase the understanding of fundamental genetic mechanisms, discover the genetic basis of human diseases, and ultimately improve patient care. The Center also coordinates Northwestern's educational activities in the area of genetics and strives to improve public understanding of the impact of genetics and genetic technologies on society.

CENTER FOR PHOTONIC COMMUNICATION AND COMPUTING (http://cpcc.northwestern.edu/)

Prem Kumar, Director
Electrical Engineering and Computer Science

The Northwestern University CPCC conducts leading edge fundamental science and engineering research that leads to the development of advanced photonic communication and computing systems. The research focuses on optical and optoelectronic systems that push the technological limits to ever increasing speeds or levels of integration or that exploit fundamental laws of nature to accomplish communication, signal processing, and computing in radically new ways. The Center provides a venue for collaboration, coordination, dissemination, and promotion of research and teaching activities in the above areas.

CENTER FOR REPRODUCTIVE SCIENCE (http://www.northwestern.edu/research/crs/)

Kelly Mayo, Director

Biochemistry, Molecular Biology, and Cell Biology

Established in 1987 in recognition of Northwestern's strength in reproductive biology, the Center for Reproductive Science (CRS) coordinates the research and training efforts of 33 faculty in nine departments on the Evanston Campus, at the Medical School and at Children's Hospital. The Center has as its dual missions enhancing research in reproductive biology and its applications to human welfare, and optimizing the training of future research and teaching scientists in the broad area of reproductive biology. The Center facilitates interactions between basic and clinical scientists in both its research and training missions through interdisciplinary research grants, research facilities, research symposia, and student training programs. The Center does not have a formal graduate program, but works closely with students pursuing the Ph.D. degree in any of Northwestern's three Life Sciences Graduate Programs (IBiS, IGP and NUIN).

CENTER FOR STRUCTURAL BIOLOGY (http://www.biochem.northwestern.edu/center.html)

Alfonso Mondragon, Director

Biochemistry, Molecular Biology, and Cell Biology

The mission of the recently established Center for Structural Biology is to foster leading-edge research in this exciting interdisciplinary field. Center researchers carry out fundamental studies on the structures, dynamics, actions, and interactions of important biological macromolecules. The Center's beautiful new research space fosters collaborative and interdisciplinary research through open, interconnected laboratories and shared space for instrumentation. Center researchers have access to state of the art instrumentation, including a 600 MHz NMR facility and a beamline for macromolecular crystallography at the Advanced Photon Source (at Argonne National Laboratory), which is the most powerful X-ray source in the world.

CENTER FOR ULTRA-SCALE COMPUTING & INFORMATION SECURITY (http://cucis.ece.northwestern.edu/)

Alok Choudhary, Director

Electrical Engineering and Computer Science

The goal of the CUCIS is to conduct highly innovative research in many synergistic areas of ultra-scale computing and information technologies. Furthermore, the goal of the center is to foster and enable inter-disciplinary research in computing technologies that scale to these levels. The CUCIS is directed by Prof. Alok Choudhary, and is presently supported by the NSF, DOE, Sandia National Labs, NASA, and Intel.

FALK CENTER FOR MOLECULAR THERAPEUTICS (http://www.northwestern.edu/nico/)

Joseph R. Moskal, Director

Biomedical Engineering

There has never been a greater need for the development of new and effective medicines for the treatment of diseases. However, the costs for creating new drugs have skyrocketed and therapies for many diseases are not being developed because the patient population is too small to be profitable. A new organizational model is necessary to translate discoveries with therapeutic potential into clinically useful compounds. The Falk Center for Molecular Therapeutics is such a model. The Center is a molecular biology-based drug discovery Center of Excellence within the Biomedical Engineering Department of McCormick School of Engineering and Applied Science at Northwestern University, tethered to a biotechnology company, Nyxis Neurotherapies, Inc.

NORTHWESTERN INSTITUTE ON COMPLEX SYSTEMS (http://www.northwestern.edu/nico/)

Daniel Diermeier and William Kath, Co-Directors

Engineering Sciences and Applied Mathematics

A university-wide institute, the distinguished and diverse NICO faculty are from all areas of research, including engineering, business, natural sciences, education, medicine, law, and the social sciences. NICO's mission is to serve as a hub and facilitator of intellectual life at NU and to produce path-breaking research in the area of complex systems transcending the boundaries of established disciplines.

NORTHWESTERN UNIV. INSTITUTE FOR NEUROSCIENCE (http://www.northwestern.edu/nuin/index.html)

The Northwestern University Institute for Neuroscience (NUIN) offers an interdisciplinary course of study leading to the Ph.D. in Neuroscience. More than 160 faculty from 20 different departments and 4 schools (The Graduate School, the Feinberg School of Medicine, The School of Communication and the School of Engineering) participate in NUIN, and many are now looking for students interested in graduate study. Northwestern University has two campuses linked by a shuttle bus, the Feinberg Medical School in downtown Chicago and the undergraduate campus in Evanston. Both campuses lie along the shores of beautiful Lake Michigan. The laboratories of NUIN faculty can be found on both campuses, as well as at the The Rehabilitation Institute of Chicago (RIC), Evanston-Northwestern Hospital (ENH) and the Children's Memorial Research Center (CMRC) in Chicago.

ROBERT H. LURIE CANCER CENTER (http://www.cancer.northwestern.edu/home/Index.cfm)

Steven Rosen, Director & Teresa Woodruff, Associate Director for Research
Neurobiology and Physiology

The physicians and basic scientists at the Cancer Center study the causes and behavior of cancer to develop more effective approaches to prevention and treatment. The Cancer Center's research programs are organized around members' strengths and foster interdisciplinary coordination and collaboration. Each member is in one of the Cancer Center's established research programs, including angiogenesis and cell motility, hormone action and signal transduction, molecular oncogenesis, and developmental biology. Through its grants program, the Center funds research projects, the purchase of equipment, and graduate student travel to national meetings.

The Center also supports the operations of shared facilities for transgenic mice, 2-D gel electrophoresis, oligonucleotide synthesis, histology, cell imaging, tissue culture supplies, and DNA and protein sequence analysis. Another important function of the Center is education. The Center hosts two annual symposia, one on basic science and one on clinical oncology, which bring scientists from around the world to speak at Northwestern University. In addition, members from Lurie Cancer Center laboratories present their work at yearly poster sessions.

WHERE TO GO FOR ASSISTANCE

The administrative staff of CBB is a valuable resource for information on tuition, coursework, registration, program-sponsored activities and more.
Please note that numbers beginning with '1' can be reached from outside Northwestern University by dialing "(847) 491" before the 4 digit extension, numbers beginning with '7' can be reached by dialing "(847) 467" before the extension, and numbers beginning with '3' can be reached by dialing "(312) 503" before the extension.

Dawn M. Graunke	Associate Director	7-1972	dawn@eecs.northwestern.edu
David Chopp	Co-Director, CBB (MEAS representative)	1-8391	chopp@northwestern.edu
Warren A. Kibbe	Co-Director, CBB (FSM representative)	3-3229	wakibbe@northwestern.edu
Ishwar Radhakrishnan	Co-Director, CBB (WCAS representative)	1-4165	i-radhakrishnan@northwestern.edu
Suzana Han	Program Coordinator	7-1972	suzana@eecs.northwestern.edu
General CBB Program Information		7-1972	cbb@eecs.northwestern.edu

The **CBB Program Office** is located in the
Ford Motor Company Engineering and Design Center
(FMCEDC or Ford) Room 2.323
2nd Floor, West Side of Building, Office number 323

2133 Sheridan Road, Evanston, IL 60208

Faculty Committees: *Committees are still being formed; members listed below may be subject to modification.*

Curriculum & Student Advisory Committee

Luis AN Amaral (Chair)	1-7850	amaral@northwestern.edu
Ishwar Radhakrishnan	1-4165	i-radhakrishnan@northwestern.edu
Ji-Ping Wang	1-4939	jzwang@northwestern.edu
Hai Zhou	1-4155	haizhou@northwestern.edu

Placement & Extramural Activities Committee

Warren Kibbe (Chair)	3-3229	wakibbe@northwestern.edu
Dawn Graunke	7-1972	dawn@eecs.northwestern.edu

Recruitment & Admissions Committee

Ji-Ping Wang (Chair)	1-4939	jzwang@northwestern.edu
David Chopp	1-8391	chopp@northwestern.edu
Gokhan Memik	1-7132	memik@ece.northwestern.edu

Other useful locations and telephone numbers:

The Graduate School (TGS)	Crown 1-502 (633 Clark)	1-7264
The Bursar's Office	619 Clark, 1st floor	1-5343
The Registrar's Office	633 Clark	1-5234
Financial Aid Office (TGS)	Contact: Mary MacLean	1-8540
Minority Affairs	Crown 1-502 (633 Clark)	1-8505
College of Arts and Sciences	1918 Sheridan	1-7559
Recreational Sports	Crown Pavilion	1-4300
Student Health Services	Searle Hall	1-8100
Housing Offices	Engelhart Hall	1-3015
International Student Office	630 Dartmouth	1-5613
Norris University Center	1999 S. Campus	1-2300
Office of Research Safety	Tech NG22	1-5581
Science-Engineering Library	2233 N. Campus	1-3362
Public Safety Department (Parking, etc)	1819 Hinman	1-3254

APPENDIX A. CBB Curriculum/Registration Requirements

SAMPLE CBB REGISTRATION (not an exhaustive listing of courses) 2006-2007

Year 1:

Fall Quarter: **STAT 465 Statistical Methods in Bioinformatics and Computational Biology (Core)** and/or
[1st Quarter] **CHEM ENG 399 Networks (Core)** – 1 - 2 credits - Minimum Grade B

CBB 460-0 Seminar Series in Computational Biology & Bioinformatics - 0 credit
Registration in 2 to 3 additional Electives (3 of 5 have to be Advanced Electives):

▪ BIOL SCI 301	Biochemistry	Elective
▪ BIOL SCI 302	Fundamentals of Neurobiology I	Elective
▪ EECS 310	Mathematical Foundations of CS	Elective
▪ EECS 311	Data Structure and Management	Elective
▪ EECS 339	Introduction to Database Systems	Elective
▪ EECS 351	Introduction to Computer Graphics	Elective
▪ ES APPM 311	Methods of Applied Mathematics	Elective
▪ ES APPM 421	Models in Applied Mathematics	Adv Elective
▪ IBIS 402	Eukaryotic Molecular Biology	Adv Elective
▪ IBIS 403	Eukaryotic Genetics	Adv Elective
▪ IEMS 304	Statistics II	Elective
▪ IEMS 450	Mathematical Programming I	Adv Elective
▪ STAT 330	Applied Statistics for Research I	Elective
▪ STAT 420	Statistical Theory & Methodology I	Adv Elective

Winter Quarter: **EECS 336 Design and Analysis of Algorithms (Core)** - Minimum Grade B
[2nd Quarter] **CBB 499-0 Research Projects** (1st Research term) 1 credit - Minimum Grade B

CBB 460-0 Seminar Series in Computational Biology & Bioinformatics - 0 credit
Registration in 2 or 3 Graduate Level Courses (3 of 5 have to be Advanced Electives):

▪ BIOL SCI 306	Fundamentals of Neurobiology II	Elective
▪ BIOL SCI 361	Proteins and Nucleic Acids	Elective
▪ BIOL SCI 395	Molecular Genetics	Adv Elective
▪ EECS 330	Human Computer Interaction	Elective
▪ EECS 339	Introduction to Database Systems	Elective
▪ EECS 394	Software Project Mgmt & Development	Adv Elective
▪ ES APPM 311	Methods of Applied Mathematics	Elective
▪ ES APPM 495	Computational Neuroscience	Adv Elective
▪ IBIS 401	Biochemistry and Biophysics	Adv Elective
▪ IBIS 407	Genomic-Scale Science	Adv Elective
▪ IEMS 450	Mathematical Programming	Adv Elective
▪ NUIN 485	Genes, the Brain, and Behavior	Adv Elective
▪ STAT 320	Statistical Theory and Methods	Elective
▪ STAT 330	Applied Statistics for Research	Elective

Spring Quarter: **BIOL SCI 323 Bioinformatics (Core)** - 1 credit – Minimum Grade B
[3rd Quarter]

CBB 499 Research Projects (2nd Research term) - 1 credit - Minimum Grade: B
CBB 460 Seminar Series in Computational Biology & Bioinformatics - 0 credit
Registration in 0 to 1 Electives (3 of 5 have to be Advanced Electives):

▪ BIOL SCI 378	Functional Genomics	Adv Elective
▪ EECS 311	Data Structure and Management	Elective
▪ EECS 317	Data Mgmt. & Information Processing	Elective
▪ EECS 328	Numerical Methods for Engineers	Elective
▪ EECS 394	Software Mgmt & Information Process.	Adv Elective
▪ IEMS 303	Statistics	Elective
▪ IEMS 460	Stochastic Models	Adv Elective
▪ STAT 320	Statistical Theory and Methods	Elective
▪ STAT 359	Statistical Methods in Bioinformatics & Computational Biology	Elective

Summer Quarter: **CBB 560 Research Internship** - 0 credits; Student will receive stipend from company or laboratory research is performed in.

YEAR 2:

Fall Quarter: **STAT 465 Statistical Methods in Bioinformatics and Computational Biology** and/or
[4th Quarter] **CHEM ENG 395 Networks** (if needed/qualified) – 1 or 2 credits - Minimum Grade B

CBB 460 Seminar Series in Computational Biology & Bioinformatics - 0 credit
CBB 499 Research Projects (3rd Research term) - 1 credit - Minimum Grade: B
Registration in 3 or 4 Graduate Level Courses (3 of 5 have to be Advanced Electives):

▪ BIOL SCI 301	Biochemistry	Elective
▪ BIOL SCI 302	Fundamentals of Neurobiology I	Elective
▪ EECS 310	Mathematical Foundations of CS	Elective
▪ EECS 311	Data Structure and Management	Elective
▪ EECS 339	Introduction to Database Systems	Elective
▪ EECS 351	Introduction to Computer Graphics	Elective
▪ ES APPM 311	Methods of Applied Mathematics	Elective
▪ ES APPM 421	Models in Applied Mathematics	Adv Elective
▪ IBIS 402	Eukaryotic Molecular Biology	Adv Elective
▪ IBIS 403	Eukaryotic Genetics	Adv Elective
▪ IEMS 304	Statistics II	Elective
▪ IEMS 450	Mathematical Programming I	Adv Elective
▪ STAT 330	Applied Statistics for Research I	Elective
▪ STAT 420	Statistical Theory & Methodology I	Adv Elective

APPENDIX B. CBB Student Checklist

2006-2007 CBB Student Forms Checklist

Check when Completed or Turned In to Program Office

Before Arriving:

08/30 Complete NU Health Services "Pre-Registration Requirements" Checklist by end of August (www.nuhs.northwestern.edu/chcheck.pdf) _____

08/15 Complete Insurance Coverage Selection Form and turn in to NU Insurance Office _____

1st Year

Upon Arrival/during CBB Orientation 09/13/06:

New CBB Student Information Form _____

Health and Dental Insurance Checklist form _____

Fall Quarter 2006 (Y1):

12/1 Winter Qtr Laboratory Research Agreement _____

Winter Quarter 2007 (Y1):

3/9 Spring Qtr Laboratory Research Agreement _____

3/16 Winter Qtr Independent Research Report _____

Spring Quarter 2007 (Y1):

6/1 Fall Qtr (Y2) Laboratory Research Agreement _____

6/8 Spring Qtr. Independent Research Report _____

Summer Quarter 2007 (Y1):

Recommendation for the Thesis Examination Committee due 6/15/07 _____

(Highly recommended that you finalize research projects with co-mentors prior to this date; submit this form along with your Independent Research Report following Independent Research I)

2nd Year

Fall Quarter 2007 (Y2):

12/2 Winter Qtr (Y2) Laboratory Research Agreement (if necessary) _____

12/8 Fall Qtr. Independent Research Report _____

Laboratory Research Agreement I *(includes title/summary)* _____

Laboratory Research Agreement II *(includes title/summary)* _____

Laboratory Research Agreement III *(includes title/summary)* _____

Research Report I _____

Research Report II _____

Research Report III _____

Recommendation for the Thesis Examination Committee (Appendix D) _____

Master's Degree Candidate Certification (TGS form) (http://www.tgs.northwestern.edu/docs/upload/pdfs/macandcert.pdf) _____

Application for Degree (TGS form) (http://www.tgs.northwestern.edu/docs/upload/pdfs/appdegree.pdf) _____

APPENDIX C. CBB Laboratory Research Agreement

CBB
PROGRAM IN COMPUTATIONAL BIOLOGY & BIOINFORMATICS

LABORATORY RESEARCH AGREEMENT
INDEPENDENT RESEARCH (CBB 499) – STUDENT/ADVISOR AGREEMENT

_____ _____
Student Name NU ID

_____ _____
Quarter Year

We the undersigned agree to work together as research advisor and student on an independent research project (formal course registration CBB 499).

Faculty Research Advisor Name (Please print): _____

_____ _____
Faculty Member Signature Date

Graduate Student Name (Please print): _____

_____ _____
Graduate Student Signature Date

_____ _____
Signature of Chairperson Date
Curriculum and Advisory Committee

RETURN TO THE CBB PROGRAM OFFICE (FORD 2.323) WITH A TITLE AND SHORT SUMMARY OR UPDATE OF YOUR PROPOSED RESEARCH PROJECT BY 5:00pm ON THE DEADLINE DATE.

APPENDIX D. CBB Recommendation for M.S. Thesis Examination Committee

CBB
PROGRAM IN COMPUTATIONAL BIOLOGY & BIOINFORMATICS

RECOMMENDATION FOR MASTER'S OF SCIENCE THESIS EXAMINATION COMMITTEE

The recommendation for M.S. Thesis Examination Committee form, completed by the program chair, must be received in the office of the Program in Computational Biology & Bioinformatics at least three (3) weeks before the date of the closed oral presentation/examination. The committee must include no fewer then three full-time members of the Northwestern University faculty, two of whom, including the chair, must be members of the Graduate Faculty. The chair of the committee is expected hold an appointment with the students Program.

Student's name: _____
Last, family, or surname *First name* *Middle Initial*

ID number: _____

Current address: _____
Number and Street *Apt* *City* *State* *Zip*

_____ _____
Phone number *E-mail address*

Scheduled date of closed oral presentation/examination: _____
Date degree is expected: _____

COMMITTEE RECOMMENDED

Typed name	Department/Program
(chair)_____	_____
_____	_____
_____	_____
_____	_____

PROGRAM CHAIR

Typed name _____ Signature _____

Program _____ Date _____

RETURN TO THE CBB PROGRAM OFFICE (FORD 2.323) BY 5:00pm ON THE DEADLINE DATE.

APPENDIX E. CBB Course Registration Form

CBB
PROGRAM IN COMPUTATIONAL BIOLOGY & BIOINFORMATICS

COURSE REGISTRATION FORM

Name	Student ID	Quarter	Year

Class Number	Dept & Catalog #	Section	Description	Instructor	Time	Room

Future Recommendation(s): _____

_____

Faculty Advisor Name (Please print):_____

_____ _____
Faculty Member Signature Date

Graduate Student Name (Please print): _____

_____ _____
Graduate Student Signature Date