

Cornell University Graduate Field of

# Genetics, Genomics & Development Graduate Student Handbook

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## THE PH.D. PROGRAM IN GENETICS, GENOMICS AND DEVELOPMENT

The Graduate Field of Genetics, Genomics and Development at Cornell University offers advanced training leading to the Ph.D. degree. The research activities of faculty members in the Field encompass a wide range of areas including gene regulation in bacteria, unicellular and higher eukaryotes (both plant and animal), population genetics, molecular evolution, developmental biology, and developmental genetics. A full list of the faculty membership in the Field can be found at <https://gendev.cornell.edu/faculty/>

The program is administered in the Department of Molecular Biology & Genetics, although membership (both faculty and students) can be found in many different departments/units on campus.

### Cornell Graduate School & Graduate Field Structure

As a Cornell graduate student, your College Registrar is the Graduate School. The central administration of graduate programs at Cornell allows graduate study to be cross-disciplinary and integrative, independent of traditional departments, colleges or campuses. (See [Understanding Field Structure](#) for more information). For the student, this allows for freedom with responsibility for creating a program that is unique to each.

The broad structure and guidelines for all Graduate Fields at the University is governed by the Graduate School, particularly with regard to registration, student status, and benchmarks leading to graduation. The [Code of Legislation of the Graduate Faculty](#) contains all of the regulations related to graduate education at Cornell. The most relevant ones are included in this book.

Within these guidelines, each Field sets the standards and requirements specific to students in the particular program. On the individual level, the student's Special Committee is the final arbiter of the student's program.

You should be sure to follow all administrative requirements of the University, [the Graduate School](#) and the Field. If you have questions about any of these requirements, please contact the appropriate office or ask the GFAs for information or a referral to the appropriate office. Note that Graduate School Forms are found on-line at <https://gradschool.cornell.edu/forms/>.

### Orientation and "Basic" Training

The University and Graduate School require certain training and compliance tasks of all graduate students. Much of this is included in the [New Student Checklist](#) which becomes available in late April/early May. The rest is taken care of in Orientation process at the beginning of your first year.

Incoming students are required to attend GGD-MBG Orientation, which generally takes place the week before classes start. During this time, students will complete required training and paperwork necessary for their program. It is our goal to have administrative requirements completed before the start of classes in order to allow students to concentrate on the academic part of their program.

Included in the mix with administrative requirements and training are activities designed to welcome you into the Department of Molecular Biology & Genetics (MBG), which is the administrative home to the Graduate Fields of Biochemistry, Molecular & Cell Biology and Genetics, Genomics & Development, and specifically to the Field of Biophysics. The MBG Welcome & Awards Ceremony is held at the beginning of the fall semester and is a good way to meet the students, staff, and faculty in an informal, non-lab setting.

## Registration

**Registration:** Registration takes place three times a year – fall, spring and summer and establishes your status as a Cornell graduate student. Registration is typically an automatic process; however, if there is a hold on your account, your registration may be blocked. Additionally, if you do not enroll in Dissertation Research for the summer, you will not be considered a registered student.

**Student Essentials** (<https://studentessentials.cornell.edu/>) is your information hub. You should go here at the beginning of each semester to ensure that you do not have any holds on your account (i.e. that you are registered). If there is a hold, clear it up as soon as possible even if it is not preventing you from being a registered student. Unresolved holds not only result in late fees but will prevent future registration.

You should keep your contact information updated in Student Essentials. It is not only a site that asks for information, but it also provides links to campus resources and information as well as contact information for important campus offices, such as the Bursar, the Registrar (OUR), Financial Aid and the Graduate School.

Your Student Essentials will also have information about your financial assistance (i.e. stipend, tuition and health insurances) and whether or not it has been processed. If there is a problem with your funding, contact the GFAs as soon as possible to get this resolved.

**Changes in Student Status:** Unless you fail to clear up registration holds by the deadline or do not register for summer, your student status should continue unless you change it. A voluntary change in student status requires completion of the appropriate form, all of which can be found on the [Graduate School Forms web site](#).

**In Absentia:** If you are going to be doing research or working on your thesis at least 100 miles away from Cornell, you may apply for In Absentia Status. IA will maintain your status as a student and allow you to have access to libraries and receive an assistantship.

**Leave of Absence:** A [Leave of Absence](#) means that you are giving up your status as a student. There are a number of different types of leaves which are detailed on the Graduate School web site. If you have questions, consult the GFAs or the Graduate School Student Services Team.

## Course Enrollment

**Grad School/University Course Information:** The Graduate School does not set [course requirements](#); these are set by the Field of Biophysics and your Special Committee. You should consult with the Director of Graduate Studies (DGS) and/or your Special Committee about the courses that you should take.

Dates for course enrollment, including pre-enrollment for the next semester, are set by the University Registrar (<https://registrar.cornell.edu/>). Make sure that you register in accordance with the published dates. NOTE: The Graduate School will only consider Course Enrollment Petitions in extremely extenuating circumstances. Check your course enrollment prior to the published add/drop dates.

Federal regulations require that all students enroll in at least 12 credit hours/semester. You should not feel obligated to enroll in 12 credit hours of actual coursework unless your DGS/Special Committee consider(s) it necessary. Enroll only in the courses that you need/want to take. In the fall and spring semesters, the Graduate School will enroll students in their Graduate Dissertation Research course in order to ensure that your record reflects 12 credit hours.

**Summer Enrollment/Registration:** All graduate students who plan to use university facilities such as libraries, computer centers, and the Gannett Health Center and/or receive a summer stipend are required to enroll in the Graduate Dissertation Research (via Student Center) for the summer. The deadline for this is the end of May. (Please note: If you register after the published deadline, FICA taxes will be withdrawn from your paycheck).

## Required Coursework in GGD

The Field of Genetics, Genomics and Development has a core curriculum comprised of a small set of courses designed to foster critical thinking skills and to provide foundational knowledge in Genetics, Genomics and Development. Graduate students must take the following courses prior to graduating (additional details about each course can be found below):

- BioMG7810, Problems in Genetics and Development,
- BTRY6010, Statistical Methods (or equivalent),
- three courses in a breadth requirement,
- BioMG7860 - Wednesday Field Seminar (audit for the first year)
- BioMG7870 -- Friday Molecular Biology & Genetics Seminar (audit for the first year)
- three semesters of BioMG7800,
- a course on ethical issues in science (e.g., BioMG7510, Ethical Issues and Professional Responsibilities)

**First Year: Students are expected to take a minimum of 12 credits of GRADED courses during their first year in our program.** Students are strongly encouraged to complete their breadth and minor requirements by the end of their first year.

**Seminar Courses:** All GG&D students also are required to attend and participate in the Wednesday Field Seminars (12:20 pm; BioMG7860) and in the Friday Molecular Biology & Genetics Seminars (4:00 pm; BioMG7870). Additional course requirements, including the graduate minor, are set by the members of the student's Special Committee.

**Grade Requirements:** For courses with a letter grade, students are expected to receive a B (3.0) or better in order to remain in good standing in the program. Grades below B- in a student's major area do not constitute satisfactory performance, and the course(s) must be retaken if it is a required course. If a student receives a grade below B- in two or more classes, he/she is at risk of being asked to leave the program (see First Year Evaluation below).

Please note that based on the academic calendar there appears to be a long break between the two semesters. However, first year graduate students are expected to be working on their first or second rotation (see Laboratory Rotations) during the intersession period.

### ***GGD Course Details***

**BIOMG7810 (2 credits), Problems in Genetics and Development, a problem solving course.** All entering students take this course in the Fall semester of their first year. It meets every Tuesday once a week; each week's discussion is led by a different professor. The problem sets consist of guided critical reviews of instructive and informative research papers, and expose you to a diversity of topics and approaches in genetics and development. Weekly problem sets and papers are handed out a week in advance; written answers are turned in the following week and discussed with the faculty member in charge of that particular week.

**BTRY6010 (4 credits), Statistical Methods I.** This course develops and uses statistical methods to analyze data arising from a wide variety of applications. Topics include descriptive statistics, point and interval estimation, hypothesis testing, inference for a single population, comparisons between two populations, one- and two-way analysis of variance, comparisons among population means, analysis of categorical data, and correlation and regression analysis. Introduces interactive computing through statistical software. Emphasizes basic principles and criteria for selection of statistical techniques.

Students can substitute this course with one of the following courses:

BTRY 6381 Bioinformatics programming  
 BTRY 6830 Quantitative genomics and genetics  
 BTRY 6840 Computational genomics  
 BTRY 6700 Applied bioinformatics

**BioMG7800 (1 credit, S/U only), Current Topics in Genetics and Development, a seminar course.** Students will be required to take three BioMG7800 courses, with one on grant proposal writing, one focusing on material presented by each week's MB&G seminar speaker, and a third one of student's choice, but not a repeat of the above two.

The BioMG7800 on Grant proposal writing will be co-taught by two or three GGD field faculty members and offered in the fall semester each year. It is required by all first year GGD students. The purpose of

the course is to teach students how to write a successful research proposal, mainly in the NSF predoctoral fellowship format. Each student will be required to put together an application during the first month of the fall semester. The proposals will be critiqued by fellow classmates and the faculty instructors through a series of mock review panels. After revising and hopefully improving the proposals through this exercise, all eligible students will submit their proposals to the NSF for real at the end of the class. Before arriving on campus, incoming first year students will be informed by the DGS of this Proposal Writing Course and that their first rotation mentors will serve as their proposal-writing mentors (see more in Laboratory Rotations). They will be asked to research the field website to find possible first rotation mentors that they can either contact before their arrival, or talk to right after they arrive, on campus. The students will then work with their mentors to come up with a research topic and proposal.

The other two forms of BioMG7800 emphasize presentation skills; generally, each student presents one seminar per course based on current research literature in the course topic. Students will be given formal feedback on their presentation by course instructors. This course is led by different faculty members each semester so that the focus varies. Each year, one to two BioMG7800 courses focused on a specific topic, and one BioMG7800 based on the MB&G seminar series will be offered. The latter is designed to encourage discussion of experiments performed by the speaker and his/her field of interest.

**BIOMG7510 - Ethical Issues and Professional Responsibilities, a discussion course.** All students are required to take this or a comparable course in scientific ethics. BioMG7510 is offered in the Spring semester. The opportunity to discuss these issues openly will be an important and valuable part of your graduate training.

**BIOMG7860 and BIOMG7870** - All post first year students sign up for one credit of BioMG7860 (in-house seminar series) and one credit of BioMG7870 (invited seminar series) each semester. **First year graduate students only sign up to audit these two courses.** The bulletin board across from the first floor elevator in the Biotechnology Building is the place to check for topics, times and places of talks.

Friday Molecular Biology and Genetics Seminar (BioMG7870): 4:00-5:00 pm Fridays during Fall and Spring semesters and occasionally during the Summer in the Biotechnology Building Conference Room (G10). These talks are given by scientists visiting from other institutions and provide an opportunity to hear and meet some of the most distinguished researchers in the areas of genetics and development. Speakers are usually invited and hosted by faculty members, but graduate students can play a significant role in choosing whom to invite. First, students can suggest names of desirable speakers to their major professor, and second, at least once a year graduate students have the opportunity to independently invite and host a distinguished scientist. Very popular speakers who would otherwise be “too busy” will often find time in their schedules if they are invited by students rather than faculty. Coffee, tea and cookies are available at 3:45 pm, and there is usually an informal “Meet the Speaker” Happy Hour immediately after the seminar in one of the lounges upstairs. In addition, there is usually an opportunity for a group of graduate students to take the speaker to lunch on Friday. If you are interested in talking individually with a speaker, see the host listed at the bottom of the seminar notice and he or she will be glad to try to schedule you.

Wednesday Field Seminars (BioMG7860): 12:20-1:20 pm Wednesdays in 226 Weill Hall. All graduate students give seminars to present their research progress. **Students join the cycle in their**

**second year and present their work at least once a year.** Second and third year students are only expected to give a half hour talk. **Students in their final semester are not required to give a field seminar but can opt out of presenting ONLY IF they plan to give a B-exam seminar during that same semester. In such cases, the student must have set a specific date for their B-exam with the approval of their committee and also must notify the Director of Graduate Studies and the Graduate Field Assistants prior to the start of the semester.**

There is an emphasis on Data Reproducibility to the Wednesday student seminar program. The first week's session will be a panel discussion of data reproducibility issues in contemporary GG&D-related research areas, led by the DGS and the Program Director along with 1-2 additional faculty. Subsequently, all students will be asked to include at least 1-2 slides in their presentation about this issue. These could include, for example: specific measures they have taken to validate the reproducibility of their own data, challenges they have faced in reproducing published data sets, how they are documenting and making available to others their data analysis procedures, and/or how data reproducibility issues are being considered for future experiments. These changes will augment our long-standing emphasis on critical discussion of experimental design that has always been a major element of the student seminars.

A draft schedule of Field seminar assignments will be circulated at the beginning of each Academic year. Students should notify the Graduate Field Assistant if they have a scheduling conflict with their assigned slot. Once the schedule is set at the beginning of the semester, students that want to reschedule their talk must find another student willing to switch slots with them. Students will be given ample notice of the date of their seminar, and must submit a title and short abstract to the Graduate Field Assistant (Room 107) one week before their talk so that it can be distributed to members of the Field. **Please note that attendance will be taken at the Wednesday Field Seminars (you must register for this course); students are required to attend at least 2/3 of the seminars in order to receive a satisfactory grade in BioMG7860.**

**Breadth requirement.** Students are to take a minimum of three courses from the list below (categories A-E) with at least one course taken from each of three separate categories. The Field recommends that a student with limited background in a particular category take a course in that group that stresses fundamental concepts. Note that classes a student takes in the breadth requirement can count towards the minor requirement. Although some courses are listed in multiple breadth categories, a single course cannot be counted more than once for the breadth requirement.

### **Biochemistry, Molecular, and Cellular Biology**

BIOMG 6310 Proteins: Structure, Function & Dynamics (F)  
 BIOMG 6330 Biosynthesis of Macromolecules (F)  
 BIOMG 6390 The Nucleus (S)  
 BIOMG 6360 Functional Organization of Eukaryotic Cells (S)

### **Development**

BIOMG 6610 Development and Evolution (S) – offered alternate springs; odd-numbered years  
 BIOMG 6870 Developmental Genetics (S) – offered alternate springs  
 PLBIO 6220 Plant Development (F)

**Genetics**

BIOMG 6391 Molecular Basis of Disease (S)  
 BIOMG 6880 Cancer Genetics (S)  
 BIOMI 6904 Bacterial Genetics (F)  
 BIOMG 6870 Genetic Methods to Dissect Biological Pathways (S) – offered alternate springs  
 PLBR 6060 Advanced Plant Genetics (S)

**Genomics**

BIOMG 6000 Genomics (F)  
 BIOMG 6880 Cancer Genetics (S)  
 BIOMG 6871 Human Genomics (F)  
 BTRY 6381 Bioinformatics Programming (S)  
 BTRY 6830 Quantitative Genomics & Genetics (S)  
 BTRY 6840 Computational Genomics (F)

**Population Genetics and Evolution**

BIOMG 6871 Human Genomics (F)  
 BTRY 6830 Quantitative Genomics and Genetics (S)  
 BTRY 6820 Statistical Genomics: Coalescent Theory and Human Population Genomics (S)

***GGD Minor Requirement***

As a GGD student, you may choose to concentrate in either genetics or developmental biology. You are also required to choose at least one minor subject. You are not limited to one minor; however, you cannot major and minor in the same subject (e.g., genetics) but are free to choose from the numerous graduate fields on campus for your minor(s). When you submit your full Special Committee request in your Student Center, you will be asked to identify the major and minor that each member of your committee represents. These will appear on your transcript as part of your program plan.

A minor provides you with an opportunity to delve with greater breadth and depth into a specific area that may help you with your individual research project and goals. The Graduate School publishes a list of major and minor subjects and concentrations for all graduate fields at Cornell (<https://www.gradschool.cornell.edu/academics/fields-of-study/fields>). You can pick any areas of study listed as your minor.

Most minors that are chosen by GGD graduate students require a couple of additional courses, which students are strongly encouraged to finish by the end of the second year. Fields often have guidelines, rather than strict requirements, for the number of courses needed to satisfy a minor. It is up to the faculty member who represents the minor to decide, in consultation with the student, how many courses and which courses are to be taken. You should discuss with potential committee members which courses they would want you to take, given your background and interests.

### ***Requirements for Minor in GGD***

Development (Field of Genetics, Genomics and Development) - requires two courses in Development that are beyond BioMG3850. Note that BioMG3850 should be taken in addition to these two courses if a student lacks the appropriate background. Participation in a weekly Developmental Biology Journal Club is strongly encouraged (see Journal Clubs).

Genetics (Field of Genetics, Genomics and Development) - has no formal requirements; individual course requirements may be specified by your committee members (usually 2 or 3 advanced courses at the 400 level or above and BioMG2810, if necessary).

### **Mandatory Responsible Conduct for Research (RCR) Training**

The integrity of research conducted at Cornell University is of the utmost importance to the institution as well as to our research sponsors. Cornell is committed to promoting and supporting the ethical and responsible conduct of research across all disciplines so that our researchers are provided an environment in which they may continue to conduct preeminent research, maintain the public's trust in the excellence of our research, and prepare current and future generations to similarly contribute to research discoveries that will address and advance national and global needs. As a result, all students are required to take the on-line RCR training in their first year of studies. For more information and to access the training, go to <http://www.oria.cornell.edu/rcr/index.html>. **Students are also required to take a one-day workshop on responsible conduct of research organized by the Office of the Vice Provost for Research at least TWICE during their graduate years, in addition to taking BioMG7510, Ethical Issues and Professional Responsibilities.**

### **Program Timeline & Benchmarks**

#### **GGD First-year Program & Assessment**

##### ***Rotations:***

All graduate students in GGD are required to complete three rotations during their first year in the program. Laboratory rotations can be a very effective way for new graduate students to get acquainted with faculty members and their lab members. They provide an opportunity for graduate students to explore in some depth areas they are considering for their Ph.D. thesis research. In addition, they allow both graduate students and faculty to test out possible working relationships. All first year students are expected to have been accepted into a lab by March 18. If necessary, rotations may continue after this point.

At the beginning of the Fall semester, GGD graduate students attend Rotation Talks in which faculty in the Field who are actively seeking graduate students discuss their research. All first-year students are expected to attend all of these talks.

To arrange for laboratory rotations, students should discuss the possibility of a rotation with individual faculty and arrange to rotate in the interested lab at a mutually agreed-upon time. At the end of the rotation talk period, students should have decided on their first rotation. Each rotation should be ~8 weeks

in length and all should be carried out in the lab of a Biophysics faculty member. The exact timing is flexible and can be worked out between the faculty and student.

Please note that graduate students do not follow the undergraduate academic calendar. Because you are paid a twelve-month stipend, you are expected to be active in academics and/or research unless the university itself is closed. During your first year, any time away should be discussed with the DGS and your rotation supervisor(s). Consult [Current Student Funding](#) for details about funding and time away.

#### **Recommended Timing for Rotation Period:**

- First rotation: September 13 – November 5
- Second rotation: November 8 – January 21
- Third rotation. January 24- March 18
- Fourth Rotation (if needed): March 21- May 13

Each rotation should be ~8 weeks in length. The exact time is flexible and can be worked out between the faculty and the student. All rotations should be carried out with full or provisional GGD Field members. At the end of each rotation, the supervising faculty member prepares a written evaluation that is informally discussed with the student. Both the student and faculty are asked to sign the evaluation form, which is then returned to the Graduate Field Assistants (GFAs).

#### How to arrange for laboratory rotations?

Early in the Fall semester, all faculty interested in hosting rotation students will give a short talk describing his/her research. All first year students are expected to attend these talks. Following these talks, students determine which research projects they find most interesting and then contact the faculty members to set up meetings to discuss the possibility of doing rotations. Faculty may review previous rotation evaluations to help them make a decision. Once an agreement is reached, students inform the DGS and the Graduate Field Assistant (GFA) of where they will be rotating.

Usually, by the end of the third rotation, students will have discussed with the rotation faculty about the possibility of joining a laboratory for thesis research. Please note that faculty may not commit to accepting a student into their lab for thesis research until the end of the third rotation. This is designed to ensure all students have the fair chance of completing their third rotation periods, before faculty make their final decisions. However, students are encouraged to have clear and honest discussion with interested faculty about the possibility of joining their labs ahead of time, so as to gauge the likelihood of joining a particular lab, and whether a summer rotation/rotations will be necessary. Students who want to initiate a fourth rotation should consult with the DGS.

#### What is expected of a graduate student on rotation?

While no one objects to a graduate student completing a project and writing a paper for publication during a rotation, no one expects it either! What is expected is self-motivated earnest effort, independent thinking, and the fullest participation possible in the intellectual life of the laboratory. If, either before or early during a rotation, a graduate student finds that his/her interests have changed dramatically, he/she should not feel trapped, but rather try to arrange a new rotation elsewhere.

## **First Year Evaluation**

In early summer, the GGD Field faculty meet as a group to discuss the progress of all first year students. Anyone who is judged not to have made satisfactory progress is asked to leave the program. Overall GPA, grades in individual courses, and rotation evaluations are all considered in this decision. Students are expected to have taken a minimum of 12 credits of GRADED courses during their first year in our program. In the absence of persuasive mitigating circumstances, students with the following performance in their first two semesters will be asked to leave the GGD program:

- two or more failed rotations (grade C), or
- two C grades in core courses, or
- one C grade in core courses AND one failed rotation.

## **Special Committee**

For your first year of study, until you choose a thesis lab, the Director of Graduate Studies (DGS) acts as your temporary Chair. Within two weeks of registration, you should go to your [Student Center](#) and add them as your temporary Chair by choosing the DGS role.

**At the end of your rotations, you will identify a faculty person to serve as the Chair of your Special committee.**

One of the most important decisions made by a graduate student at Cornell involves the selection of the Special Committee. The progress of each graduate student is guided and supervised by the Special Committee, which consists of the thesis research supervisor, also called major professor (Chair of the Committee), and two faculty members, one of whom represents the minor subject chosen by the student (see below). Students should assemble a Special Committee early in their 3<sup>rd</sup> semester but are encouraged to begin seeking the advice of possible committee members before this, since much of the student's coursework is taken during the first year. The DGS serves as temporary Chairperson and faculty adviser until a Special Committee is chosen.

Graduate students in the Field of Genetics, Genomics and Development may choose as their concentration either genetics or developmental biology. In addition, each student must choose one minor subject. Possibilities for minors include biochemistry, genetics, developmental biology, microbiology, evolutionary biology, cell biology, plant biology, plant molecular and cell biology, neurobiology and behavior, biometry (computational biology concentration), or a number of other possible subjects. You are not limited to one minor. **Note, however, that you cannot major and minor in the same subject (e.g., genetics).** Each year the Graduate School publishes a list of major and minor subjects and concentrations for all graduate fields at Cornell. This list can be viewed on the Graduate School web site at <https://gradschool.cornell.edu/admissions/degrees-fields/cugradfos/>.

The Special Committee system offers great flexibility to the Ph.D. program since it permits tailoring of the program to the specific interests of the student. We encourage you to talk to other graduate students and faculty and to seek as much information as possible before selecting your committee members. Make an appointment to meet with each potential committee member and bring relevant materials to the meeting (e.g., curriculum vitae, course records, and summary of research plans if possible). Be prepared to discuss why he or she would be an appropriate committee member. It is important that both understand each other's expectations: What courses will they require, can they help with certain experiments, etc.

Once your committee has been selected, don't panic if you realize as your research program develops that someone else might be more appropriate. Remember, you are responsible for putting together a committee that

best suits your needs. You can change your Committee on-line in your Student Center. Please note that no changes may be made in your special committee after passing the A-Exam, except with the Dean's approval.

### **Annual Committee Meetings and Student Progress Review**

**Students are required to meet with their entire committee at least once a year to discuss progress and plans (see PROGRESS REPORTS).** It is the student's responsibility to arrange the meeting. This meeting should take place as soon as possible after your Wednesday Field Seminar, and certainly within two weeks of the seminar. Remember to notify your committee of such seminars. Regular meetings with the full committee (a minimum of once a year) will help keep your program on track and can help avoid those awful moments at your defense when a committee member asks why you did not do this control or that experiment. You can also meet with them individually along the way. Use your committee for guidance and feedback. That's why they are there.

**Senior students must present a "final-year plan" to their committee, which is to be part of the progress report.** This should include a short outline of experiments that they still plan to do as well as a proposed timeframe for graduation. Students entering the sixth year of the program will be asked to send the DGS a detailed description of their graduation plans and timeline.

### **Student Progress Review**

**As a graduate student in your second year and beyond, you are required to meet with your entire committee at least once a year to discuss progress and plans for your research project and completion of your program.** You should arrange this meeting to take place immediately following your Wednesday seminar (or as soon after as possible thereafter). It is the student's responsibility to arrange this meeting and to provide faculty with the Student Progress Review (SPR) report. The Student Progress Review (SPR) report is **due within 30 days of your Wednesday seminar** or by May 31 at the latest.

The annual progress report supports communication between the student and their Special Committee, helps to gauge the progress being made toward graduation and, as of 2017, is the basis of annual benchmarks toward graduation required by the Graduate School. It is used by the Field to monitor student progress, as well as such administrative purposes as award nominations and collection of assessment data for the Graduate School. The Progress Report is found on-line (see links below which can also be found on the GGD Current Student Forms page).

Regular meetings with the full committee (a minimum of once a year) will help keep your program on track. You should also meet with individual members of your committee along the way in order to get information and feedback on your program and research. Your committee is there to provide you guidance and feedback.

Process for completion of annual Student Progress Report:

1. Schedule a meeting with your Special Committee that coincides with your Field seminar. The purpose of this meeting is to discuss your seminar as well as your portion of the Student Progress Review.
2. Complete the Student Section of the online Student Progress Review, save and download a draft to distribute to your entire Special Committee **at least seven (7) days prior** to your seminar.
3. After your seminar, meet with Special Committee to discuss your progress and planning. This meeting should take place **within two weeks of your seminar, if not immediately thereafter.**
4. After your meeting, finalize the Student Section of the SPR and submit it. Once you click submit, your advisor will be routed to your Chair so they can complete the Advisor section and submit it. The rest of

your committee can also view the form, however, only your Chair electronically signs and submits it. (Note: Once you submit the SPR, you will be unable to edit it).

5. Your Committee Chair should submit their portion of the online form **within 30 days of your seminar**.

Links to current Student Progress Report are provided on the [GGD website \(Forms\)](#). Note: In addition to the progress report, **all 5th year and beyond students must present a “final-year plan” to their committee, as part of the progress report. This will be a part of Section 5: Field Questions of the SPR.**

### ***Individual Development Report***

The Individual Progress Report should be a part of your Student Progress Review and may even help you to complete it. The IDP must be done each year as part of your progress review. However, the document itself is for use by you and your faculty mentor; it is not collected by the Field or the Graduate School. The Field does not mandate the form this takes, but many faculty and students alike have found the guide and suggestions found in a Molecular Cell Forum article [“Yearly Planning Meetings: Individualized Development Plans Aren’t Just More Paperwork”](#) very useful.

### ***Expectations Discussion:***

This important conversation should take place between students and faculty at the beginning of each rotation, when joining a lab and every year thereafter. The conversation will not only provide guidance and transparency but also lead to more effective communication between mentor and mentee and increased productivity and sustained progress toward a student’s degree. As with the IDP, the Field does not prescribe the format or content of the conversation; this is meant to be a confidential conversation between mentee and mentor. Guidelines for this conversation have been drafted by the GGD graduate students who make up the GGD Climate Committee. These are available on the GGD web site (forms page).

Students and faculty are asked to affirm that the IDP and the Expectations conversation have taken place each year as part of the SPR process by writing a sentence indicating this in the existing SPR questions. Students can report it in "Goals and/or Plans for Professional Development" section; faculty should indicate this in the "Student’s Overall Progress" box.

Students are evaluated each year at the annual Field meeting held in early summer. Progress reports, teaching evaluations, rotation evaluations and progress towards degree completion are all considered.

### **Student Funding & Appointments**

GGD graduate students are admitted with full funding, which is contingent upon satisfactory progress. Students making satisfactory progress receive financial support, including stipend, tuition, and health insurance. The first year of funding is supported through fellowships and training grant appointments. In the second year, and for the duration of the program, support comes from the thesis advisor, teaching assistantships and individual awards that the student may receive.

**Stipends:** The stipend rate is set by the Graduate School and generally set in January or February for the following academic year.

Graduate student stipends are considered taxable by the U.S. Internal Revenue Service and the State of New York. GRA and TA stipends are administered through Payroll and typically have taxes taken out of each check. Fellowships are typically paid in lump sums throughout the year and do not have taxes withheld. Students

should consult their tax advisor to determine how best to handle payment of taxes to suit their particular circumstances. Cornell faculty and staff cannot offer tax advice. General information is available on the [Graduate School website](#) as well as in the [University Division of Financial Affairs](#). The Office of Global Studies also provides information about filing taxes for international students.

**Tuition Payments:** Tuition payments are made through the university financial system and credited to your Bursar bill. Fall tuition is credited by August and Spring tuition is credited by January. The tuition payment should be taken care of automatically for most students. If you have questions regarding your Bursar bill, please see the GFA in 107 Biotech.

**Health Insurance:** All registered grad students receive an individual Student Health Insurance Plan (SHIP), an accident/illness policy that meets the health insurance standards developed by the American College Health Association. The yearly premium is paid by your source of financial support and should be taken care of automatically. Please contact the GFA if there remains a charge on your Bursar bill. Additional family coverage and/or optional dental and vision insurance is available at a cost to the student. More information can be found on the Office of Student Health Benefits web site, <http://studenthealthbenefits.cornell.edu/>

**Summer Support:** The funding commitment made to the student includes full summer support. The student should continue to make progress toward their degree during the summer months in the same way as they do during the academic year. Summer stipend rates should only be adjusted if there is a commensurate adjustment of effort.

## Methods of Payment to Graduate Students

Graduate student appointments are governed by [University Policy 1.3](#).

**Graduate Research Assistant (GRA) or Teaching Assistant (TA):** While acting as a Graduate Research Assistant or a Teaching Assistant, a student's stipend is processed through the payroll system. A student must be registered to receive a stipend check. Also, in accordance with federal regulations, in order to be paid as a GRA or TA, a graduate students must fill out an I-9 form. This form is necessary for a student to receive a stipend.

A GRA/TA is paid semi-monthly a fixed amount based on the annual stipend rate. Timecards are not required or collected. Taxes are withheld from the student check; the amount will vary depending on how the student fills out the W-4 (withholding) form. The W-4 form can be changed anytime during the year through the Workday system. The student will receive a W-2 (Wage and Tax Statement) from the university at the address listed on your paycheck or on-line, depending on your preference. You are strongly encouraged to use direct deposit; forms can be obtained from <http://www.dfa.cornell.edu/payrollservices/services/directdeposit.cfm>. Physical checks are mailed to student's local address of record. The first check should be available in mid- or late August.

**Fellowship:** A student on a fellowship (either university fellowship or supported by a departmental fellowship) is paid once per semester through the Bursar system in lump sums. (Training grant support is processed like a fellowship). Payment is issued at the beginning of each semester of study (August; January; June). Most stipend checks should be available at the Bursar's Office in Day Hall after registration and are released to registered Cornell students presenting a valid Cornell ID. Taxes **are not** withheld from fellowship checks, and you are responsible for paying estimated taxes on your taxable income. You are strongly encouraged to sign up for direct deposit. Forms can be obtained at <https://www.dfa.cornell.edu/tools-library/forms/student-refund-direct-deposit-form-nelnet>.

**Fellowships** are awarded from the Genetics, Genomics and Development Training Grant, as well as from the Graduate School.

- NIH Training Grant in Genetics, Genomics and Development: Students who are US citizens or permanent residents are eligible for support by the NIH Training Grant in Genetics, Genomics and Development. Appointments to the training grant are made competitively for one year periods. Decisions about the training grant are made by a committee composed of the Principal Investigator of the Training Grant, the Director of Graduate Studies, and an elected member of the faculty from the Field.
- University-Based Fellowships: Fellowship funding is available from Cornell University on a competitive basis for incoming students through various sources, including Graduate School and various other units at the University. Applicants to the program indicate their desire to be considered for this funding in their application for admission and are nominated by the Field. (e.g., fellowship, Dean's Excellence fellowship, SUNY fellowship, and Presidential Life Sciences fellowship).
- Predoctoral fellowships (including some reserved for under-represented minority students) are awarded by The National Science Foundation and the National Institutes of Health to students in the early stages of graduate study. Please contact the DGS or your faculty advisor to obtain more information about these fellowships.
- The [Graduate School Fellowships website](#) lists fellowships from a variety of sources.

**Time Away:** Graduate students appointed on any combination of full assistantships or fellowships for spring, summer, and fall terms are entitled to two weeks (ten weekdays) of annual vacation each 12-month period (August 21 through August 20) in addition to Cornell University holidays (when the university is officially closed); vacation time will be prorated for students appointed for shorter periods of time (e.g., 4 days for a student appointed on an assistantship or fellowship for only one semester during the calendar period August 21-August 20). University holidays generally include the following days: Martin Luther King Jr. Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Thanksgiving and the following day, and winter break (generally six working days from December 25 through January 1). Days on which classes are not in session but the university is open (e.g., institutionally-scheduled academic breaks in Fall Semester, January intersession, Spring Semester) are not automatic vacation time nor holidays for graduate students appointed on assistantships, but graduate students appointed on assistantships may request in advance to take vacation during such periods.

Vacation time will be prorated for students appointed for shorter periods of time (e.g., 4 days for a student appointed on an assistantship or fellowship for only one semester during the calendar period August 21-August 20).

Vacation plans should be discussed in advance with the advisor.

**Student International Travel:** Students who are appointed on assistantships must be in the US to be in compliance with tax and labor laws. Travel outside the US is restricted to a period of less than 30 days.

**External Fellowships:** Students are encouraged to apply for outside funding. Should a student be awarded funding from an external source, this will replace the previous funding source until such time as the external funding ends. External funding may not be combined with other internal sources of funding.

**Questions about Funding/Stipend:** If you have questions about your funding or Bursar bill, contact the GFAs and/or the person responsible for graduate student appointments in your mentor's department.

## Teaching Requirement & Professional Development Opportunities

All graduate students in the Field of Genetics, Genomics and Development are required to participate in teaching for one semester and are encouraged to apply for a second semester position in the Department of Molecular Biology and Genetics or in another department. Most students supported as TAs serve as teaching assistants for the undergraduate Genetics course, BIOMG2810. Doing so strengthens and broadens their genetics background and thus serves as a good base for graduate training. Other students serve as teaching assistants for one of the other courses offered by the Department of Molecular Biology and Genetics. However, a TA position from other departments can also fulfill the TA requirement of GGD.

### For a TA position in MBG, see the following guidelines:

The summer before teaching begins, students receive from the Associate Chair of MBG, who makes TA assignments, a list of courses that are given in the Department of MBG, and a list of the responsibilities of TAs in each course. Each student ranks the courses in order of TA preference. While the Associate Chair tries to accommodate these preferences for teaching assignments, the teaching needs of the department take precedence over individual preferences.

Preferences in TA assignment:

- 1) A student whose thesis advisor is a member of MBG.
- 2) A student in the Field of GGD or BMCB who has not TAed previously.
- 3) Any other student.

If no student in the highest priority category is willing or able to TA a particular course, a student from a lower priority category will be chosen.

International students are required by the University to have an interview by the International TA Development Program (ITADP) to assess competency in English. Students who receive a 28 or above on the TOEFL are exempt from assessment. In some cases, students from non-English speaking countries are required to take an additional course, given by the ITADP, during their second year to improve teaching skills. Occasionally, students may also be required by ITADP to take an English-as-second language course.

All students who are interested in teaching and improving their teaching skills are encouraged to participate in many of the workshops and symposia organized by the Center for Teaching Excellence at Cornell (<http://www.cte.cornell.edu/programs-services/grads-future-educators-tas/index.html>).

GG&D students should take their teaching duties seriously. Teaching performance is evaluated by the undergraduates in the courses and reviewed by the teaching faculty of the department. This review becomes a part of the graduate record and is included in consideration for TA awards by the College of Agriculture and Life Sciences (CALs) and by the Department of MBG (the Joe and Rita Calvo Teaching Award). Furthermore, demonstrated excellence in teaching (communication skills) will greatly strengthen your future applications for jobs, both inside and outside academia.

## Career Resources

Students have access to a variety of **Career Service Resources** on campus. Among these are:

- [Careers Beyond Academia](#)
- [Cornell University Career Services](#)
- [CALs Career Development Office](http://cals.cornell.edu/academics/advising/career/) (<http://cals.cornell.edu/academics/advising/career/>)

- [Office of Postdoctoral Studies](#)

Career seminars are offered throughout each year by GGD or other fields on campus. A Careers Course on various career paths is offered once every other years and often includes GGD alumni who have chosen a variety of career paths.. Career-related issues will also be discussed by speakers during the bi-annual **Graduate Student Symposium**, which will be organized by both GGD and BMCB students.

## Outreach Activities

Cornell has a large number of opportunities for students to get involved in outreach. The [Engaged Cornell Hub](#) offers an opportunity to learn about some of these programs. [Experience Cornell](#) website allows you to explore all the different opportunities to be engaged locally and globally. (Filter opportunities by choose “Cornell Graduate/Professional Students” in the Eligibility filter).

An **Expanding Your Horizons Workshop** is usually held every year on campus. The conference, for girls in the 6th-8th grades, is organized and staffed by women graduate students, postdoctoral, and faculty volunteers. This activity provides a good way to meet other women in math and science, and to share experiences with others interested in education and teaching. For more information, go to the [EYH Cornell Chapter website](#) and the [Cornell Center for Materials Research site](#).

## Required Exams

Exams are a benchmark of progress toward your degree. The Graduate School requires two exams in your progress toward the PhD. Both exams must be scheduled with the Graduate School **at least seven days prior** using the Scheduling forms that are found on the [Grad School Forms page](#). The results form must be submitted with all approvals **within three days** of the exam.

Exams must be announced. The A exam is announced to Field faculty; according to the Code of Legislation, faculty in the Field must be invited to attend, in practice, it rarely happens. The B Exam is usually preceded by a dissertation seminar; the seminar is open to the Cornell community, the exam is not.

## GGD Exam Guidelines: A-Exam – Admissions To Candidacy

To qualify as a Ph.D. candidate, each graduate student must pass an “Admission to Candidacy” exam (or A-exam) before the start of the fifth semester. The examiners are the members of the student’s Special Committee and one other faculty member (to be chosen jointly by the student and thesis advisor). The purpose of the exam is to test the student’s level of knowledge and ability to design research strategies.

### ***Procedural Details***

The examination consists of a written proposal for a research project on a student’s thesis project or on an unrelated project, and the student’s oral defense of the proposal (the actual A-exam). The format of the proposal should be either that of an NSF or an NIH grant request (**15 double-spaced pages of text, 12-point type or larger-see below for details**). It should explain how the research will answer some important scientific question, or (at least) how the research will rule out some possible answers to an important question. Individual members of the Committee may add special requirements to be included in the proposal; for example, a detailed protocol for mapping a gene involved in the proposal, etc. The major professor is permitted one reading of the proposal prior to submission to the exam Committee. The student must deliver a copy of the completed proposal to each exam Committee member no later than one week before the A-exam. At the A-exam, the Committee will question the

student about various aspects of the proposal; but their questions need not be limited to the proposal and should assess the student's ability to analyze and plan experiments in genetics or development, and their knowledge of genetics or development.

Satisfactory defense of the proposal and related questions at the A-exam leads to admission of the student to candidacy for the Ph.D. Failure of the exam leads to one of the following: A one-time rescheduling of the exam; a decision to terminate the student at the Master's degree level upon completion of a Master's thesis; or dismissal from the program (at the discretion of the student's committee).

**The A-exam must be taken by the beginning of a student's fifth semester in graduate school (September 15 of your third year).** To ensure that the exam will be completed within this time frame, students will be asked to set an exam date in the summer after their fourth semester (June 15). Students who have not set a date by this time will have one set by the Director of Graduate Studies.

**Remember that, in addition to your Special Committee members, you need to ask one additional faculty member to join to read your proposal and attend the examination.** This person is not officially a member of your committee, and should not sign the Schedule of Examination form or the Results of Examination Form. The additional faculty member does not necessarily have to be in the Field of Genetics, Genomics and Development; but if you decide to invite someone other than a Field member, please check first with your Special Committee Chair.

You should give a copy of your proposal to each member of your examination committee at least **a week** before the exam.

**It is essential that the Schedule of A Exam form be completed at least 7 days prior to the A-exam.** The on-line form must be signed by the GFA, members of your Special Committee and the Director of Graduate Studies. **You must submit the Results of Examination form within 3 business days after the exam.** These (and all other Grad School forms) are found on the Graduate School Forms web site at <http://www.gradschool.cornell.edu/forms>.

### ***Specific A-Exam Information***

This information was kindly provided by Volker Vogt and Tim Huffaker, Department of Molecular Biology and Genetics.

### **Format of the exam**

The format has a written and an oral component. The written component takes the form of a grant proposal and is described below. You may use a PowerPoint presentation to support your written proposal. You may only have five (5) printable slides with limited animation. Up to five (5) additional slides containing supplementary data that is already in the written proposal may be added. These should only be used for clarification if those experiments are discussed in the exam.

The oral component is a defense of this proposal and you can expect that the majority of questions will be directly related to your proposal or to areas that are considered off-shoots of it. During the oral part of the A exam, the committee should devote at least 10 minutes to discuss **Data Reproducibility**. The 1/2 page section on the proposal should serve as a starting point for a more in depth discussion with the committee.

Your committee member representing a minor subject area, however, represents a special case. This person has the responsibility to ascertain that you have achieved competency in that subject area, and the topic of the research proposal may not afford a good opportunity to do this. We recommend that you meet with the person

in question, and determine prior to the A-exam how he/she suggests you prepare. Some committee members representing minor subject areas may ask broadly-based questions on very basic concepts, whereas others may address a more narrow area and ask the candidate to be prepared for questions in that area.

In addition to the evaluation of your proposal, the A-exam is the time when committee members will discuss and evaluate your performance in the laboratory.

### **The written proposal**

Your proposal should be written following the format specified below which is based on the guidelines for NIH grant proposals. Your proposal can be written on a topic that either does or does not relate to your research. In either case, you should enter your A-exam with a comprehensive knowledge of the literature in the area you have chosen.

Writing on your research more closely approximates a real life situation, because if you pursue a career in research science, you will have to write many proposals about what you plan to do. The special benefit in writing about your research is that it provides you the opportunity to organize your actual research plan and to dig deeply into the literature in your field.

Writing about a topic unrelated to your research allows you to explore a new area, one that deeply interests you, but one that you do not plan to pursue for graduate research. It may be an area you want to pursue at some later stage in your career. To find an unrelated topic, you might browse through recent journals—especially ones of general interest, like *Science* and *Nature*. Find a problem that really interests you and then decide what unanswered questions are raised by the paper. What techniques could be used to answer them? Pursue these ideas with further reading. If you think you have a topic, a good idea is to discuss it in general terms with someone who might know about this topic, such as a faculty member in this or another department.

Once you have narrowed the topic, develop a few (say three) specific questions you want to answer. Don't write down questions that are too general. By being specific, the questions will keep your proposal focused on the topic. After you have come up with a few specific questions, sketch in outline form what experiments you might do to answer them. Then work through the details to flesh your ideas out as a real proposal.

Your proposal will be judged for its innovation, quality and organization. Your thoughts should be developed logically and should represent some real insight in the field. The exam is meant to challenge your thinking and provoke discussion between you and your examiners. The format does not serve a useful purpose if the proposal and the exam:

1. Simply espouses "the party line" and echoes common themes in the lab (if you are writing on your own research).
2. Does not address interesting issues in the field.
3. Proposes only a small incremental advance in research.
4. Offers only pedestrian solutions to problems.
5. Fails to evoke dialectics and debate.

Finally, matters of writing style and impeccable grammar are absolutely essential for successful proposals. Simple flaws can mar an otherwise perfect proposal. The A-exam proposal is an exercise in meeting the highest standards of style and presentation.

### ***Specifics on writing the proposal***

You should follow the format specified below which is based on the format for NIH grant proposals. Strict page limitations are set for grant proposals, and thus also for your proposal. Page limitations are specified below; each page should be double spaced with margins of at least one inch and in a font not smaller than Times 12 point. **The total length of the proposal, including figures, is 15 pages. Literature cited is not included in this page limit.** The proposed work should be limited in scope, so that a postdoctoral fellow (perhaps with the help of a technician) could accomplish the bulk of the work in three years. Study sections that review grants are very critical of

proposals that describe five times as much work as could actually be done, even if very good descriptions of experiments are given.

An important section of all grant proposals is the progress report or preliminary data. However, this section is not a deciding element in the A-exam, and students should not put off taking an A-exam for want of more data. Preliminary data is useful in charting the future course of research; however, the A-exam is not intended to judge research accomplishments, but to assess the prospects for research based on the student's ability to conceive, investigate and defend a research proposal.

Here is the format you should follow: (suggested page limits for each section in double spaced text are provided). **Note: Exams that are over the 15 total page limit will be returned to the student so that they conform to page requirements!**

- A. Abstract** ( $\leq 1$  page). This is a summary of the proposed work, with enough of an introduction to allow someone not expert in the field to understand what is planned and to appreciate its importance.
- B. Introduction** ( $\leq 6$  pages). The Introduction is one of the most important sections of your proposal. This section introduces the topic and system, and summarizes what is already known. The review should be comprehensive but not simply be a chronology of events; it should represent a critical appraisal of developments in the field and an evaluation of the present state of affairs. You should cite review articles as well as original research articles that are relevant. If appropriate, unpublished results can be included as a minor component of this section. Other research results that you have may be best incorporated into the Experimental Design and Methods section below. End this section with a clear statement of the overall goal of the work.
- C. Specific Aims.** ( $\leq 1$  page). This section states crisply the hypothesis you are testing, or the questions you will try to answer. It also provides a list of each separate approach (aim) you will use to reach the overall goal. Use subheadings if appropriate **(1)**.
- D. Experimental Design and Methods** ( $\leq 10$  pages). This is the meat of your proposal and should be organized according to the specific aims and presented clearly. Critical experiments should be described so that examiners appreciate your mastery of the subject. Experiments, important controls and contingency plans need to be fully described.

Outline for each of the specific aims (use the same headings and subheadings) how you will proceed to test the hypothesis or answer the question posed. Give enough detail so the reviewer can judge if the experiment is likely to work. You don't need to give details about common procedures since these can be referenced. For example, molecular biological methods that are described in a manual such as Current Protocols in Molecular Biology needn't be repeated (buffers, times of incubation, etc.). But if there is a basic protocol you rely on for a large fraction of the work, you should lay it out for the reader. The reviewer is looking for indications that you have carefully thought out every step in the proposed procedure. If you are not sure every step is feasible, so indicate and describe what you will do if the step doesn't work.

There are several types of design problems that occur frequently, both in A-exam proposals and in real grant proposals.

1. *Achieving the goal requires finding something.* A favorite criticism of some kinds of proposals is that they are nothing but "fishing expeditions" (by implication, with little chance of catching a big one). Don't plan to spend more than a fraction of your research time seeking something that you may not find **(2)**. Even if the payoff looks large, and if the chances look good, you won't get grant money (at least not at the beginning of your career) if a search is the main thing the proposal is about. Build into the proposal experiments that will yield results no matter how they come out **(3)**.

2. *Too many contingencies.* If achieving a major goal Z requires you first to achieve Y, and Y requires X, and so forth, the probability of reaching the end goal Z may not be high (4).
3. *Limitation of starting material.* Know how much starting material is available, how much this costs to obtain (money or labor), and what size of an operation you would need to work it up to achieve your goal (5).

An important part of the "Experimental Design and Methods" section is a description of how data will be interpreted. This is especially true for quantitative data. No one obtains funding just to make measurements! Grant proposals are frequently criticized because the results obtained will be "purely descriptive" (a favorite phrase of criticism often levied by reviewers). What is the meaning of the data you hope to collect? Being explicit about your interpretations is a key element in convincing the reviewer that the papers you write will make a significant contribution to the field (instead of confusing the field so that others will need to clean up afterwards, as so often happens).

At the end of the "Experimental" section, it is wise to put in a paragraph or two about possible pitfalls. Nothing is guaranteed to work. If you let the reviewer know what you think the major limitations are, then you make clear the fact that you have thought about them. If you anticipate a potential problem, then you should indicate what alternative procedures you will use to get around it (6).

- E. Significance** ( $\leq 1$  page). With the present competition for financial support, it has become crucial to argue that your results will be of importance for answering fundamental questions, or that they will lead to avenues of inquiry, or that they will be of practical relevance to medicine or biotechnology (for example). State succinctly why the taxpayer should support your proposed work.
- F. References.** These should be in the regular journal format, with titles. Twenty-five should be enough, although more are often included. Choose them carefully. Just cite the most recent, or the one or two most important references of a series. Use reviews for older literature references, adding "see \_\_\_ for review."
- G. Figures and Tables.** Figures and tables are often useful as an aid to the text. It is quite appropriate to reproduce figures from a review or other important article (state clearly from where taken). Figures may also be useful to show the reader what data you expect and how the data will be interpreted. Key figures and tables should be placed in the appropriate positions in the text and they count toward the page limits.

#### **Time required to prepare the proposal**

You should plan to spend about one month of full time work to prepare your proposal. Some students can do the background research and then write a thoughtful proposal in three weeks, while some take six weeks. Two months is definitely too long!

#### **General comments on writing**

Good writing is an essential component in your quest for funding! If you are famous, you may get a poorly written grant proposal funded. However, most of us have seen funding denied to very well established investigators who have submitted carelessly or poorly written proposals. On the other hand, if you are not well known, given the competition for research funds that exists today, your proposal will almost certainly remain without financial support if it is poorly thought out or poorly written. In a well-written proposal, the eye of the reader moves down the page in an unbroken manner, from sentence to sentence and paragraph to paragraph. The logic of the presentation is so clear, and the writing so free of distractions, that he almost never has to read a sentence twice. This requires good use of transitions, between sentences (7) and between paragraphs (8). A particularly important principle of good writing that is often neglected is paragraph structure. Each paragraph should have a topic sentence (usually the first sentence) that tells what the paragraph is about. Another principle is to use uniform

tense (9). Yet another principle (often mis-taught by teachers of scientific writing) is to avoid overuse of the passive voice (10). Keep in mind that a well-written proposal requires multiple revisions. Each word and sentence should say exactly what you want to say—no more and no less.

#### Footnotes:

1. One format might be: "The overall aim is to..." , or "The long term goal is to.....", followed by one or a few sentences. Then the actual specific aims could simply be listed, perhaps with subheadings 1. [1a,1b]; 2. [2a,2b,2c]; 3. Often the best way to phrase your aims is in terms of an hypothesis: "The hypothesis to be tested is that....."
2. For example, don't draw up a proposal with the major aim to identify by differential display a cDNA representing a messenger RNA that is produced in mammalian cells in response to growth factor stimulation. That is truly a fishing expedition and there is not much to say about the cDNA until it is found. Or as another example: suppose you want to study what proteins interact with a yeast cytoskeletal protein, by mutating the gene for that protein, and then cloning second site suppressor genes. This is an excellent approach and has many precedents. But even so, the second site suppressors may not be obtainable. Hence, in the absence of direct evidence that this approach is workable in your system, don't put all your eggs in this basket.
3. For example, if you are studying a particular protein that is available in pure form, do some enzymological characterization that will answer an important question, or map functional domains of the protein by mutagenesis—in such cases whatever you find or measure may be useful.
4. For example, suppose you want to study the properties of a very minor cellular protein, say the protein product of the *mos* oncogene. Your plan is to purify the protein, make monoclonal antibodies, use the antibodies to fish out the right gene from a cDNA expression library, hook up the gene to strong inducible promoter, insert this construct into an *E. coli* expression system, induce and finally purify the protein. All these are standard steps, but the chances of success, starting with no knowledge about the protein, are slim. Purifying minor proteins may be difficult (suppose this one is membrane bound and inactivated by detergents). Maybe the protein is not very antigenic in mice. The monoclonals may well not work in the western blot screening procedure. The expressed protein may be toxic even low doses, or it may well precipitate in the cell. Don't base too much of the proposal on such a series.
5. For example, don't propose to grow primary animal cells in culture as a source for a minor protein you want to purify in milligram amounts. Think ahead that one plate of cells, costing roughly a dollar in plastic plus growth medium, contains only a milligram of total protein. Since you would need thousands of plates to obtain enough starting material, this strategy would not be workable.
6. For example, suppose you plan to overexpress a certain foreign protein by introducing the gene into CHO cells along with the gene for dihydrofolate reductase, and then selecting for gene amplification with methotrexate. This is a reasonable procedure, but it might turn out that the protein is toxic to the cells, and thus production will not be high, or the protein may become mutated to a less toxic form, or the clone may simply not be obtainable. You should anticipate these problems, and indicate if troubles arise, a different eukaryotic expression system (for example baculovirus) will be used instead.
7. A transition can be a word or a phrase or clause showing how what follows relates logically to what came before. For example: "However,..."; "Nevertheless,..."; "In addition,..."; "By contrast,..."; "In order to..."; or "Based on these results,..."; etc.
8. For example, "To generalize these observations, ..."; "With the aim of elucidating the molecular biology of this phenomenon,..."; etc.
9. There is a lot of confusion about usage of tense in scientific writing, and also some leeway. In general, if you are describing particular experiments that were done in the past (either yours or those of others), use the past tense. "Optimal conditions for cell growth were established"; "The blot was hybridized with nick-translated probe from clone X"; "Smith et al. cloned the receptor gene." By contrast, if you are describing

generalizations, or making a statement that had validity and still has validity, use the present tense. "Smith et al. showed that the fms oncogene has a protein kinase activity." No matter what convention you use, do not switch between tenses without good reason.

10. There is nothing wrong with saying, "Harris and Jones investigated the relationship....", or "We investigated...", or (for example, in the context of a proposal) "I will investigate..." To the contrary, active voice is much preferable to the passive "The relationship was investigated by Harris and Jones..." In this latter case at least the identity of the actors (H and J) is clear. But if you say, "The relationship was investigated..." (meaning "we" did), the reader may well be confused who did it. Overuse of the passive voice is a common hallmark of poor scientific writing, and is frequently accompanied by this sort of confusion. Get in the habit of using active voice, at least at the start of a paragraph or description, to identify authorship absolutely clearly. Then in continuations of the descriptions, if no ambiguities arise, you may use passive, in order to emphasize the results instead of the authorship.

### **How much help can you receive in preparing your proposal?**

Connecting to others in the research community is essential in competitive research and evidence of your involvement in science. A factor in evaluating your proposal is whether you have made these interconnections. Although you should seek out as much information as you can find about your topic, the major ideas should be yours, as should all the writing, of course. The following guidelines were crafted with the idea of encouraging input from others while at the same time focusing attention on your efforts.

In meeting with a faculty member about your proposal, it is expected that you will describe the general nature of the problem under investigation, the specific questions that you are proposing, and an overview of the approaches that you plan to take. In addition to comments on importance and feasibility, some faculty may provide you with factual material or with references.

Once you have written a complete proposal that contains all of the questions that you expect to pose and all of the experimental approaches you intend to follow, give your proposal to several senior graduate students or postdoctoral fellows and faculty advisor, and ask them for criticism. If they provide you with ideas that you use, give them credit for those ideas. For example, "(latter two controls suggested by Chelsea Clinton)". The criticisms should be general (e.g. "this section is awkward", "this is unclear", "why not expand this section to include related studies?"). No one but you should be doing the actual writing.

### **Possible outcomes of the A-Exam**

At the conclusion of the A exam, both the student and the Special Committee Chair must leave the room. The remainder of the examining committee discusses the performance of the student and arrives at a provisional outcome (pass/conditional pass/fail). The Special Committee Chair returns to the room and after further discussion a final definitive outcome is agreed upon.

Some possible outcomes of the A-exam are described below. While one of these outcomes will apply in most cases, it should be noted that the final outcome is determined by the Special Committee and they are not limited to the examples given below. Some factors that may be judged in evaluation of the A-exam are:

- importance of the problem chosen
- an introduction that demonstrates a command of the field.
- evidence of creativity in formulating experimental approaches
- feasibility of the proposed experiments
- whether a range of different approaches are brought to bear on the problem
- whether the scope of the proposed experiments is feasible for a three-year project
- adequacy of control experiments
- clarity of the proposal
- ability to deal with questions
- communication / presentation skills

- breadth of knowledge

**1. Unqualified pass.**

**2. Pass conditional on rewriting the proposal.** This option will be exercised when the committee judges that the proposal and the defense are adequate but that some aspect of the proposal needs to be improved. The committee may specify that the entire proposal or that parts of it need to be revised. Some reasons for revision are:

- a. The writing needs to be improved (for example, grammar, clarity, or logical flow of ideas).
- b. Some aspect of the science needs to be rethought (for example, better controls, more cautious interpretation, or more detailed description).
- c. An additional section needs to be incorporated into the proposal.

The student is expected to rewrite the proposal within 2 weeks and resubmit it to the examination committee members for approval. The extent to which the major professor wants to be involved in the rewriting is up to him or her.

**3. Fail.** The student can fail the exam because either the written proposal or the oral defense is judged inadequate. In that case, the committee will usually recommend one of three actions. If the committee has confidence in the overall ability of the student to complete the Ph.D. program, then they may recommend that the student retake the A-exam. In this case, they will specify whether an entirely new proposal on a different topic is to be written or whether they expect a major rewriting of the original proposal. Note that the rules of the Graduate School specify that a second A-exam cannot be scheduled earlier than 3 months after the first.

If the committee has some question concerning the motivation or ability of the student to complete the Ph.D. program, it will usually recommend that the student complete a piece of research, write a Masters-level thesis based on that work, and then defend that thesis. If the student wants to continue for a Ph.D. degree, and his or her committee judges that the Masters-level work and thesis defense demonstrates qualification, then the thesis defense may be accepted in lieu of an A-exam. In some cases, the Special Committee may specify that reentering the Ph.D. program requires retaking the A-exam.

If the committee feels that gap between the student's ability/motivation and the expectation of the program is too wide to be bridged, it may recommend dismissal of student from the program.

**What can I do to ensure that I pass my A-exam?**

We have three suggestions:

1. Read several proposals written by former students. Copies of these can be obtained from the Graduate Field Assistant.
2. Read carefully the specifics on writing the proposal, below.
3. If you are worried about being nervous, and having to think on your feet while being nervous, it may help you to have a practice run. You can do this by asking several students to read your proposal and then act as examiners during a mock 2-hour exam.

**Remember this: everyone in this field wants you to succeed.**

**GGD Guidelines: Thesis Defense – B-Exam**

**Genetics, Genomics and Development graduate students are expected to produce at least one high quality first-author publication as a condition for obtaining the Ph.D. Degree.** The oral defense of the Ph.D. Thesis (or "B" exam) before the special committee occurs after the student has distributed the dissertation to the special committee members. The student must deliver a copy of the thesis to their committee at least one week before

the exam. **In addition, at least 7 days before the exam the student must fill out the Schedule of B Exam form, which must be approved by the GFA as well as the student's Special Committee and the DGS).** An open seminar, often scheduled as a Wednesday field seminar, is given as close to as possible, if not immediately before, the B-exam. The seminar announcement should include the title and summary of the thesis research, as well as status of publications resulting from the thesis research. **Within 3 business days after the exam, a results of examination form must be completed.**

The Field expects **GGD students to complete their PhD degree in six years or less.** Senior students will be asked prior to the completion of their fifth year in the program to provide the DGS a written summary detailing remaining experiments and manuscript plans, a thesis outline, and a brief description of post-graduation plans. In cases where a student has stayed in the program for significantly longer than 6 years, in consulting with the student's Special Committee, the DGS will set a deadline by which the student must defend his/her thesis. The student will also be informed that defending the thesis is not a guarantee that he/she will receive a Ph.D. degree.

To familiarize yourself with the format of a typical thesis in our field, you can access a collection of theses completed by graduate students in GGD and BMCB in Room G09 (the Elizabeth Keller Reading Room) located on the ground floor of the Biotechnology Building. You need to stop by 107 Biotech to sign out the key to gain access to this room. Please note that materials are **NEVER** to be taken from this room. Full collections of dissertations are maintained in Mann Library.

### **GGD Research Paper Awards**

The Field of GGD awards a yearly prize for **two** best papers first-authored by graduate students. One prize is generously provided by Frank Meleca of Laboratory Product Sales and is known as the LPS award. The other prize is generously provided by a former GGD alum, Bill Wellnitz, and is known as the Wellnitz Award. An evaluation committee of three faculty members will pick what they judge to be the best GG&D paper published during the current calendar year. Please note that faculty who sponsor students for the award are not eligible to serve on the evaluation committee, which is appointed on an ad hoc basis by the Director of Graduate Studies. All graduate students in the Field who have been first-author on a paper in the current calendar year are eligible, including previous winners and those who have since left Cornell. If two papers are deemed equivalent, and one of the students had won the award previously, then the award will go to the other student.

A GGD faculty mentor or student should submit an electronic version of their paper to the Director of Graduate Studies and the Graduate Field Assistant. Please include with the paper a letter from the mentor outlining both the importance of the paper and the contributions made by the student. The name of the award winner will be announced in May and will be inscribed on a plaque in the MBG departmental offices, and a list of all of the student publications for the year will be posted near the plaque.

A notice will be sent in late winter/early spring to both students and faculty calling for nominations.

### **Journal Clubs and Other Activities**

**There are a large number of journal clubs held on campus.** Participation is on a voluntary basis, but students are encouraged to attend the Journal Clubs in their area of interest. Below are some of the Journal Clubs that meet on a regular basis. Students are encouraged to consult with faculty and their colleagues to identify others of interest:

- **Bacterial Genetics Journal Club**
- **Cell Biology Journal Club**
- **Cellular and Molecular Neurobiology Journal Club**

- **Cornell Vertebrate Genomics Meeting**
- **Developmental Biology Journal Club**
- **Environmental Microbiology Journal Club**
- **Eukaryotic Gene Regulation Journal Club**
- **Molecular Evolution Journal Club**
- **Neuroethology Journal Club**
- **Repair, Replication & Recombination (R3) Group**
- **Reproductive Biology Journal Club**
- **Sexual Selection Journal Club**
- **Stem Cells and Cancer Journal**
- **Virology Journal Club**
- **Topics in Quantitative Genomics**
- **Cornell Stem Cell Program Meeting**

Most labs also have their own weekly lab meetings. Students who are members of the particular lab, or are rotating in, the lab attend; others are welcome.

### **GGD-BMCB Biennial Symposium**

In conjunction with the field of BMCB, the Field of GGD co-organizes a full day research symposium every other year. Students take the lead in organizing this event, and identify a focus area, establish a budget, and invite and host the speakers. Students from both fields participate on the organizing committee, with each field playing the lead organizational role in alternating years. The symposium features scientific presentations from leading scientists typically from a variety of settings (academic, industry, government, etc.) as well as workshops held only for GGD and BMCB graduate students by the same visiting scientists. The symposium has proven to be an outstanding opportunity for trainees to network with prominent scientists in their fields of interest.

### **Research & Travel Grants**

#### **Research Grants**

Numerous grants are available for students who take the time and effort to apply for them. Grantsmanship is an important skill in academia and one worth refining early. Some proposals must be submitted in the name of a faculty member, such as those awarded by the National Science Foundation (NSF), the National Institutes of Health (NIH), the US Department of Agriculture (USDA) Competitive Grants Program, the Department of Energy (DOE), the Department of Defense (DOD), the World Health Organization (WHO), and the National Geographic Society. The Office of Sponsored Programs (373 Pine Tree Road, East Hill Plaza, 5-5014) has a Federal Register of weekly listings of available money and has several compendia of agencies and industries that provide research grants. Other research grants are awarded directly to graduate students. Some of the more reliable sources include:

1. Cornell Chapter of [Sigma Xi, the Scientific Research Society](#). This is an especially good source for new graduate students. Awards are in the \$100 to \$300 range. Application deadline is in February.
2. [American Association of University Women](#) offers Grants-in-aid, Dissertation Completion Grants, and Postdoctoral Fellowships for women. These are very competitive — available to women in all fields.
4. [Grants for Improving Doctoral Dissertation Research](#) Funds are available for almost every facet of research except stipends and tuition. Proposals are written by students but submitted on behalf of the student by the major advisor through Cornell's Office of Sponsored Programs.
5. [Fulbright grants](#) support graduate study or research abroad. Competitive, but well worth the effort if you plan to study overseas.

6. **Congressionally Directed Medical Research Grants.** This program funds research for graduate students whose projects focus on a variety of human diseases. Information on the grants can be found at <http://cdmrp.army.mil/> Students at Cornell have won these awards!

## Travel Grants

The Graduate School provides grants for research and conference related travel to enable full time students to present at professional meetings or conduct research. For specific information on these awards is found on the [Travel Funding Opportunities](#) page on the Graduate School web site.

The **Center for International Studies** awards funds for Ph.D. candidates for research-related travel having direct relevance to international or “comparative” studies.

The **NIH Training Grant in Genetics, Genomics and Development** provides travel funds (typically \$300) for students appointed on the Training Grant. Students are encouraged to use these funds and should discuss their travel plans early with their major professor (the conference must take place before the student’s appointment expires). Requests should be sent to the PI of the training grant (Andrew Grimson) with copies to Cathy Ervay and Vic Shaff.

## Graduate Student Life & Support

The Field of GGD very carefully chooses students admitted to our program and our graduate community is committed to the success of each student, both in completing their graduate program and moving toward individual career goals. There are many sources of support for students within the Field, the department, college, and university.

### University-wide support:

The Graduate School Office of Academic & Student Affairs has a guide for research students that covers, among other topics, suggested [strategies and avenues to resolve conflict](#) with your mentor. The [Office of Graduate Student Life](#) offers programming and resources to support and enhance the well-being and work-life balance of Cornell graduate students. The Graduate School also provides a list a range of [resources available](#) to Cornell Graduate Students.

On the University level, there are a number of offices dedicated to the health and well-being of Cornell students and creating a [caring community](#). The [University Ombudsman](#) is a place where any member of the Cornell community can have a confidential conversation about problems or issues within the Cornell community.

The **Graduate and Professional Student Assembly** is a major forum for discussion and implementing actions that affect graduate students. Each Field has a student representative on the assembly.

## Field/Department Support

**GGD Student Representatives:** **Two student representatives** are selected each year from the first year class near the end of the first year. The student reps coordinate graduate student help during the recruitment of new graduate students, communicate with the DGS on behalf of all GGD students about curricular and other issues, and attend the GGD faculty Field meetings (except for discussions on individual students in the spring Field

meeting). Additional interactions and social gatherings are organized by the **GGD Graduate Student Association (GGDGSA)**.

**GGD Climate Committee's** mission is to address the wide range of graduate student experiences that exist, identify issues that students are facing, and provide actionable solutions to ensure an environment where all graduate students are able to do their best work. They created [tips for incoming students](#) and you can see committee members and other recent projects [here](#).

**MBG Diversity Council** was created by students in the three Graduate Fields administered in the department -- BMCB (Biochemistry, Molecular, and Cell Biology), GGD (Genetics, Genomics, and Development), and Biophysics. Its mission is to promote, enhance and expand the diversity of the MBG community in order to create an inclusive environment for all. All students, postdocs, staff and faculty in MBG and associated Fields are welcome to join! <https://www.cornellmbgdiversity.org/>

The **MBG Diversity, Equity & Inclusion (DEI) Committee** advises MBG's Faculty Lead for Diversity & Inclusion and includes faculty, graduate students, postdocs and staff. For more information about MBG's commitment to diversity and inclusion, go to <https://mbg.cornell.edu/diversity-equity-inclusion/>

**MBG Peer Support Network:** Individual volunteers from the faculty, students and staff serve as contacts for students who need support or have questions/concerns. Volunteers are not councilors but caring folks willing to listen and provide support and resources where appropriate. <https://mbg.cornell.edu/about/facilities-and-resources/peer-support-network/>

## Conflict Resolution

Communication is key in graduate student life. You should have frequent conversations with your mentor regarding expectations and progress. However, if you feel you are struggling or there is an issue or conflict with your mentor or another community member, you should feel free to reach out to members of the support system that surrounds you for help in resolving the conflict.

An important step in resolving conflict is to talk about it with the person with whom the conflict has arisen. You may feel you need support or suggestions about how best to do this, particularly if the issue/conflict is with your Special Committee Chair.

Often it helps to talk to your graduate student colleagues who may have experienced similar feelings/situations and can provide insights or resources that helped them. The DGS, GFAs are also available to listen and help or direct you to other resources.

The [Ombudsman Office](#) offers a neutral, confidential place for members of the Cornell community to discuss problems.

The Dean of Students Office includes a [Care & Crisis Services Team](#). You should feel free to contact them for help even if the conflict is not a crisis. They can offer advice and suggest avenues for resolution.

## Social Life

The **Annual MBG Awards and Welcome Ceremony** is held each year as part of the MBG-Field Orientation and is a good way to meet the students, staff and faculty. It is organized in large part to welcome the incoming class of graduate students and also celebrate the achievements of the department and Graduate Field Communities over the past year.

[Intramural Sports](#) are a great way to get to know people. There are many sports activities, softball, volleyball and basketball are possibilities, and several students and faculty play ice hockey with graduate student teams. Look for sign-up sheets on bulletin boards around the building and ask your fellow students.

[The Big Red Barn](#) is a place to eat, socialize and meet other graduate students. You can reserve space there at no cost for professional or social activities.

For a list of a variety of campus groups, see:

- [Graduate School Student Communities](#)
- [Campus Groups: Grad/Professional Student Organizations](#)

## History of Genetics, Genomics & Development at Cornell University

by Adrian Srb, 1985 & 1991; Antonie Blackler, 1997

When the Division of Biological Sciences was created at Cornell in 1964 as one of the recommendations of the Morison Commission -- an extramural group appointed by President Perkins to examine the organization of basic biology at the University, genetics and development as areas of research and teaching became the responsibility of the newly created Section of Genetics, Development & Physiology -- a hybrid collection of faculty drawn from three departments in the Endowed and Statutory Colleges. The new Division was headed by Robert A. Morison, the Chairman of the Commission whose influence is still manifest in much of the Division's structure and activities.

The geneticists of the new Section were drawn, for the most part, from the Department of Plant Breeding. This department had a distinguished history that could be traced back to the era of Rollins A. Emerson and his "school" of maize geneticists of the 1920s and '30s. Emerson's group carried out research that established maize as one of the best known 'genetic' organisms and worked out many extensions of Mendelian principles. Some of Emerson's students and others associated with his group went on to be the most influential geneticists of their generation -- the Nobel laureates George W. Beadle and Barbara McClintock, and the distinguished geneticists Milislav Demerec, Marcus Rhoades, George Sprague, Charles Burnham, and E.G. Anderson<sup>1</sup>.

In 1964 the geneticists of the new Section were Bruce Wallace, a population geneticist who did his experimental work with *Drosophila*; Harry Stinson, an *Oenothera* geneticist; and Adrian Srb, a fungal geneticist working primarily with *Neurospora*. The need for strength in the biochemical aspects of genetics was met by a new faculty appointment, Ross MacIntyre, who used biochemical genetic approaches to evolutionary and developmental problems in *Drosophila*.

The developmental faculty was drawn from the former Department of Zoology, the history of which could be traced back to the time of Burt G. Wilder, a neuroanatomist whose collection of human brains still forms part of the University archives. In 1964, the Department of Zoology was emerging from some internal divisiveness. The four Zoology faculty attached to the new Section were William Wimsatt, known for his work on the reproduction of bats; John Anderson, whose laboratory researched the regenerative properties of echinoderms; Samuel Leonard, closing a long career in the isolation and characterization of reproductive hormones; and Antonie Blackler, a developmental biologist whose studies of embryonic germ line cells in amphibia had genetic implications. Blackler had just arrived from Switzerland as the last appointment in the Department of Zoology.

The remaining faculty were drawn from the Department of Botany. Among them was Charles Uhl, a plant cytogeneticist whose research interests focused on cytotaxonomic problems in succulent plants; and Harlan Banks, a paleobotanist. The 'physiology' of the new Section's title really meant plant physiology, and a coherent faculty nucleus was created from old and new appointments, among which may be noted those of André Jagendorf, Roderick Clayton, Dominick Paolillo, and Peter Davies.

Even with this considerable mustering of strength in genetic and developmental research, Section members saw gaps, particularly in molecular aspects of genetics that needed to be filled if the University were to have a thoroughly modern array of research programs. A request for two new positions was considered favorably. As a result there were appointed Gerald Fink, a molecular geneticist using yeast as an experimental object; and Peter Bruns, a geneticist working with the ciliate *Tetrahymena*. An additional appointment of Richard Hallberg was made in the area of developmental biology to create a focal point for training and research in molecular aspects of development, and an electron microscopist, Mandayam Parthasarathy, was also added to the faculty. Hallberg, whose work with the frog *Xenopus* principally concerned the role of ribosomal proteins, subsequently left for a position at Iowa State University.

During the 1970s, much of the genetic and developmental research ascribable to the Section, later to be called the Section of Genetics and Development with the departure of the plant-oriented faculty to a new Section of Plant Biology, can be described in reference to the professorial staff assembled as noted in the preceding paragraphs. The details cannot possibly be dealt with in this brief space, but important general features include the following:

Wallace continued his status as one of the world's best population geneticists, in part by writing a series of books and monographs treating various aspects of his field in highly innovative ways. Experimentally, he demonstrated the heterotic effects of deleterious mutations induced by irradiation in *Drosophila* populations, and also used original approaches to examine a series of questions in ecological genetics.

MacIntyre and his group succeeded in the isolation and characterization of mutations affecting enzymes having important metabolic functions. Analysis of the *Drosophila* enzyme mutants gave insight into the puzzling classical genetic phenomenon known as position effect variegation. Some of the mutants gave opportunities for studies of the genetic control of behavioral responses.

Before leaving the University for the Whitehead Institute at MIT, the Fink group carried out molecular genetic studies of yeast that yielded better understanding of mutation and recombination, capped by the demonstration of genetic transformation in yeast -- the first such in a eukaryote and very important for subsequent progress in the molecular biology of higher organisms.

Bruns invented techniques that permitted him to establish *Tetrahymena* as a useful and attractive organism for genetic research, and to explore the potential of the ciliate as a model developmental system.

In Srb's laboratory cytoplasmic inheritance was extensively studied in *Neurospora*, with mitochondrial systems being shown to have substantial autonomy in reference to chromosomal influence. Other work utilized mutants in an analysis of the sexual reproductive process operating in fungi and the developmental sequence of ascospore maturation.

Until assuming full-time administrative duties in the Division, Stinson conducted intriguing studies of plastid genetics in *Oenothera*. In the absence of a regular diploid system, Blackler used interspecific hybrids of *Xenopus* to study the expression of nucleolar and various enzyme patterns. Wimsatt became involved in the reproductive and economic biology of vampire bats and edited a three volume treatise of bat biology. Uhl defined numerous karyotypes in taxonomically related succulent plants while elaborating their systematic and ecological relationships.

Further reorganization of the biological sciences at Cornell provided additional strength to the Section of Genetics and Development and at the same time filled a significant gap in its research programs. Stanley Zahler was transferred into the Section from the Department of Microbiology. Until Zahler's arrival prokaryote genetics had no representation in the group designated as having primary responsibility for genetics. After earlier work with myxobacteria, Zahler had a major influence in establishing *Bacillus subtilis* as an effective object of genetic analysis. His isolation of appropriate transducing phages provided a potent tool for a refined analysis of the *B. subtilis* genome. On his retirement in 1994, active recruiting for a replacement was successful in bringing a yeast geneticist to the Section -- Eric Alani, whose laboratory group is studying mismatch repair mechanisms in yeast chromosomes. By the addition of Valley Stewart of the Section of Microbiology as a Joint Appointee in Genetics & Development, the bacterial genetics lacuna later caused by the Zahler retirement was covered. Stewart's research is directed to the genetic regulation of nitrate metabolism in gram-negative bacteria.

With the arrival of the 1980s, the Section, to replace Gerald Fink, appointed Thomas D. Fox who, like Fink and Alani, is a specialist in the molecular genetics of yeast. Fox focuses on the regulation of mitochondrial genes at the translational level.

The restructuring within the Division of Biological Sciences that ultimately created the Section of Plant Biology, as noted above, put the genetics and development faculty in a favorable position to reevaluate the mission of the Section of Genetics and Development (as it became now known). It was concluded that Cornell was underrepresented in developmental biology; hence a case was made for new appointments of developmentalists whose research would be firmly based in genetic thinking and approach. The result was that the Section hired three young biologists who might equally well be called geneticists or developmentalists but whose problem areas for research were clearly developmental in character. The emphasis was, and still is, on the genetic underpinnings of development. These appointees were: Michael Goldberg, who investigates the molecular and genetic bases of mitosis in *Drosophila*; Mariana Wolfner, who studies sexual differentiation and fertility in *Drosophila* by isolating, and defining molecular sequences that are transcribed at particular stages; and Kenneth Kemphues, who uses mutants in analyzing critical cytoplasmic steps in the very early development of the nematode *Caenorhabditis elegans*.

With the departure of Wallace in 1981 to the State University of Virginia, and the untimely death of Wimsatt thereafter, three more appointments were made to fill major lacunae in the representation of genetic research. Maureen Hanson joined the Section in 1985 to represent and develop the relatively new area of the molecular genetics of plants. She also has a significant research involvement in the mitochondrial genetics of higher plants, notably *Petunia*. Charles Aquadro, joining the Section in 1985, is a *Drosophila* geneticist who is a leader in the area of molecular population genetics. His group is involved in quantitative studies of the extent of genetic variation in natural populations of *Drosophila*. Willie Mark represented mammalian developmental genetics after joining Section in 1988; his laboratory examined insertional mutagenesis in mice (he left the Section in 1995).

Extra strength was added when Rob Last of the Boyce Thompson Institute for Plant Research joined the Section in 1990 as Adjunct Professor. His laboratory represented genetic and molecular approaches to understanding plant growth and reaction to environmental stresses.

Over the years, present and past geneticists from the Section received many honors and awards that recognize research excellence. For example, Srb, Wallace, and Fink are members of the National Academy of Sciences. Bruns, MacIntyre, and Srb have been awarded Guggenheim Fellowships. Wallace and Srb received Fulbright awards. Fox was the recipient of an NIH Research Career Development Award and Wolfner was the recipient of an NSF Career Advancement Award. Wolfner also was awarded an American Cancer Society Faculty Research Award. Hanson received a McKnight Foundation Individual Research Award and is the Liberty Hyde Bailey Professor of Plant Molecular Biology. Last received a National Science Foundation 1990 Presidential Young Investigator Award. Blackler served as a National Science Foundation Division Director in 1980 & 1981.

<sup>1</sup> See *A Feeling for the Organism, The Life and Work of Barbara McClintock* by E.F. Keller, 1983. (Freeman, NY).