

NYU DEPARTMENT OF BIOLOGY
2008-2009 GRADUATE STUDENT HANDBOOK

FOREWORD

Welcome to the Department of Biology at New York University. This handbook has been developed to help biology graduate students become familiar with the department's requirements and regulations as well as to provide an overview of the department's research programs and services provided by the university.

The Biology Department offers both Masters and Doctoral degrees. Our goal is to train and educate the next generation of scientists in all aspects of career development with regard to research, teaching and service to the community at the highest levels of excellence.

We have a distinguished faculty whose research covers a breadth of biological systems as well as a variety of approaches including molecular and cell biology, molecular genetics, genomics and informatics. An overriding theme of our department is to understand biological regulatory mechanisms and their evolution within and across species. The department currently has areas of research and graduate educational concentration in the following areas:

-Genomics & Systems Biology	-Cancer & Cell Biology	- Developmental Biology
-Molecular Genetics	-Microbiology & Immunology	- Molecular Evolution
-Neurobiology	-Plant Biology	- Environmental Science

The department has grown significantly in the genomics and molecular-genetics era with the hiring of a large number of new faculty in recent years. In recognition of the biological revolution benefiting from new genomic and bioinformatic approaches, the department is undergoing a new phase of development with the hiring of 14 new genomic faculty in 6 years. This expansion plan also involves the construction of the Center for Genomics & Systems Biology which houses genomic core facilities as well as new state-of-the-art "open plan" research laboratories, designed with the department's exceptional spirit of collaboration and interaction in mind.

The Center for Genomics & Systems Biology is a highlight of the department's new growth and development which draws on the complementary strengths of Biology/Genomics and Bioinformatics at NYU's Department of Biology and NYU's Courant Institute of Mathematical & Computer Sciences. A goal of the Center is to use comparative genomic and bioinformatic approaches to understand how changes in biological regulatory mechanisms have evolved to lead to species diversity. The intellectual platform upon which this vision rests is the pairing of molecular conservation at the genomic level with the dramatic diversity of life.

The Biology Department also hosts strong collaborative research and educational programs with other NYU departments and divisions including the Courant Institute of Mathematical Sciences, NYU Langone Medical Center's Skirball Institute, the Department of Chemistry, the Center for Neural Science, and the Department of Anthropology. We have also formed highly successful research and teaching consortia with New York institutions specializing in genomics and evolution including the American Museum of Natural History, the New York Botanical Garden and Cold Spring Harbor Laboratory.

We wish you the greatest success and welcome you to the NYU Biology Department's Graduate Program.

Gloria Coruzzi, *Department Chair*

CONTENTS

Foreword by Gloria Coruzzi, Department Chair	1		
Contacts	4		
I. Graduate Study in Biology	5		
A. Admission to the Graduate Program	6		
B. Financial Assistance	8		
II. Master of Science (MS)	9		
A. MS Program in General Biology	9		
1. Degree Requirements	9		
2. Research Paper	9		
B. MS Program in Recombinant DNA Technology	10		
C. MS Program in Computers in Biological Research	11		
D. M.A. Program in Biomedical Journalism	11		
E. MS-M.B.A. Program	11		
F. MS Program in Oral Biology	12		
III. Master of Philosophy (M. Phil.)	12		
IV. Doctor of Philosophy (PhD)	13		
A. Typical PhD Program	13		
1. 1st Year	13		
2. 2nd Year	14		
3. 3rd and Subsequent Years	14		
B. Degree Requirements	14		
1. Coursework	14		
2. Teaching	16		
3. Qualifying Examination	17		
a. Part I: Written Research Proposal	17		
b. Part II: Oral Research Proposal Defense	18		
4. Thesis Proposal and Oral Preliminary Examination	18		
5. Annual Advisory Committee Meetings	20		
6. Dissertation and Dissertation Defense	20		
C. BRIDGES: Molecular Systematics of Plant & Animal Species Training	22		
D. Developmental Genetics Program	22		
E. Advisement	22		
F. Changing Mentors or Advisory Committee Members	23		
G. Time Commitment / Stipends	23		
H. Departmental Awards	23		
I. Travel	24		
V Graduate Student Regulations	25		
A. Standards of Behavior	25		
B. Advisement/Registration	25		
C. Change of Status	25		
D. Transfer of Credits	25		
E. Academic Probation	26		
F. Graduation	26		
G. Full-time Equivalency	26		
H. Leave of Absence	27		
I. Readmission	27		
		VI. Information about the University	28
		A. Graduate Student Housing	28
		B. Graduate Student Lounges	28
		C. Office for International Students and Scholars	28
		D. The Libraries	28
		E. Computing Facilities	29
		F. Health Insurance	29
		VII. Additional Information about the Department	30
		A. Graduate Biology Group	30
		B. Poster Sessions	30
		C. Departmental Conferences/Symposia and Seminars	30
		D. Recent PhD Recipients	31
		E. New Doctoral Students	31
		VIII. Faculty Research Interests	32
		A. Areas of Research	32
		B. Department Faculty	34
		Efrain Azmitia	34
		Kenneth Birnbaum	35
		Justin Blau	36
		Richard Bonneau	37
		Richard Borowsky	38
		Suse Broyde	39
		Francesca Chiaromonte	40
		Gloria Coruzzi	41
		*Robert DeSalle (AMNH) *affiliated appointment in Biology	42
		Claude Desplan	43
		Patrick Eichenberger	44
		David Fitch	45
		Kristin Gunsalus	46
		Edo Kussell	47
		Fabio Piano	48
		Michael Purugganan	49
		Nikolaus Rajewsky (MDC) *affiliated appointment in Biology	50
		Michael Rampino	51
		Carol Reiss	52
		Matthew Rockman	53
		Christine Rushlow	54
		David Scicchitano	55
		Walter Scott	56
		Mark Siegal	57
		Stephen Small	58
		Daniel Tranchina	59
		Tyler Volk	60
		C. Department Associates	61

CONTACTS

Questions concerning the graduate programs or any of their requirements should be addressed as noted to the following individuals:

Dr. Gloria Coruzzi (gloria.coruzzi@nyu.edu), *Department Chair*
(departmental policy issues)

Dr. Stephen Small (sjs1@nyu.edu), *Director of Graduate Studies - PhD Program*
(admission, program requirements, advisory committees, examinations,
programmatic approvals)

Dr. Christine Rushlow (chris.rushlow@nyu.edu), *Director of Graduate Studies -
Masters Program* (admission, program requirements, advisement, theses,
programmatic approvals)

Jenny Kim (jenny.kim@nyu.edu), *Director of Administration*
(department policy issues)

Gail Kashishian (gk6@nyu.edu), *Coordinator of Student Advisement*
(degree requirements, assistantships and fellowships, course selection)

Myriam Rodriguez (mtr1@nyu.edu), *Administrative Aide, Graduate Program*
(registration, student records, class schedules, forms)

NYU Department of Biology, Center for Genomics & Systems Biology
31 Washington Place, Room 1009 Silver Center
New York, NY 10003-6688
212-998-8200, Fax 995-4015

<http://biology.as.nyu.edu/page/home.html>

I. GRADUATE STUDY IN BIOLOGY

Biology is the study of life in all its diverse forms. In recent years Biology has been revolutionized with the development of powerful genomic, molecular and cellular techniques that are now being applied to areas across the spectrum of science, from genetics and development to ecology, behavior and biomedicine. New fields of Computational Biology, including Bioinformatics and Systems Biology, are now providing insights into how the parts list of each organism is put together into a working whole. A new highlight of NYU's Department of Biology is its Center for Genomics & Systems Biology, whose mission is to study biological regulatory mechanisms and their evolution at the level of systems and networks, across a range of species spanning microbes, plants and animals.

The principal aim of graduate studies in Biology is the preparation of students to contribute to the advancement of science. This is accomplished by providing students with a broad background in the fundamentals of modern biological sciences, training in state-of-the-art research methods, and acquisition of skills required to conceive and complete a substantial, significant and original research project. Additionally, graduate training should include mastery of techniques for the presentation of scientific information, and knowledge of the structure of the scientific enterprise and its institutions. This training permits students to enter traditional career paths in academia and research. It also provides entry into related fields that include business, administration, communications, and education. Although the field is competitive, graduates with the necessary skills, dedication and energy find rewarding careers in Biology.

The biological sciences consist of a number of established sub-disciplines. What distinguishes graduate training in a unified department of biology from that in a more specialized department (such as biochemistry or microbiology) is its breadth. Education in a biology department is designed to provide students with an exposure to a variety of perspectives (genomic, bioinformatic, molecular, developmental, genetic, evolutionary) and a variety of systems (prokaryotes, simple eukaryotes through higher plants and mammals, including humans). Although the most intensive component continues to be a defined and focused research project in one area, graduate students in the Biology Department have an opportunity to learn about close and more distantly related subjects through coursework, seminars, colloquia, and interactions with a large and diverse faculty. Increasingly, such multidisciplinary training and perspective is important in successful research and academic (and alternative) career paths. This is the basic philosophy of our program.

The Department of Biology has two programs of graduate study, one leading to the Masters degree and the other to the Doctorate. Since its organization in 1894, the department has awarded 2,308 MS degrees and 891 PhD degrees. Included among the graduates are many who have gone on to notable careers in science and science-related fields. Some recent biology graduates are listed in Section VII.

The Masters degree is obtained through a coursework program designed for either part- or full-time students. Students enrolled in the Masters degree program have 5 options for their course of study: 1) MS General Biology provides a broad base in the principles of modern biology which frequently includes advanced coursework in genomics, cell biology, biochemistry, molecular biology, microbiology, physiology, neurobiology, immunology, genetics and organismal biology; 2) MS Computers in Biologic Research provides students with a firm understanding of the application of computer technology to both theoretical and practical aspects of the study of biology; 3) MS Recombinant DNA Technology is designed to give the student a thorough training in molecular biology, including design of molecular biological approaches to problems in the broad range of biology and hands-on training in molecular biological laboratory techniques; 4) MS Biomedical Journalism is an interdepartmental collaborative course of study combining modern aspects of biological sciences with training in journalistic and communication skills (granting of degrees subject to final approval); 5) a joint MS-MBA in Biology is offered in conjunction with NYU's Stern School of Business; 6) MS Oral Biology is offered in collaboration with the NYU College of Dentistry.

The PhD program, for full-time students only, is designed to develop independent research scientists with a thorough training in modern biology and stresses the development of quantitative mechanistic approaches to biological research. Thesis research can be undertaken in labs emphasizing biochemistry, molecular biology, genomics and bioinformatics, cell biology, developmental biology, genetics, physiology, neurobiology, microbiology, plant molecular and developmental biology, immunology, virology, population studies, ecology and evolution. The PhD program includes joint programs for graduate training with NYU Medical School/Skirball Institute in Developmental Genetics and in Molecular Evolution in a track called BRIDGES, in collaboration with prominent research institutions like the American Museum of Natural History and New York Botanical Garden).

A. Admission to the Department

Graduate students come to the NYU Biology Department from a variety of backgrounds and institutions. Admission is highly competitive, with applications to the doctoral program generally exceeding offers of admission more than ten-fold. PhD students in our program form a cohesive and interactive group; they truly learn as much from one another as from the faculty. Typically, on completion of their education, they go on to excellent positions in research laboratories, academic institutions, or additional training.

Online and paper applications for the MS and PhD programs are available on the Graduate School of Arts and Science web site. The Graduate School prefers that applicants file the application online; however, you can download a paper copy of the application. Complete information about applying is available at their Application Resource Center, <http://gsas.nyu.edu/page/grad.admissionsapplication.html>, including information regarding the GRE and TOEFL, letters of recommendation, and transcripts.

Applications for admission to the MS Program are accepted on a continuing basis, and students may begin their studies in either the fall, spring or summer semesters.

Applicants for admission to the MS program must have successfully completed an undergraduate major in a science with a B average or better and must submit letters of recommendation from three individuals who are in a position to evaluate the applicant's academic and/or scientific potential. The Graduate Record Examination (GRE) is required for admission to the MS Program.

Applications for admission to the PhD program in 2009-2010 are due no later than December 12, 2008. PhD students begin their course of study in the fall semester and attend full-time.

Minimal requirements for admission to the PhD program are as follows:

- An undergraduate major in a science with a B or better average.
- Three letters of recommendation from individuals who are capable of assessing the applicant's academic and scientific potential.
- Graduate Record Examinations (verbal, quantitative, analytical; the advanced test in biology is recommended).

Foreign applicants to the MS or PhD program whose native language is not English must submit scores of the Test of English as a Foreign Language (TOEFL) which is administered by the Educational Testing Service. Upon acceptance to the program, foreign students are required to also take the examination administered by the NYU American Language Institute to determine their level of English proficiency. In the event of a deficiency in this area, the Department may require the student to complete language training at their own expense and without course credit towards their degree.

On occasion, nontraditional students (e.g., students with undergraduate majors in non-science fields or students whose undergraduate grades do not reflect their special skills in scientific research) may be admitted to the program on a provisional basis. In these cases, the Admissions Committee and/or Director of Graduate Studies may prescribe undergraduate coursework or other remedial study to make up for deficiencies in background. These courses, usually taken without credit towards the graduate degree, must be completed satisfactorily prior to full acceptance of the student into the graduate program.

Students who choose to study without seeking admission to a degree program may apply as a nonmatriculant to the Department. Though not matriculated at the Graduate School, students must meet the same application deadlines and scholastic standards as students who are matriculated in a degree program. Nonmatriculants may register for a maximum of 12 points, at which time they must either petition the Director of Graduate Studies, MS Program, for a change of status or, if they are interested in the PhD program, submit an application to the GSAS Office of Graduate Enrollment Services (GES).

Applicants with foreign credentials or nonimmigrant visas should refer to the admission, tuition, and financial aid section of the GSAS bulletin or web site for additional requirements.

B. Financial Assistance

Doctoral students are admitted to the program with the assurance of financial support. Initially, this takes the form of a graduate teaching assistantship, which provides a stipend and tuition remission.

Tuition remission provided through assistantship and fellowship covers the tuition and fees per point that each student registers for each semester. Tuition for the 2008-2009 academic year is \$1,206 per point, plus additional nonrefundable registration and service fees.

Graduate students are strongly encouraged to actively seek their own external fellowship support. Such awards are available from a variety of federal (National Science Foundation, National Institutes of Health), private (Howard Hughes Foundation), public, charitable and industrial sources. Students are also eligible to apply for numerous grants that provide research costs, travel and other project funding. Information on such financial support can be obtained from the Coordinator of Student Advisement.

University fellowships and scholarships (i.e., Dean's Dissertation Fellowship) are also available on a competitive basis to support students. The GSAS Office of Student Affairs & Academic Services at One Half Fifth Avenue (<http://gsas.nyu.edu/page/grad.life>) is an important source of information on both extramural and intramural financial assistance. Please refer to the GSAS Bulletin and the GIGS web site (www.nyu.edu/gsas/fininfo/gigs.html) for additional financial aid information.

Although Masters students are not eligible for departmental financial aid, a small number of graduate teaching assistantships may be awarded when positions are available. Masters students who are employed may find that they are eligible for tuition remission benefits from their employer.

II. MASTER OF SCIENCE (MS)

PLEASE NOTE: For each MS Biology Program (A. through F.), 24 of the total credits required for each program must be in the Department of Biology at New York University (course numbers beginning with G23).

A. MS Program in General Biology

1. *Degree Requirements:* Complete 36 graduate points with an average of B or better. Up to 12 points of graduate-level science courses completed at NYU may be taken in departments including Neural Science, Mathematics, Computer Science, Basic Medical Sciences, Physics or Chemistry. Students enrolling in courses in other NYU departments must obtain prior permission from the course instructor as well as the Director of Graduate Studies.

Courses numbered at the 1000- and 2000-level are open to students in the MS program. A total of 12 credits may be taken in individualized study at the 3000-level (either a Journal Club, Reading or Research course); of these 12 credits, the maximum number of Research credits is 8. Curricula are based on the individual student's background, interests, and future career goals. Advisement on course selection should be sought from the department's Coordinator of Student Advisement and/or Director of Graduate Studies - Masters Program.

All entering MS students will be required to take a full-year intensive team-taught core lecture course. In the Fall semester, Bio Core I, Molecules & Genomes (G23.1001), will survey the major topics of up-to-date molecular and cellular biology starting with molecular structure and function of proteins and poly-nucleic acids, and ends with cell division and apoptosis. In the Spring semester, Bio Core II, Cells & Systems (G23.1002), will survey the major topics of modern biology including genetics, systematics, genomics, systems biology, developmental genetics, plant biology, immunology, neurobiology, population genetics, evolution, and geobiology. The topics in both courses will be taught by Biology faculty with expertise in each area. The purpose of these courses is to insure that all Biology graduate students have a comprehensive background in modern biology. MS students requesting a waiver of these courses should send a written petition to the Director of Graduate Studies, MS Program.

All MS students enrolled in Lab in Molecular Biology III and IV (G23.1124-25) or Research (G23.3303-04) must prepare a poster to be presented at the Spring MS Poster Session, which provides students the opportunity to discuss their research with other students and faculty members.

2. *Research Paper.* The research paper is to be prepared under the supervision of an approved faculty examiner. Each student must choose the faculty examiner. The student and the examiner must then agree on a topic for the paper and a schedule for the paper's preparation. The schedule should include a date for the submission of at least one preliminary draft.

Once the examiner and topic have been selected, the student must submit this information via email to the Director of Graduate Studies, MS Program. A final paper on the assigned topic must be submitted to the examiner. The examiner will then evaluate and grade the paper. The grade is either "Pass", "Pass with Distinction" or "Fail". The examiner should notify the Director of Graduate Studies

of the grade in writing. The student is required to submit a copy of the paper to the Director of Graduate Studies for inclusion in the student's file.

Usually, the basis for the completion of the research paper is library study - i.e., after selection of a suitable topic by the student and advisor, the student will research the topic in the library by reading and analyzing original literature on the subject, and then prepare a substantive analysis which will constitute the paper. The format for the paper may vary but should generally include an Abstract, Introduction (Statement of the Topic and its importance), Literature Review or Background, Conclusions or Discussion, and References.

Students may also prepare a paper based on their own original laboratory research. The requirements for a Masters paper based on such research are the same as those for a paper based on a library research topic, although the format of the paper should be similar to that of a paper in a professional research journal (Abstract, Introduction, Materials and Methods, Results, Discussion, Literature Cited).

Further information on the requirements for the Masters research paper may be obtained from the Director of Graduate Studies for the Masters Program or the Coordinator of Student Advisement.

B. MS Program in Recombinant DNA Technology

This MS degree program is designed to meet the needs of students with varied academic background who desire to develop significant experience in recombinant DNA. Both strategies of modern molecular biology and specific training in lab techniques are emphasized. Applicants with training in other areas who have a special interest in recombinant DNA technology will be considered for admission. The required total number of credits is 36.

Students admitted to this program are required to take the following courses (or equivalent substitution with permission of the Director of Graduate Studies):

- BioCore I and II (G23.1001 and G23.1002)
- Lab in Molecular Biology I-IV (G23.1122-.1125)

Lab in Molecular Biology I and II is a course sequence designed as a research project. In the Fall semester students perform experiments with the aim of cloning and characterizing a gene at the molecular level (a *Drosophila melanogaster* gene, for example) including DNA sequence analysis. In the Spring semester students perform functional studies of the protein encoded by the gene (analysis of a transcription factor, for example).

Lab in Molecular Biology III and IV consist of an independent research project by the student under supervision of a research mentor. The mentor is usually a faculty member of the Department of Biology at NYU, but can also be a faculty member at another institution. Once the mentor has been selected, the student must submit this information, in writing, to the Director of Graduate Studies. In both cases the mentor must communicate with the instructor/supervisor of Lab III and IV about the research project, progress of the student, and the final grade. In general, Lab III and IV each require about 20 hours per week of lab work. If Labs III and IV are taken simultaneously, approximately 40 hours per week are required. If both are taken during the summer, the research project extends until the end of August.

Students in this program must complete a research paper as described above. The scientific results obtained during Lab III and IV may be integrated into this paper.

C. MS Program in Computers in Biological Research

The Computers in Biological Research program has been designed for students with academic backgrounds in biology and computer science who desire in depth training in applications of computer technology to computational modeling, bioinformatics and laboratory research in genomics. The required total number of credits is 36.

Students admitted to this program are required to take BioCore I and II (G23.1001 and G23.1002), and will be advised regarding additional courses they should take based on their background.

Each student must complete a special research project under the supervision of a sponsor (or co-sponsor) who is a Biology or Computer Science faculty member. Students may seek approval from the Director of Graduate Studies, Masters Program, for a sponsor outside these departments or outside of the university. A report of the research, similar in length and format to a MS qualifying paper (thesis), must be approved by the sponsor. The sponsor must then sign a MS approval form available from the Administrative Aide, Graduate Program.

D. MS Program in Biomedical Journalism

The accredited MS Program in Biomedical Journalism, offered jointly by the departments of Biology and Journalism, is designed to provide journalism training to Biology MS candidates. The program is also described under "Global & Joint Program Studies" (GloJo) on the Department of Journalism's web site, at <http://journalism.nyu.edu/prospectivestudents/coursesofstudy/joint/>.

Admission to the program in Biomedical Journalism must be granted by both departments. Graduate Record Examination scores (general aptitude) are required from each applicant. Admission to the joint program for applicants without a background major in biomedical sciences (or the equivalent) will be conditional pending completion of certain basic undergraduate courses in biology.

A total of 42 points is required for this degree: 22 points (five courses) are required in Journalism, and 20 points (five courses) are required in Biology. Bio Core I (G23.1001) and Bio Core II (G23.1002) are two of the required Biology courses for this program. For details on coursework in Journalism, please visit their web site at <http://journalism.nyu.edu/prospectivestudents/coursesofstudy/joint/>.

E. MS-M.B.A. Program

This joint program will lead to an MS in Biology (GSAS) and M.B.A. (Stern School of Business). This program meets a need for academic preparation and training of Scientist-Managers and Research Directors for the biotechnology and pharmacology industry, academic Industrial Liaison personnel, Investment Specialists for the financial sector, and Government Regulatory personnel.

Students earn 30 credits in GSAS-Biology and complete a Qualifying Thesis plus 54 credits at the Stern School of Business. This is a full-time program, with the first year and summer at GSAS and the second and third years at Stern.

The GMAT and GRE exams are required for the application process, and each program's prerequisites remain; for instance Stern considers business experience essential and Biology requires the pre-medical core curriculum to matriculate in graduate level courses. Admissions are made by each school's admissions committee and students must be admitted to both programs to qualify for the joint degree. Additional information on this program is available on the Biology web site, <http://www.nyu.edu/fas/dept/biology/graduate/biologymba.html>.

F. MS Program in Oral Biology

The Oral Biology program is offered through the Graduate School of Arts & Science Department of Biology in collaboration with the NYU College of Dentistry, and all candidates must meet requirements of both schools. This program requires a bachelors degree or equivalent, regardless of whether the student has advanced clinical training. MCAT or DAT scores may be submitted in lieu of the GRE.

Two distinct areas of specialization are available to students in Oral Biology:

Research-Intensive track; 8 credits must be based on a mentored laboratory research project leading to a thesis and/or peer-reviewed publication.

Didactic-Intensive track; a scholarly in-depth discussion of a current area of oral biology that is approved by the student's advisor must be completed.

Students are required to take BioCore I and II. Students in the Research-Intensive track are also required to take Lab Practicum I and II. For current course descriptions, see www.nyu.edu/dental/advanceded/oralbiology/courses.html and www.nyu.edu/gsas/Programs/Bulletin.

III. MASTER OF PHILOSOPHY (M.PHIL.) DEGREE

The Master of Philosophy degree is conferred only to students accepted as candidates in a doctoral program who have fulfilled all doctorate requirements except the dissertation and its defense (72 credits and passing both the qualifying examination and thesis proposal examination).

IV. DOCTOR OF PHILOSOPHY (PHD)

The PhD program is a full-time program designed to develop independent research scientists with a thorough training in modern biology. The major component of the program is the completion of an original and substantive research project under the direction of a member of the department faculty. Students are also expected to become contributing members of the Department's scientific community, participating in journal clubs, seminar series, and other opportunities for the exchange of scientific information. The responsibility for tracking and advising a student is shared among the Department Chair, the Director of Graduate Studies for the Doctoral Program, and the Coordinator of Student Advisement, as well as each student's advisory committee that includes the student's PhD thesis advisor. The relative importance of these groups changes during the student's graduate career; overall, their role is to guide the student through a series of milestones leading to a PhD degree, ideally in about 5 years.

Students in the doctoral program are reappointed annually by the Director of Graduate Studies for the Doctoral Program in consultation with the Department Chair. The appointments are contingent on the demonstration that the students are making adequate progress towards the completion of their degrees. Such progress is judged by the achievement of certain milestones within a specified time-frame, i.e., completion of first-year coursework and laboratory rotations with adequate grades and evaluations, passing the qualifying examination at the end of the first year, and the thesis proposal examination at the end of the second year. Starting in year 3, these milestones are annual thesis committee meetings, designed to monitor the student's progress toward the PhD degree (see below). Milestones must be achieved by June 15th of each year, in order to ensure reappointment by September 1st of the next year. A degree of flexibility is permitted to accommodate the needs of individual students, but a formal evaluation of progress must be made annually by the advisory committee and reported to the Director of Graduate Studies for the Doctoral Program and the Department Chair.

A student who does not make adequate progress towards completion of their degree will be placed on probation for one semester. An additional committee meeting must be held before the end of the probationary semester. If sufficient progress is not made in the probationary semester, the student will be subject to dismissal from the PhD program by the Department Chair.

A. Typical PhD Program

The following is an example of a typical doctoral program in the department. More details for each major component are provided in subsequent sections.

1. *1st Year (the year in which a student begins study towards a PhD degree regardless of previous degrees or experience).* This year is intended to allow students to advance their education with graduate courses chosen to establish a breadth of understanding principles of contemporary biology and a firm foundation for their research. The student, with the advice of the Coordinator of Student Advisement and the Director of Graduate Studies for the Doctoral Program selects courses for the first year prior to or during registration. First Year students must

satisfactorily complete the required courses outlined in Section B below, serve as teaching assistants in undergraduate or graduate Biology laboratory courses, perform research rotations in three laboratories, and choose a laboratory for their thesis project. Students must also sustain the PhD Qualifying Exam, which is given in the last week of May each year (see below).

Students should use the summer of this first academic year to begin their thesis research. Funds to support the student in this first summer will be provided by the student's faculty mentor or by student grants.

2. *2nd Year.* Toward the end of the summer of the first year, students should meet with their mentor and the Coordinator of Student Advisement to choose their 2nd year courses and discuss their progress. During the 2nd year, students should complete the majority of their coursework, serve as teaching assistants in undergraduate or graduate Biology courses, and continue their research. They also should choose their thesis committee, and present and orally defend their thesis proposal by June 15th of the second year.

3. *3rd and subsequent years.* These years are devoted to research and other professional activities. Serving as a teaching assistant may be required during the third year. Students are expected to make sustained progress in their research and participate in journal clubs, predoctoral colloquia and the departmental seminar series. During this period, the students meet annually with their Thesis Committee to review progress and discuss proposed studies. Typically, during this period, students begin to publish their results in the literature, and present their findings at professional meetings.

B. Degree Requirements

1. *Coursework.* Students are required to complete 72 graduate credits (with a B or better grade average). At least 36 of these credits must be in courses at the 1000 and 2000 level; the remaining credits may be selected from the 3000 level (Journal Clubs, Predoctoral Colloquia, Reading, Research, and Thesis Preparation courses).

Required courses:

- **BioCores 1-4 (G23.1001, G23.1002, G23.2003 and G23.2004)** Entering PhD students are required to take full-year intensive team-taught core lecture courses, taught by Biology faculty with expertise in each area. BioCores 1 and 2 are designed to ensure that all Biology graduate students have a comprehensive background in modern biology. BioCores 3 and 4 will expose PhD students to research papers, train them to analyze literature, and prepare them for their qualifying exam in the Spring semester of their 1st year.

In the Fall semester **BioCore 1, Molecules & Genomes**, surveys the major topics of molecular and cellular biology starting with molecular structure and function of proteins and poly-nucleic acids, and ending with cell division and apoptosis. **BioCore 3, Molecules & Genomes/tutorial**, complements BioCore 1 by providing an in-depth discussion of modern papers on topics related to those addressed in the lecture course (i.e. molecular and cellular biology from molecular structure and function of proteins/nucleic acids to cell division and apoptosis).

In the Spring semester **BioCore 2, Genes, Cells & Systems**, surveys major topics of modern biology including genetics, systematics, genomics, systems biology, developmental genetics, plant biology, immunology, neurobiology, population genetics, evolution, and geobiology. **BioCore 4: Cells & Systems/discussion** complements BioCore 2 by providing an intensive Socratic format discussion of papers on topics related to those addressed in the lectures.

- **The Art of Scientific Investigation (G23.3001)** This required course in the ethics and communication of scientific research is designed to complement the more information-based courses offered by the Biology Department. It will equip PhD students with the necessary skills to conduct research ethically and be aware of the ethical and societal implications of their research. It will also train students in effective scientific communication; paper-writing, presenting research to different audiences, and fellowship- and grant-writing.
- **Statistics in Biology (G23.2030)** or a demonstrated working knowledge in statistics through prior coursework. The level of sophistication in statistics for any student and the requirements to demonstrate this proficiency (e.g. coursework), is determined by the student's Advisory Committee. Courses in statistics (including G23.2030) will count towards the 36 required credits in 1000 and 2000-level courses in Biology.
- **Predocutorial Colloquium: Lab Rotation (G23.3034 and .3035)** Given in a two-semester sequence, this must be taken during the first year in the doctoral program. The purpose is to introduce students to several members of the faculty and the experimental approaches, techniques, and styles of their laboratories, and to help students select a thesis advisor. The rotations also provide the potential thesis advisor a basis on which to evaluate the student for acceptance into his/her group.

At the beginning of the Fall semester, members of the Biology faculty give presentations to describe their research interests. Students then select three faculty research laboratories in which they will work under the direction of the faculty member.

The timetable for the 2008-2009 laboratory rotations is:

Rotation 1, 9/22/08 to 11/21/08 (9 weeks)

Rotation 2, 11/24/08 to 1/30/09 (10 weeks, includes fall and winter holidays)

Rotation 3, 2/2/09 to 4/3/09 (9 weeks, includes spring break)

The rationale for the laboratory rotation timetable is to prevent individual rotations from extending too long, as well as to prevent overlaps between rotations. Additionally, if 3 rotations are completed by 4/4/09, this will allow time for the student to concentrate on preparing for the qualifying exam, held in the last week of May. Also, finishing 3 rotations in a timely fashion will permit each student to choose a thesis mentor before the end of the academic year.

Specific requirements and expectations for each of the three rotations should be arranged at the beginning of each lab rotation in consultation with the faculty member in charge of each lab. At the end of each rotation, the professor will certify, in writing, that the student has successfully completed the assigned work and give a grade reflecting the student's work.

Students are required to complete their lab rotations prior to choosing a mentor, even if they enter the program with a particular laboratory and faculty mentor in mind; this permits changes in a student's selection without prejudice. It also provides an opportunity to "test the waters" in different fields, learn a variety of techniques and approaches, and make personal contacts with faculty and fellow students who will prove useful in their thesis research and later careers.

Each student should choose a thesis advisor by May 1st of their first year. This choice is subject to prior approval by the Director of the Doctoral Program, and must be confirmed in writing, signed by both the student and the proposed mentor. In some cases, a fourth rotation is required. This rotation should be completed in the summer of the first year.

- **Predocutorial Colloquium/Graduate Student Seminar (G23.3015)** All PhD students are required to participate in this course every semester. This course consists of a weekly seminar at which students in their second year and beyond present the results of their research. In addition to the educational benefit, the goals of this course are to help train students in seminar presentation, to increase their level of confidence in presenting formal scientific seminars, and to provide students with a formal mechanism for sharpening their seminar and question-period skills. The ability to communicate effectively (both verbally and in written form) to an audience of wide backgrounds is essential for a successful scientific career.

The seminars are 25 minutes long followed by a 5-minute question period.

A seminar schedule will be distributed at the beginning of each academic year to doctoral students and faculty. A faculty member is assigned to serve as a “seminar host” for each student. Students are required to meet with their hosts at least one week prior to their seminar date to obtain advice on preparation, delivery and audio-visuals (as appropriate). It is the student’s responsibility to set up the meeting with the faculty host well in advance of the seminar. Faculty hosts also provide constructive critiques following each presentation, both verbally to the student and in a brief written evaluation submitted to the department, and provide a grade.

All doctoral students are required to attend these student seminars; faculty are strongly encouraged to attend, especially members of the student’s Advisory Committee. Support from a large familiar and friendly audience helps the students gain confidence in their abilities, a major aim of this course.

- * **Departmental Seminars** Although not a formal course, attendance at the Monday seminar series is required of all doctoral students. This series exposes students to the latest research developments in a variety of fields which contributes to the breadth of the research experience, and provides exposure to different styles of seminars, how they are organized and presented. Attendance at other relevant research seminars and meetings in the vast NYC biomedical community is also encouraged. Please see Section VII for more information.
- * **The Non-Retreating Retreat** This a day-long event that will be held at the beginning of each academic year. This year’s event on September 12, 2008, included lectures from selected faculty and a formal presentation of Graduate Student Awards, as well as a poster session. All students are encouraged to participate in the poster session, and doctoral students in their third year and beyond are required to present a poster describing their current research at the PhD poster session. All PhD students are expected to attend this event.

2. Teaching. Doctoral students are expected to participate in teaching for a maximum of 6 semesters during the first 3 years in the program. All students including those on fellowships must teach a minimum of 1 year. Teaching is important preparation for graduate students who will undertake academic careers. Documented teaching ability is increasingly important in faculty recruitment.

Teaching is also an integral part of learning, and many students use these assignments to complement their coursework and to sharpen their knowledge and

skills in particular areas of biology.

These assignments will not exceed an average maximum of 20 hours per week during the academic term including preparation time, examinations and meetings, and they are usually found to be interesting and stimulating.

Many students have a special interest in teaching and can undertake more intensive assignments, with the approval of their mentors and the Director of Graduate Studies, Doctoral Program. These could include coordination of teaching assistants in large courses, lecturing in selected courses, participation in special innovative, multidisciplinary courses for non-science majors.

3. Qualifying Examination. The Qualifying Examination is taken by all PhD students at the end of their first year. This examination tests the student’s skills in scientific writing, reasoning, analysis and interpretation of data in the literature, integration of scientific concepts, and creativity in the design of new experiments. Students progressing well in their training should need no specific preparation for the exam.

The exam consists of two parts: a written research proposal and an oral presentation of the proposal that is defended before a committee of three faculty members. Committee members are assigned to each student by the Director of Graduate Studies, PhD Program, in collaboration with the instructors of record from BioCore III and IV.

a. *Part I: Written Research Proposal.* A general topic for the exam will be announced on April 13, 2009, by the PhD Program Director. Within this general topic, students must select the specific area of research they will address in the research proposal. **This area must be independent of their proposed thesis research or any other research previously conducted (including undergraduate or Masters level projects).** Development of a substantive and experimentally tractable question or hypothesis is a significant component of the examination; thus, it is recommended that students give serious thought to the proposal question long before the date due. The student first submits to the examining committee an abstract that briefly summarizes the question or hypothesis, and then lists several specific aims for experiments designed to address the question or hypothesis. The committee either accepts the abstract or rejects it. If rejected, the committee provides suggestions for improvement, and the student revises the abstract. Once accepted, the student then prepares a research proposal limited to 15 single-spaced pages, using the form of an NIH or NSF grant application. The proposal should include an Abstract, Specific Aims, Background and Significance, Experimental Design, and References. It is particularly important that the background section contain a detailed, critical analysis of the relevant literature pertaining to the proposal. It is also required that the proposed experiments use techniques from two different broadly defined areas, such as molecular biology and cell biology, in order to illustrate the breadth of the student’s background and skills. The research proposed should encompass work expected to take 3-5 years.

The proposal and an updated CV must be submitted to the committee at least one week prior to the oral examination. A copy of the proposal must also be submitted to the Coordinator of Student Advisement for inclusion in the student’s file.

The proposal is evaluated on the basis of analytical skills, writing skills, appropriateness of the individual experiments, logical presentation of proposed experiments, and the overall experimental approach.

The format of the examination requires that students abide by a very high standard of ethical conduct. *They may not confer with faculty, scientists, each other or*

anyone else concerning any aspect of the written or oral exam, including scientific content or language. Failure to abide by these rules will result in dismissal from the program.

b. *Part II: Oral Research Proposal Defense.* The oral exam is a further test of the student's understanding of the topics contained in the written proposal. It should explore any weaknesses that become apparent in the written proposal and give the student an opportunity to expand on various aspects of the proposal. However, the exam is not restricted to the specific substance of the student's proposal; committee members are expected to digress into related areas to explore the student's knowledge of major relevant themes in modern biology.

The oral section of the examination is conducted in the last week of May (see below). The examination begins with a 20-30 minute presentation of the overall goal, aims and approaches of the student's proposal, followed by questions from the examining committee.

The committee provides a single grade of "Pass", "Pass With Distinction" or "Fail" for the entire exam. The grade is usually the result of a clear consensus; in the event of a difference of opinion, the majority rules. The student is told of the grade as well as the reasons for the decision including any dissenting opinions at the conclusion of this meeting. In the event of a "Fail" the student is provided with a list of specific deficiencies and given one opportunity to repeat the entire exam, no later than August 15, 2009. A second failure automatically dictates termination from the program, and the student is expected to depart before December 31, 2009. No changes can be made in the composition of the committee for the second examination without explicit permission from the Department Chair and the Director of Graduate Studies for the Doctoral Program.

The written and oral portions of the exam are intended to be a learning experience for the student. In the proposal evaluation and oral component, strengths and weaknesses should be pointed out in a constructive manner with the intent of improving the student's ability to analyze, interpret and apply scientific information.

The timetable for the Spring 2009 Qualifying Exam is:

4/6/09	Meeting with DGS to review guidelines.
4/13/09	Topic Declaration to DGS and Committee Assignments.
4/20/09	Abstract to Examining Committee.
4/27/09	Committee Comments back to the student
5/5/09	Abstract approved by Committee, sent to Gail Kashishian.
5/22/09	Final Written Proposal to Committee
5/26-5/29/09	Oral Examination Period

Doctoral students who have completed 36 points and passed their Qualifying Examination can apply for a MS degree. Please refer to the Graduation Section of this handbook for information regarding applying for a graduate degree.

4. Thesis Proposal Examination. The thesis proposal is presented to the thesis advisory committee and defended orally before June 15th of the second year. The purpose of this requirement is to test the student's ability to place their proposed thesis research in the context of current knowledge in the field, state concisely and specifically the questions they intend to address (Specific Aims) and demonstrate ability to approach these questions with the most appropriate techniques available.

The PhD thesis proposal is prepared in the form of an NIH or NSF grant application. It must adhere to the guidelines set by the granting agency, and include the

following sections: Abstract, Specific Aims, Background and Significance, Preliminary Results, and Research Design and Methods. The total proposal is limited to 25 single spaced pages. This document must be submitted to the student's examining committee at least two weeks prior to the oral defense of the proposal.

The thesis proposal is presented to an examining committee consisting of the student's sponsor, three additional Biology Department faculty members, and at least one, and no more than two, external readers (see Section F). This committee is chosen by the student under the guidance of his/her mentor, and under normal circumstances, this committee will remain intact for the duration of the student's tenure as a PhD student. Students are responsible for arranging the time of the examination. If for any reason a member of the committee is unable to attend, the Department Chair and Director of Graduate Studies must be consulted to determine if the examination can proceed.

Approximately one month before the examination, the student should contact the Administrative Aide, Graduate Program, to obtain the form on which the student lists committee members and other pertinent information regarding the student's examination; this form must be signed by the student's sponsor and will then be approved by the Director of Graduate Studies and the Department Chair.

In general, the examination begins with the student's presentation of the overall goals, specific aims and approaches to be used in the study, plus any additional data obtained since preparation of the proposal. This presentation should last 20-30 minutes; it should not be a reiteration of the entire proposal but should highlight important questions and experimental approaches to be used. Thereafter, committee members ask the student questions about the work, its background or the studies proposed. Questions are usually designed to determine the student's comprehension of the field of study, ability to defend the approaches to be used, ability to properly interpret the results obtained, and capacity to alter methods and approaches in response to the needs of the study or the intermediary findings. In this regard, questioning is generally focused on the proposal and the particular field of research it represents, but excursion into other areas is not excluded.

The student's oral examination is either sustained or not sustained by the committee. Additionally, the committee will either accept the proposal in principle or reject it. If accepted, the proposal is taken as a framework for the studies expected to comprise the student's dissertation research. However, acceptance does not mean that the entire proposal must be completed in order to then accept the dissertation, nor does it guarantee the converse: that if the aims of the proposal are completed then the dissertation must be accepted. Completion of the final dissertation and its acceptance remain the prerogatives of the committee and should be seen as subject to the normal variations and vagaries of the scientific process.

The committee may also provisionally sustain the examination or provisionally accept the proposal, contingent upon the revision of one particular aspect of the material or correction of a deficiency. In this case, the revision may be reviewed by one or more Committee members, at the discretion of the Committee, followed by relief of the provisional status.

Students whose oral examination is not sustained or whose thesis proposal is not accepted by a majority of the committee will be placed on probation for one semester, and will be permitted to repeat the examination one time before the end of

the probationary semester. No changes may be made in the composition of the committee for the second examination without the prior approval of the Department Chair and the Director of Graduate Studies for the Doctoral Program.

When PhD students pass their Thesis Proposal, they become PhD candidates.

5. Annual Advisory Committee Meetings. After sustaining the Qualifying and Thesis Proposal Examinations, students are required to meet annually with their Advisory Committees (the membership is the same as that of the thesis proposal). This annual meeting is compulsory; it must be held before June 15th of each year. These meetings are used both to evaluate performance and assess progress towards degree completion, and enlist expertise of the Committee in guiding subsequent studies. Students must submit a brief (5-10 page) progress report and an updated CV to committee members as well as the Administrative Aide, Graduate Program, at least one week prior to the meeting. A written report of the student's progress must be made by the Committee to the Department. This report, together with grades and other evaluations of performance, is used to determine annual reappointment to the doctoral program. A copy of the report should be provided to the student.

Scheduling these annual meetings is the responsibility of the student. At each meeting, the student should present new data, discuss problems in the work and any changes in direction or approach, and provide objectives for the following year. The Committee may ask questions related to both background, experimental details, interpretation and analysis, and suggest additional experiments and new approaches.

If the committee determines sufficient progress has not been made the student will be placed on probation for one semester, and required to schedule another meeting before the end of the probationary period. If sufficient progress is not demonstrated in the second meeting, the student will be required to leave the program.

6. Dissertation and Dissertation Defense. The principle element of the doctoral program is the completion of a substantial, scholarly, original and independent research study. The mechanism by which this is demonstrated is the completion of a dissertation, which the student must present and defend before an examining committee. Successful completion of this requirement constitutes the final basis for conferral of the doctorate.

The point at which the sufficient data and analysis have been developed to comprise an acceptable thesis is determined by the student's mentor and Advisory Committee. Only students who have been admitted to candidacy are permitted to defend their thesis. The dissertation must be prepared in accord with the requirements of GSAS, which can be obtained from the Office of Academic & Student Life (OASL), One-Half Fifth Avenue, Garden Level.

Approximately one month before the dissertation defense, the student should contact the Administrative Aide, Graduate Program, to obtain the necessary forms for this exam. It is the student's responsibility to arrange the time for the defense, secure the presence of committee members, and arrange for any facilities necessary. At least seven copies of the dissertation (one for the student, one for the sponsor(s), one for each member of the committee, and one for the office) must be distributed at least two weeks prior to the date of the dissertation defense. The membership of the committee for this examination is usually the same as that for the thesis proposal exam, but it must be approved by the Department Chair and Director of Graduate Studies. If for any reason a member of the committee is unable to attend, the Department Chair and Director of Graduate Studies must be consulted to determine if the examination can proceed. Prior to distribution of the dissertation to committee

members, the dissertation must be approved by the student's sponsor.

The dissertation defense generally begins with a presentation by the student of their results, in a typical seminar format, lasting approximately 45 minutes. This component of the examination is open to the public; an announcement of the defense is distributed to Department members and posted. Thereafter, the meeting is closed and members of the Defense Committee question the student. This component of the examination is not open to the public but can be attended by other full-time members of the department faculty, who may also question the student. Such questions are usually related to the substance of the dissertation and are designed to test the student's comprehension of the field, ability to explain the results, and justify the conclusions obtained. However, the questions may range widely from this theme, at the discretion of the Committee.

The Committee must vote to accept the dissertation and the student's presentation in order for the student's performance to be considered acceptable. The Committee may require revision of the dissertation without re-examination. In the event that the student fails, re-examination is at the discretion of the Committee but, if permitted, can only occur once.

Once a doctoral candidate applies for graduation, he/she should obtain a PhD packet from the GSAS Office of Academic & Student Life, One-Half Fifth Avenue, Garden Level. It contains forms and information regarding preliminary and final dissertation deadlines.

The following materials must be submitted to the GSAS OASL approximately *six weeks before the degree date* (before the dissertation defense):

- A preliminary copy of the dissertation double-spaced and in accordance with GSAS guidelines. This will be returned to the student with a receipt.
- Two copies of the title page, in the proper format (see GSAS guidelines).
- A signed pink Abstract Approval Form and two copies of the abstract in the proper format. An abstract is a brief description of the dissertation. It must be typed, double-spaced, and can not exceed 350 words. The full title of the dissertation, candidate's name, and name and affiliation of the NYU research advisor must appear in the header.
- Two signed original copies of the Doctoral Dissertation Agreement Form, found in the "Publishing Your Dissertation" booklet.
- Two copies of the Library Instruction Form (Microfilm Form #2).
- Survey of Earned Doctorates and GSAS Doctoral Survey.

Once the revisions suggested during the dissertation defense have been made, the final copy of the dissertation, with the original signature of the sponsor(s) and the signed *yellow* Advisor Approval Form, must be submitted to the GSAS OASL. The final copy of the dissertation must be on white, water-marked, 20 lb. bond paper and submitted in a black spring binder.

At least 4 copies of the final accepted version of the dissertation must be submitted for distribution (for the student, the sponsor(s), the department, and an original for the Degree & Diploma Office). Individual members of the Committee may also request from the student a final copy of the dissertation for their records.

C. BRIDGES: Training in Molecular Systematics of Plant & Animal Species
Biotic Resources: Integrating Development, Genetics, Evolution and Systematics (BRIDGES) is a specialized training track in molecular evolution. Students in this track are trained to use molecular approaches to understand the evolution and diversity of plants and animal species, and aspects related to the conservation and curation of these biotic resources.

The **BRIDGES** track was developed jointly by faculty at NYU and its affiliated institutions, The New York Botanical Garden (NYBG) and The American Museum of Natural History (AMNH), which curate and study large collections of plant and animal species. Curators from NYBG and AMNH are involved in the training of NYU Biology PhD students, both at the level of teaching in courses and in directing thesis research, in collaboration with an NYU advisor.

Core courses developed for the **BRIDGES** track include: G23.1072 **BRIDGES I, Molecular Controls of Organism Form and Function** (metabolism, signaling, and development highlighting the use of molecular and genetic studies in model plant and animal systems); G23.1069 **BRIDGES II, Principles of Evolution** (molecular evolution and systematic theory and applications to animals and plants).

D. Developmental Genetics

The Department of Biology, together with faculty from NYU's School of Medicine, offer a specialized track in Developmental Genetics:

<http://www.med.nyu.edu/sackler/dgp/curriculum.html>

Students admitted into this track will participate in a DG curriculum that consists of core courses, a special 2-term course in developmental genetics (Foundations in Developmental Genetics I and II), an upper-level genetics course, laboratory rotations, seminars, student research symposia, journal clubs, and thesis-related research. The curriculum includes training in general concepts of developmental biology and the techniques and modes of inquiry of modern developmental genetics. Students in the DG track must fulfill the general requirements of the Sackler Institute or Department of Biology and the specific requirements of the DG track.

School of Medicine faculty involved in this program are listed on page 61.

E. Thesis Advisement

The chief overseer of a student's doctoral program is the thesis mentor. The choice of a mentor is made by mutual consent after the student completes the required lab rotations, and requires the written approval of the Director of the Doctoral Program. Mentors are usually full-time members of the department's faculty, although affiliated faculty and faculty at other institutions can also serve as co-mentors.

There is a tacit agreement between the student and the mentor: the student agrees to undertake and complete in a timely fashion a substantive original research project of mutual interest, suitable for presentation as a doctoral thesis and for publication in the scientific literature; the mentor agrees to provide the student with training, support, resources, guidance and intellectual leadership.

To assure a breadth of expertise and perspective in a student's education and research progression the department also requires that all students have a Thesis Committee to provide overall guidance and help monitor progress. This committee

consists of the student's faculty mentor, three additional Biology Department faculty members, and at least one but no more than two external readers. If the student is in an inter-institutional program, one of the Departmental members is replaced by a member from the collaborating institution.

The external reader should be an independent specialist in the area of the student's dissertation research from outside the department, and not a collaborator in the thesis project. If the reader is not a member of NYU's Faculty of Arts and Science (FAS), a curriculum vitae (CV) of the proposed reader must be submitted to the department for approval and submission to the FAS Graduate Curriculum Committee. The CV should be filed well in advance of the scheduled examination. External readers are generally selected from local institutions. The department does not fund travel or subsistence for external examiners. Examiners are encouraged to attend all committee meetings but are required to attend the thesis proposal examination and dissertation defense.

Developing the composition of the examining committee is the responsibility of the sponsor(s) and student and must be approved by the Director of Graduate Studies, Doctoral Program. Students should feel free to consult with their advisory committee about any issue concerning their graduate career.

F. Changing Mentors or Advisory Committee Members

Students may wish to change their mentor or members of their Advisory Committee. In such circumstances, students should first consult with their current advisors to determine an appropriate course of action. If a change is deemed necessary, the student may then petition the Department in writing. Such petitions must be approved by the Department Chair and the Director of Graduate Studies for the Doctoral Program. Changes should not be considered lightly as they are often disruptive and can add significant time to a student's doctoral training. Nevertheless, the Department recognizes that changes, for any number of reasons, are legitimate and often necessary to serve the best interests of the student.

G. Time Commitment/Stipends

The doctoral program is a full-time commitment. Students are expected to actively pursue the goals of the program throughout the year. Specifically, students are appointed to the program for a 12 month period. Doctoral students may not engage in outside employment or other appointments unless special permission is granted by the student's mentor, the Chair and the Director of Graduate Studies.

H. Departmental Awards

Five recognition awards are available to doctoral students based on excellence in research, teaching, or service to the department. Awards are presented annually at the Non-Retreating Retreat, which is held early in the autumn semester.

The *Gladys Mateyko Research Award* is presented to a senior doctoral student who has demonstrated outstanding research accomplishments and potential. Criteria for this award include performance on the Qualifying Exam, the Thesis Proposal, research publications, and presentations at professional meetings

The *Charlotte A. Pann Memorial Research Award* is presented to a senior doctoral student who has demonstrated outstanding research accomplishments and potential. Criteria for this award are the same as those for the Gladys Mateyko Research Award (above).

The ***Biology Department Teaching Award I*** is presented to a junior doctoral student who has demonstrated excellence as a teaching assistant in the introductory laboratory course that accompanies Principles of Biology.

The ***Biology Department Teaching Award II*** is presented to a mid-level doctoral student who has demonstrated excellence as a teaching assistant or coordinator in the laboratories or recitation sections that accompany other courses.

The ***Biology Department Service Award*** is presented to a senior doctoral student who has made outstanding contributions to the department and academic environment.

I. Travel

A significant component of the professional development of doctoral students is attendance of and participation in major scientific meetings in their fields. The department strongly encourages students to report their findings at such meetings and offers travel funds to help defray the cost of attendance. GSAS also provides travel funds, as well as travel grants to support longer visits to other institutions to carry out collaborative research or to learn new techniques. Many of the professional scientific organizations also offer travel fellowships for students. Applications for any of these travel grants should be made as early as possible, generally at the beginning of the academic year, as funds are often limited and awards are made competitively.

A Student Travel Grant Application is available in the Departmental Forms section of the Biology Department web site. The completed application should be submitted to the Director of Graduate Studies, PhD Program, for approval.

Doctoral students who receive travel funds are required to present a poster at the Annual Poster Session in the fall semester.

V. GRADUATE STUDENT REGULATIONS

A. Standards of Ethical Behavior

The department requires that all its members (students, faculty and staff) adhere strictly to the highest standards of ethical academic and scientific behavior. This includes strict enforcement of accepted principles of scientific integrity. Among the offenses considered unacceptable and taken as grounds for immediate dismissal from the graduate program are: plagiarism, falsification, cheating, sexual harassment, bias and discrimination. Deviation from these standards should be reported to the Chair, the Directors of Graduate Studies or the appropriate University office (FAS Sexual Harassment Panel; contact the Dean at the GSAS Office of Academic & Student Affairs, 998-8060).

Any questions regarding this policy or issues relating to ethical behavior may be addressed to the same individuals.

B. Advisement/Registration Procedures

Students first discuss their course schedule with their advisor or advisory committee. Some courses may require permission of the instructor prior to registration, as noted in the bulletin. After obtaining approval of the schedule by the Coordinator of Student Advisement and any other approvals required, the student receives an access code for each course for registration and then completes the process using Torchtone (212-995-4747) or Albert (www.albert.nyu.edu/).

Continuous Registration: GSAS requires continuous enrollment of its students each fall and spring semester until the degree sought is granted. This can be accomplished by (1) registering for at least 1 point each fall and spring until the degree is conferred; (2) taking an approved leave of absence, except in the semester of graduation; or (3) registering for Maintenance of Matriculation (G47.4747) during semesters when no course work is being taken until the degree is conferred.

C. Change of Status

Students may enroll in graduate Biology courses on a non-matriculated basis for up to 12 points. Current nonmatriculated students in the Department with an average GPA in graduate-level courses of 3.0 or better who wish to change to the MS program must submit a written request to the Director of Graduate Studies (the request should list the courses taken by the student, the semester in which the courses were taken, and the grades received in the courses).

Current nonmatriculated and MS students who wish to change to the doctoral program should contact the Administrative Aide, Graduate Program, to obtain the forms required for consideration of admission to the program. Students should be aware that the application review process for the doctoral program is highly competitive; students already enrolled in a program in Biology are reviewed in the same fashion as new applicants who have applied through the Graduate School.

D. Transfer of Credit

Students who have successfully completed graduate coursework elsewhere may be eligible to obtain credit for these courses applicable to their graduate degree

program at NYU. Consideration for such advanced standing is determined by the Department within the first calendar year of attendance.

Courses for which a Masters degree has been awarded may be considered for transfer credit toward the PhD but not toward a second Masters degree. Only courses with a grade of B (3.0) or better will be considered. A grade of P or S is considered for transfer credit only if it was received for a research or reading course culminating in the conferral of a Masters degree, or with the submission of a written statement from the school issuing the grade that the grade is equivalent to the grade of B or better. Courses considered for transfer credit must have been taken at a recognized and accredited graduate institution and must be substantially equivalent to those offered by GSAS.

Transfer credit can not exceed the difference between the number of points needed for a degree in GSAS and the minimum number of points that must be earned within GSAS. For the MS degree, a minimum of 24 points must be earned in GSAS. For the MPH and the PhD, a minimum of 32 points must be earned in GSAS. Approval for transfer of credit is required from the department's Director of Graduate Studies and the Office of the GSAS Dean. Requests for approval must be accompanied by an official transcript, course descriptions and syllabi.

E. Academic Probation

A student who has not maintained an average of B or better or has not fulfilled a degree requirement in the appropriate time frame (e.g., a doctoral student who does not take the Thesis Proposal Examination in the Spring of his or her second year of matriculation) will be placed on academic probation. If the circumstances of the probation have not been corrected within one semester of the institution of probationary status, the student is subject to dismissal by the Department Chair.

F. Graduation

Degrees are conferred in September, January, and May; NYU's Commencement ceremony is held in May. A degree candidate must apply for graduation within the specified application period through TorchTone, 212-995-4747. Graduation deadlines are available at <http://www.nyu.edu/registrar/graduation/deadlines.html>.
One year must lapse between conferral of all degrees awarded through GSAS.

It is the responsibility of graduate students to know the deadlines for submission of any necessary forms required for graduation. Failure to meet a September or January graduation deadline will require the maintenance of matriculation by fee for an additional semester. However, if the May graduation deadline is missed, no additional fee is required to file for a degree in September.

G. Full-Time Equivalency

Students registering for less than 12 points per semester may obtain full-time equivalency if they meet the criteria stated on the Certification of Full-Time or Half-Time Status (For Students Taking Course Work) Form. This form requires approval by the Department Chair or Director of Graduate Studies. Students maintaining matriculation by fee who wish to obtain full-time equivalency should complete a Full-Time/Half-Time Maintenance of Matriculation Form. These forms can be obtained from the Administrative Aide, Graduate Program.

H. Leave of Absence

A student in "good standing" (maintaining an average of B or better) who is obliged to withdraw temporarily for national service, serious illness, or compelling personal reasons may request a leave of absence. If granted, students on leave maintain matriculation and are assured of readmission at the end of the leave. A leave of absence (except for national service or other reasons approved in advance by the Dean) does not change any time limits fixed by the Graduate School or the department for completion of the degree. Students with more than one incomplete grade (IP/IF) for each year of registration are presumed not to be in good standing. A student who wishes to request a leave of absence must submit either a written statement to the Director of Graduate Studies and the Chair explaining the "compelling personal reasons", a doctor's letter in the event of serious illness, or evidence of national service. If the department approves the request, a Leave of Absence Request Form, the student's GSAS transcript and the documentation received from the student are then sent by the department to the Dean.

I. Readmission

A student who has been matriculated but then fails to register for at least one entire academic year must apply for readmission and pay an application fee. This applies to students maintaining matriculation by fee as well as those taking courses. Students who have completed all coursework and are readmitted are responsible for the maintenance of matriculation fees for the intervening years. The time to degree for a readmitted student begins with the *first* semester of the *first* admission.

VI INFORMATION ABOUT THE UNIVERSITY

A. Graduate Student Housing

The Graduate School offers housing opportunities through the Graduate Housing Office and Off-Campus Housing. Information may be obtained from GSAS Office of Graduate Enrollment Services (<http://gsas.nyu.edu/page/grad.admissions.ges>).

B. Graduate Student Lounges

The Biology Graduate Student Lounge is located adjacent to the department office in room 1008 Silver Center. The lounge provides meeting space, carrels for study, and computers and accessories for graduate student use.

The GSAS Graduate Student Commons, 120 Silver Center, is for the exclusive use of GSAS students. It is a place for study and quiet conversation. The Commons has a small, non-circulating library of books and periodicals.

C. Office for International Students and Scholars (OISS)

The Office for International Students and Scholars provides a broad range of visa services and support for international students. In addition to University and governmental procedures and policies, the staff helps international students take full advantage of various social, cultural, and recreational opportunities offered by the University and the city. The office administers legal responsibilities pertinent to nonimmigrant statuses for international students, scholars, researchers, and faculty. This office offers professional and peer advisement on immigration, financial, employment, and personal matters through personal appointments, specialized orientations, workshops, newsletters, weekly coffee hours, and various other programs. OISS is also responsible for counseling all NYU students on study abroad opportunities and initially determines whether credits for study abroad will be accepted by NYU.

The Office for International Students and Scholars, 561 LaGuardia Place, first floor, is open to students and faculty from 9 a.m. to 5 p.m., Monday through Friday. The phone number is 212-998-4720; e-mail address intl.students.scholars@nyu.edu.

D. The Libraries

The Elmer Holmes Bobst Library and Study Center houses a collection of over 3.3 million volumes and 29,000 current serial titles. The Dr. Jerome S. Coles Science Library occupies the 9th and part of the 10th floors and contains the science, health and technology collections. Subject strengths in the life sciences collection include molecular biology, genetics, plant physiology and biochemistry, zoology, physiology, biochemistry, microbiology, biophysics and neural science. There is also a large collection of electronic journals in the life sciences accessible through Bobst's website (<http://library.nyu.edu/>). Reference assistance and instruction in scientific information retrieval and other electronic resources in the sciences is available in the reference center on the 9th floor. Individual appointments and consultations may be arranged by contacting the Biological Sciences Librarian,

http://library.nyu.edu/research/lib_arc.html. Additionally, Bobst Library offers a variety of services to graduate students including free interlibrary loan and limited document delivery for material not owned by NYU or consortium libraries.

Bobst Library is the centerpiece of NYU's system of 8 specialized libraries, <http://library.nyu.edu/about/locations.html>. The Frederick L. Ehrman Medical Library, <http://library.med.nyu.edu>, has a health science collection of over 174,000 volumes and 7200 current journals and supports the NYU Medical Center's educational, scientific research and patient care programs. Bobst Library is a member of the Research Library Association of South Manhattan, which includes libraries of Cooper Union for the Advancement of Science & Art and the New School University, where NYU students have borrowing privileges. In addition, students have visiting privileges at New York Public Libraries. NYU's membership in METRO, <http://library.nyu.edu/about/metro.html>, the New York City regional consortium of over 300 libraries, provides services ranging from reciprocal on-site access to interlibrary loan. To check the current METRO Directory consult with Bobst Library reference staff, 212-998-2626.

To obtain further information on other products and services available through Bobst Library, check its website (<http://library.nyu.edu/>).

E. Computing Facilities

In addition to the numerous personal computers available in the departmental offices and laboratories, students have access to a variety of sophisticated computing facilities and systems, software, computer classes, communications devices, and the like through the university's, Academic Computing Facility (ACF). The ACF should be contacted for listings of the latest resources available.

Graduate students must obtain an NYU Internet account. The Academic Computing Facility offers NYU Internet accounts to NYU students enrolled in degree or diploma programs. These accounts provide e-mail as well as network access from desktop computers to the NYU Web and a wealth of information resources at NYU and around the world. To apply for an NYU Internet account, students should take a current valid NYU ID to any ACF computer lab. The ACF also offers an introductory-level classes in computer and network use. Schedules are available at any ACF computer lab and are posted on the NYU web.

F. Health Insurance

The University offers two health insurance plans, the Domestic Student Health Insurance Plan for students who are U.S. citizens or permanent residents, and the International Student Health Insurance Plan for international students. Health insurance is mandatory for students living in University housing and for international students. For information about health insurance benefits and costs, contact the New York University Insurance Department (998-2755).

VII. ADDITIONAL INFORMATION ABOUT THE DEPARTMENT

A. Graduate Biology Group

All Biology Department graduate students automatically belong to an organization known as the Graduate Biology Group (GBG). The purpose of the GBG is to represent the interests of its constituency (all Biology graduate students) at university functions. Representation on various committees, at departmental faculty meetings, Graduate Student Council meetings, and miscellaneous University functions, are undertaken by the GBG. Also, the GBG is involved in the recruitment of faculty candidates by encouraging graduate students to attend faculty candidate seminars and subsequent graduate students meetings with the candidate.

With a budget obtained from GSAS based on the number of graduate students, the GBG organizes various functions including the annual Non-retreating Retreat, student-sponsored seminars, and social functions. The GBG executive board is composed of 6 members. Although many of the duties are carried out by these executive board members, all students are encouraged to become active members. It is noteworthy that involvement in the GBG often helps a student academically, as several University awards take service and GBG participation into account.

The GBG is an important component of the department; helping to unite the students and mold the academic environment into a favorable one for study and research. It is a progressive organization that is constantly pursuing these goals.

B. Poster Sessions

The Department of Biology holds two graduate student poster sessions each year, a PhD poster session held on the day of the non-retreating retreat, and an MS poster session held in the Spring semester. The poster sessions give students an opportunity to present their research to other graduate students, faculty members, and undergraduates. All doctoral students are encouraged to participate in the PhD poster session, and doctoral students in their third year and beyond are required to present a poster describing their current research. MS students who are currently doing or have done laboratory research during the past year and were enrolled in G23.1124-25, Lab in Molecular Biology III and IV or G23.3303-04, Research, are required to present a poster describing their research at the MS poster session.

C. Departmental Conferences/Symposia and Seminars

The department hosts special events and symposia which include the participation of internationally recognized scientists as keynote speakers and a large audience of faculty and graduate students. A recent example from the 2007-2008 calendar is:

“**Systems Biology Across All Scales**”, our 7th Annual Genomics Symposium, sponsored by the Department of Biology/Center for Genomics & Systems Biology.

In addition to special symposia and conferences, the department conducts weekly seminars held at 4:00 p.m. on Monday afternoons. These seminars provide graduate students and interested individuals from the region with the opportunity to gain knowledge about a broad range of current research in the field of biology.

Attendance at these seminars is required of all students in the doctoral program (unless they are specifically excused by the Chair), and is also strongly recommended for students in the masters program.

Recent Departmental Seminars:

- Martin Blaser, MD**, Chair, Department of Medicine, NYU School of Medicine
“*Conversations between a Colonizing Microbe and its Human Host*”
- Mark Blaxter, PhD**, Evolutionary Biology, University of Edinburgh
“*Comparative Nematode Genomics: Evolution of Gene Structures and Noncoding DNAs*”
- Zemer Gitai, PhD**, Molecular Biology, Princeton
“*Quantitative and High-Throughput Analysis of Bacterial Cell Biology*”
- Christine Jacobs-Wagner, PhD**, Molecular, Cellular & Developmental Biology, Yale
“*Cell Polarity, Cell Morphogenesis and the Cytoskeleton in Bacteria*”
- Laura Johnston, PhD**, Genetics & Development, Columbia Medical Center
“*Cell Proliferation and Growth During *Drosophila* Development*”
- John T. Lis, PhD**, Molecular Biology & Genetics, Cornell
“*Tracking Transcription Factor Dynamics and Function During Gene Activation*”
- Peter Reddien, PhD**, Biology, MIT
“*Regeneration Initiation and Polarity in Planarians*”
- Michael Rosbash, PhD**, HHMI/Biology, Brandeis
“*Circadian Rhythms and Gene Expression*”
- Jean Thierry-Mieg, DSc**, National Center for Bioinformatics, NIH
“*The Wonderful Complexity of the Human Genes*”
- Deborah Yelon, PhD**, Developmental Genetics, NYU Medical Center
“*Regulation of Organ Dimensions: Establishing Heart Size and Shape in Zebrafish*”

D. Recent PhD Recipients

- Alexandra Dimitri** (2008), Academic Development for Science, NYU Abu Dhabi.
- Jeremy Lynch** (2006), Post-Doctoral Fellow, University of Cologne.
- Esteban Mazzoni** (2006), Post-Doctoral Fellow, Columbia University.
- Eugenia Olesnicky** (2006), Post-Doctoral Fellow, University of Colorado Denver Health Science Center.
- Amanda Ochoa-Espinosa** (2008), Post-Doctoral Fellow, Biozentrum, University of Basel.
- Lauren Raz** (2006), Professor, Institute of Natural Sciences, National University of Colombia.
- Natalie Velarde** (2008), Policy Analyst, Department of Homeland Security.
- Gozde Yucel** (2008), Post-Doctoral Fellow, Stanford University.

E. New Doctoral Students Admitted for 2008-2009

- Ashley Bate**, BS 2008, Eastern Michigan University
- Dalton Conley**, Ph.D. 1996, MPA 1992, Columbia; BA 1990, UC Berkeley
- Lisa Davey**, MS 2007, George Washington University; BS 2005, Loyola College
- Taniya Kaur**, MS 2007, BS 2006, University of Delhi
- Wei-Hsiang Lin**, BS 2007, National Taiwan University
- Hsiao-Yun Liu**, MS 2007, NYU; BS 2004, Fu-Jen University, Taiwan
- Long Qian**, BS 2008, Peking University
- Irina Nudelman**, MS 2005, Northeastern University; BS 2003, University of Toronto
- Nathan Poslusny**, BS 2006, UNC Chapel Hill
- Daniela Ristova**, BS 1992, MS 2008, Ss. Cyril & Methodius University, Macedonia
- Yujia Sun**, BS 2008, Tsinghua University, Beijing

VIII. FACULTY RESEARCH INTERESTS

A. Areas of Research

Listed below are the Biology Department's research areas including the faculty members involved in each field.

Following these pages, in alphabetical order, is a brief summary of each faculty member's current research and representative publications. This is to serve as an introduction and general guide to the members of the department. The summaries are not comprehensive or inclusive. Research interests can change for any number of reasons. Updates on faculty and their interests, as well as more detailed information on their research and background, may be obtained through the department's website (www.nyu.edu/gsas/biology).

Cancer & Cell Biology - Research in this area includes molecular experiments and computer analyses to understand how specific environmental pollutants create mutations in DNA, and how DNA-repair mechanisms protect cells from such damage. Other projects study mechanisms involved in oncogene-mediated tumorigenesis, with emphasis on how oncogenes are activated and how they function to control cytoskeletal organization and mitosis. There are several projects designed to understand interactions of tumors and host tissues, with the eventual goal of designing immunologically based treatments of some cancers. Research in this area includes collaborations with colleagues in NYU's Chemistry Department. Some treatments are being tested in preclinical systems and clinical trials in collaboration with colleagues at the NYU Medical School.

Suse Brojde David Scicchitano

Developmental Biology - Research in this area includes examination of mechanisms that control embryonic development, cell-cell signaling, transcriptional patterning, cell differentiation, and morphogenesis. These processes are studied in model systems for animal and plant development, including *Drosophila*, *C. elegans*, and *Arabidopsis*. Researchers in this area are part of a joint Developmental Genetics program with members of the Skirball Institute at NYU Medical School. This program is supported by a training grant from the NIH, and provides a formal vehicle for interactions with faculty and students studying other developmental systems including vertebrates. Regional meetings of *Drosophila* and *C. elegans* researchers are hosted by the department.

Ken Birnbaum Claude Desplan Patrick Eichenberger David Fitch
Fabio Piano Matthew Rockman Christine Rushlow Mark Siegal
Stephen Small

Environmental Science - Research in this area spans the inter-relationships of Earth's changing environments and evolution of life, the roles of life in the earth system, biogeochemical aspects of global change, and space life support, concerning the cycling of materials by living systems and the coupling of biological models to physical and chemical processes.

Michael Rampino Tyler Volk

Genomics & Systems Biology - The new revolution in biology called genomics has as its goal the analysis of the complete genetic material of organisms. These are rapidly emerging fields in which subdisciplines are only beginning to be defined. The area of functional genomics attempts to determine the function of genes based on high-throughput approaches, starting from the complete genomic sequences of one or more species. The areas most intensively studied include RNA expression analysis, large-scale mutagenesis, and cross-species comparative genomic analysis. Our Center for Genomics & Systems Biology uses all of these approaches with a focus on using evolutionary insights to address biological regulatory networks, and sponsors classes, seminars and workshops in Genomics and Bioinformatics. These activities also involve collaborations with colleagues at NYU's Courant Institute of Math & Computer Sciences.

Ken Birnbaum Richard Bonneau Francesca Chiaromonte Gloria Coruzzi
Rob DeSalle (AMNH) Patrick Eichenberger Kristin Gunsalus Edo Kussell
Fabio Piano Michael Purugganan Matthew Rockman Mark Siegal
Stephen Small

Microbiology & Immunology - Research in this area includes genomic and genetic approaches to identify the sets of genes involved in sporulation in bacteria, and the study of the environmental effects caused by genetically engineered microorganisms. Research in the interface of microbiology & immunology includes the study of inflammatory responses to viral infections, regulation of the blood brain barrier, neuroimmunology, and immunological interactions between tumors and host tissues. The goal of much of this research is to design novel modalities for the treatment of viral infections and cancer.

Patrick Eichenberger Carol Reiss

Molecular Evolution - Research in this area includes the study of the process of evolution, with emphasis on genetic changes underlying morphological evolution in several model systems including worms, insects, and fish. Other research is focused on the phylogenetic relationships among organisms using molecular tools. Researchers have initiated strong working relationships with the Department of Anthropology, the American Museum of Natural History (AMNH), the New York Botanical Garden (NYBG) and the NYC Aquarium. One of these alliances is the BRIDGES track, that provide a rare opportunity for students to become involved in fieldwork and to study evolutionary mechanisms in a wide range of organisms. Regular regional meetings bring together molecular evolutionists to discuss research and share ideas.

Ken Birnbaum Richard Borowsky Gloria Coruzzi Rob DeSalle (AMNH)
Claude Desplan David Fitch Fabio Piano Matthew Rockman
Mark Siegal

Molecular Genetics - A major strength of the department, molecular genetic approaches attack a wide variety of biological problems. Our labs use state of the art molecular techniques to analyze and manipulate DNA and protein structure. There is a major focus on the use of model systems that can be genetically manipulated, including bacteria, yeast, nematodes, insects, mice, and plants. These systems permit the easy identification and functional analysis of genes involved in a multitude of biological processes. Researchers in this area have access to several core facilities including the DNA Sequencing Center and the Center for Genomics & Systems Biology, which contain equipment for high throughput generation and analysis of DNA sequences and gene expression data.

Ken Birnbaum Justin Blau Gloria Coruzzi Claude Desplan
David Fitch Fabio Piano Carol Reiss Matthew Rockman
Christine Rushlow David Scicchitano Mark Siegal Stephen Small

Neurobiology - Research in this area includes molecular studies that probe the functions of ion channels to genetic and electrophysiological analyses of the development, plasticity, and functioning of neural circuits in intact nervous systems. Other projects include genetic analyses of circadian rhythms, studies of inflammatory effects caused by viral infection, and psychophysical, electrophysiological, and theoretical analyses of visual perception and orientation. Researchers have initiated collaborations with investigators from NYU's Center for Neural Science (CNS), many of whom hold joint appointments in the Biology Department. These alliances generate excellent opportunities for interactions with researchers in other areas of neurobiology.

Chiye Aoki (CNS) Efrain Azmitia Justin Blau Claude Desplan
Eric Klann (CNS) Carol Reiss Alex Reyes (CNS) Dan Sanes (CNS)
Walter Scott Robert Shapley (CNS) Daniel Tranchina

Plant Biology - Research in this area includes advanced training in plant molecular biology and molecular genetics of *Arabidopsis*, with specific emphasis on developmental genetics, biochemical genetics, and signal transduction. NYU Biology also offers a joint graduate track with the New York Botanical Garden (NYBG) called BRIDGES in which students are trained to use modern molecular and genomic techniques to understand plant biodiversity, systematics, evolution, and economic botany. This collaboration provides unique opportunities for students to combine field-work with molecular analysis and genomic approaches to the study of plant evolution and development. The department also hosts regional Plant Molecular Biology group meetings.

Ken Birnbaum Ken Cameron (NYBG) Gloria Coruzzi Doug Daly (NYBG)
Amy Litt (NYBG) Rob Martienssen (CSHL) Dick McCombie (CSHL) Michael Purugganan
Dennis Stevenson (NYBG)

B. Department Faculty

Efrain Azmitia, Professor; Adj. Professor of Psychiatry, NYU School of Medicine; B.A., Washington University, St. Louis; M.A., Cambridge, UK; PhD 1973, The Rockefeller University.

Research Interests:

In the past few years we have begun to look at both basic and clinical material. Our basic studies examine the effects of 5-HT and S100B on the generation of stem cells during development and after brain injury to adult mice and rats. In clinical studies, we are looking at postmortem brain tissue from patients who died with dementia and depression. The comorbidity may be caused by a dual pathology involving 5-HT dystrophic and synuclein positive axons in hippocampus and prefrontal cortex.

Stem Cells: In the brain, stem cells are believed to provide a reservoir of neurons that are used throughout development and extend into the adult period. In studies performed on neonatal rats, we saw that the number of cells generated in the hilus region of the dentate gyrus was reduced when the animals were treated with a 5-HT1A receptor agonist. In more recent work, we found an increase in the number of cells positive for double-cortin after a cortical lesion in the adult. The importance of stem cells and how they contribute to recovery after a brain injury is a major question currently being investigated.

Comorbidity: In humans, the loss of brain 5-HT neurons is associated with depression. This has been largely established by indirect evidence. Depression appears to be a risk factor for subsequent dementia. The comorbidity of depression and dementia is poorly understood. In studies of human postmortem tissue from Parkinson's disease, Pick's disease and Lewy Body Dementia all showed extensive damage of 5-HT axons in hippocampus, entorhinal cortex and prefrontal cortex. These same brains showed synuclein positive fibers in hippocampus and prefrontal cortex. The presence of dual pathology may help explain the comorbidity of depression and dementia. Our previous work showed that 5-HT fibers, by activation of the 5-HT1A receptor and release of glial S100B, functions as a cortical trophic factor. It is interesting to speculate that the loss of 5-HT fibers and depression may contribute to the appearance of synuclein and dementia.

The work in the laboratory is based on a detailed understanding of mammalian neuroanatomy, especially of the limbic system coupled with an expertise in neuroplasticity and development. The importance of serotonin (5-HT) as a regulator of neuronal differentiation and brain homeostasis is stressed,

Representative Publications:

Cruz D.A., Eggan S.M., Azmitia E.C. and Lewis D.A. (2004) Serotonin1A receptors at the axon initial segment of prefrontal pyramidal neurons in schizophrenia. *Am. J. Psychiatry* **161**:739-742.

Abbas S.Y., Nogueira M.I. and Azmitia E.C. (2007) Antagonist-induced increase in 5-HT1A-receptor expression in adult rat hippocampus and cortex. *Synapse* **61**(7):531-539.

Azmitia E.C. (2007) Serotonin and brain: evolution, neuroplasticity, and homeostasis. *Int Rev Neurobiol.* **77**:31-56.

Kenneth Birnbaum, Assistant Professor; BA 1984, U Penn; PhD 2000; NYU.

Research Interests:

The research in my lab focuses on two inter-related questions: how do multi-cellular organisms construct specialized cells and how are the genetic components of these specialized cells assembled over evolution? My approach combines genomics and molecular genetic tools including new cell-type expression profiling techniques I have developed. Early results indicate that genetic pathways have a "plug and play" modularity; that is, cell types share transcriptional programs due to highly regionalized and discrete gene regulation and due to gene duplication of entire pathways. Putting these observations together, the larger question is what combination of events - including both gene recruitment and pathway duplication - contribute to the evolutionary birth of new cell types or new cellular functions.

Two experimental approaches are being used to address this larger question. The first project is large-scale reverse genetics guided by a detailed map of gene expression in the root and other organs. This project focuses on duplicated pairs that overlap in expression in the root to help answer questions about the role of the duplication in genome evolution and to discover new regulators of *Arabidopsis* development. The second project is creating detailed maps of gene expression in the roots of other plant species, such as rice. This will help us to track changes in gene expression over evolution at the genome level.

Representative Publications:

Birnbaum K, DeSalle R., Peters C.M. and Benfey P.N. (2003) Integrating gene flow, crop biology and farm management in the on-farm conservation of avocado (*Persea Americana*, Lauraceae). *American Journal of Botany* **90**:1619-1627.

Birnbaum K. and Benfey P.N. (2004) Network building: transcriptional circuits in the root. *Current Opinion in Plant Biology* **7**(5):582-588.

Birnbaum K., Jung J.W., Wang J.Y., Lambert G.M., Hirst J.A., Galbraith D.W. and Benfey P.N. (2005) Cell type-specific expression profiling in plants via cell sorting of protoplasts from fluorescent reporter lines. *Nat. Methods* **2**(8):615-619.

Nawy T., Lee J.Y., Colinas J., Wang J.Y., Thongrod S.C., Malamy J.E., Birnbaum K., Benfey P.N. (2005) Transcriptional profile of the *Arabidopsis* root quiescent center. *Plant Cell* **17**(7):1908-1925.

Galbraith D.W. and Birnbaum K. (2006) Global studies of cell type-specific gene expression in plants. *Annu. Rev. Plant. Biol.* **57**:451-475.

Gifford ML, Dean A, Gutierrez RA, Coruzzi GM, Birnbaum KD. Cell-specific nitrogen responses mediate developmental plasticity. *Proc Natl Acad Sci U S A.* 2008 Jan 15; **105**(2):803-8

Justin Blau, Associate Professor; BA 1991, Cambridge; PhD 1996, London University, UK.

Research Interests:

How do genes control behavior? We are addressing this question by studying how a molecular clock in a discrete number of pacemaker neurons in the brain can control behavior of a whole animal – in this case the fruit fly, *Drosophila*. Like humans, *Drosophila* show 24-hour rhythms of activity/rest cycles and are even less sensitive to touch and sound while resting, indicating that they are in a sleep-like state.

Our research spans the three major questions in circadian biology:

- (1) How does a molecular clock run with a precise 24 hour period?
- (2) How does the clock interact with environmental signals such as light?
- (3) How is molecular clock information transformed into rhythms of pacemaker neuron activity?

Our research uses a combination of molecular, genetic, genomic, anatomic and behavioral approaches. Two recent developments that facilitate our understanding are a simple behavioral readout of pacemaker neuron excitability, and a transcriptional profile of purified pacemaker neurons.

Representative Publications:

- Nitabach M., Blau J. and Holmes T. (2002) Electrical silencing of *Drosophila* pacemaker neurons stops the free-running circadian clock. *Cell* **109**:485-495.
- Cyran S., Buchsbaum A., Reddy K., Lin M., Glossop N., Hardin P.E., Young M.W., Storti R. and Blau J. (2003) *vriille*, *Pdpl* and *dClock* form a second feedback loop in the *Drosophila* circadian clock. *Cell* **112**:329-341.
- Tsai L.T., Bainton R.J, Blau J. and Heberlein U. (2004) Lmo mutants reveal a novel role for circadian pacemaker neurons in cocaine-induced behaviors. *PLoS Biology* **2**:2122-2134.
- Mazzoni E., Desplan C. and Blau J. (2005) Circadian pacemaker neurons transmit and modulate visual information to control a rapid behavioral response. *Neuron* **45**:293-300.
- Cyran S.A., Yiannoulos G., Buchsbaum A.M., Saez L., Young M.W. and Blau J. (2005) The Double-Time protein kinase regulates the subcellular localization of the *Drosophila* clock protein Period. *J. Neurosci.* **25**:5430-5437.
- Collins B., Mazzoni E.O., Stanewsky R. and Blau J. (2006) *Drosophila* Cryptochrome is a circadian transcriptional repressor. *Current Biology* **16**:441-449.

Richard Bonneau, Assistant Professor; BA 1996, Florida State University; PhD 2001, University of Washington in Seattle.

Research Interests:

Dr. Bonneau joined the department as a part of the joint initiative between Computation in Science & Society and the Center for Genomics & Systems Biology. A pioneer in the field of Systems Biology, his work focuses on developing and implementing methods for modeling global regulatory circuits in model systems, and he has played a critical role in the development of "Rosetta", one of the most successful protein folding programs.

Representative Publications:

- Bonneau R., Reiss D.J., Shannon P., Facciotti M., Hood L., Baliga N.S., Thorsson V. (2006) The Inferelator: an algorithm for learning parsimonious regulatory networks from systems-biology data sets *de novo*. *Genome Biol.* **7**(5):R36.
- Shannon P.T., Reiss D.J., Bonneau R., Baliga N.S. (2006) The Gaggle: an open-source software system for integrating bioinformatics software and data sources. *BMC Bioinformatics* **7**:176.
- Bonneau R, Facciotti MT, Reiss DJ, Schmid AK, Pan M, Kaur A, Thorsson V, Shannon P, Johnson MH, Bare JC, Longabaugh W, Vuthoori M, Whitehead K, Madar A, Suzuki L, Mori T, Chang DE, Diruggiero J, Johnson CH, Hood L, Baliga NS. A predictive model for transcriptional control of physiology in a free living cell. *Cell*. 2007 Dec 28;131(7):1354-65
- Kye MJ, Liu T, Levy SF, Xu NL, Groves BB, Bonneau R, Lao K, Kosik KS. Somatodendritic microRNAs identified by laser capture and multiplex RT-PCR. *RNA*. 2007 Aug;13(8):1224-34.
- Malmström L, Riffle M, Strauss CE, Chivian D, Davis TN, Bonneau R, Baker D. Superfamily assignments for the yeast proteome through integration of structure prediction with the gene ontology. *PLoS Biol.* 2007 Apr;5(4):e76.
- Facciotti MT, Reiss DJ, Pan M, Kaur A, Vuthoori M, Bonneau R, Shannon P, Srivastava A, Donohoe SM, Hood LE, Baliga NS. General transcription factor specified global gene regulation in archaea. *Proc Natl Acad Sci U S A.* 2007 Mar 13;104(11):4630-5.

Richard L. Borowsky, Professor; BA 1964, Queens; M. Phil. 1967, PhD 1969, Yale.

Research Interests:

The Borowsky laboratory works on molecular evolution, multigenic trait evolution, and genetic variation in cave fishes. Current projects include the genomic analysis of the Mexican cave tetra and the molecular phylogeny of cave fish populations. The lab has active field programs in Mexico and Thailand

Representative Publications:

Borowsky R. and Mertz L. (2001) Genetic differentiation among populations of the cave fish *Schistura Oedipus* (Cypriniformes: Balitoridae). *Env. Biol. Fishes* **62**:225-231.

Borowsky R. and Vidthayanon C. (2001) Nucleotide diversity in populations of balitorid cave fishes from Thailand. *Molecular Ecology* **10**:2799-2805.

Borowsky R. and Wilkens H. (2002) Mapping a cave fish genome: polygenic systems and regressive evolution. *J. Hered.* **93**:19-21.

Trajano E., Mugey M., Krejca J., Vidthayanon C., Smart D. and Borowsky R. (2002) Habitat, distribution, ecology and behavior of cave balitorids from Thailand (Teleostei: Cypriniformes). *Ichthyol. Explor. Freshw.* **13**:169-184.

Protas M., Hersey C., Kochanek D., Zhou Y., Wilkens H., Jeffery W.R., Zon L.I., Borowsky R. and Tabin C. (2006) Genetic analysis of cavefish reveals molecular convergence in the evolution of albinism. *Nature Genetics* **38**:107-111.

Protas M., Conrad M., Gross J., Tabin C. and Borowsky R. (2007) Regressive evolution in the Mexican cave tetra, *Astyanax mexicanus*. *Current Biology* **17**(5):452-454.

Suse Broyde, Professor; B.S., College of the City of New York; PhD 1963, Polytechnic Institute of Brooklyn.

Research Interests:

The Laboratory of Computational Structural Biology employs state-of-the-art computer modeling techniques to gain understanding of how environmental chemical carcinogens present in automobile exhaust, tobacco smoke and cooked foods, as well as hormones used in estrogen replacement therapy, and endogenous oxidation products damage the structures of our DNA. This damage causes mutations that initiate carcinogenesis. Structural and functional properties of DNA lesions and their interactions with polymerase and repair enzymes are delineated. Collaborative research involving experimental biological, biochemical and biophysical techniques is carried out with the laboratories of Prof. David Scicchitano (Biology Department) and Prof. Nicholas Geacintov (Chemistry Department).

Representative Publications:

Dimitri A., Jia L., Shafirovich V., Geacintov N.E., Broyde S. and Scicchitano D.A. (2008) Transcription of DNA containing the 5-guanidino-4-nitroimidazole lesion by human RNA polymerase II and bacteriophage T7 RNA polymerase. *DNA Repair (Amst)*. **7**(8):1276-1288.

Ding S., Shapiro R., Cai Y., Geacintov N.E. and Broyde S. (2008) Conformational properties of equilenin-DNA adducts: stereoisomer and base effects. *Chem Res Toxicol*. **21**(5):1064-1073.

Broyde S., Wang L., Rechkoblit O., Geacintov N.E. and Patel D.J. (2008) Lesion processing: high-fidelity versus lesion-bypass DNA polymerases. *Trends Biochem Sci*. **33**(5):209-219.

Xu P., Oum L., Geacintov N.E. and Broyde S. (2008) Nucleotide selectivity opposite a benzo[a]pyrene-derived N2-dG adduct in a Y-family DNA polymerase: a 5'-slippage mechanism. *Biochemistry*. **47**(9):2701-2709.

Broyde S., Wang L., Zhang L., Rechkoblit O., Geacintov N.E. and Patel D.J. (2008) DNA adduct structure-function relationships: comparing solution with polymerase structures. *Chem Res Toxicol*. **21**(1):45-52.

Cai Y., Patel D.J., Geacintov N.E. and Broyde S. (2007) Dynamics of a benzo[a]pyrene-derived guanine DNA lesion in TGT and CGC sequence contexts: enhanced mobility in TGT explains conformational heterogeneity, flexible bending, and greater susceptibility to nucleotide excision repair. *J Mol. Biol.* **374**(2):292-305.

*This work is supported by funds from NIH
and computational resources from NSF.*

Francesca Chiaromonte, *Visiting Associate Professor; Assistant Professor, Penn State University; PhD 1996, University of Minnesota.*

Research Interests:

My interests as a statistician cover multivariate analysis and regression (dimension reduction, supervised and unsupervised classification, non-parametrics), computational techniques (re-sampling, perturbation and permutation schemes), and Markov modeling. In collaboration with several statisticians I research Sufficient Dimension Reduction, a body of theory and methods for handling high-dimensional regression and classification problems, which is closely related to graphics and data visualization.

I have become heavily involved in the analysis and modeling of large-scale genomic data. In collaboration with researchers at the Center for Comparative Genomics and Bioinformatics (PSU) and the Center for Biomolecular Science and Engineering (UCSC), I worked on data from pair-wise and multiple whole-genome alignments between human and other species (e.g. mouse, rat and chicken). Using a comparative approach, these data allow us to investigate aspects of evolution and function. I have been involved in projects concerning alignment scoring methodology, genome-wide variation and co-variation of divergence processes, estimation of the share of the human genome under purifying selection, genome-wide scores to aid in the prediction of regulatory elements (RP scores), etc. Ongoing work concerns data reduction, modeling and computational tools for supervised and unsupervised classification of genomic elements based on short alignment patterns. I also worked on the analysis of global gene expression data (e.g. from microarrays).

Representative Publications:

- Kolbe D., Taylor J., Elnitski L., Eswara P., Li J., Miller W., Hardison R.C. and Chiaromonte F. (2004) Regulatory potential scores from genome-wide 3-way alignments of human, mouse and rat. *Genome Research* **14**:700-707.
- Yang S., Smit A.F., Schwartz S., Chiaromonte F., Roskin K.M., Haussler D., Miller W. and Hardison R.C. (2004) Patterns of insertions and their covariation with substitutions in the rat, mouse and human genomes. *Genome Research* **14**:517-527.
- Taylor J., Tyekucheva S., Zody M., Chiaromonte F. and Makova K.D. (2006) Strong and weak male mutation bias at different sites in the primate genomes: insights from the human-chimpanzee comparison. *Mol Biol Evol.* **23**(3):565-573.
- King D.C., Taylor J., Elnitski L., Chiaromonte F., Miller W., Hardison R.C. (2006) Evaluation of regulatory potential and conservation scores for detecting cis-regulatory modules in aligned mammalian genome sequences. *Genome Res.* **15**(8):1051-1060.

This work is funded by grants from NIH and NSF.

Gloria M. Coruzzi, *Carroll & Milton Petrie Professor; Department Chair; B.S. 1976, Fordham; PhD 1979, NYU School of Medicine.*

Research Interests:

1. Plant Gene Networks and Systems Biology. Our lab uses genomic and systems biology approaches to understand how signaling by nitrogen nutrient treatments affects gene networks linking metabolism with development. Our approach starts with integration of genomic data into an *Arabidopsis* “multinetwork” where “edges” connecting gene “nodes” are supported by multiple data/evidence including metabolic pathway connections, protein:protein and protein:DNA interactions, microarray data, microRNA:mRNA targets, and literature-based interactions. As proof-of-principle, we have these multi-networks to identify key nodes controlling nitrogen-responsive gene networks in specific organs and in cell-types of *Arabidopsis* wild-type and mutants. We have implemented tools for data integration, analysis and visualization into a web-tool called the “VirtualPlant”, which renders the multivariate genomic information in visual formats that facilitate the extraction of testable biological hypothesis. This work is performed in collaboration with NYU’s Courant Institute of Math & Computer Sciences.

2. Plant evolutionary genomics: Gymnosperms, genomes and seed evolution. We are using genomic approaches to identify genes associated with the evolution of seeds, a key agronomic trait in plant evolution. We are sequencing ESTs from the genomes of the most primitive living seed plants (Cycad, Ginkgo & Gnetales), and developing phylogenomic tools to generate genome-scale phylogenetic trees, to identify novel genes responsible for the evolution of seeds. This work is being performed as part of The NY Plant Genomic Consortium that includes investigators from NYU Biology, NYU Courant, NYBG, AMNH and CSHL.

Representative Publications:

- Chiu J., Lee E., Egan M., Sarkar I.N., Coruzzi G.M. and DeSalle R. (2006) OrthologID: automation of genome-scale ortholog identification within a parsimony framework. *Bioinformatics* **22**:699-707.
- de la Torre J.E.B., Egan M.G., Katari M., Brenner E., Stevenson D.S., Coruzzi G.M. and DeSalle R. (2006) ESTimating plant phylogeny: lessons from partitioning. *BMC Evol. Biol.* **6**:48.
- Gutiérrez R.A., Lejay L., Chiaromonte F., Shasha D.E. and Coruzzi G.M. (2007) Qualitative network models and genome-wide expression data define carbon/nitrogen-responsive biomodules in *Arabidopsis*. *Genome Biology* **8**:R7.
- Poultney C., Gutiérrez R.A., Katari M.S., Gifford M.L., Paley W.B., Coruzzi G.M. and Shasha D.E. (2007) Sungear: Interactive visualization, exploration and functional analysis of genomic datasets. *Bioinformatics* **23**:259-261.

This work is funded by NIH, DOE and NSF 2010 and Plant Genome Grants.

Rob DeSalle, *Distinguished Research Scientist in Residence; Associate Curator, American Museum of Natural History; BA 1976, University of Chicago; PhD 1984, Washington University.*

Research Interests:

The research conducted in the AMNH Molecular Laboratories centers on three major connected areas. Systematics is the first and foremost area of research in the labs with studies conducted by several students and post-docs on systems as diverse as stalk eyed flies, bioluminescent marine invertebrates, cetaceans and Lepidoptera. The second major area of research utilizes the systematic expertise to apply genetics to conservation issues. In collaboration with Wildlife Conservation Society geneticists and in the museum's newly established Conservation Genetics Program in the AMNH Biodiversity Center museum scientists examine a wide range of conservation issues ranging from field studies of endangered humpback whales to genetics of captive zoo populations. The third major area of interest in the lab stems from the recent excitement generated by developmental biology. This area of research attempts to examine the utility of developmental information in systematics and the major project in this area concerns the evolution of insect wings and wing venation.

Representative Publications:

- Planet P.J., Kachlany S.C., Fine D.H., DeSalle R. and Figurski D.H. (2003) The widespread colonization island of *Actinobacillus actinomycetemcomitans*. *Nature Genetics* **34**:193-198.
- Rosenfeld J.A., Sarkar I.N., Planet P.J., Figurski D.H. and DeSalle R. (2004) ORFcurator: molecular curation of genes and gene clusters in prokaryotic organisms. *Bioinformatics* **20(18)**: 3462-3465.
- Bonacum J., O'Grady P.M., Kambysellis M. and Desalle R. (2005) Phylogeny and age of diversification of the planitibia species group of the Hawaiian *Drosophila*. *Mol. Phylogenet. Evol.* **37(1)**:73-82.
- Chiu J.C., Lee E.K., Egan M.G., Sarkar I.N., Coruzzi G.M. and DeSalle R. (2006) OrthologID: automation of genome-scale ortholog identification within a parsimony framework. *Bioinformatics* **22(6)**:699-707.
- de la Torre J.E., Egan M.G., Katari M.S., Brenner E.D., Stevenson D.W., Coruzzi G.M. and DeSalle R. (2006) ESTimating plant phylogeny: lessons from partitioning. *BMC Evol. Biol.* **6**:48.
- Lienau E.K., DeSalle R., Rosenfeld J.A. and Planet P.J. (2006) Reciprocal illumination in the gene content tree of life. *Syst. Biol.* **55(3)**:441-453.

Claude Desplan, *Silver Professor; B.S. 1975, Ecole Normale Supérieure St. Cloud, France; D.Sc./PhD 1983, Université Paris VII.*

Research Interests:

Our laboratory addresses mechanisms of development. We are analyzing how color information is perceived by the *Drosophila* retina and processed by the brain. Color vision is achieved through comparison in the brain of inputs coming from photoreceptors containing photopigments sensitive to different wavelengths. These 'rhodopsins' are expressed in mutually exclusive patterns in the fly eye and in cones of the vertebrate retina. This implies that there is a process for choosing a given rhodopsin gene while repressing all others. Another mechanism must then inform the brain of its connection to a photoreceptor with a specific color sensitivity. We use molecular and genetic approaches to identify functions involved in the elaboration of this system. The brain circuitry underlying processing of color visual information is also investigated in connection with color discrimination behavior assays. We hope to understand how color vision and phototactic behavior have evolved in flies and in other systems.

We also study the evolution of early embryonic development in insects. The morphogenetic gradient of Bicoid is essential for anterior development in the fly embryo. However, *bicoid* is not conserved and represents a new function specific to flies, which has taken over the function performed by another ancestral system. This 'Evolution & Development' approach allows us to use the deep knowledge of *Drosophila* development to uncover the mechanisms of axis formation in a very different insect, the wasp *Nasonia*. We have developed powerful genetic, genomic and molecular tools in this new model system and have reconstructed in exquisite details the patterning events that generate segmentation in this species that diverged from flies over 250 million years ago.

Representative Publications:

- Wernet M., Mazzoni E., Çelik A., Duncan D., Duncan I. and Desplan C. (2006) Stochastic expression of spineless creates the retinal mosaic for color vision. *Nature* **440**:174-180.
- Lynch J., Brent A., Leaf D., Pultz M. and Desplan C. (2006) Localized maternal old patterns anterior and posterior in the long germ wasp *Nasonia*. *Nature* **439**:728-732.
- Brent A.E., Yucel G., Small S. and Desplan C. (2007). Permissive and instructive anterior patterning functions rely on mRNA localization in the wasp embryo. *Science* **315**:1841-1843..
- Losick R. and Desplan C. (2008) Stochastic choices and cell fate. *Science* **320**:65-68.
- Sprecher S. and Desplan C. (2008) Switch of *rhodopsin* expression in terminally differentiated *Drosophila* sensory neurons. *Nature* **454**:533-537.

Research is supported by grants from NIH.

Patrick Eichenberger, Assistant Professor; PhD 1997, University of Geneva, Switzerland.

Research Interests:

Bacillus subtilis is a non-pathogenic soil bacterium that has been extensively studied as a model organism for over thirty years. When *B. subtilis* cells are starved, they initiate a developmental program that culminates in the formation of highly resistant spores. Hence, the sporulation process constitutes a relatively simple system in which the generation of distinct cell types can be investigated, both genetically and biochemically. In previous work in the laboratory of Prof. Richard Losick at Harvard, we used a variety of genomics techniques to identify most, if not all, of the genes that were specifically turned on during sporulation in *B. subtilis*. However, the function of many of these newly identified genes remains undetermined.

Our characterization of newly-identified sporulation genes focuses on genes that participate in the formation of the outermost structure of the mature spore: the spore coat. The coat is a proteinaceous shell surrounding the spore and is made of more than fifty different proteins in *B. subtilis*. Spore coat assembly is a dynamic process which can be studied by fluorescence microscopy. A systematic program of GFP fusions to newly-identified sporulation genes is in progress and subcellular localization of the resulting protein fusions is investigated in wild type cells and in spore coat morphogenetic mutants. The ultimate goal is to obtain an assembly map of the entire developing spore coat.

Recently, a second class of genes has attracted our interest. These genes are expressed during the ultimate stages of sporulation and encode proteins involved in DNA repair during the process of spore germination.

In parallel, we are using genomics approaches to study the sporulation process in related *Bacillus* species.

Representative Publications:

- Eichenberger P., Fujita M., Jensen S.T., Conlon E.M., Rudner D.Z., Wang S.T., Ferguson C., Haga K., Sato T., Liu J.S. and Losick R. (2004) The program of gene transcription for a single differentiating cell type during sporulation in *Bacillus subtilis*. *PLoS Biol.* **2**:e328.
- Ben-Yehuda S., Fujita M., Liu X.S., Gorbatyuk B., Skoko D., Yan J., Eichenberger P., Rudner D.Z., Marko J.F., Liu J.S. and Losick R. (2005) Defining a centromere-like element in *Bacillus subtilis* by identifying the binding sites for the chromosome-anchoring protein RacA. *Molecular Cell* **17**(6): 773-782.
- Kim H., Hahn M., Grabowski P., McPherson D.C., Otte M.M., Wang R., Ferguson C.C., Eichenberger P. and Driks A. (2006). The *Bacillus subtilis* spore coat protein interaction network. *Molecular Microbiology* **59**:487-502.
- Wang S.T., Setlow B., Conlon E.M., Lyon J.L., Imamura D., Sato T., Setlow P., Losick R. and Eichenberger P. (2006) The Forespore line of gene expression in *Bacillus subtilis*. *J. Molecular Biology* **358**(1):16-37.
- Eichenberger P. (2007) Genomics and cellular biology of endospore formation. *Bacillus Cellular and Molecular Biology* (P. Graumann, ed.), Caister Academic Press, Norfolk, pp. 375-418.

David H.A. Fitch, Associate Professor; A.B. 1980, Dartmouth; PhD 1986, University of Connecticut.

Research Interests:

Using the model system *C. elegans*, we characterize genes responsible for morphogenesis, a collection of fundamental developmental mechanisms that shape and organize cells into particular forms. *C. elegans* is complex enough to share components and mechanisms of more complex multicellular animals, but is simple enough to be described in complete terms. As a model for morphogenesis, we study the sexually dimorphic tail tip. This simple feature is constructed of only 4 cells that, in males only, fuse very late in larval development and change their cellular structure and position. We have found that genes in different pathways control male tail morphogenesis: e.g., the Wnt signaling pathway, the sex determination pathway, and the "heterochronic" pathway (involving microRNA control of the timing of cell fates). Our goal is to identify all the components regulating male-specific tail morphogenesis and uncover some of the mechanisms by which these components work to precisely form this structure at the right time in the right sex.

Evolutionary changes in the development of the male tail have also occurred. Using molecular phylogenetic analysis in combination with developmental profiling, we are reconstructing the changes that have occurred in male tails during the evolution of family Rhabditidae (of which *C. elegans* is a member). Interestingly, some of our male tail mutants of *C. elegans* closely mimic evolutionary changes, suggesting candidate genes that could have been involved in evolutionary changes. Our "zoo" of rhabditid nematodes is the largest in the world and is an important resource for evolutionary comparisons using *C. elegans*. These investigations will provide information about the genes and processes that are not only conserved in morphogenetic mechanisms but will also provide insight into the ways that these mechanisms can change to produce variation in multicellular form.

Representative Publications:

- Zhao X., Yang Y., Fitch D.H.A. and Herman M.A. (2002) TLP-1 is an asymmetric cell fate determinant that responds to Wnt signals and controls male tail tip morphogenesis in *C. elegans*. *Development* **129**(6):1497-1508.
- Kiontke K., Gavin N.P., Raynes Y., Roehrig C., Piano F. and Fitch D.H.A. (2004) *Caenorhabditis* phylogeny predicts convergence of hermaphroditism and extensive intron loss. *Proc. Natl. Acad. Sci.* **101**(24):9003-9008.
- Fitch D.H.A. and Kiontke K. (2005) The relationships of *Caenorhabditis* and other rhabditids. *WormBook* (The *C. elegans* Research Community, ed.), pub. <http://www.wormbook.org>.
- Del Rio-Albrechtsen T., Kiontke K., Chiou S.-Y. and Fitch D.H.A. (2006) Novel gain-of-function alleles demonstrate a role for the heterochronic gene *lin-41* in *C. elegans* male tail tip morphogenesis. *Dev. Biol.* **297**(1):74-86.
- Kiontke K., et al. (2007) Trends, stasis, and drift in the evolution of nematode vulva development. *Curr Biol.* **17**(22):1925-1937.

Research is supported by the National Science Foundation and other sources.

Research Interests:

My research combines computational and experimental work to address questions of how molecular networks specify cellular and developmental processes. We have used an integrative approach based on combined maps of molecular interactions, gene expression, and phenotypes to characterize gene networks in *C. elegans* early embryogenesis (Gunsalus 2005). We are extending this work in various directions, in collaboration with investigators at NYU and other institutions. Current work in *C. elegans* includes: 1) characterization of genetic interaction networks during embryogenesis (with F. Piano); 2) genome-scale analysis of 3'UTRs and their functional elements, particularly microRNA-target relationships [with F. Piano, N. Rajewsky (MDC, Berlin), and J. Kim (U. Mich.)]; and 3) phenotypic and integrative analysis of gonadogenesis (with J. Hubbard, NYU). A new project aims to use bioinformatic methods to predict and analyze gene functions in the early mouse embryo using RNAi and systematic phenotypic analysis (with N. Noyes, NYU).

To help researchers interpret and synthesize large-scale functional genomic data, my lab also develops databases and visualization tools. To facilitate a systems-level view of molecular interaction networks, an interactive graph visualization tool called N-Browse (<http://www.gnetbrowse.org>) allows researchers to explore different types of functional relationships in an integrated way. RNAiDB is a web-accessible database of RNA interference (RNAi) phenotypes in *C. elegans* (<http://www.rnai.org>), and the UTRome database provides online access to 3'UTRs and their functional elements in *C. elegans* (<http://www.utrome.org>).

Representative Publications:

- Gunsalus K.C., Ge H., Schetter A., Goldberg D., *et al.* (2005) Predictive models of molecular machines involved in early *C. elegans* embryogenesis. *Nature* **436**:861-865.
- Lall S., Grun D., Krek A., Chen K., Wang Y.L., Dewey C.N., Sood P., Colombo T., Bray N., MacMenamin P., Kao H.L., Gunsalus K.C., Pachter L., Piano F. and Rajewsky N. (2006) A genome-wide map of conserved microRNA targets in *C. elegans*. *Curr Biol* **16**:460-471.
- Pujana M.A., *et al.* (2007) Network modeling links breast cancer susceptibility and centrosome dysfunction. *Nat Genet* **39**:1338-1349.
- Mangone M., Macmenamin P., Zegar C., Piano F. and Gunsalus K.C. (2008) UTRome.org: a platform for 3'UTR biology in *C. elegans*. *Nucleic Acids Res.* 36 (Database issue):D57-62.
- Kao H.-L. and Gunsalus K.C. (2008) Browsing multidimensional molecular networks with the generic network browser (N-Browse). *Current Protocols in Bioinformatics* (September) 1-9.

Research Interests:

Classical studies of molecular biology revealed how cells sense their environment and respond to change, establishing the centrality of gene regulation in cellular physiology. Numerous mechanisms in bacteria, however, function in a largely deregulated way, generating a diversity of responses across the population, without necessarily sensing the environment.

The existence of such stochastic mechanisms raises several (increasingly difficult) questions:

- (1) How do microorganisms employ stochasticity to their advantage?
- (2) Can we distinguish such adaptive stochasticity from useless noise that is simply too costly for cells to avoid?
- (3) How, and under what circumstances, do sensing mechanisms evolve?

My research employs theoretical and computational modeling of bacteria populations in fluctuating environments, and comparative genomics of experimentally-characterized stochastic switches.

Closely related topics of research include the evolution of mutation rates, mutator phenotypes, and mutational hotspots in genomes. My other interests include protein folding and protein evolution.

Representative Publications:

- Kussell E., Shimada J. and Shakhnovich E.I. (2003) Side-chain dynamics and protein folding. *Proteins* **52**:303-321.
- Kussell E., Kishony R., Balaban N.Q. and Leibler S. (2005) Bacterial persistence: a model of survival in changing environments. *Genetics* **169**:1807-1814.
- Kussell E. and Leibler S. (2005) Phenotypic diversity, population growth, and information in fluctuating environments. *Science* **309**:2075-2078.
- Kussell E., Leibler S. and Grosberg A.Y. (2006) Polymer-population mapping and localization in the space of phenotypes. *Phys. Rev.* **97**:068101.

Fabio Piano, Associate Professor; BA 1988; MS 1991; PhD 1995, NYU.

Research Interests:

Our broad interest is understanding how the genome guides a single cell, the egg, to form a complex multicellular organism. Related to this question is how evolution has shaped embryogenesis to give rise to the different animal forms in nature. We approach these broad problems by studying molecular mechanisms underlying early embryonic development using functional genomics approaches in the model *C. elegans* and related nematodes. To do this we use RNA interference (RNAi) followed by time-lapse microscopy. In our tests we have identified about 500 genes required for embryogenesis; only 10% of these had been identified in traditional genetic screens. To use these new large-scale phenotypic datasets, we have developed ways to digitally represent phenotypes to be able to mine the complex data. We use the data to guide two broad lines of investigation; (1) functional network analysis of the genome, and (2) molecular dissection of actin-based cellular processes. From the initial analyses we have found clusters of genes required for basic processes such as mitotic spindle formation, cytokinesis, cell cycle progression and asymmetric cell division. These clusters contain genes that are conserved in humans, functions unknown. We are thus exploiting *C. elegans* as a model to study “system-level” questions by integrating the phenotypic data with proteomic and transcriptomic data to view molecular processes underlying early embryogenesis. In a related project we use the early nematode embryo as a model to study evolution of developmental mechanisms. Comparisons across species reveal fundamental differences during early embryogenesis. Significantly, in some species the wild-type patterns of early cleavages resemble those produced by various *C. elegans* mutants. We are studying mechanisms underlying phenotypic diversity in different species. The functional genomic approaches in *C. elegans* provide a springboard to launch molecular studies underlying embryonic diversity across nematodes.

Representative Publications:

- Lall S., Grun D., Krek A., Chen K., Wang Y.-L., Dewey C.N., Sood P., Colombo T., Bray N., MacMenamin P., Kao H.-L., Gunsalus K.C., Pachter L., Piano F and Rajewsky N. (2006) A genome-wide map of conserved microRNA targets in *C. elegans*. *Current Biology* **16**:460-471.
- Velarde N., Gunsalus K.C., Piano F. (2007) Diverse roles of actin in *C. elegans* early embryogenesis. *BMC Dev Biol.* **7**:142.
- Maruyama R., Velarde N.V., Klancer R., Gordon S., Kadandale P., Parry J.M., Hang J.S., Rubin J., Stewart-Michaelis A., Schweinsberg P., Grant B.D., Piano F., Sugimoto A. and Singson A. (2007) EGG-3 regulates cell-surface and cortex rearrangements during egg activation in *Caenorhabditis elegans*. *Curr Biol.* **17**(18):1555-1560.
- Min J., Kyung Kim Y., Cipriani P.G., Kang M., Khersonsky S.M., Walsh D.P., Lee J.Y., Niessen S., Yates J.R. Gunsalus K., Piano F. and Chang Y.T. (2007) Forward chemical genetic approach identifies new role for GAPDH in insulin signaling. *Nat Chem Biol.* **3**:55-59.

Michael Purugganan, Professor; B.S. 1985, University of the Philippines; M.A. 1986, Columbia University; PhD 1993, University of Georgia.

Research Interests:

Focusing on understanding the molecular evolutionary dynamics of developmental pathways, work revolves around studying the molecular evolution of genes that control shoot architecture and flower development in the wild mustard weed *Arabidopsis thaliana*, assessing the evolutionary forces that act in plant developmental pathways at the species level, and mapping and isolating genes that underlie natural variation in shoot architectures and life histories. This work combines concepts and techniques in molecular population genetics, quantitative genetics, developmental biology and evolutionary ecology.

Research includes studying the evolution and ecology of daylength-dependent inflorescence development patterns, evolution of meristem allocation patterns, and molecular population genetics of the inflorescence developmental pathway in *Arabidopsis*. Another major thrust in our laboratory is to use island species that have undergone recent, rapid adaptive radiation to study the genetics and molecular evolution of genes that control development.

Representative Publications:

- Caicedo A.L., Stinchcombe J.R., Olsen K.M., Schmitt J. and Purugganan M.D. (2004) Epistatic interaction between *Arabidopsis* FRI and FLC flowering time genes generates a latitudinal cline in a life history trait. *Proc. Nat. Acad. Sci.* **101**:15670-15675.
- Cork J.M. and Purugganan M.D. (2005) High-diversity genes in the *Arabidopsis* genome. *Genetics* **170**:1897-1911.
- Moore R.C. and Purugganan M.D. (2005) The evolutionary dynamics of plant duplicate genes. *Current Opinion in Plant Biology* **8**:122-128.
- Moore R.C., Grant S.R. and Purugganan M.D. (2005) Molecular population genetics of redundant floral-regulatory genes in *Arabidopsis thaliana*. *Molecular Biology & Evolution* **22**:91-103.
- Olsen K.M., Caicedo A.L., Polato N., McClung A., McCouch S.R. and Purugganan M.D. (2006) Selection under domestication: evidence for a sweep in the rice Waxy genomic region. *Genetics* **173**:975-983.
- Ehrenreich I.M., Stafford P.A. and Purugganan M.D. (2007) The genetic architecture of shoot branching in *Arabidopsis thaliana*: a comparative assessment of candidate gene associations vs. quantitative trait locus mapping. *Genetics* **176**:1223-1236.

Nikolaus Rajewsky, *Global Distinguished Professor; Director of Bioinformatics, Professor of Systems Biology, Max-Delbrück-Center for Molecular Medicine; Ph.D. 1997, University of Cologne, Germany.*

Research Interests:

The Rajewsky Lab uses computational and experimental methods to dissect, systems-wide, function and evolution of gene regulation in metazoans. One major focus is to understand more about gene regulation by small RNAs, in particular microRNAs. To probe general mechanisms in gene regulation of microRNAs, the lab works with cell lines. We are also investigating the function of small RNAs during very early development of *C. elegans*. Furthermore, the lab has established planaria as a model system within the lab. These freshwater flatworms are famous for their almost unlimited ability to regenerate any tissue via pluripotent, adult stem cells. The lab is studying the role of small RNAs in planarian regeneration..

Representative Publications:

- van Nimwegen E., Zavolan M., Rajewsky N. and Siggia E.D. (2002) Probabilistic clustering of sequences: inferring new bacterial regulons by comparative genomics. *Proc. Natl. Acad. Sci.* **99**:7323-7328.
- Rajewsky N., Socci N.D., Zapotocky M. and Siggia E.D. (2002) The evolution of DNA regulatory regions for proteo-gamma bacteria by interspecies comparisons. *Genome Res.* **12**:298-308.
- Rajewsky N. and Socci N.D.S. (2004) Computational identification of microRNA targets. *Developmental Biology* **267**:529-535.
- Rajewsky N. (2006) MicroRNA target predictions in animals. *Nature Genetics* **38**:1452-1456
- K. Chen and Rajewsky N. (2006) Natural selection on human microRNA binding sites inferred from SNP data. *Nature Genetics* **38**:1452-1456.
- Thai T.H., Calado D.P., Casola S., Ansel K.M., Xiao C., Xue Y., Murphy A., Frendewey D., Valenzuela D., Kutok J.L., Schmidt-Supprian M., Rajewsky N., Yancopoulos G., Rao A. and Rajewsky K. (2007) Regulation of the germinal center response by microRNA-155. *Science* **316**:604-608.

Michael R. Rampino, *Associate Professor of Earth and Environmental Science; B.A., Hunter; PhD 1978, Columbia University.*

Research Interests:

My research interests range across the earth sciences. A major long-term project is to investigate the causes of mass extinctions of life. Evidence of a large asteroid impact at the time of the disappearance of the dinosaurs led to work on the connection between impacts and extinctions. This work has taken me to geological localities on six continents. My current research is focused on the Permian/Triassic (250 million years ago) and the Triassic-Jurassic (201 million years ago) mass extinctions, with ongoing field studies in North America, Europe, Japan and South Africa.

Another area of research and fieldwork has been the study of Indonesian volcanic eruptions such as Krakatoa (1883), Tambora (1815) and Toba (73,000 years ago), and their effects on global climate, including, for Toba, an episode of near-extinction in human evolutionary history.

Recent projects include computer modeling of climate at the NASA Goddard Institute for Space Studies in NYC, observational studies of asteroids with astronomers at the Harvard -Smithsonian Center for Astrophysics and Mt. Wilson Observatory in California, and joint appointments at the Universities of Florence and Urbino in Italy working with paleoclimate specialists and the EPICA European Ice Core Group.

Representative Publications:

- Rampino M.R. (2002) Supereruptions as a threat to civilizations on Earth-like planets. *Icarus* **156**:562-569.
- Steiner M.B., Eshet Y., Rampino M.R. and Schwindt D.M. (2003) Fungal abundance spike and the Permian-Triassic boundary in the Karoo Supergroup (South Africa). *Palaeo*³ **194**:405-414.
- Baliunas S., Donahue R., Rampino M.R., Gaffey M.J., Shelton J.C. and Mohanty S. (2003) Multispectral analysis of Asteroid 3 Juno taken with the 100-inch telescope at Mount Wilson Observatory. *Icarus* **163**:135-141.
- Prokoph A., Rampino M.R. and ElBilali H. (2004) Periodic components in the diversity of calcareous plankton and geological events over the past 230 M yr. *Palaeo*³ **207**:105-125.
- Palamarczuk S., Chamberlain J.C. Jr., Koeberl C., Barreda V. and Rampino M. (2006) Bajada de Januel Neuquen Province, Argentina: Complete or incomplete K/PLG boundary section? Abstracts, Geological Society of America.
- Rampino M.R. (2006) Impacts and climate. *Encyclopedia of Paleoclimate and Ancient Environments* (Gornitz V., ed.), Springer.

This work is supported by grants from NASA, the Department of Energy, Mt. Wilson Observatory, and a New York University Research Challenge grant.

Carol Shoshkes Reiss, Professor; A.B. 1972, Bryn Mawr; MS 1973, Sarah Lawrence; PhD 1978, Mt. Sinai Graduate School of Biomedical Sciences, CUNY.

Research Interests:

My research interests are viral immunology, ranging from innate to cellular signaling as well as molecular aspects, and pathogenesis of infection. My lab has been studying the interaction between vesicular stomatitis virus (VSV) and the mouse. We are probing the role of the immune system in clearance of viral infections from the central nervous system and use many research tools including knockout hosts. The cell biology and molecular biology of how interferons alter cellular metabolism to prevent viral replication is under investigation. We are examining cytokine-triggered responses *in vitro* and in the CNS, including signal transduction and down-stream events. The effects of a number of commonly used drugs (statins, PPAR- γ agonists and bisphosphonates) and endogenous molecules (endocannabinoids) on the ability of neurons to replicate virus are also being investigated. We are also engineering biological response modifiers into VSV for application in viral oncolysis.

Representative Publications:

- Yang J., Tugal D. and Reiss C.S. (2007) The role of the proteasome-ubiquitin pathway in regulation of the IFN- γ -mediated antiviral response in neurons. *J. NeuroImmunology* **181**:34-45.
- Trottier M.D., Lyles D.S. and Reiss C.S. (2008) Differential expression of type 1 IFN in the periphery and CNS of mice in response to VSV infection. *J. NeuroVirology* **13**:1-12.
- Herrera R.A., Oved J.H. and Reiss C.S. (2008) Disruption of IFN- γ -mediated antiviral activity in Neurons: the role of Cannabinoids. *Viral Immunology* **21**:141-152.
- Yang J., Dennison N.N. and Reiss C.S. (2008) .PIN: a novel protein involved in IFN-gamma accumulation of NOS-1 in neurons. *DNA Cell Biol.* **27**(1):9-17.
- D'Agostino P.M., Yang J. and Reiss C.S. (2008) Distinct mechanisms of inhibition of VSV replication in neurons mediated by Type I and Type II IFN. *Virus Reviews & Res.* (in press).
- D'Agostino P.M., Amenta J. and Reiss C.S. (2008) IFN- β treatment of neurons leads to hypophosphorylation of P protein (submitted).

This research is supported by grants from the National Institutes of Health.

Matthew Rockman, Assistant Professor; BA 1997, Yale University; PhD 2004, Duke University.

Research Interests:

We study the evolutionary and molecular causes of heritable phenotypic variation. What are the mutations that contribute to variation within and among species? Do these evolutionarily relevant mutations exhibit characteristic properties that distinguish them from the larger set of all possible mutations? How do the mechanisms by which traits develop influence the evolution of those traits? How, in turn, does evolution shape those developmental mechanisms? To gain the empirical data necessary to address these questions, we are developing methods to improve our ability to discover mutations underlying variation. We are experimentally dissecting natural variation in morphological, behavioral, and molecular phenotypes in the nematode *C. elegans* in order to characterize its genetic basis. Our ultimate aim is to use natural variation as a tool for understanding the developmental processes that leads from genotype to phenotype and the evolutionary processes that feed back from phenotype to genotype.

Representative Publications:

- Rockman M.V. and Wray G.A. . (2002) Abundant raw material for cis-regulatory evolution in humans. *Mol. Biol. Evol.* **19**:1991-2004.
- Rockman M.V., Hahn M.W., Soranzo N., Zimprich F., Goldstein D.B. and Wray G.A. (2005) Ancient and recent positive selection transformed opioid cis-regulation in humans. *PLoS Biology* **3**:e387.
- Rockman M.V. and Kruglyak L. (2006) Genetics of global gene expression. *Nat. Rev. Genet.* **7**:862-872.
- Seidel H.S., Rockman M.V. and Kruglyak L. (2008) Widespread genetic incompatibility in *C. elegans* maintained by balancing selection. *Science* **319**:589-594.
- Rockman M.V. and Kruglyak L. (2008) . Breeding designs for recombinant inbred advanced intercross lines. *Genetics* **179**:1069-1078.
- Palopoli M.F., Rockman M.V., TinMaung A., Ramsay C., Curwen S., Aduna A., Luarita J. and Kruglyak L. (2008) Molecular basis of the copulatory plug polymorphism in *Caenorhabditis elegans*. *Nature* (in press).

Christine A. Rushlow, Associate Professor; Director, Master's Program; BA 1977, PhD 1983, University of Connecticut.

Research Interests:

The broad goal of my laboratory is to understand the mechanisms that underlie cell growth and differentiation. Cell communication is an important mechanism that involves the transduction of information from one cell to others via signaling molecules such as growth factors. One of the most versatile groups is the TGF- β family of signaling molecules. TGF- β molecules play crucial roles in directing cell growth and cell fate in diverse groups of organisms ranging from flies to humans. In humans they inhibit proliferation of lymphoid and hematopoietic cells thus limiting inflammatory response and promoting wound healing. They also induce bone morphogenesis in the developing fetus and adults. We use the fruit fly *Drosophila melanogaster* as a model system to identify and characterize the cellular responses to TGF- β signaling during development. The TGF- β molecule Dpp acts in a concentration dependent manner as a morphogen to subdivide the dorsal region of the fly embryo. High levels of Dpp are present in the dorsal most region of the developing embryo and instruct cells to differentiate into a flat squamous epithelial tissue called the amnioserosa. Lower levels of Dpp give rise to more lateral ectodermal cells that remain as columnar epithelia. We study the molecular mechanisms underlying Dpp morphogenetic activity. We recently demonstrated that the amnioserosa is established by a feed forward mechanism, whereby one regulator, Dpp, activates a second regulator, Zen, and then both regulate downstream target genes in the dorsal most region. We propose that Zen/Smads sit atop a genetic hierarchy comprising a set of direct target genes, as well as further downstream genes, that together function in a network that eventually leads to amnioserosa differentiation. We further propose that some of the downstream genes in the network are regulators of cell division, cell shape changes, and cell polarity changes since these are all processes that are affected during the differentiation of squamous epithelial cells (flat like floor tiles) from the columnar (like bricks on end) morphology of the embryonic blastoderm. We are currently testing the roles of candidate genes involved in these processes such as cell cycle inhibitors, RhoGEFs and apical-basal polarity markers.

Representative Publications:

- Rushlow C. (2004) Dorsoventral patterning: a Serpin pinned down at last. *Current Biology* **14**:R16-18.
- Xu M., Kirov N. and Rushlow C. (2005) Peak levels of BMP in the *Drosophila* embryo control target genes by a feed-forward mechanism. *Development* **132**(7):1637-1647.
- Lin M-C., Park J., Kirov N. and Rushlow C. (2006) Threshold response of *C15* to the Dpp gradient in *Drosophila* involves the cumulative effect of Smads, Zen, and negative cues. *Development* **133**:4805-4813.
- Yao L.C., Phin S., Cho J., Rushlow C., Arora K. and Warrior R. (2008) Multiple modular promoter elements drive graded brinker expression in response to the Dpp morphogen gradient. *Development*. **135**(12):2183-2192.

David A. Scicchitano, Professor; Director, Undergraduate Studies; BA 1981, Susquehanna; PhD 1986, Penn State University.

Research Interests:

The research in my laboratory primarily involves the study of interactions of chemical and physical agents with DNA, and the processing of the resulting damage by cells. To that end, we have been examining the removal of chemical adducts from discrete regions of the genome. This is being done in an effort to characterize a phenomenon known as DNA repair heterogeneity that is typified by the preferential removal of DNA damage from active genetic loci. The implications of biases in DNA repair are vast: Certain segments of the chromosome might be more susceptible to mutagenesis than other domains, making them hot spots for the induction of a variety of detrimental biological outcomes including tumorigenesis and cell death.

A second area of ongoing research involves investigating the effect of site-specific DNA damage on transcription by a variety of RNA polymerases. We use oligo-nucleotides containing polycyclic aromatic hydrocarbons, an important class of chemical carcinogens, for these studies. We have shown that some of these adducts impede transcription elongation; furthermore, the degree of inhibition is dependent upon the stereochemical configuration of the DNA lesion.

Representative Publications:

- Perlow-Poehnelt R.A., Likhterov I., Scicchitano D.A., Geacintov N.E. and Broyde S. (2004) The spacious active site of a Y-family DNA polymerase facilitates promiscuous nucleotide incorporation opposite a bulky carcinogen-DNA adduct: elucidating the structure-function relationship through experimental and computational approaches. *J. Biol. Chem.* **279**: 36951-36961.
- Scicchitano D.A. (2005) Transcription past DNA adducts derived from polycyclic aromatic hydrocarbons. *Mutat Res.* **577**(1-2):146-154.
- Perlow-Poehnelt R.A., Likhterov I., Wang L., Scicchitano D.A., Geacintov N.E. and Broyde S. (2007) Increased flexibility enhances misincorporation: temperature effects on nucleotide incorporation opposite a bulky carcinogen-DNA adduct by Y-family DNA polymerase. *J. Biol. Chem.* **282**:1397-1408.
- Dimitri A., Goodenough A.K., Guengerich F.P., Broyde S. and Scicchitano D.A. (2008) Transcription processing at 1,N²-ethenoguanine by human RNA polymerase II and bacteriophage T7 RNA polymerase. *J Mol Biol.* **375**(2):353-366.
- Dimitri A., Jia L., Shafirovich V., Geacintov N.E., Broyde S. and Scicchitano D.A. (2008) Transcription of DNA containing the 5-guanidino-4-nitroimidazole lesion by human RNA polymerase II and bacteriophage T7 RNA polymerase. *DNA Repair (Amst)*. **7**(8):1276-1288.

*Work is supported by grants from the
National Institutes of Health and New York University.*

Walter Scott, Professor; B.S., Western Kentucky University; M.D. 1960, University of Louisville.

Research Interests:

My research interests are centered on the physiology of the vertebrate kidney, which is responsible for maintaining water and ion balance of the body. We study the regulation of the transport and permeability of ions and water through epithelial membranes and the modulation of these fluxes by hormones. In particular, we are interested in the intracellular signaling processes involved in these tissue responses.

Representative Publications:

- Yu L., Tolvo A. and Scott W.N. (1993) Atrial natriuretic factor enhances the hydro-osmotic response of toad bladder to sub-maximal doses of vasopressin. *Life Sciences* **53**:541-546.
- Tolvo A., Videlingum A.N. and Scott W.N. (1995) Cellular Diacylglycerol modulates the antidiuretic effects of vasopressin. *Biochem. Biophys. Acta.* **892**:434-438.

Mark L. Siegal, Assistant Professor; B.S. 1993, Brown; PhD 1998, Harvard.

Research Interests:

Our aim is to understand the evolution of the gene networks controlling development. We use both experimental and computational approaches to pursue this goal. Our major experimental focus is on the process of sexual differentiation in *Drosophila* and related species. Sexual differentiation is a powerful model system for studying the evolution of development because many aspects of sexual morphology, physiology and behavior differ between closely related species, thereby enabling high resolution comparative analysis. We are currently studying the evolution of *intersex*, a key regulatory gene required for female differentiation. We have cloned homologs of *intersex* from invertebrates and vertebrates, and used transgenics to show that, unlike other sex-determination factors, the function of the Intersex protein is broadly conserved. We are also interested in the divergence of the downstream programs of sex-specific gene expression. We combine genome-wide analysis of sex-biased gene expression with functional assays across closely related species to identify cases of interesting regulatory evolution.

We complement our experimental work with theoretical investigations into the evolution of gene networks. A central question is how networks achieve robustness against environmental and genetic variation, so that development leads to reliable phenotypic outcomes. A crucial related question is how this robustness constrains phenotypic divergence. We are testing these predictions at a genome scale using the yeast, *Saccharomyces cerevisiae*. We also plan to test these ideas in flies, by using a quantitative genomics approach to identify genes involved in sexual differentiation that harbor allelic variation, and then to investigate how variation in these genes is buffered and how these genes contribute to phenotypic differences between species.

Representative Publications:

- Bergman A. and Siegal M.L. (2003) Evolutionary capacitance as a general feature of complex gene networks. *Nature* **424**:549-552.
- Arbeitman M.N., Fleming A.A., Siegal M.L., Null B.H. and Baker B.S. (2004) A genomic analysis of *Drosophila* somatic sexual differentiation and its regulation. *Development* **131**:2007-2021.
- Siegal M.L. and Baker B.S. (2005) Functional conservation and divergence of *intersex*, a gene required for female differentiation in *Drosophila melanogaster*. *Development Genes and Evolution* **215**:1-12.
- Siegal M.L., Promislow D.E. and Bergman A. (2007) Functional and evolutionary inference in gene networks: does topology matter? *Genetica* **129**:83-103.

Stephen J. Small, Professor; Director, Doctoral Program; BA 1973, Thomas More College; PhD 1988, University of Cincinnati.

Research Interests:

We are interested in how transcription factors organize the body plans of multicellular animals during early embryogenesis. The body plan of *Drosophila* consists of 14 contiguous segments along the anterior-posterior axis, and is generated by a network of transcription factor gradients that establish increasingly refined patterns (stripes) of gene expression. We are interested in the mechanisms that control this pattern. Our primary focus is on the structure and function of DNA regulatory elements that function as transcriptional switches. These switch elements are 500-1000 bp in length, and contain binding sites for activator and repressor proteins. We use three basic approaches in our work. First, we use a combination of biochemical, genetic, and reporter gene experiments to examine how a few select regulatory elements function at the molecular level. Second, we change the shapes and concentrations of gradients in the embryo by targeted misexpression experiments. Third, we use genomic experiments and bio-informatics to identify novel regulatory elements in genomic sequences. Our ultimate goals are to understand how patterns of gene expression are generated, and to describe in detail the molecular network that organizes the *Drosophila* body plan. This work will provide a strong foundation for studies on the evolution of insect body plans.

Representative Publications:

- Clyde D., Corado M., Wu X., Paré A., Papatsenko D. and Small S. (2003) A self-organizing system of repressor gradients establishes segmental complexity in *Drosophila*. *Nature* **426**:849-853.
- Ochoa-Espinosa A., Yucel G., Kaplan L., Pare A., Pura N., Oberstein A., Papatsenko D. and Small S. (2005) The role of binding site cluster strength in Bicoid dependent patterning of the *Drosophila* embryo. *PNAS* **102**:4960-4965.
- Oberstein A, Pare A., Kaplan L. and Small S. (2005) Site-specific transgenesis by Cre-mediated recombination in *Drosophila*. *Nature Methods* **2**:583-585.
- Yucel G. and Small S. (2006) Morphogens: precise outputs from a variable gradient. *Current Biology* **16**:R29-31.
- Brent A., Yucel G., Small S. and Desplan C. (2007) Permissive and instructive anterior patterning relies on mRNA localization in the wasp embryo. *Science* **315**:1841-1843.
- Yu D. and Small S. (2008) Precise registration of gene expression boundaries by a repressive morphogen in *Drosophila*. *Current Biology* **18**:868-876.

This work is supported by grants from the National Institutes of Health and the National Science Foundation.

Daniel Tranchina, Professor; BA 1975, SUNY Binghamton; PhD 1981, The Rockefeller University.

Research Interests:

My research in computational biology and neuroscience integrates data from experimental studies, theoretical analysis, mathematical modeling, and computer simulation.

One of my ongoing projects in vertebrate phototransduction focuses on light adaptation in rods and cones, and the reproducibility of rod responses to single photons. Electrophysiological and biochemical data provide a basis for developing mathematical models that accounts for light adaptation and statistical properties of the single-photon response in terms of the molecular mechanisms underlying phototransduction.

Another ongoing project involves the development of “statistical mechanical” methods for modeling large neural networks. These methods employ the theory of the probability (population) density function. Factors that make conventional methods unwieldy or intractable - thousands of neurons and millions of synapses - are used to great advantage in these methods. Similar neurons are lumped together into populations, and one tracks the distribution of neurons over state space in each population. The state of a neuron is determined by the dynamic variables in the underlying single-neuron model. The population firing rate is given by the flux of probability across a particular surface in state space. Neurons are coupled via stochastic synapses; the rate of excitatory/inhibitory input events for a target neuron is determined by the rate of action potentials in each of the presynaptic populations and by the average number of synapses the postsynaptic neuron receives from each of these populations.

I have recently begun to analyze and model stochastic synthesis and degradation of mRNA and proteins. A goal is to understand sources of large fluctuations in the number of transcripts from genes that are expressed at low levels, the consequences for protein levels, and the implications for cell physiology in general.

Finally, I am collaborating with Gloria Coruzzi and her lab on a project involving the identification and modeling of gene regulatory networks underlying nitrogen assimilation and metabolism in *Arabidopsis*.

Representative Publications:

- Hamer R.D., Nicholas S.C., Tranchina D., Lamb T.D. and Jarvinen J.L.P. (2005) Towards a unified model of vertebrate rod phototransduction. *Visual Neuroscience* **22**(4):417-436.
- Raj A., Peskin C.S., Tranchina D., Vargas D.Y. and Tyagi S. (2006) Stochastic mRNA synthesis in mammalian cells. *PLoS Biol.* **4**(10):e309.
- Ly C. and Tranchina D. (2007) Critical analysis of dimension reduction by a moment closure method in a population density approach to neural network modeling. *Neural Comput.* **19**(8):2032-2092.

Tyler Volk, Associate Professor of Biology and Environmental Studies; B.S. 1972, University of Michigan; MS 1982, PhD 1984, NYU.

Research Interests:

Is there any way to look at our universe as a whole - from atoms to Shakespeare - as a unity with governing principles? In my work and writing, have tried to I examine reasons for phenomena across a number of different scales. One approach examines how patterns at one level in the nesting of nature influence patterns at another level. That has taken me into a study of the biosphere as an internally interacting and complex system of “spheres”: atmosphere, oceans, soils, and biota, with focus on the global carbon cycle and on the role of life at various key nodes. A second approach is to seek universal patterns that are “discovered” independently in various systems at diverse levels in the nesting of nature. These patterns (metapatterns) recur because they possess inherent functions, and systems that can evolve find these patterns useful to employ, even though the systems seem quite different from from the biological to the cultural and mental.

Representative Publications:

Volk T. (1995) Metapatterns Across Space, Time, and Mind, Columbia University Press.

Volk T. (2003) Gaia's Body: Toward a Physiology of the Earth, MIT Press.

Volk T. (2004) Gaia is life in a wasteworld of by-products. Scientists Debate Gaia (S.H. Schneider *et al.*), MIT Press, 27-36.

Volk T. and Bloom J.W. (2007) The use of metapatterns for research into complex systems of teaching, learning, and schooling, Part I: Metapatterns in nature and culture. Complicity: Intl. J. Complexity & Education 4:25-43.

Bloom J.W. and Volk T. (2007) The use of metapatterns for research into complex systems of teaching, learning, and schooling, Part II: Applications. Complicity: Intl. J. Complexity & Education 4:45-68.

Volk T. (2008) CO2 Rising: The World's Greatest Environmental Challenge, The MIT Press.

C. Department Associates

American Museum of Natural History (AMNH):

Dr. Rob DeSalle <http://research.amnh.org/amcc/staff2.html>
Dr. Paula Mikkelsen <http://research.amnh.org/~mikkel/>
Dr. Howard Rosenbaum <http://research.amnh.org/biodiversity/center/staff/stffrosenbaum.html>

Cold Spring Harbor Laboratory (CSHL):

Dr. Robert Martienssen <http://www.cshl.org/public/SCIENCE/martien.html>
Dr. Richard McCombie <http://www.cshl.org/public/SCIENCE/mccombie.html>

Max Delbruck Center for Molecular Medicine

Dr. Nikolaus Rajewsky <http://www.mdc-berlin.de/rajewsky/>

New York Botanical Garden (NYBG):

Dr. Kenneth Cameron http://sciweb.nybg.org/science2/profile_23.asp
Dr. Douglas Daly http://sciweb.nybg.org/science2/profile_32.asp
Dr. Amy Litt http://sciweb.nybg.org/science2/profile_106.asp
Dr. Dennis Stevenson http://sciweb.nybg.org/science2/profile_8.asp

NYU Center for Neural Science

Dr. Chiye Aoki <http://www.cns.nyu.edu/corefaculty/Aoki.php>
Dr. Adam Carter <http://www.cns.nyu.edu/corefaculty/Carter.php>
Dr. Eric Klann <http://www.cns.nyu.edu/corefaculty/Klann.php>
Dr. Alex Reyes <http://www.cns.nyu.edu/corefaculty/Reyes.php>
Dr. Dan Sanes <http://www.cns.nyu.edu/corefaculty/Sanes.php>
Dr. Robert Shapley <http://www.cns.nyu.edu/corefaculty/Shapley.php>

NYU Langone Medical Center

Dr. Martin Blaser <http://www.med.nyu.edu/people/blasem01.html>
Dr. Jane Carlton <http://www.med.nyu.edu/parasitology/faculty/jcarlton.html>

NYU Langone Medical Center's Skirball Institute, Developmental Genetics Program

Dr. Iannis Aifantis <http://pathology.med.nyu.edu/people/faculty/aifantis-iannis>
Dr. Erika Bach <http://www.med.nyu.edu/pharmacology/labs/bach/>
Dr. Steve Burden <http://skirball.med.nyu.edu/research/mn/burdenlab/>
Dr. Jeremy Dasen <http://www.med.nyu.edu/sackler/dgp/faculty/dasen.html>
Dr. Ramanuj Dasgupta <http://www.med.nyu.edu/people/dasgur01.html>
Dr. Adrian Erlebacher <http://www.med.nyu.edu/people/erleba01.html>
Dr. Gordon Fishell <http://saturn.med.nyu.edu/research/dg/fishelllab/bio.html>
Dr. Jane Hubbard <http://skirball.med.nyu.edu/research/sb/hubbardlab/>
Dr. Hannah Klein <http://www.med.nyu.edu/people/H.Klein.html>
Dr. Ruth Lehmann <http://skirball.med.nyu.edu/research/dg/lehmannlab/>
Dr. Cynthia Loomis <http://www.med.nyu.edu/Research/loomic01.html>
Dr. Jeremy Nance <http://skirball.med.nyu.edu/research/dg/nancelab/>
Dr. Hyung Don Ryoo <http://www.med.nyu.edu/people/ryooh01.html>
Dr. Susan Schwab <http://www.med.nyu.edu/people/schwas13.html>
Dr. Greg Suh <http://saturn.med.nyu.edu/research/mn/suhlab/personnel.html>
Dr. Jesus Torres-Vazquez <http://skirball.med.nyu.edu/research/dg/torreslab/>
Dr. Jessica Treisman <http://skirball.med.nyu.edu/research/dg/treismanlab/>
Dr. Dan Turnbull <http://skirball.med.nyu.edu/research/sb/turnbulllab/>
Dr. Deborah Yelon <http://skirball.med.nyu.edu/research/dg/yelonlab/>

NYU Steinhardt School of Culture, Education & Human Development

Dr. Susan Kirch http://steinhardt.nyu.edu/faculty_bios/view/Susan_Kirch