



Human Genetics
at the University of Chicago

Graduate Program Handbook

Molecular Biosciences Cluster
Biological Sciences Division

2017-2018
Academic Year

The guidelines in this handbook are official policies of the Department of Human Genetics. Students and faculty of the department are expected to follow these policies. Students with questions not answered by this handbook are encouraged to contact the Graduate Affairs Administrator or the Chair of the Curriculum Committee.

ACADEMIC AND HUMAN GENETICS CALENDAR

Autumn Quarter 2017

September 4	Labor Day
September 12-22	Preliminary examinations
September 18-22	Orientation week
September 25	Autumn quarter classes begin
November 3-5	Molecular Biosciences Retreat
November 18	Winter quarter rotation decisions due
November 23-24	Thanksgiving holiday observance
December 9	Quarter ends

Winter Quarter 2018

January 3	Winter quarter classes begin
January 15	Martin Luther King, Jr. Day
February 3	Spring quarter rotation decisions due
February 9	College Break
March 17	Winter quarter ends

Spring Quarter 2018

March 23	Thesis committee members submitted (2 nd year students)
March 26	Spring quarter classes begin
April 30	Thesis proposals due (2 nd year students)
May 1	Summer quarter rotation decisions due
May 11*	Schedule oral qualifying exams (2 nd year students)
May 28	Memorial Day holiday
June 9	Convocation
June 9	Spring quarter ends

Summer Quarter 2018

June 18	Summer quarter begins
July 4	Independence Day observance
August 25	Summer quarter ends

*The oral qualifying exam does not need to be taken on May 11th but must be scheduled by that date. The exam must be completed by the end of spring quarter 2018.

Department of Human Genetics Administration

<u>Title/Position</u>	<u>Name</u>	<u>Location</u>
Department Chair	Carole Ober	CLSC 425
Graduate Affairs Administrator	Candice Lewis	CLSC 115D
Curriculum Committee	Anna DiRienzo, Chair	CLSC 424
	Matthew Stephens	CLSC 422
	Marcelo Nobrega	CLSC 319A
	Vincent Lynch	CLSC 325B
Seminar Committee	John Novembre, Chair	CLSC 421
Student Representatives	Kevin Magnaye	Ober Lab Lynch Lab
	Manny Vazquez	

Human Genetics Graduate Students

Name	Advisor	Lab Location	Email Address
Aracena , Katie	Di Rienzo	unaffiliated	karacena@uchicago.edu
Biddanda , Arjun	Novembre	CLSC 417	abiddanda@uchicago.edu
Blake , Lauren	Gilad	CLSC 317	leblake@uchicago.edu
Clay , Selene	Di Rienzo	unaffiliated	seleneclay@uchicago.edu
Drazer , Michael	Godley	KCBD 7240	mdrazer@medicine.bsd.uchicago.edu
Eres , Ittai	Gilad	CLSC 317	ittai@uchicago.edu
Farris , Kathryn	Di Rienzo	unaffiliated	kmfarris@uchicago.edu
Gileta , Alexander	Novembre	CLSC 407	agileta@uchicago.edu
Gonzales , Natalia	Abney	CLSC 506	ngon@uchicago.edu
Gray , Olivia	Di Rienzo	CLSC 431E	oagray@uchicago.edu
Hernandez , Liana	Ober	CLSC 501	lianah@uchicago.edu
Magnaye , Kevin	Ober	CLSC 501	kmagnaye@uchicago.edu
Marcus , Joseph	Novembre	CLSC 417	jhmarcus@uchicago.edu
Mika , Katelyn	Lynch	CLSC 301	kmmika@uchicago.edu
Pavlovic , Bryan	Gilad	CLSC 317	bjp@uchicago.edu
Rhodes , Katherine	Gilad	CLSC 301	klrhodes@uchicago.edu
Turchin , Michael	Stephens	CLSC 417	mturchin20@uchicago.edu
Vazquez , Juan (Manuel)	Lynch	CLSC 301	juanvazquez@uchicago.edu
Venkat , Aarti	Thornton	GCIS W504	aartiv@uchicago.edu
Washington , Charles	Ober	CLSC 501	washingtonc@uchicago.edu

Human Genetics Faculty Members

Name	Dept	Room	Phone	E-mail Address
Abney, Mark	HG	CLSC 423	2-3388	abney@genetics.uchicago.edu
Ahsan, Habibul	HS	AMB N102A	4-9956	habib@uchicago.edu
Bell, Graeme	MED	AMB N237	2-9116	g-bell@uchicago.edu
Chen, Mengjie	MED	KCBD 3220A	4-3175	mchen12@medicine.bsd.uchicago.edu
Das, Soma	HG	AMB G705A	4-1036	sdas@genetics.uchicago.edu
Del Gaudio, Daniela	HG	AMB G705B	4-6751	ddelgaudio@bsd.uchicago.edu
Di Rienzo, Anna	HG	CLSC 424	4-1037	dirienzo@genetics.uchicago.edu
Drummond, Allan	BMB	GCIS W234	4-2017	dadrummond@uchicago.edu
Gershon, Elliot	MED	MC 3077	4-2660	egershon@yoda.bsd.uchicago.edu
Gilad, Yoav	MED	CLSC 325C	2-8507	gilad@uchicago.edu
Gilliam, T. Conrad	HG	AMB S106	2-5777	cgilliam@bsd.uchicago.edu
Godley, Lucy	MED	MC 2115	2-4140	lgodley@medicine.bsd.uchicago.edu
He, Xin	HG	CLSC 420	4-7678	xinhe@uchicago.edu
Lahn, Bruce	HG	CLSC 507	4-4393	blahn@genetics.uchicago.edu
LeBeau, Michelle	MED	AMB H212Q	2-0975	mlebeau@medicine.bsd.uchicago.edu
Li, Zejuan	HG	G705C	4-1606	zli7@bsd.uchicago.edu
Lynch, Vincent	HG	CLSC 319C	4-1326	vjlynch@uchicago.edu
McPeck, Mary Sara	STAT	E 129	2-7554	mcpeck@galton.uchicago.edu
Moskowitz, Ivan	PEDS	KCBD 5118	4-0462	imoskowitz@peds.bsd.uchicago.edu
Nicolae, Dan	MED	KCBD 3220E	4-3896	nicolae@galton.uchicago.edu
Nobrega, Marcelo	HG	CLSC 507	4-7919	nobrega@uchicago.edu
Novembre, John	HG	CLSC 421	4-8217	jnovembre@uchicago.edu
Ober, Carole	HG	CLSC 507C	4-0735	c-ober@genetics.uchicago.edu
Olopade, Olufunmilayo	MED	KCBD 8100	2-1632	folopade@medicine.bsd.uchicago.edu
Pierce, Brandon	HS	MC 2000 W264	2-1917	bpierce@health.bsd.uchicago.edu
Rzhetsky, Andrey	MED	KCBD 10160A	2-2561	arzhetsk@bsd.uchicago.edu
Stephens, Matthew	HG	CLSC 422	2-8332	stephens@galton.uchicago.edu
Thornton, Joseph	HG	GCIS W208	4-3423	joet1@uchicago.edu
Waggoner, Darrel J.	HG	AMB O500	4-4860	dwaggoner@genetics.uchicago.edu
Yang, Lixing	MED	GCIS W432	4-2948	lixingyang@uchicago.edu

PROGRAM OF STUDY IN BRIEF

First Year

The first year of graduate study is spent taking classes, exploring research opportunities, and performing laboratory rotations.

Graduate students in the BSD are required to take nine courses for the Ph.D. Most classes are completed within the first year. In addition to the course requirements, students are required to attend HGEN 31900, Introduction to Research (often referred to as "AllStars"), to acquaint them with faculty research programs within the Molecular Biosciences cluster. Students are also required to complete two lab rotations, which are short research projects in at least two different laboratories. These rotations can be performed during the first academic year or during the summer quarter (either before the first year or between the first and second years), but in all instances must be completed before beginning dissertation research in the autumn quarter of the second year. *In some circumstances, students may do a rotation during the summer prior to their first year to ease transition to the university and city and to allow the possibility for an additional research rotation. It is also possible, although strongly discouraged, to complete a third rotation in the fall of the second year.*

First-year students are also required (and advanced students expected) to attend the Human Genetics Seminar Series, Work-in-Progress Seminars, and Human Genetics Journal Club when their class schedule permits.

Second Year

Just prior to the start of the second year, students take the preliminary examination as a first step towards candidacy for the Ph.D.

By the beginning of the second year, students choose a research advisor. Some students choose to complete a third rotation in the fall quarter, but this requires permission from the Curriculum Committee.

A minimum of coursework may continue through the second year, together with fulfilling TA requirements. Most of the second year is spent developing a research project and preparing the student to submit a written proposal for dissertation research. This proposal must be defended before an oral qualifying examination committee before the end of spring quarter.

Passing the oral qualifying exam permits the student to enter into candidacy for the Ph.D.

The members of the oral qualifying exam committee are chosen by the student in consultation with his or her advisor. Committee members must be approved by the Curriculum Committee. The oral qualifying exam committee is comprised of the student's research advisor and three or four other faculty members. The oral qualifying exam committee selects a chairperson from the committee members who is not the research advisor.

Choosing an Advisor Outside of the Department of Human Genetics. If a student chooses an advisor who does not have a primary or secondary appointment in the department, the student and prospective faculty advisor must submit a petition for approval to the Curriculum Committee. When choosing an advisor outside of the department, it is important to design a project that is appropriate for a Ph.D. in human genetics. In addition, the thesis committee must include at least two members with a primary appointment in the Dept. of Human Genetics.

Advanced Years

After the qualifying exam, the student performs full-time thesis research while continuing to participate in departmental events such as seminars, journal clubs, etc. Students are welcome to audit courses in which they have an interest.

Finally, each graduating student writes a dissertation describing his or her research, presents the work in a public seminar and defends it before his/her faculty examining committee.

The dissertation research period should take approximately 12-16 quarters, with the total duration of coursework and research not to exceed 26 quarters.

Evaluation

The Department of Human Genetics expects every student, throughout his or her term in the program, to have numerous informal conversations with the members of the Curriculum Committee, professors in their courses, their research advisor and doctoral committee members. This way, students obtain frequent appraisals of and constructive advice on their progress.

At least one formal evaluation of each student's progress must take place each academic year. In the first and second years, the evaluation is based on the student's performance in courses, laboratory rotations and the preliminary and qualifying examinations. In later years, the research advisor and doctoral committee report to the Curriculum Committee on the student's dissertation research progress after annual meetings. If the Curriculum Committee is apprised of deficiencies in performance, the student will receive a letter describing those deficiencies and making suggestions as to how they might be remedied.

REQUIREMENTS FOR THE Ph.D. DEGREE

A Ph.D. candidate must fulfill certain formal coursework requirements, pass preliminary and qualifying examinations and present a satisfactory dissertation describing the results of original research.

The department expects a knowledge of and proficiency in human genetics. This requirement will normally be met by fulfilling the formal coursework listed below, but the program is flexible. Courses taken at other institutions, in other departments, or as part of the Medical School curriculum may substitute for genetics courses with approval of the Curriculum Committee.

Formal Coursework

Eight courses and at least two lab rotations are required to fulfill the requirements for a Ph.D. In order to maintain full-time status, students are expected to take three courses each quarter or two courses and a lab rotation during the first year. One elective course may be taken in the second year. Anything less than full-time student status requires the approval of the Curriculum Committee. Students must complete eight graded courses and two rotations prior to taking the qualifying exam at the end of their second year. (It is permissible for students to take the qualifying exam during the quarter they satisfy their final course requirement and no later than the ninth quarter since admission.)

Required Courses:

- 1. MGCB 31400 Genetic Analysis (fall)**
- 2. HGEN 47000 Human Genetics (fall)**
- 3. HGEN 46900 Human Variation and Disease (spring)**

4. Plus one of the following:

- HGEN 47100 Introductory Statistical Genetics (winter)**
- DVBI 35600 Vertebrate Developmental Genetics (spring)**
- MGCB 31500 Genetic Mechanisms (winter)**
- MGCB 31300 Molecular Biology II (spring)**
- ECEV 35600 Population Genetics I (winter)**

5. Plus Two Lab

Rotations:

BSDG 40100-11 Human Genetics Laboratory Rotation

**Two lab rotations count as one class.*

6. Plus Four

Electives:

Students must take four electives (selected by the student from a list approved by the Curriculum Committee), including one statistics course at a level appropriate to the student's background and research interests. A course list is available on pages 19-23 of this Handbook.

- Students must petition the Curriculum Committee for approval of courses not listed in this handbook as "approved".
- At least three of the four electives and all of the requirements must be completed before attempting the preliminary exam.
- All four electives must be taken before the qualifying exam.
- One elective course may be taken pass/fail. Additional courses may be taken pass/fail subject to the approval of the instructor and the Curriculum Committee.
- If a student wishes to take an undergraduate course to fulfill an elective requirement, he/she must petition the Curriculum Committee for approval.

Students should note that several courses have prerequisites for enrollment or require the consent of the instructor. For example, MGCB 314 is a prerequisite for MGCB 315. Students entering the department with advanced coursework at the graduate level should inquire whether this coursework can substitute for required load of elective credits.

A total of four graded electives must be taken. The electives can be selected according to the student's interests and the availability of courses.

Students are expected to have a grade average of "B" or higher in their required courses and a "B" average overall. Students who fail to maintain a "B" average after

second quarter will be placed on academic probation. Students concluding their first year with less than a "B" average or less than a "B" in a required course will be terminated from the program after spring quarter unless otherwise recommended by the Curriculum Committee. Students who receive a D or F in any course, during any quarter, will be put on immediate academic probation, regardless of GPA.

Introduction to Research

All first-year students are required to attend the HGEN 31900 *Introduction to Research* course ("AllStars") during the autumn and winter quarters. This course is designed to provide incoming students with information on the variety of faculty research opportunities available and experience with oral presentations. The seminars are held Tuesdays and Thursdays, 12:00 PM-1:20 PM. This course is offered pass/fail. Strict compliance with the attendance policy is required for a passing grade.

Scientific Ethics Course(s)

All first-year students are required to attend a scientific ethics class organized by the Dean of Students Office. This course is offered during the spring quarter and features sessions on scientific ethics that often involve examining case studies. The course organizer distributes announcements with the title of each talk and the name of the faculty members who will present.

A second ethics course is required in year four.

Prescribed Courses

In some instances, a student's undergraduate training may not have prepared him/her for a required course. In such cases, the Curriculum Committee will prescribe an appropriate graduate or undergraduate course if necessary. In some such cases, the prescribed course can be counted as a graduate elective.

Reading Courses

Reading courses taken for a grade must be approved by the Curriculum Committee prior to registration. Every reading course must conform to the following requirements: 1) it must meet weekly, 2) the instructor must provide a syllabus for the course and an evaluation of the student's performance, both of which will become part of the student's file, and 3) the student must submit a written paper.

Laboratory Rotations

Students are required to perform at least two laboratory rotations *before* selecting an advisor and laboratory to pursue a Ph.D. dissertation.

The purpose of lab rotations is to expose the student to different research environments, broaden his or her acquaintance with useful laboratory techniques and introduce him/her to the conceptual framework of experimental design. Students undertake short research projects in at least two different laboratories before beginning their dissertation research. At the end of the rotation, the student should write a two- to three page report on his/her rotation project(s) and/or prepare an oral presentation, at the discretion of the sponsor. The sponsor will grade the report or presentation and will provide the Curriculum Committee with an evaluation of the student's performance.

Rotations are typically performed in the winter, spring and summer quarters during the first year of study. In exceptional circumstances a student can begin a rotation the summer prior to the start of the first academic year.

During the academic year each rotation lasts ten weeks, coinciding with the academic quarter. One or even two rotations can be performed during the summer when the student is able to devote full time to research.

Students arrange their own rotations by contacting potential mentors directly. All Human Genetics faculty members are potential rotation mentors. After the student and mentor have agreed on the time period for the rotation, the student should inform Graduate Affairs Administrator of the arrangement. He will then inform the Curriculum Committee of the proposed rotation and let the student know if the rotation has been approved. ***Students who would like to rotate with a faculty who does not have a primary appointment in the Department of Human Genetics must petition the Curriculum Committee for approval by informing the Graduate Affairs Administrator.***

Teaching Assistantships

The abilities to communicate verbally and to teach are important skills for a successful research career. As such, all students are required to serve as teaching assistants (TAs) for two quarters, with responsibilities that may include leading discussion groups, writing problem sets, and running laboratories.

Students normally undertake their teaching assistantships during the second and third years. A course designed to train graduate students to be an effective TA may be taken in lieu of one of the two assistantships. The student must receive approval from the Curriculum Committee prior to accepting a teaching assistantship.

Students with extensive teaching experience at the graduate level (e.g. while studying for a Master's degree) are permitted to petition for waiver of the teaching requirement. The petitioner must provide documented evidence of prior teaching experience. For additional information, please contact the Graduate Affairs Administrator.

Preliminary and Qualifying Examinations

The Preliminary Examination

The Biological Sciences Division requires that "a general oral or written qualifying examination, separate from course examinations, must be passed by the student upon the major subject offered and such subordinate subjects as may be required by the Department concerned." In the Department of Human Genetics, this examination will be given in the fall after completion of the first year. Students will be given a set of questions covering broad areas in classical and human genetics.

The exam lasts for approximately two hours. To prepare for the exam students are allowed to use books, reference materials and lecture/seminar notes to answer the questions. Students are also free to discuss the questions among themselves and with faculty.

Students will be given the full list of Preliminary Examination questions at the beginning of the Summer quarter. The examination committee will choose which questions to ask.

The purpose of this exam is to provide practice in oral presentations and discussion as well as to demonstrate the ability to think critically.

The Curriculum Committee chooses three to four examiners for each examining committee from departmental faculty. The names of the examining committee are provided to the student two days prior to the exam.

Based upon the student's performance, the prelim examining committee recommends one of the following options to the Curriculum Committee:

- A. Pass unconditionally
- B. Pass conditionally
- C. Fail

The Curriculum Committee then meets to consider the examining committee's recommendation, taking into account the student's overall academic performance as well as his or her performance on the examination. If a student who fails the exam is allowed to retake it, a new committee containing at least one member of the original preliminary examining committee and at least one new member will be selected by the Curriculum Committee in consultation with the chair of the Department of Human Genetics.

The Qualifying Examination

The qualifying examination evaluates a student's ability to propose and defend a doctoral thesis research plan. Upon successful completion of the exam, the qualifying examining committee becomes the student's doctoral advisory committee. Students must have the endorsement of his/her research advisor in order to stand for the qualifying exam. In the event that a research advisor declines to endorse a student for the qualifying exam, the Curriculum Committee will review the student's record and determine if that student will be allowed to seek a new research advisor or be asked to leave the program.

After the student chooses a research advisor and defines his/her project, the student, in consultation with the research advisor, formulates a list of four or five prospective qualifying exam committee members (including the student's advisor) and submits the petition to the Curriculum Committee for approval. **A list of proposed committee members and a short description or working title of the thesis must be submitted to the Graduate Affairs Administrator by no later than March 23, 2018.** It is not uncommon for the Curriculum Committee to recommend adding or changing the composition of the committee to broaden the overall expertise of the committee. Final decisions on committee membership are made by agreement between the Curriculum Committee, the research advisor and the student.

In addition to approving the initial thesis advisory committee, the Curriculum Committee must also approve replacements when members of a doctoral committee resign. In the

event that more than one member of a doctoral committee resigns, the Curriculum Committee will meet to consider the circumstances that led to the resignations and decide on an appropriate course of action. Possible courses of action include (but are not limited to) replacement of doctoral committee members, formation of a new doctoral committee or reconsideration of the student's qualifications for candidacy.

After the qualifying exam, the qualifying exam committee will continue to serve as an advisory committee throughout the student course of the student's doctoral research. This doctoral committee will be chaired by a member other than the student's advisor. The function of the doctoral committee is to monitor the student's progress and to assist the student in the development of the dissertation research. For this reason, the choice of the members of the doctoral committee should be based on their knowledge and expertise in the area of the student's research. In the event the student chooses to work with a member of the faculty who does not have an appointment in the Human Genetics, the student must petition the Curriculum Committee for approval. At least two members of the doctoral committee, including the chair, must have primary appointments in the Department of Human Genetics.

It is important to note that the qualifying exam is not a thesis defense. It does not require preliminary results although, if available, they may be used.

The exam tests the student's ability to:

1. Choose a topic. That is, to formulate an important biological question;
2. Propose a coherent set of avenues to answer the question;
3. Summarize critically the current literature on that topic; and
4. Describe a series of experiments, taking into account possible pitfalls and therefore alternative approaches.

The written proposal should be modeled after an NIH postdoctoral grant application and it should be organized as follows:

Specific Aims (no more than 1 page): describe at least three specific aims and the broad, long-term objectives of the proposed research to test a stated hypothesis.

Research Strategy (no more than 6 pages): this section should be further divided into:

- 1) Significance of the proposed studies, including background information, and 2) Approach (including preliminary studies, if any) to provide experimental support of the proposed hypothesis. This is not a place for trivial experimental details.

All proposals must have a title sheet (not included in page limits) and the author's name on each page. Pages must be numbered.

The thesis proposal must be submitted to Graduate Affairs Administrator by April 30, 2018. The oral qualifying exam must be scheduled by May 11, 2018.

Annual Doctoral Committee Meetings

Within six months of passing the oral qualifying exam, the student should schedule a meeting with his/her doctoral committee, unless it is waived by the doctoral committee and approved by the Curriculum Committee. All students should meet at least once a year with their doctoral committee and present a brief (up to three pages) written report of their research as a basis for discussion. The report must be distributed at least one week prior to the scheduled meeting. **Remember to send a copy of the report to the Graduate Program Administrator and notify the administrator of the day and time of your meeting.**

After the fourth year, a minimum of two meetings per year may be required, with at least three members of the doctoral committee present at each meeting. These meetings help to ensure that students are making adequate progress toward the completion of their research and to provide the student with a broader base of expertise on which to seek help and advice. They also strengthen the student's acquaintance with faculty other than the research advisor, providing a basis for future letters of recommendation.

With doctoral committee approval, a student may prepare a dissertation. Following each meeting the chair of the doctoral committee prepares a summary and sends it to the student and the research advisor for approval and signature.

Penultimate Meeting

The doctoral committee should be convened six months before a student expects to receive his/her degree to indicate their agreement that the student is nearing completion of his/her research and to arrange for subsequent

approval that the student may begin writing the dissertation.

In general, the mentor and other members of the advisory committee strive to minimize the possibility of an unsuccessful thesis defense via thoughtful and straightforward advice to the candidate.

The penultimate meeting is particularly important in this regard. Permission to write should not be granted if more than one member of the committee lacks confidence that the thesis will be acceptable. The written report from the penultimate meeting should contain a fairly detailed description of any additional work that needs to be completed prior to submission of the thesis. This list should be limited to a small number of minor items. If, in the judgment of the advisory committee, substantial work is needed prior to the defense, an additional meeting should be scheduled to review such progress before permission to write is granted.

Presentation of the Dissertation

Each graduating student writes a dissertation describing his or her research. After the penultimate meeting, the student must prepare a draft of the thesis and have it approved by his/her advisor before sending it to the other thesis committee members for review. Following approval by the student's sponsor, the thesis must be submitted to the doctoral committee for a two-week reading period, prior to the defense date. At this stage, the thesis should be in near final form and not in a draft state. A student's defense date must be scheduled at least one week before the Dissertation office's thesis submission deadline. The student then presents the work in a public seminar, and defends it before the doctoral committee.

The university has strict rules concerning the preparation of the dissertation. Detailed information can be obtained from the Dissertation Office located on the 1st floor of the Regenstein Library, Room 100B or visit their webpage <http://www.lib.uchicago.edu/e/phd/>, which has the most current information about upcoming deadlines, required forms, etc.

The Ph.D. dissertation should contain a description of the research performed. In addition, it must contain:

1. An introduction covering the scientific background of the project(s);

2. A discussion of the student's own results and their significance in the field; and
3. A summary of the work.

These should be separate sections of the thesis that must be written independently by the student. Published manuscripts may be included as chapters in the thesis, but a separate introduction, discussion and summary covering the entire thesis are still required. In

cases where collaborative experiments are included in the thesis, the student must clearly indicate the specific contributions of the individuals involved.

The final dissertation, together with a certificate of approval signed by the department chair, must be submitted to the Dissertation Office no later than three weeks before the date of the convocation.

The final exam committee consists of the student's doctoral committee members and up to one additional faculty member at the discretion of the student and his/her advisor. At least two of the exam committee members must be primary Human Genetics faculty.

1. Each member of the thesis defense committee must vote "yes" or "no" on the defense form immediately following the defense (i.e. before leaving the room). Thesis defense committee members are not allowed to abstain from voting.

2. If more than one member of the committee votes "no" the student will be required to revise the thesis according to instructions provided by the exam committee and meet any additional conditions set by the Student Affairs/Curriculum Committee within one week of the defense. The revised thesis must then be defended in a closed session with a committee consisting of at least one member of the original committee and at least one new member.

3. If following the defense of the revised thesis, a candidate receives more than a single "no" vote from a committee member, the candidate will be denied the Ph.D.

Master's Degrees

The Department of Human Genetics does not admit students directly into an MS program. Masters degrees are awarded only to students who are enrolled in the PhD program. The requirements for the MS can be satisfied entirely by course-work, lab rotations and passing a preliminary and qualifying examination, the latter of which includes a written proposal. No separate thesis is required. The course requirements are the same as those for the PhD program, namely: students must complete four required courses

(MGCB 31400 Genetic Analysis of Model Organisms, HGEN 47000 Human Genetics, HGEN 46900 Human Variation and Disease, and a statistical course chosen to be at the appropriate level depending of the student's background), four electives and two lab rotations. Students are expected to have a grade average of "B" or higher in their required courses and a "B" average overall. One elective course may be taken pass/fail. Students are also required to attend the Human Genetics Seminar Series, Work-in-Progress Seminars, and Human Genetics Journal Club when their class schedule permits.

Doctoral Students in the Department of Human Genetics may apply for the MS at any time after they have completed the requirements. Contact the Graduate Administrator so that the proper paperwork is submitted verifying your courses (above). Keep your expected graduation date set to the date you anticipate receiving the Ph.D.

Seminars

In addition to formal courses, there are many regularly scheduled research seminars that help keep students current on new developments in human genetics and related disciplines.

All students are expected to attend monthly Department of Human Genetics Seminars, class schedules permitting.

Seminars are held on Wednesdays at 4:00 pm in CLSC 119. Check the "Departmental Events" tab on the Human Genetics website (<http://genes.uchicago.edu/events>) for the most current schedule.

The Department of Human Genetics Seminar Series occurs monthly and features a research talk by a visitor from outside the University of Chicago.

The Department of Human Genetics Journal Club Seminar is a monthly presentation of a current journal article of current relevance to the field of human genetics research. Presentations are made by pre-doctoral students in consultation with a faculty member.

The Department of Human Genetics Work-in-Progress Seminar occurs once a month and is a presentation by a pre- or post-doctoral researcher in a Human Genetics' faculty member's lab. The seminar allows members of the department to stay abreast of faculty research projects throughout the department.

Students are encouraged to attend monthly seminars and Journal Clubs sponsored by the

Committee on Genetics, Genomics and Systems Biology and the Institute for Genomics and Systems Biology. Flyers are posted throughout the Cummings Life Sciences Building in advance of these events. You will find seminar notices posted in the Department of Human Genetics by the third, fourth and fifth floor elevators and at the other locations in the Cummings Life Sciences Center.

FINANCIAL SUPPORT

The Department of Human Genetics attempts to ensure that all students registered in the Ph.D. program are provided with adequate financial aid. **Financial support is guaranteed to all incoming students for their first four years, subject to satisfactory academic performance.** Support for subsequent years of study is subject to the student's satisfactory research progress, as determined by the faculty sponsor, the Doctoral Committee and the Division of Biological Sciences.

Sources of Support

Students receive tuition plus a stipend. The various sources of support are:

- Training Grants
- Departments
- External Fellowships
- University Fellowships
- Research Assistantships

Payment of Stipend Checks

University fellowships and NIH checks are paid in equal quarterly installments at the beginning of each quarter and cover the calendar year. Taxes are owed on (but not deducted from) these payments. See section on "Taxes" below.

Advanced students are often paid from NIH grants under the title "Research Assistant Type B" (RA-B). RA-B students are paid on a monthly basis on the last working day of each month. Taxes will be deducted from RA-B checks.

University fellowships and NIH training grants pay for student health insurance, fees, and tuition without the student having to make separate payments. RA-B students are responsible for paying their health insurance and fees from their salary each quarter. However, tuition is paid by the Division.

Taxes

Graduate student stipends are taxable by Illinois and the federal government. Students on fellowships and NIH training grant support must calculate and pay estimated taxes several times a year. IRS form 520 provides information on determining what portion of your stipend is taxable and how and when to pay taxes on this income. The forms are available from the IRS website.

Loans

For information on the various types of loans that are available to graduate students, you should consult Student Loan Administration (6030 S. Ellis Ave, Edelstone Center 2nd Floor, 773-702-6061). This office can provide short-term loans during temporary financial crises, for example if a stipend check is delayed or if you are transferring from a fellowship to an assistantship. The office also has up-to-date information on federally-sponsored student loan plans.

Loan applications are available from the Office of the Dean of Students and are processed by the Graduate Financial Aid Office. See Leslie New, Graduate Financial Aid Counselor, for eligibility requirements.

Supplies and Research Expenses

Students supported on training grants have small annual allowances for supplies. Requests for supplies are handled by the administrator of the specific training grant. For questions regarding the allowance for supplies provided by the Genetics and Regulation Training Grant, please contact Stephen Santell at ssantell@bsd.uchicago.edu.

In general, the cost of research supplies and equipment are covered by grants or contracts held by the faculty member in whose laboratory you are working. Limited supply funds are available on training grants, and are disbursed on an annual pro-rated basis, directly to the laboratories in which trainees are working.

Travel to Scientific Meetings

Attendance at scientific meetings is an important part of the educational process. Limited funds may be available, with preference generally given to students who have passed the preliminary exam and who are scheduled to present a paper or a poster at the meeting.

Should you wish to apply for support, check with the source of your funding, be it an agency, faculty member or training grant. When making your request, please supply the following information: purpose of meeting and relevance to the research; title, place and time of the meeting; title and authors of paper being presented; and amount requested for travel, registration fees, food, and lodging.

REGISTRATION

General Information

About one week before the dates designated for registration, the Graduate Affairs Administrator will contact students via email informing them of the days and times when they may register online. If a student does not register for their courses online prior to the deadline, he or she will be charged the applicable Late Registration Fee (~\$100).

Special registration procedures have been established for the first year students in the autumn quarter. First year students will meet individually with an advisor from the Curriculum Committee to map out a program of study for the first year. In special circumstances, second year students will meet with members of the Curriculum Committee to review their progress in the preceding year and to discuss further degree requirements.

Residency Status

All students fall into one of three levels of residency, depending on the number of quarters they have been registered at the university. The number of units for which a student should register each quarter is determined by his/her residency status. The three levels and the number of corresponding registration units are:

Scholastic Residence

Scholastic Residence is primarily a period of coursework. The number and distribution of courses are listed below.

Research Residence

Research Residence is a period of both courses and independent research depending on the student's academic progress. A student who has completed the Scholastic Residence requirement, and who is judged by faculty to be making satisfactory progress toward the doctorate, is required to register in the quarter in which the degree is awarded.

Advanced Residence

A graduate student who does not complete the doctorate during the period of Research Residence is required to register for Advanced Residence for a minimum of three quarters during each academic year until the receipt of the degree. The registration requirement ceases in the quarter in which the Ph.D. is awarded.

STATUS

UNITS

Scholastic Residence (quarters 1-6)	Coursework/300 units Rotations
Research Residence (quarters 7-12)	Coursework/300 units Research
Advanced Residence (quarters 13 and on)	Research/300 units

Leave of Absence

A student may, if necessary, apply for a Leave of Absence from the Ph.D. program to be approved by the chair of the Curriculum Committee (Anna Di Rienzo).

Pro-Forma Registration

Students in Advanced Residence, whose dissertation research requires residence away from Chicago, may register pro-forma. This status allows registration as a full-time student without payment of tuition. A fee of \$75 per quarter is assessed. Pro-forma status establishes a good faith relationship between the student and the university. The following regulations apply:

1. Pro-forma registration is approved for only one academic year at a time.
2. Applications for pro-forma registration must be approved in writing by the Department of Human Genetics Chair, whose signature means that the student's work away from Chicago is recognized as essential to the dissertation. Normally, students applying for pro-forma status will have been admitted to candidacy and have had dissertation topics approved. For students on the Graduate Residence Track, pro-forma status will normally begin only after completion of Scholastic Residence.
3. An applicant for renewal of pro-forma status must show the Curriculum Committee Chair that good use has been made of the time already spent "on location" and that additional time is essential to completing the original task. Renewals of pro-forma status must be approved by the Dean of Students.
4. A student on pro-forma status may not be gainfully employed for more than 19 hours a week.

5. Pro-forma students may not use the facilities of the university nor the time of its faculty, except for progress reports that may be required by the student's department.

6. A copy of the approved application must be filed with the registrar.

7. The registrar will certify that a pro-forma student is duly registered at the university to any agency requiring such certification.

8. The fact that a registration is pro-forma will be noted on the student's academic record.

9. Pro-forma registrations do not count toward satisfying a student's residence requirements toward a degree.

Visiting Non-Degree Students

Students who have moved to the university with their advisor but who are completing a Ph.D. degree at their home institution are given the status of Visiting Non-Degree Student. This affords access to libraries and to athletic facilities while they complete their degrees.

MISCELLANEOUS INFORMATION

Curriculum Committee

This faculty committee is responsible for advising all students during the first year of graduate study or until a research advisor has been chosen. Each student will be assigned a member of the committee to serve as temporary advisor during this time and to aid in selecting courses and arranging lab rotations. This committee conducts a quarterly review of each student's course performance and administers the preliminary examination. Members of the Curriculum Committee meet with first-year students after each quarter to discuss any issues concerning the first-year curriculum or other topics of concern.

Student Representatives

Students in the department elect three student representatives to relay student concerns to the Curriculum Committee. At anytime should a student representative have an agenda item for this group, he or she should contact the Graduate Program Administrator to add that item to the agenda of the next meeting. Each representative serves a three year term. Every summer a new representative is elected by the

Human Genetics students and the most senior representative rotates off.

In addition, the department seeks student volunteers to assist in cluster events, such as orientation, recruitment and the retreat planning. These are volunteers who are interested in participating and contributing to these events. The Graduate Program Administrator will ask for volunteers each year. Those students interested in assisting with these activities should contact the Graduate Program Administrator.

Administrator for Student Curriculum

The Graduate Affairs Administrator (Candice Lewis) provides assistance to students on a variety of questions and problems as they arise. Her office is located in CLSC 115D, the phone number is 773- 834-6864 and email address is ctlewis@uchicago.edu.

Molecular Biosciences Retreat

The Molecular Biosciences retreat provides an opportunity for students, post-docs, and faculty to meet in a pleasant, informal setting to learn about the various research programs of the various research laboratories. The program consists of several sessions of presentations by students and post-docs with each session chaired by a faculty member. The retreat is held annually, usually in mid-November.

First year students are required to attend the retreat and all students must have one presentation (poster or platform) at a retreat (ours or another cluster's) during their graduate career.

The Biological Sciences Learning Center

This complex is located at the northern end of the Science Quadrangle. The Learning Center provides classrooms, laboratories, and research facilities for undergraduate, graduate, and medical programs. In addition, offices of the Dean of Students for the Division of Biological Sciences are located in the Learning Center.

Chicago Card, Library & Network Privileges Office

The Chicago Card, Library & Network Privileges Office is located in the Regenstein Library (JRL 100F, 773.702.8782). At this office you can obtain your Student ID. Visit: <http://www.lib.uchicago.edu/e/using/access/priv.html> for the most up to date hours of operation.

Bursar's Office

The Bursar's Office, located in Room 101 Administration Building, is open from 9:00 AM to 3:00 PM, Monday through Friday.

Tuition Inquiries & Bursar Restrictions 702-7086

Check Cashing Privileges 702-7074

Other Information 702-8000

University Health Insurance/Services

The university requires that all students carry medical insurance. We strongly encourage students to participate in the university's plan even if they are also enrolled in a parental or an employer plan. Student Accident and Sickness Insurance (SASI), the university insurance plan, offers two levels of coverage: the Basic and Advantage Plans.

Health insurance coverage is mandatory. During the time you are registered at the University, you are required to enroll in either the U-SHIP Basic or Prescription Advantage coverage, or waive enrollment by providing evidence that you have coverage in a health insurance plan that is comparable to U-SHIP.

Waiver Procedure information is found on the university website at <https://studentinsurance.uchicago.edu/>. Unless you waive U-SHIP enrollment during the enrollment period, you will be automatically enrolled in U-SHIP Basic coverage.

There is an annual insurance premium for the insurance plans. These premiums, along with the Student Health and Wellness Fee, are assessed in quarterly installments during the academic year and are added to your autumn, winter, and spring tuition bills.

You may enroll your spouse, domestic partner, and children under 19 years of age. Information about this option is found at http://studenthealth.uchicago.edu/studentinsurance/health_USHIPfamily.shtml.

Yvette Jones
Admin 231
773-834-4543 (Press #2)

Julie Dunlap
Admin 232
773-834-1554 (Press #2)

Yvette and Julie are employees of United Healthcare/Student Resources. . They will

receive walk-in visits and phone calls Monday-Friday, 8:30 a.m. - 5 p.m. They will also answer questions directed to the healthaffairs@uchicago.edu e-mail address.

The University Health Service has two components:

1. The Student Care Center (SCC) is located at 860 E. 59th Street, R100. SCC hours are 8:00 AM to 5:00 PM, Monday through Friday, in addition a late clinic is offered on Tuesday's beginning Autumn Quarter until 7:00 PM

2. The Student Counseling and Resource Service (SCRS), located at 5737 S. University Avenue, is open from 8:30 AM to 5:00 PM, Monday through Friday. The SCRS provides diagnostic evaluation, psychotherapy and services for students who are experiencing difficulties in studying and learning or in managing time commitments, as well as emergency services for all students. For an evaluation, outside referral, or assignment to a therapist call 773-702-9800 to schedule an appointment. Emergency cases are taken immediately during regular hours of 8:30 AM to 5:00 PM During evenings and weekends, a therapist is available by phone only by calling 773-702-3625 and asking for the therapist-on-call.

Computing Facilities

Many different computing resources are provided throughout the university. Some of these resources exist for the specific needs of the faculty and staff of a particular department, while other facilities are available to all university members. The Networking Services & Information Technologies (NSIT) runs three general-purpose computer facilities for members of the university community. There are no charges for the use of these facilities; even printing is free. The facilities are very popular during the day, early evening, and examination weeks. To use these facilities a valid University of Chicago ID card is required.

Commonly known as USITE clusters, these computing facilities are located in the Crerar, Harper, and Regenstein libraries. Crerar Library is the largest and most technologically advanced computer facility on campus. For more detailed information on the technology available to you in each facility visit: <http://intech.uchicago.edu/cc> or 773-702-7894.

Regenstein (A-Level)
Open during A-level hours

Crerar (Basement)
Open during library hours

Harper (West end, Wieboldt 310)
Open during library hours

Computer Science Instructional Lab
(Ryerson Annex)

Walker Computing Site (Walker 307)

Edelstone Computing Site
(6030 S. Ellis)

Biological Sciences Learning Center (Lower
Level) (924 East 57th Street)

Please visit each facility to view the most
current computing hours or
<http://nsit.uchicago.edu/services/usite.html>

Email Accounts

Much of the communication between
Department of Human Genetics staff, students,
and faculty is by email. It is imperative that all
students establish email accounts and check
those accounts regularly, at least once a day.
E-mail accounts can be set up via the web:
<https://cnet.uchicago.edu>

Keys

The Department of Human Genetics office
issues keys needed by students working in the
building. Please come to the main office in
CLSC 115 to inquire about keys. For graduate
students, this includes building entrance key
cards and laboratory keys.

Parking

You may obtain an assigned parking space on
campus by paying a monthly fee. Assignments
for campus lots are available at the Campus
Parking Office (773-702-8969), located at 5525
S. Ellis Ave, Room 171.

For space in the multi-level parking structure at
58th and Cottage Grove, you must apply to the
Hospital Parking Office, located in the garage.

Transportation

For Chicago area public transportation bus
routes, maps and schedules (CTA, Metra, Pace,
and other transportation options), as well as on-
campus parking information is available at
<http://facilities.uchicago.edu/transpparking/index.html>.

Umbrella Service

Umbrella Service is not a transportation service,
but an usher service offered by University
Security. An individual or group may call
campus security at 773-702-8181 and request a
patrol car to accompany them from their place
of departure to their destination anywhere within
Hyde Park. This service is extremely useful late
at night.

SafeRide Program

The SafeRide Program, formerly the Late Night
Van Service, provides the campus community
with safe, on-demand transportation during late-
night hours within the area patrolled by the
University of Chicago Police Department. The
hours for this service are Wednesday, 12:00
midnight to 4:00 AM, and Thursday through
Saturday, 12:00 midnight to 6:00 AM This
service is on a "first call, first come" basis, so
delays may occur. To utilize this service call
773-702-2022 and give your exact pickup
address.

Recreation on and near Campus

There are two main student centers on campus.
The Reynolds Club, located at 57th Street and
University Avenue, includes the Hutchinson
Commons, home of the largest food court on
campus, with a wide variety of fast food
restaurants; the C-Shop, which stocks coffee
and pastries; the North Lounge; ATM's; and a
variety of recreation rooms. Information on
student life can be found at
<https://studentactivities.uchicago.edu>.

The Gerald Ratner Athletics Center is a 15,000-
square foot, state-of-the-art, athletic and
recreational facility. With its fitness center,
gymnasiums, dance studios, classrooms, 50-
meter swimming pool, and more, it is designed
to support the university's various sports teams
as well as the fitness needs of other users.
Graduate students receive membership for free.
During the academic year, the Ratner Center is
open from 6:00 AM to 12:00 midnight on
weekdays and Sundays and from 8:00 AM to
9:00 PM on Saturdays. For additional
information about this facility visit their website:
<http://athletics.uchicago.edu/facilities/ratnercenter.htm>

Ida Noyes Hall, on 59th Street between
Woodlawn and Kimbark, was modeled after an
English manor house. It houses the Max

Palevsky Cinema, a 500-seat theater in which Doc Films screens movies every night of the academic year. For more information on Doc Films, visit <http://docfilms.uchicago.edu>. Ida Noyes also contains The Pub, Ida's Café, Career Advising and Planning Services (CAPS) and the University of Chicago independent student newspaper office, the *Chicago Maroon*.

Millennium Park Concert Series:
<http://www.millenniumpark.org/parkevents/>

Chicago at Large

Chicago is an exciting venue for cultural pursuits including museums, music, theatre, and dining out. The Chicago Symphony, the Lyric Opera, jazz and blues clubs, The Goodman Theater, and off-loop theatres are all excellent. Both inexpensive ethnic restaurants and expensive special-occasion restaurants abound.

Chicago Area Festivals, Exhibits and Special Events Websites in the Chicagoland Area

For information on outdoor concerts, cultural and neighborhood festivals, art fairs and other special events in the Chicagoland area visit the following websites:

The Chicago Convention and Tourism Bureau:
www.choosechicago.com

Chicago Guide:
www.uchicago.edu/docs/chicagoguide

Chicago Special Events for the Chicago Traveler:
www.chicagotraveler.com/chicago_special_events

Special Events Management:
www.chicagoevents.com

Metromix:
<http://metromix.chicagotribune.com>

The Chicago Tribune:
www.chicagotribune.com/entertainment

The Chicago Sun Times:
<http://www.suntimes.com/index.html>

The Chicago Reader:
<http://www.chicagoreader.com>

Chicago Magazine:
<http://www.chicagomag.com>

Ravinia:
<http://www.ravinia.org>

Chicago Athlete Magazine:
www.chicagoaa.com

COURSES AVAILABLE TO DEPARTMENT OF HUMAN GENETICS STUDENTS

REQUIRED COURSES 1st YEAR CURRICULUM:

HGEN 47000 Human Genetics I. Ober, Nobrega, Waggoner. This course covers classical and modern approaches to studying cytogenetic, Mendelian, and complex human diseases. Topics include chromosome biology, single gene and complex diseases, non-Mendelian inheritance, cancer genetics, human population genetics, and genomics. The format includes lectures and student presentations. *Autumn.*

MGCB 31400 Genetic Analysis of Model Organisms. Bishop, Ferguson, Malamy, Moskowitz. Coverage of the fundamental tools of genetic analysis as used to study biological phenomena. Topics include genetic exchange in prokaryotes and eukaryotes, analysis of gene function, and epigenetics. *Autumn.*

HGEN 46900 Human Variation and Disease. Di Rienzo, Novembre. This course focuses on principles of population and evolutionary genetics and complex trait mapping as they apply to humans. It will include the discussion of genetic variation and disease mapping data. *Spring.*

HGEN 31900 Introduction to Research. Lectures on current research by departmental faculty and other invited speakers. A required course for all first-year graduate students in Human Genetics. *Autumn, Winter.*

HGEN 40300 Non-Thesis Research. Laboratory rotations, and all research prior to passing the Qualifying Examination. *Autumn, Winter, Spring, Summer.*

BSDG 55000 Scientific Ethics Seminar. Required of all First Year BSD grad students. *Spring*

CHOOSE AT LEAST ONE OF THE FOLLOWING TO FULFILL 1 COURSE

REQUIREMENT:

HGEN 47100 Human Genetics III: Introductory Statistical Genetics. He, Nicolae, Pierce. This course focuses on genetic models for complex human disorders and quantitative traits. Topics covered also include linkage and linkage disequilibrium mapping genetic models for complex traits, and the explicit and implicit assumptions of such models. *Winter.*

OR

HGEN 31100 Evolution of Biological Molecules. Thornton, Drummond. Introductory graduate-level course connects evolutionary changes imprinted in genes and genomes with the structure, function and behavior of the encoded protein and RNA molecules. Central themes are the mechanisms and dynamics by which molecular structure and function evolve, how protein/RNA architecture shapes evolutionary trajectories, and how patterns in present-day sequence can be interpreted to reveal the interplay data of evolutionary history and molecular properties. *Winter*

OR

HGEN 48600 Fundamentals of Computational Biology: Models and Inference. Novembre, Stephens. Covers key principles in probability and statistics that are used to model and understand biological data. There will be a strong emphasis on stochastic processes and inference in complex hierarchical statistical models. Topics will vary but the typical content would include: Likelihood-based and Bayesian inference, Poisson processes, Markov models, Hidden Markov models, Gaussian Processes, Brownian motion, Birth-death processes, the Coalescent, Graphical models, Markov processes on trees and graphs, Markov Chain Monte Carlo. PQ: STAT 244 or equivalent. *Winter.*

OR

ECEV 35600 Population Genetics I. Wu, Kreitman. Examines the basic theoretical principles of population genetics, and their application to the study of variation and evolution in natural populations. Topics include selection, mutation, random genetic drift, quantitative genetics, molecular evolution and variation, the evolution of selfish genetic systems, and human evolution. *Spring.*

OR

HGEN 47300 Genomics and Systems Biology. Gilad. This lecture course explores technologies for high-throughput collection of genomic-scale data, including sequencing, genotyping, gene expression profiling, and assays of copy number variation, protein expression and protein-protein interaction. In addition, the course will cover study design and statistic analysis of large data sets, as well as how data from different sources can be used to understand regulatory networks, i.e., systems. Statistical tools that

will be introduced include linear models, likelihood-based inference, supervised and unsupervised learning techniques, methods for assessing quality of data, hidden Markov models, and controlling for false discovery rates in large data sets. Readings will be drawn from the primary literature. Evaluation will be based primarily on problem sets. *Spring*.

OR

MGCB 31300 Molecular Biology II. Ruthenberg/Staley. Eukaryotic Gene Expression. Transcription and Posttranscriptional Regulation. Analysis of regulatory pathways and mechanisms involved in the control of eukaryotic gene activity. *Spring*.

OR

DVBI 36400 Developmental Mechanisms. Ferguson, Fehon. This course provides an overview of the fundamental questions of developmental biology, with particular emphasis on the genetic, molecular and cell biological experiments that have been employed to reach mechanistic answers to these questions. Topics covered will include formation of the primary body axes, the role of local signaling interactions in regulating cell fate and proliferation, the cellular basis of morphogenesis, and stem cells. *Winter*.

ADDITIONAL ELECTIVE COURSES TO CHOOSE FROM TO FULFILL 4 COURSES:

HUMAN GENETICS

HGEN 39900 Readings in Human Genetics. HG Faculty. A course designed by students and faculty member. All reading courses must be approved by the Curriculum Committee prior to registration. See page 8 for our policy on reading courses. *Autumn, Winter, Spring, Summer*

HGEN 47400 Introduction to Probability and Statistics for Geneticists. Abney. This course is an introduction to basic probability theory and statistical methods useful for people who intend to do research in genetics or a similar scientific field. Topics include random variable and probability distributions, descriptive statistics, hypothesis testing and parameter estimation. Problem sets and tests will include both solving problems analytically and analysis of data using the R statistical computing environment. *Autumn*

HGEN 48800 Fundamentals of Computational Biology: Algorithms and Applications. He, Novembre. This course will cover principles of data structure and algorithms, with emphasis on algorithms that have broad applications in computational biology. The specific topics may include dynamic programming, algorithms for graphs, numerical optimization, finite-difference, schemes, matrix operations/factor analysis, and data management (e.g. SQL, HDF5). We will also discuss some applications of these algorithms (as well as commonly used statistical techniques) in genomics and systems biology, including genome assembly, variant calling, transcriptome inference, and so on. *Spring*

HGEN 36400 Molecular Phylogenetics. Thornton

In this course you will learn the fundamental concepts and current techniques for inferring evolutionary relationships from gene sequence data and testing hypotheses about molecular evolution using those phylogenies as a scaffold. We will cover the theoretical basis of phylogenetic methods in evolutionary and statistical theory, including the justifications and applications for maximum parsimony, evolutionary distance, maximum likelihood, and Bayesian analysis. We will discuss cases in which these methods have been applied to understand the evolution of taxa, genes, and diseases. Offered alternate (even) *Spring*

BIOCHEMISTRY AND MOLECULAR BIOLOGY

BCMB 30400 Protein Fundamentals. Keenan, Koide, Kossiakoff. The course covers the physico-chemical phenomena that define protein structure and function. Topics include: 1) the interactions/forces that define polypeptide conformation; 2) the principles of protein folding, structure and design; and 3) the concepts of molecular motion, molecular recognition, and enzyme catalysis. PQ: BMB 30100, which may be taken concurrently, or equivalent. *Autumn.*

DEVELOPMENTAL BIOLOGY

DVBI 35600 Vertebrate Developmental Genetics. Prince. This advanced-level course combines lectures, student presentations, and discussion sections. It covers major topics in the developmental biology of vertebrate embryos (e.g., formation of the germ line, gastrulation, segmentation, nervous system development, limb patterning, organogenesis). The course makes extensive use of the current primary literature and emphasizes experimental approaches including embryology, genetics, and molecular genetics. *Spring.*

ECOLOGY AND EVOLUTION

ECEV 35901 Genomic Evolution. Long. Canalization, a unifying biological principle first enunciated by Conrad Waddington in 1942, is an idea that has had tremendous intellectual influence on developmental biology, evolutionary biology, and mathematics. In this course we will explore canalization in all three contexts through extensive reading and discussion of both the classic and modern primary literature. We intend this exploration to raise new research problems which can be evaluated for further understanding. We encourage participants to present new ideas in this area for comment and discussion. *Autumn.*

MOLECULAR GENETICS AND CELL BIOLOGY

MGCB 31600 Cell Biology I. Turkewitz, Glick. Eukaryotic protein traffic and related topics, including molecular motors and cytoskeletal dynamics, organelle architecture and biogenesis, protein translocation and sorting, compartmentalization in the secretory pathway, endocytosis and exocytosis, and mechanisms and regulation of membrane fusion. *Autumn.*

MGCB 31200. Molecular Biology I. Rothman-Denes, Lucia. Nucleic acid structure and DNA topology; methodology; nucleic-acid protein interactions; mechanisms and regulation of transcription in eubacteria, and of replication in eubacteria and eukaryotes; mechanisms of genome and plasmid segregation in eubacteria. *Winter*

MGCB 31700 Cell Biology II. Glotzer, Kovar. Chromatin structure and its role in transcription communication between nucleus and cytoplasm, translation, protein folding and assembly, molecular chaperones, elements of signal transduction, homeostasis, growth control and the cell cycle, cytoarchitecture, cell adhesion and migration. *Winter.*

MGCB 32000 Quantitative Analysis of Biological Dynamics, Munro, Rust. This course covers quantitative approaches to understanding biological organization and dynamics at molecular, sub-cellular and cellular levels. A key emphasis is on the use of simple mathematical models to gain insights into complex biological dynamics. We also will cover modern approaches to quantitative imaging and image analysis, and methods for comparing models to experimental data. A series of weekly computer labs will introduce students to scientific programming using Matlab and exercise basic concepts covered in the lectures. *Spring.*

MICROBIOLOGY

MICR 34000 Bacterial Pathogenesis. Missiakas, Schneewind, Shuman. This course focuses on the genetics and molecular biology of bacterial pathogens with emphasis on host-pathogen interactions. The course will cover topics ranging from toxin production and secretion to evasion of host-responses and antibiotic resistance. Current techniques and discoveries will be covered in a paper-based discussion section. *Winter.*

STATISTICS

STAT 24400-24500 Statistical Theory and Methodology I, II. Barber/ Wu Wei. Principles and techniques of statistics with emphasis on the analysis of experimental data. First quarter: Discrete and continuous probability distributions, transformation of random variables; principles of inference including Bayesian inference, maximum likelihood estimation, hypothesis testing, likelihood-ratio tests, multinomial distributions and chi-square tests. Second quarter: Multivariate normal distributions and transformations, Poisson processes, data analysis, t-tests, confidence intervals, analysis of variance and regression analysis. *Autumn, Winter.*

STAT 35500 Statistical Genetics. McPeck. This is an advanced course in statistical genetics. Prerequisites are Human Genetics 47100 and Statistics 24400 and 24500. Students who do not meet the prerequisites may enroll on a P/NP basis with consent of the instructor. Prerequisites are either Human Genetics 47100 or statistics preparation at the level of Statistics 24400 and 24500. This is a discussion course and student presentations will be required. Topics vary and may include, but are not limited to, statistical problems in linkage mapping, association mapping, map construction, and genetic models for complex traits. *Spring*

*A complete list of courses is available on the Department of Human Genetics website:
<http://genes.uchicago.edu/education/courses>*

