Graduate Program in Human Genetics
Student and Faculty Handbook
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A. GENERAL INFORMATION

The Human Genetics Program offers the Doctor of Philosophy (Ph.D.) and Master of Science (M.S.) degrees through the Rackham School of Graduate Studies.

This handbook outlines the steps necessary to complete the requirements for the Ph.D. degree in Human Genetics, with relevant information for M.S. and M.S.T.P. candidates as well. This includes information about lab rotations, choice of Ph.D. program, selection of thesis advisor, course work, preliminary exam, dissertation committee, and completion of degree requirements.

1. HUMAN GENETICS GRADUATE PROGRAM DIRECTORY

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2. PROGRAM GOALS

Human Genetics began as a field linking specific mutations to disease. Today human genetics has transformed into a far more diverse realm of study and is one of the most exciting and fastest-growing fields in the biomedical sciences. The research of current faculty covers a broad range of areas, including genomics, population and statistical genetics, genomic instability, the genetic epidemiology of common diseases, complex trait analysis, disease gene identification, gene therapy, regulation of gene expression, developmental genetics, and cancer genetics. Graduate students have the opportunity to carry out interdisciplinary genetics research in these diverse areas.

The goal of the Human Genetics graduate program is to train the next generation of human geneticists by providing a rigorous learning environment and rich scientific milieu. Our Ph.D. graduates pursue careers in a variety of areas, including academia, government, and biotechnology. Many of our alumni hold academic research and teaching positions and are prominent leaders in genetics research. Students who demonstrate mastery of knowledge in the field of human genetics and contribute substantial and original scientific knowledge to the field will earn a Doctor of Philosophy (Ph.D.) in Human Genetics.

B. TIMETABLE

A provisional timetable for completion of the training program is provided, although each student is guided through the program individually. The timetable is organized according to candidacy status for the Ph.D. degree.

Students are required to register as a full time student for each Fall, Winter and Spring/Summer term. Please feel free to discuss any aspect of these requirements with the Director at any time.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>To be completed by:</th>
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<tbody>
<tr>
<td>PRE-CANDIDATE (Year 1 and 2)</td>
<td></td>
</tr>
<tr>
<td>Lab rotations (2 mandatory; additional possible)</td>
<td>Spring/Summer semester of Year 1 (within PIBS)</td>
</tr>
</tbody>
</table>
Choice of Ph.D. program | End of Year 1 in PIBS (usually by June 1)
---|---
Selection of thesis advisor (mentor) | By the end of Year 1 for most students, with occasional exceptions
Coursework | End of Year 2
Preliminary Exam, oral and written, after which candidacy is achieved | Year 2
CANDIDATE (Year 3 and Beyond)
Dissertation committee formed | Beginning of Year 3 (by September)
First dissertation committee meeting | During Year 3 (by December)
Completion of degree requirements | Approximately 5 years from time of entry into the PIBS Year 1

C. REQUIREMENTS OF THE HUMAN GENETICS PROGRAM

1. REQUIREMENTS OF THE HUMAN GENETICS PH.D. PROGRAM

The program of study leading to a Ph.D. degree normally requires 4-6 years beyond a Bachelor of Science (B.S.) degree. The first two years of the program are occupied with course work and hands-on research experiences, beginning with a series of laboratory rotations. In the normal course of events, a student will choose a research mentor at the end of the first year. Once a student passes the Preliminary Examination and successfully completes course work and research rotations, he or she will become a Candidate for the Ph.D. degree in Human Genetics. The student will assemble a doctoral thesis committee within 3 months of advancing to candidacy. The final 2-4 years of the doctoral program are spent primarily on original scientific research.

To receive the Ph.D. degree, each doctoral student is required to write a thesis, representing a substantial and original contribution to the field of human genetics, and defend the thesis before his or her thesis committee.

Summary of requirements:
1. At least two laboratory research rotations.
2. A minimum of 18 credit hours in graduate-level course work (see Section F.1).
3. Successful completion of the preliminary examination.
4. Successful completion of a research project and defense of a thesis.
5. Publication of thesis research in a peer reviewed journal.

2. REQUIREMENTS OF THE M.S. DEGREE IN HUMAN GENETICS

The field of human genetics has grown dramatically in recent years, in large part due to rapid advances in new technologies for discovery and the explosion of new data and resources. Human genetics interfaces with multiple research and clinical disciplines, with new opportunities in basic science, clinical diagnostics and industry. The Master's degree program (M.S.) in Human Genetics provides focused graduate training in both general and human genetics. It is designed for individuals seeking advanced training in genetics for employment or research opportunities or for matriculation to competitive Ph.D., M.D. or other advanced degree programs. The course of study can be completed in one year or extended over a longer time period.
The Human Genetics MS program includes alternative Research Track or Coursework only track.

**Research Track:** The research track allows graduate students to learn from and contribute to ground-breaking work being performed within the Department of Human Genetics. Students in this track typically matriculate in the summer or fall concurrent with acceptance into the laboratory of a faculty mentor in Human Genetics. Students will take courses and conduct laboratory research during the Fall and Winter terms culminating with acceptance of a written MS thesis to be completed in the summer term.

**Coursework Track:** The non-research track is a course-oriented track most suitable for applicants interested in matriculating to medical, law or other professional programs. Students in this track typically matriculate in the fall and complete course work during Fall and Winter terms.

The course of study in either track supports the development of critical thinkers, as students learn from world-renowned leaders in the field of human genetics. Students enjoy multiple opportunities for close mentorship by these experts, as well as the ability to take electives in related departments within the Medical School and elsewhere in the University of Michigan community.

To receive the M.S. degree, each student must complete a minimum of 24 hours of didactic coursework over a period of 1 or 2 years (see Section F.4).

**D. LAB ROTATIONS**

Each Ph.D. student is required to complete a minimum of two laboratory rotations with different faculty members. The purposes of these experiences are to allow the student to choose a research mentor/laboratory for their thesis research and to expose the student to multiple methods of research inquiry, areas of research investigation, and technology.

The two laboratory rotations should be completed during the first 12 months of enrollment and must be completed prior to the selection of a mentor. For the Fall and Winter rotations, students enroll in PIBS 600. Students may also do a lab rotation in the Summer term prior to their first year in the PIBS program, and students who have not yet selected a mentor following their Fall and Winter rotations may also wish to do a rotation in the Summer following the PIBS-1 year (with special permission). PIBS students have the option of doing two shorter rotations per term in the Fall and Winter (subject to permission of the mentor). Full term rotations are still strongly encouraged. See PIBS Orientation Handbook for details: [http://www.med.umich.edu/pibs/pdf/orientationbook.pdf](http://www.med.umich.edu/pibs/pdf/orientationbook.pdf)

MSTP students entering the program will have completed two lab rotations, with a possible third, during the summers.

**E. CHOICE OF PH.D. PROGRAM AND MENTOR**

Each student will select a mentor from the Human Genetics Faculty to guide his or her dissertation research. As soon as possible after completion of the laboratory rotations, the student should submit his/her choice of mentor to the Program in Biomedical
Sciences (PIBS) and the Human Genetics Program Student Services coordinator. The selection of a mentor should occur by the end of the first year of study.

**F. COURSE WORK**

1. **GENERAL OVERVIEW/REQUIREMENTS**

   A minimum of 18 credit hours in didactic graduate-level course work (course number designated 500 and above), excluding seminars and research, is required. In addition to the core Human Genetics courses and PIBS 503 (Section F.2), at least six credits of elective courses are required to advance to candidacy. Students can select electives that complement their research training to fulfill the requirements (Section F.3).

   Students usually take 9-14 credits per semester in their first two years. Discussion with the Human Genetics academic advisor will tailor each student's course of study to their individual background and future career goals.

   The Rackham Graduate School requires students to maintain a grade point average of B (3.0 on a 4-point scale, from C- to A+). Grades below a B- cannot be used to fulfill degree requirements. If your GPA falls below B, you will receive a letter of warning from Rackham and be placed on academic probation for the subsequent term, and your academic record and progress will be reviewed with you. If you are on probation for two consecutive terms, additional action will be taken. In addition, the Department of Human Genetics requires all students to receive grades no lower than a B- in required courses. Should you receive a lower grade, you will be asked to repeat the class or undertake additional coursework.

2. **REQUIRED COURSES**

<table>
<thead>
<tr>
<th>CORE COURSE REQUIREMENTS FOR THE PH.D. IN HUMAN GENETICS</th>
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<tbody>
<tr>
<td>1. HUMGEN 541 (3 cr), HUMGEN 542 (3 cr), HUMGEN 544 (3 cr), HUMGEN 803 (2 cr)</td>
</tr>
<tr>
<td>2. 4 semesters of HUMGEN 821/822 (or equivalent student seminar from another department that includes seminar presentation). (1 cr per semester)</td>
</tr>
<tr>
<td>3. Statistics is also required and this requirement may be met by any of several statistics classes in the list of electives or by demonstrating a recent equivalent undergraduate class.</td>
</tr>
<tr>
<td>4. PIBS 503 (1 cr)</td>
</tr>
<tr>
<td>5. PHARM 502 (2 cr), Introduction to Scientific Writing, is strongly recommended for all students.</td>
</tr>
</tbody>
</table>

   **TRAINING IN ETHICAL ISSUES IN SCIENCE**

   **PIBS 503. Research Responsibility and Ethics.** Upon entering the Graduate Program through PIBS, students are issued copies of the Rackham Graduate School “Student Handbook” and the University of Michigan Medical School “Guidelines for Responsible Conduct of Research.” The former addresses the standards of student behavior expected of all members of the graduate community. The latter discusses in depth the responsibilities of a Ph.D. mentor, appropriate methods of data collection and analysis, guidelines for manuscript authorship and issues pertaining to relationships between
industry and academic institutions. PIBS503 is in session every fall from September to December. Course materials including case studies and podcast lectures are available online through CTools, and discussion will take place in small-group sessions offered at many different times throughout the semester.

**Credits:** 1 (Fall)
**Director:** Barald

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**HUMAN GENETICS COURSE INFORMATION GUIDE**

**HG 541. Molecular Genetics**

HG541, Molecular Genetics, is a course that explores how the information content of the DNA genome is (i) organized, propagated, and altered, and (ii) functionally expressed by regulated transcription into RNA - the core molecular properties and processes of genetic systems that underlie all further investigations of organismal, clinical, and population genetics. HG541 will focus on developing an advanced modern understanding of the nature of biological systems, DNA, RNA, replication, and transcription. We will explore what experimental research in humans and model organisms has taught us about these reactions while simultaneously exposing gaps in our understanding. These objectives will be achieved by coupling lectures on core molecular genetic concepts with discussions of classical and current scientific literature in smaller sections. Throughout, attention will be given to newer genome-wide analysis methods that are dramatically increasing our understanding of the extent of genetic variation and the many modes of gene expression. Also, students will be introduced to recombinant DNA technologies as one important way that molecular genetic reactions are reduced to practice in biological research. Upon completion of HG541, students will appreciate the directions research in molecular genetics is heading and be able to draw on this insight as they pursue further studies and research in diverse areas of genetics and biology.

**Credits:** 3 (Fall)
**Course Director:** Wilson
**Instructors:** Wilson, Kalantry, Kidd, Kim, Kitzman, Moran, Mueller, Sekiguchi, Arlt, Kopera

**Prerequisites:** In addition to a college-level introductory biology class, a more advanced class in either genetics or biochemistry is required. This course is excellent preparation for HG 542.

**Syllabus:** [HG541 Syllabus 2014.pdf](#)

**HG 542. Molecular Basis of Human Genetic Disease**

HG 542 will emphasize important topics, principles, and methods of genetics and molecular genetics as they relate to human disease using specific genetic disorders to illustrate key points. The course covers the topics of chromosomal and genomic structural variation and disorders, Mendelian inheritance and monogenic traits, non-Mendelian inheritance, complex genetic disorders and cancer genetics. Papers from the current and classic literature will supplement lecture material.

**Credits:** 3 (Winter)
**Director:** Antonellis
**Instructors:** Glover, Antonellis, Burmeister, Camper, Kalantry, Moran, Sekiguchi, Willer

**Prerequisites:** HG 541 or equivalent, or approval of course director.

**Syllabus:** [HG542 Syllabus 2015.pdf](#)

**HG 544 Basic Concepts in Population and Statistical Genetics**
The concepts and analytic methods for studying variation in human populations are the subject matter of this course. The topics covered include the distribution of genetic variation, major forces of genetic stasis and change, molecular population genetics, quantitative traits, linkage analysis, association tests, and the role of the environment. We take a problem solving approach and present the basic models of population, quantitative, and statistical genetics at a mathematical level appropriate to students in the life sciences. Our focus is on current human genetics research. However, most of what we present is broadly useful and applies to natural populations of other species.

**Credits:** 3 (Fall)

**Instructors:** Douglas, Li, Kidd

**Prerequisites:** A foundation in genetics and familiarity with the basic statistics and probability.

**Syllabus:** [HG544 Syllabus 2014.pdf](#)

**HG 803 - Current Topics in Genetics**

HG 803 is a 2-credit course intended for students who wish to gain further exposure to selected, advanced research topics and methods in genetics. The course is organized into six units/topics, each of which is covered in a series of two to four, weekly two-hour sessions, supervised by faculty members with expertise in genetics research. Recently published research manuscripts from the genetics field represent the discussion material for each of the weekly sessions, and the discussion places a heavy emphasis on student-led presentations, critical analysis and active participation from all students enrolled in the course. Class size is limited to 12 students.

**Potential Topics for Winter 2015:**

- New Therapies for Genetic Disease
- Positional Cloning of Disease Genes
- Epigenetics
- MicroRNAs and RNA Interference
- Neurogenetics
- Genetics of complex diseases

**Credits:** 2 (Winter)

**Director:** Innis

**Instructors:** Innis, Antonellis, Bielas, Cheung, Iwase, Kalantry, Keegan, Kim, Saunders

**Prerequisites:** HG541 or HG542 and permission of instructor.

**Syllabus:** [HG803 Syllabus 2015.pdf](#)

**HG 821/822. Student Seminar**

In order to enhance knowledge of topics in genetics-related research as well as critical thinking and seminar presentation skills, students present papers from the current genetics literature. Students in the Department of Human Genetics are required to register and participate in 4 semesters of HG821/822; presentations are required in two of these semesters. All students participate in weekly practice sessions for the speakers and in post-presentation reviews.

**Credit:** 1 (Fall/Winter)

**Director:** Kohrman

**Instructors:** Kohrman, Antonellis, Burke, Martin, Willer
3. ELECTIVES COURSE DESCRIPTION

**HUMAN GENETICS ELECTIVES**

**HG 580 Neurobiology of Developmental Disorders**
This seminar and reading course is focused on cellular and molecular aspects of mammalian developmental neurobiology. Genetic and epigenetic principles underlying the emergence and maintenance of the mammalian nervous system will be explored in the context of human disorders that lead to structural brain abnormalities, intellectual disability and autism. The intent of this course is to present current topics in developmental neuroscience in the context of animal models and human diseases that have contributed to our understanding of the biochemical, molecular and cellular processes of brain development and functions. Graduate students are required to write an analysis of a primary research paper to receive graduate level credit.

*Credits: 3 (Winter)*

*Director: Bielas*

*Instructors: Iwase, Kwan*

**HG 630 Advanced Topics in Cellular and Molecular Genetics**
This course consists of a series of seminars and discussions on a special topic of interest to students, presented by invited speakers over several weeks each semester. The seminars are open to the University community. Registration for this course is limited to PIBS students, graduate students in CMB and Human Genetics, and students supported by the Predoctoral Genetics Training Program. These "short courses" are coordinated and sponsored cooperatively by the CMB Program and the Genetics Predoctoral Training Program.

*Credit: 1 (Fall/Winter)*

*Prerequisites: Must have instructor permission to register (send request to Karen Grahl at kgrahl@umich.edu).*

**HG 665 Statistical Population Genetics**
Advanced course in population genetics, focusing on mathematical models and statistical methods for data analysis. Topics include infinite and finite population phenomena, population structure, admixture, mutation models, coalescent methods, recombination, and linkage disequilibrium.

*Credits: 3 (Winter, every other year)*

*Instructors: Zoellner*

*Prerequisites: Advisory*

**ELECTIVES FROM OTHER GRADUATE PROGRAMS**

**BIOINF 527 - Introduction to Bioinformatics and Computational Biology**
This course introduces students to the fundamental theories and practices of Bioinformatics and Computational Biology via a series of integrated lectures and labs. These lectures and labs will focus on the basic knowledge required in this field, methods of high-throughput data generation, accessing public genome-related information and data, and tools for data mining and analysis. The course is divided into four areas: Basics of Bioinformatics, Computational Phylogeny (includes sequence analysis), Systems Biology and Modeling. There will be weekly homework, two take-home exams, and students will prepare and present group projects.

*Credits: 4 (Fall)*
**Course Director:** Brian D. Athey  
**Prerequisites:** Upper level or graduate level Statistics or concurrent enrollment in Statistics; Calculus I & II; Biochemistry, Molecular Biology, or Cellular Biology; or permission of instructor.

**BIOLCHEM 550 - Macromolecular Structure & Function**
This course will relate protein structure to various aspects of protein function. The course will begin with a general introduction to three-dimensional protein structure including discussion of structure determination methods and forces in protein structure and stability. Significant sections of the course include (i) binding and allostery, (ii) enzyme catalysis, (iii) protein-nucleic acid interaction, and (iv) signal transduction and membrane proteins. The emphasis will be to relate details of structure to the function of the proteins discussed. The course will include a molecular graphics component aimed at hands-on experience for the students.  
**Credits:** 3 (Fall)  
**Course Director:** Dr. Zhaohui Xu  
**Prerequisites:** two terms of organic chemistry; Introductory Biochemistry or permission of instructor. Physical chemistry is recommended.

**BIOLCHEM 576 - Signal Transduction**
A review of hormone and neurotransmitter receptors as well as the cellular effectors that are regulated by receptor activation. Oncogene products as signal transducers and the interaction of the known signaling pathways are also covered. The various techniques used to study signal transduction as well as important experimental strategies employing these techniques will also be presented.  
**Credits:** 1 (Winter)  
**Course Director:** Dr. Stephen Fisher

**BIOLCHEM 591 - Special Topics in Signal Transduction**
A literature based discussion course that will cover both seminal discoveries in signal transduction as well as recent advances in the field. The course will meet once per week for two hours, throughout the semester. Two research papers will be discussed each week. Grading is based on short weekly problem sets and a presentation by each student. Prior course work in biochemistry and cell biology is strongly encouraged.  
**Credits:** 2 (Fall)  
**Course Director:** Dr. Liangyou Rui  
**Prerequisites:** Prior course work in biochemistry and cell biology is strongly encouraged.

**BIOLCHEM 640 - Post-transcriptional Gene Regulation.**
A discussion based course that will cover the mechanisms and the biological roles of post-transcriptional gene regulation in eukaryotes. Topics will include RNA interference, microRNAs, regulated polyadenylation, subcellular regulation of translation, and others. The class will focus on reading and discussion of the recent literature, but topics will be introduced by short lectures.  
**Credits:** 2 (Winter, next offered 2014)  
**Course Director:** Dr. David Turner and Dr. Dan Goldman.

**BIOLCHEM 650 - Mechanisms of Eukaryotic Gene Expression**
Topics will cover eukaryotic RNA polymerases, general transcriptional factors, mechanisms of transcriptional regulation mediated by protein and RNA, and chromatin structure and modification/remodeling. An emphasis will be placed on structural and
mechanistic aspects of transcriptional regulation. The course will consist a combination of lectures and participatory discussions of primary research literature. (no textbook required)

Credits: 3 (Winter)
Course Director: Dr. David Engelke
Prerequisites: Introductory biochemistry; introductory genetics or permission of instructor.

BIOSTAT 553 - Applied Biostatistics
Fundamental statistical concepts related to the practice of public health: descriptive statistics; probability; sampling; statistical distributions; estimation; hypothesis testing; chi-square tests; simple and multiple linear regression; one-way ANOVA. Taught at a more advanced mathematical level than Biostat 503. Use of the computer in statistical analysis.

Credits: 4 (Fall)
Instructor: Bin Nan
Prerequisites: Calculus

BIOSTAT 601 - Probability & Distribution Theory
Fundamental probability and distribution theory needed for statistical inference. Probability, discrete and continuous distributions, expectation, generating functions, limit theorems, transformations, sampling theory.

Credits: 4 (Fall)
Instructor: Lu Wang and Yi Li
Prerequisites: Three terms of calculus

BIOSTAT 602 - Biostatistical Inference
Fundamental theory that is the basis of inferential statistical procedures. Point and interval estimation, sufficient statistics, hypothesis testing, maximum likelihood estimates, confidence intervals, criteria for estimators, methods of constructing test and estimation procedures.

Credits: 4 (Winter)
Instructor: Hyun Min Kang
Prerequisites: Biostat 601

BIOSTAT 666 - Statistical Models & Numerical Methods in Human Genetics
Introduction to current statistical methods used in human genetics. Topics will include sampling designs in human genetics, gene frequency estimation, the coalescent method for simulation of DNA sequences, linkage analysis, tests of association, detection of errors in genetic data, and the multi-factorial model. The course will include a simple overview of genetic data and terminology and will proceed with a review of numerical techniques frequently employed in human genetics.

Credits: 3 (Fall)
Instructor: Goncalo Abecasis
Prerequisites: Biostat 602 or Perm. Instr.

CANCBIO 553 - Molecular Biology of Cancer
This is a didactic, team-taught course comprising two 90-minute classes per week, and evaluations by mid-term and final (take home) exams. This course is currently listed in the Departments of Microbiology and Immunology and of Pathology. We anticipate that the following two courses will also receive approval from those departments.
Credits: 3 (Winter)
Course Director: Colin Duckett

CANCBIIO 554 - Cancer Pathogenesis & Treatment
This is a team-taught class comprised of a combination of didactic and paper-based discussions.
Credits: 3 (Fall)

CDB 530 - Cell Biology
This graduate course is designed to present basic information as well as the most recent developments in key areas of cell biology. Course consists of both lectures by faculty in their areas of expertise and small discussion groups that delve more deeply into lecture material and discuss primary literature. Both will expose students to current experimental approaches in cell biology. Students will be expected to demonstrate their knowledge of course material by participation in discussion groups and by examinations.
Credits: 3 (Fall)
Instructor: Lois Weisman

CDB 580 - Developmental Biology
This course is a graduate-level introduction to the principles of development, with an emphasis on current research topics that illustrate fundamental principles. Early events in development will be the focus of the course including how cells divide, differentiate, and form tissues and organs in the correct position. Primary developmental processes including fertilization, cleavage, gastrulation, neurulation and organogenesis will be studied, using a variety of model systems. The organizational structure of the course includes lectures by CDB and guest faculty, with discussion sessions approximately every two weeks. Students are expected to read assigned material from the textbook and journal articles, and to participate actively in discussion sessions.
Credits: 3 (Winter)
Instructor: Scott Barolo

CDB 680/681/682 - Organogenesis of Complex Tissues (680 every fall; 681 odd years; 682 even years)
The course will cover multiple aspects of organogenesis, including: morphological and molecular events underlying organ formation; quantitative aspects of gradient formation, tissue modeling and cell behavior; in vitro and in vivo experimental systems; parallel pathways for organ formation in various model organisms; adult organ structure and pathology; organ regeneration/repair; stem cell systems: cell and tissue engineering; and carcinogenesis.
Credits: 4
Instructor: Deborah Gumucio

EPID 516 - Genomics in Epidemiology
This course relates genomics to the core public health discipline of epidemiology emphasizing the use of genomics to help describe disease frequency and distribution and to gain insights into biological etiologies. Topics include genetic material in disease, in families and in populations; the investigation of multifactorial traits; model-based linkage analysis; model-free linkage analysis; segregation analysis; allele association and linkage disequilibrium; and gene-gene interactions and gene-environment interactions. Issues related to implementing studies are considered.
Credits: 4 (Winter)
Instructor: Patricia A. Peyser
Prerequisites: Epid 503 or equivalent; Epid 515 or equivalent; Biostat 503 or equivalent

HUMGEN 650 - Medical Genetics
HUMGEN 665 - Statistical Population Genetics (odd years)
Advanced course in population genetics, focusing on mathematical models and statistical methods for data analysis. Topics include infinite and finite population phenomena, population structure, admixture, mutation models, coalescent methods, recombination, and linkage disequilibrium.
Credits: 3 (Winter)
Instructors: Zoellner

MICROBIOL 504 - Cellular Biotechnology
Cellular Biotechnology. Provides an overview and integration of six disciplinary foci: cell biology and culture ecology and evolution molecular genetics and protein engineering bioseparation and processing biosensing and analysis cellular modeling, prediction, and control.
Credits: 3 (Winter)

MICROBIOL 607 - Microbial Pathogenesis
Topics include regulatory mechanisms of pathogens, toxins and toxinogenesis, secretion, adherence and invasion. The course is literature-based, although each session begins with a discussion by the instructor to provide context and background for papers under discussion. Primarily covers bacterial pathogens.
Credits: 2 (Winter)
Prerequisites: Introductory microbiology or permission of course director.

MICROBIOL 612 – Microbial Informatics
Increasingly, microbiologists are generating large and varied datasets that must be integrated with data from traditional approaches to test hypotheses and identify new avenues of research. This course will give microbiologists the background they need to design robust experiments, implement traditional statistical approaches for small and large datasets, and utilize the R statistical programming software. The R statistical software language will be used throughout the course to introduce students to statistical techniques and computer programming.
Credits: 3 (Fall, even-numbered years)
Instructor: Patrick Schloss

MICRBIOL 615 - Viral Pathogenesis I
Molecular and Cellular Determinants of Viral Pathogenesis. Concepts of viral pathogenesis and controls. Early events, entry, receptors, tropism determinants. Replication and interactions with host defenses. Transmission in populations; smallpox as a paradigm. The format includes a combination of lecture and critical analysis of primary literature.
Credits: 2 (Winter)
Course Directors: Akira Ono and Christiane Wobus.
Prerequisites: Microbiology 503 or equivalent.

MICRBIOL 619 - Special Topics in Microbiology & Immunology
These one-credit courses will be one-time offerings, each covering an area of current microbiology, immunology or related research, to be held 4 weeks of winter or fall term, respectively.
MICRBIOL 640 - Molecular & Cellular Immunology
This three-credit course is focused upon molecular and cellular aspects of vertebrate immunology. Topics covered include: Mechanisms of antigen recognition in innate and adaptive immunity, antigen processing and presentation, the MHC, generation of diversity in immune receptors, B and T cell development, activation, differentiation, death and effector functions; mechanisms of homeostasis and immunosuppression; NK cells and other innate immune cell types, immunological tolerance and its breakdown; microbial immunity; and immune cell signal transduction. The course includes both didactic lectures and discussion-type seminars based upon contemporary research papers. A previous introductory course in immunology is recommended.

Credits: 3 (Fall)
Course Director: Dr. Cheong-Hee Chang.
Prerequisites: Graduate standing; Physics, Biology 305, Biol. Chem. 415, and MCDB 436/Micrbiol 502 or equivalent; permission of instructor for undergraduates or non-candidate for degree (NCFD) students.

PATH 581 - Tissue, Cellular & Molecular Disease
This course introduces students to basic pathophysiologic mechanisms, the molecular basis for disease and the morphologic expression of human disease. The course will begin with a review of normal histology and then focus on a rigorous presentation of cellular and molecular mechanisms which appear to be common to a number of diseases including cell response and injury, inflammation and immunity, infectious disease, disturbances of the circulation and neoplasia. Specific prototypic disease entities are then presented within the context of these mechanisms and the molecular events that govern their induction and maintenance.

Credits: 3 (Winter)
Course Director: James Varani
Prerequisites: Instructor Permission

PHARMACOL 502 - Introduction to Scientific Communications
Pharmacology 502 introduces second-year graduate students to essential scientific communication skills. Beginning with the relatively easy task of learning to search the literature over the Internet and ending with the challenges of writing an NRSA grant application and giving a short seminar, each student will develop confidence in both written and spoken scientific communication. Class meetings alternate between presentations by local experts on various topics and student presentations of their work in progress. In-depth analysis of student writing and presentation skills will be provided in class by the instructor, by other students working in small groups, as well as by guest scientists. Through a series of assignments, each student will write a grant over the course of the semester on a topic of his or her choice. By the end of the term each student will have polished and revised the proposal to a high quality product that will be presented both orally and in written form to the rest of the class. Finally, each student will participate in a mock study section to constructively evaluate each other's grants.

Credits: 2 (Fall)
Prerequisites: Permission of instructor

PHYSIOL 555 - Integrative Genomics
The objective of this course is to provide students with the intellectual underpinnings to design, analyze, and interpret gene function experiments in a mechanistic manner using
genetically engineered animals. Genetic engineering of animal models will be presented, with integration of gene function through tissue/organ, system and organismal levels. Importantly, the course will highlight complexities due to gene interactions with the environment, such as effects due to nutrition, exercise, pathogen infection and disease. Physiologic studies will highlight both vertebrates and invertebrates, including fly, worm and mouse, to give students an appreciation of the strengths and weaknesses of different model organisms to approach integrative questions.

This course features professional skills development, including critical evaluation of the scientific literature, oral presentations, development of research project specific aims, grant writing, and peer-review of grants through student lead study sections. There are no conventional tests in this class.

Credits: 3 (Winter)

Course Director: Scott Pletcher

STATS 400 - Applied Statistical Methods
Statistics and the scientific method; observational study versus designed experiment; visualization; introduction to probability; statistical inference; confidence intervals; one-sample tests of hypothesis; two-sample problems; analysis of variance (ANOVA); blocked designs; tests for association and independence (chi-square tests); regression and correlation; and non-parametric tests.

STATS 425 - Introduction to Probability
Basic concepts of probability; expectation, variance, covariance; distribution functions; and bivariate, marginal, and conditional distributions.

Credits: 3 (Fall)
Prerequisites: Math 215

STATS 426 - Introduction to Theoretical Statistics
An introduction to theoretical statistics for students with a background in probability. Probability models for experimental and observational data, normal sampling theory, likelihood-based and Bayesian approaches to point estimation, confidence intervals, tests of hypotheses, and an introduction to regression and the analysis of variance.

Credits: 3 (Winter)
Prerequisites: Stat 425 and prior or concurrent enrollment in Math 217, 412 or 451.

STATS 500 - Applied Statistics I
Linear models; definitions, fitting, identifiability, collinearity, Gauss-Markov theorem, variable selection, transformation, diagnostics, outliers and influential observations. ANOVA and ANCOVA. Common designs. Applications and real data analysis are stressed, with students using the computer to perform statistical analyses.

Credits: 3 (Winter)
Prerequisites: Math 417 and Stat 250/350, 280 or 426.

STATS 503 - Applied Multivariate Modeling
Topics in applied multivariate analysis including Hotelling's T-squared, multivariate ANOVA, discriminant functions, factor analysis, principal components, canonical correlations, and cluster analysis. Selected topics from: maximum likelihood and Bayesian methods, robust estimation and survey sampling. Applications and data analysis using the computer is stressed.

Credits: 3 (Winter)
Prerequisites: Stat 500

4. COURSE REQUIREMENTS FOR M.S. STUDENTS
The core course requirements for the Masters degree (M.S.) in Human Genetics include:

1. Research and Coursework Tracks:
   a. 12 hours of coursework in Human Genetics.
      i. HUMGEN 541 (3cr), HUMGEN 542 (3 cr) and HUMGEN 544 (3 cr) are all required.
      ii. At least 2 semesters of HUMGEN 821/822 (Student Seminar) are required (1 cr per semester). In the latter, students must present a seminar in at least one of the semesters.
      iii. Additional HUMGEN courses can be HUMGEN 803 (2 cr) (Instructor's permission is required if HUMGEN 541 has not been completed previously), or courses in other departments such as Integrative Genomics (in Physiology).
   b. Additional relevant courses from other science departments for a total of 24 credits minimum for completion of degree (see Ph.D. curriculum for a list of many courses that are appropriate).

2. Research Track: From 7 to 10 hours of research in HUMGEN 800 with a primary or secondary Human Genetics faculty member (but not 990 level research, which is pre-candidate for the Ph.D., and cannot count towards the M.S. degree). These research credits can be counted towards the total of 24 credit hours required for the M.S. degree.

This curriculum can be completed over the course of a single calendar year or may be extended over additional semesters.

5. COURSE REQUIREMENTS FOR MSTP STUDENTS
MSTP students receive 18 credit hours for medical school coursework. This typically includes training in biochemistry and cell biology to satisfy course requirements in these areas. MSTP students are required to take the core coursework in Human Genetics including HG541, HG542, HG544, PIBS503 and 2 semesters of the student seminar course, HG 821/822. Three elective credits are waived for MSTP students; thus, they need to select a minimum of three elective credits of graduate coursework to fulfill the requirement for the Ph.D. degree.

G. PRELIMINARY EXAM

1. GOALS/OVERVIEW
The purpose of the Human Genetics Preliminary Examination is to allow students to demonstrate their ability to think critically and to design experiments that will test hypotheses and contribute to the understanding of basic genetic principles.

The qualifying exam will test the student’s ability to:
- Focus on a topic that addresses an important biological question, selected from mini reviews provided by a faculty committee.
- Critically and succinctly summarize the current literature on that topic.
2. TIMELINE
The Preliminary Examination is an oral exam given in early May at the end of the second year, following submission of a written research proposal. Students will be enrolled in Pharmacology 502 during winter semester of their 2nd year, covering grant format and writing skills using their thesis research as a topic. The qualifying exam will begin after the end of Winter semester, following Pharm 502.

The exam process should occupy no more than 4-5 weeks, including the time to select one of the topics provided, refine and research the topic, design an experimental strategy, write a proposal, prepare an oral presentation and defend it. To accommodate the time and effort required for the exam, students can reduce the time committed to laboratory research by up to 50% or an appropriate level after discussion with the mentor.

Example of Prelim Exam Timeline (from 2013):
- April 19 (Fri) - Topics distributed; each student submits choices within 24 hrs.
- April 22 (Mon) - Topic assignment to students
- April 30 (Tues) - Draft of Abstract and Specific Aims due for review
- May 3 (Mon) - Specific Aims approved or revisions suggested
- May 20 (Mon) - Written exam due
- May 27 - Oral exams, 2 hrs in length, administered by a single faculty committee for all students taking the examination that year.

3. DESCRIPTION
The Human Genetics Preliminary Examination is comprised of a written proposal and an oral exam. Each student is expected to choose a topic for a grant proposal, from a short list provided, in an area of research that is unrelated to the research program of their mentor’s laboratory, their own anticipated Ph.D. thesis research and the topics the student has previously prepared for other courses or presentations (e.g., student seminar). One examination committee comprised of five Human Genetics faculty will administer the exam for all students in order to make the process as consistent as possible.

The detailed format of the exam is described below:

A. Students will be given a list of mini-reviews (selected by the exam committee), each of which focuses on a key topic/question in one of our three core areas (Molecular Genetics, Medical Genetics or Population/Statistical Genetics).

B. Students will choose three mini-reviews and rank them in order of preference as an exam topic. Students will be given their first choice if they are the only one selecting that topic or will be assigned their next available choice. The selected topic will serve as the starting point for their exam.

C. Students will be expected to formulate and address a significant hypothesis based on their selected topic. One week will be available to prepare a 1-page
Abstract and Specific Aims document that will be reviewed by exam committee members within 2 or 3 days after submission.

D. Two additional weeks will be available to complete a 5-page research proposal in the selected area. Students will be expected to read the relevant literature and experimental approaches in the topic area.

E. Students will complete a 2 hour oral exam on their proposal. All students will be examined within a 1 - 2 day period by the exam committee, which will include faculty from each of the three core areas.

The oral exam tests the student’s ability to reason analytically and to develop ideas and defend them to a scientific review. The emphasis is on hypothesis testing and experimental design, as well as general knowledge in the field of Human Genetics. The student will be expected to have an understanding of the limitations and potential pitfalls of the proposed experiments. The student should be familiar with the key past experiments that led to the hypothesis and the important basic concepts underlying the approaches to be used. Committee members will expect students to be sufficiently familiar with each proposed technique and to understand its theoretical basis and limitations, but will not expect detailed knowledge of experimental conditions, such as buffer components and incubation temperatures.

4. EVALUATION AND ADVANCEMENT TO CANDIDACY

Immediately after the oral examination, the performance of the student will be evaluated by the exam committee. The committee can decide to pass the student unconditionally, to fail the student unconditionally, or request remediation to assist in making a final evaluation. The committee may ask students to retake the examination on the same topic or a new topic, or to rewrite all or part of the written proposal. In addition, the committee may recommend other requirements for a less than satisfactory performance (e.g. assign additional coursework). If the exam committee identifies deficiencies in the student’s knowledge base and/or performance, the mentor will be asked to develop a training plan to address these issues. The plan will be included in the preliminary exam report and evaluated by the exam committee. A student will be dismissed from the Human Genetics Program if he or she fails either the written or oral portion of the examination a second time.

The outcome of the exam and evaluation of the student’s performance will be summarized in writing. Prelim exam reports will be communicated to the student by one member of the examining committee. The report will also be forwarded to the Education Committee, which will evaluate students for advancement to candidacy, prior to presentation to the faculty as a whole. The student’s overall progress and performance on the exam will be presented at a full faculty meeting and a final decision regarding promotion will be made. Admission to candidacy will be based upon evaluation of the student’s laboratory performance and the mentor’s assessment of his/her research potential as well as the student’s performance on the oral preliminary examination and overall academic record during the first two years.

5. MSTP STUDENTS

MSTP students entering the Human Genetics Program after their M2 year are considered to be at the same level as students entering the Program after 1 year in
PIBS. The MSTP students will take their preliminary exam after one year in the Ph.D. program, on the same schedule as the Ph.D. students (in April-May).

H. DISSERTATION COMMITTEE

1. OVERVIEW
Once a student has achieved Candidacy for the Ph.D. degree, he/she will select a thesis committee that will be chaired by the research mentor. The thesis committee members should be selected by September of Year 3. The names of the faculty members should be forwarded to the Graduate Student Administrator and Director of Graduate Studies for review by September 30.

The dissertation committee guides the research project and progress of the student. The committee members can be of greatest assistance in addressing research problems, suggesting alternative strategies and assessing progress. In addition, thesis committee members are an important source of support for the student's future professional life.

2. COMMITTEE COMPOSITION
The committee must consist of at least 2 faculty members from the Department of Human Genetics (in addition to the chairperson/mentor) and at least one “cognate” faculty member from another department. Most committees include a total of 5 faculty members.

3. LOGISTICS: DOCUMENTS, PRESENTATIONS
Students should provide their committee a brief description of the data they will be presenting at least three working days in advance of the committee meeting. After the first meeting, the document should also include a summary of the progress made since the previous meeting. Thesis committee meetings generally last 2 hours and include an oral presentation by the student, discussion of the project and an assessment of the student’s progress. Any concerns can be raised and discussed with the student and mentor at this time. The meeting should conclude with the development of a clear, specific 6 month plan based on the discussions. Students and their mentors will complete a Thesis Committee Meeting Report (below), which is signed by the student and each member of their committee. Committee members can also elect to submit an independent Committee Report with additional, personalized comments for the student and mentor. Individual reports should be forwarded to the mentor and also signed by the student. All documents should be returned to the Graduate Student Administrator within 7 days of the meeting.

4. FREQUENCY OF MEETINGS
The first thesis committee meeting must be convened within 3-6 months after achieving candidacy. At this meeting, the student will be expected to provide a broad overview of their thesis research project and an outline of the experimental aims that will be pursued. Students will be required to have thesis committee meetings every 6 months throughout the duration of their graduate careers. Prior to the meeting, the student will notify the Human Genetics student services representative of the date.
Graduate students who do not comply with the Human Genetics graduate program policy will be required to schedule a meeting with their mentor and the Director of Graduate Studies for a formal review of their performance and progress. In the event that the student and mentor still do not comply with the thesis committee meeting policy, they will be required to meet with the Chair of the Department of Human Genetics, who will evaluate the training situation. If insufficient progress is being made on the thesis research, the student may lose eligibility for training grant slots, award nominations and/or TA positions until improvements in performance are observed.

5. FORMS TO BE COMPLETED
The following thesis committee meeting report forms should be completed by the dissertation committee. These are important documents for evaluation of the student’s progress during graduate training and an opportunity to highlight strengths and weaknesses of the student’s performance.
A. Dissertation Committee Meeting Summary form. To be prepared by the thesis advisor and signed by all committee members and student.

**DISSERTATION COMMITTEE MEETING SUMMARY**

*Human Genetics Graduate Program*

The Chair and faculty members of the Dissertation Examination Committee should complete this form, obtain the candidate’s signature, and return to Karen Grahl (kgrahl@umich.edu) **within 7 days after the meeting**.

<table>
<thead>
<tr>
<th>Candidate Name:</th>
<th>Committee Members Present</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>____________________________</td>
<td>X □PI □Chair □Co-chair</td>
<td>__________</td>
</tr>
<tr>
<td>Meeting Date: __________</td>
<td>X □PI □Chair □Co-chair</td>
<td>__________</td>
</tr>
<tr>
<td>Year student reached Candidacy: _______</td>
<td>X □PI □Chair □Co-chair</td>
<td>__________</td>
</tr>
<tr>
<td></td>
<td>X____________________</td>
<td>__________</td>
</tr>
</tbody>
</table>

The next meeting will be in the next ( □Fall □Winter □Spring/Summer ) Term.

1. The student’s progress since the last committee meeting has been: outstanding—acceptable—improvement needs □ □ □ □ □
2. The student’s commitment of time and effort to their research has been: outstanding—acceptable—improvement needs □ □ □ □ □
3. The student’s intellectual contribution to their thesis project is: outstanding—acceptable—improvement needs □ □ □ □ □
4. The student is able to grasp appropriate concepts and design experiments. agree—unclear—disagree □ □ □ □ □
5. The student draws sound conclusions from results, considers alternative models, and develops testable hypotheses. agree—unclear—disagree □ □ □ □ □
6. The research plan for the upcoming year as presented by the student is acceptable. agree—unclear—disagree □ □ □ □ □
7. The research presented is in a state suitable for publication. agree—unclear—disagree □ □ □ □ □
8. The student is ready to begin writing the dissertation. □Yes □No
   If “Yes,” in which term is the student expected to defend his/her thesis? ________________
NARRATIVE REPORT  Brief summary of the committee meeting, including comments describing the following: (1) student’s progress since last meeting; (2) outstanding strengths; (3) areas that need improvement; (4) research goals for the next year; (5) preparation for future career goals (use additional pages as needed).

Candidate’s comments (optional): use additional pages, if necessary.

Candidate signature:  I have read and understand this progress summary.

X____________________________
**B. OPTIONAL: Dissertation Committee Meeting Report form.** To be completed by individual faculty committee members, forwarded to the Chair and signed by the student.

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**DISSERTATION COMMITTEE MEETING REPORT**

**Human Genetics Graduate Program**

**Optional form for individual committee members**

Faculty members of the Dissertation Examination Committee can elect to complete this form to provide an independent evaluation of the student. Please forward to the thesis committee chair for review within 7 days after the meeting. This form will be included in the final committee report.

**Candidate Name:** ______________________________________

**Committee Member submitting report:** ______________________________________

**Meeting date:** _______________

1. The student's progress since the last committee meeting has been:
   - outstanding
   - acceptable
   - improvement

2. The student's commitment of time and effort to their research has been:
   - outstanding
   - acceptable
   - improvement

3. The student's intellectual contribution to their thesis project is:
   - outstanding
   - acceptable
   - improvement

4. The student is able to grasp appropriate concepts and design experiments.
   - agree
   - unclear
   - disagree

5. The student draws sound conclusions from results, considers alternative models, and develops testable hypotheses.
   - agree
   - unclear
   - disagree

6. The research plan for the upcoming year as presented by the student is acceptable.
   - agree
   - unclear
   - disagree

7. The research presented is in a state suitable for publication.
   - agree
   - unclear
   - disagree

8. The student is ready to begin writing the dissertation.
   - Yes
   - No

**Additional comments:**

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**Candidate signature:** I have read and understand this report.

X______________________________
I. TEACHING EXPERIENCE

A semester of teaching is a valuable part of our Ph.D. program experience. It is recommended that students obtain one semester of teaching experience. The timing is flexible. A variety of teaching opportunities are available in the Department of Human Genetics via core graduate courses and in the Department of Biology via undergraduate courses and laboratory sections. The Department of Biology application deadlines for fall and winter semester Graduate Student Instructor (GSI) positions are March and November respectively.

J. SCHOLARLY ACTIVITIES

1. FRIDAY AFTERNOON RESEARCH SEMINARS

On Friday afternoons, an hour-long Research-In-Progress seminar is presented by Human Genetics graduate students, postdoctoral fellows and other trainees to the Department. This is an excellent venue for trainees to refine their oral presentation skills, gain experience with answering questions and receive feedback on their research.

2. SYMPOSIA

JAMES V. NEEL LECTURESHP

This annual lectureship honors James V. Neel, M.D., Ph.D., a pioneer in the study of human genetics and one of the first to foresee its importance in the diagnosis and treatment of medical conditions. During his 39-year career in the U-M Medical School, Neel established one of the first clinics to evaluate and counsel people with hereditary diseases. In 1956, Neel established the first academic department of human genetics in the United States at the University of Michigan Medical School, which he chaired for 25 years. The Neel Lectureship features an international leader in research who shares their experiences and underscores the importance of research in genetics. The annual event also includes the presentation of the James V. Neel Award, which recognizes the outstanding academic and research achievements of Human Genetics Ph.D. and Genetic Counseling Master's students.

THOMAS D. GELEHRTER LECTURESHP

This annual lectureship honors Dr. Thomas D. Gelehrter, a leader within the human genetics community and internationally recognized as an expert in human genetics. Dr. Gelehrter joined the University of Michigan Medical School faculty in 1974 and served as chair of the Department of Human Genetics for 17 years, from 1987 to 2004. He is currently an active Professor Emeritus in the department. The Lectureship builds upon Dr. Gelehrter’s career dedicated to promoting excellence in research, education, and care in medical genetics and will be an enduring legacy that continues to raise awareness about the importance of medical genetics and improve this vital field. Invited to speak at the annual lectureship is a prominent scientist in the field of medical genetics, who embodies the principles that inspired Dr. Gelehrter’s outstanding contributions to human genetic research, teaching and patient care.

THE MICHIGAN PREDOCTORAL TRAINING PROGRAM IN GENETICS ANNUAL RETREAT
The Genetics Training Program (GTP) is an interdisciplinary graduate program that provides enriched genetics education for students receiving their Ph.D. degrees in six departments: Biological Chemistry, Ecology and Evolutionary Biology, Human Genetics, Microbiology and Immunology, Molecular, Cellular and Developmental Biology and Pharmacology. The goal of the program is to train investigators who can combine disciplinary expertise with the new research opportunities of the genomic era. The GTP, one of the oldest NIH supported training programs, continues to be a vital component of graduate education and biomedical research at the University of Michigan. A GTP retreat is held in the Spring and features a keynote address by a leading genetics researcher, student research talks and a poster session by current trainees. Website:  http://www.hg.med.umich.edu/gtg/

3. HUMAN GENETICS RETREAT
The Human Genetics Retreat is an annual event that brings together faculty, students, fellows and staff for a program of scientific discussion and social interactions. The events include poster sessions, talks by trainees and faculty and a keynote address from an invited speaker who is a leader in the field of human genetics. The graduate student recipients of the James V. Neel Fellowship awards for outstanding scholarly achievement and the Anita and Howard Cramer Family Fellowship for academic excellence are recognized at the retreat. The retreat is generally held in the Fall over a 2 day period at an off-campus site. During free time, attendees have an opportunity to informally gather and engage in a variety of activities, including hiking, team sports, bonfire, or dancing.

K. INDIVIDUAL DEVELOPMENT PLANS
Human Genetics Ph.D. and Master’s students will initiate an Individual Development Plan (IDP) at the beginning of their second year in the graduate program. The IDP is an online tool accessible through the PIBS website that is intended to assist students in monitoring of their progress toward completing the graduate training. The IDPs will also help the graduate program facilitate students’ entre into their chosen career path. In addition, the online IDP tool provides a mechanism for students to communicate ideas or problems with their mentors in a neutral setting.

Overall, the tool will help individual students:
- Map their intended career path.
- Identify skills, strengths, and areas for improvement.
- Plan and track completion of activities and accomplishments.
- Identify ways for their mentor to help.
- Analyze and report on their graduate training.

Students will be asked to initiate their IDP by December of their second year, and updates will be requested annually.

L. LEAVES AND ABSENCES

1. LEAVES
Guidelines and policies for official Leaves of Absence can be found on the Rackham Graduate School website:
http://www.rackham.umich.edu/current_students/doctoral_students/phd_students/understanding_registration/leave_of_absence/

All requests for official Leaves of Absence of up to one year must be submitted to the Human Genetics Director of Graduate Students and reviewed by the Education Committee. Leaves may be taken for medical or personal reasons. A formal letter indicating the reason and duration of the leave must be submitted to the Human Genetics Chair or Director of Graduate Studies. Students on leave for more than one year will be expected to reapply for admission to the Program if they desire to return to graduate studies.

2. ABSENCES

Unapproved absences are not allowed. Students that are not engaged in full-time work, including coursework, research and other relevant scholarly activities, will not be considered in good standing in the Program and will be subject to dismissal. The mentor and program director will meet with the student in poor standing to discuss the absences and sub-par performance and outline a plan for remediation during a probation period. After the probationary period, the student’s work in the laboratory, productivity, participation in programmatic activities and attendance at critical research meetings will be evaluated by the Education Committee, which will make a final recommendation regarding dismissal.

3. VACATIONS

Students can take two full weeks of vacation (10 business days, M-F) of their choice per year (in consultation with their thesis mentor). Additional vacation days include recognized federal holidays, Season Days (i.e., the 4 working days that fall between Christmas Day and New Year’s Day), and other times when the University is officially closed. Your thesis mentor and PIBS Director must approve exceptions.

M. STUDENT FINANCIAL SUPPORT

All students in good standing will be provided with a monthly stipend, comprehensive health care coverage, and coverage of tuition and fees. For the first year, PIBS will cover all expenses. In year two, the student will be supported by a combination of individual fellowships, pre-doctoral training grant funds, institutional funds and research grants. Once a mentor has been selected and the student has passed the preliminary examination at the end of year 2, funding will be provided by the mentor’s laboratory unless training grant support or other fellowships are available. Human Genetics faculty members who accept Human Genetics students must send the Human Genetics Program the source of funding (include the grant number) that will support that student in the years that the graduate student is a member of their lab.

Should the mentor not be able to meet the financial responsibility for any Human Genetics student in his or her lab, the financial obligation will be discussed with the Program Director and Department Chair.
1. TRAINING GRANTS

GENETICS TRAINING GRANT
The Michigan Predoctoral Training Program in Genetics (GTP) is an interdisciplinary program that provides enriched genetics education for students receiving their Ph.D. degrees in six departments: Biological Chemistry, Ecology and Evolutionary Biology (EEB), Human Genetics, Microbiology and Immunology, Molecular, Cellular and Developmental Biology (MCDB) and Pharmacology.
Website: http://hg.med.umich.edu/gtg/

GENOME SCIENCES TRAINING GRANT
The Genome Science Training Program (GSTP) at the University of Michigan provides support for pre- and post-doctoral training at the interface of statistical, computational, and molecular genetics under support from the National Human Genome Research Institute of the National Institutes of Health.
Website: http://csg.sph.umich.edu/training/

2. RACKHAM AWARDS AND OTHER FELLOWSHIPS
There are a number of additional opportunities for Human Genetics graduate students to compete for fellowships, both through the University of Michigan as well as external funding sources. The Rackham Graduate School has many funding opportunities for Ph.D. and Master's students. Detailed descriptions can be found on the Rackham website (http://www.rackham.umich.edu/funding/). In addition, federal and private foundations offer fellowships with application deadlines throughout the year. The program strongly encourages graduate students to apply for these funding sources as part of their training experience. To facilitate the identification of appropriate fellowship opportunities, the graduate program has assembled a list of internal and external funding agencies for mentors and students.

FOUNDATION
- Predoctoral Fellowship (American Heart Association) http://my.americanheart.org/professional/Research/FundingOpportunities/ForScientists/Winter-2013---Predoctoral-Fellowship_UCM_443316_Article.jsp
- American Lung Association Lung Health Dissertation Grant (American Lung Association) http://www.lungusa.org/finding-cures/grant-opportunities/grant-offerings.html
- Dennis Weatherstone Predoctoral Fellowship Program (Autism Speaks) http://www.autismspeaks.org/science/grants-program/open-grants-how-apply
- Cancer Research Institute Student Training and Research in Tumor Immunology (STaRT) Grant (Cancer Research Institute) http://www.cancerresearch.org/programs/STaRT/apply/
- Young Investigator Award--neurofibromatosis (NF) (Children's Tumor Foundation) http://www.ctf.org/CTF-Awards-Grants-and-Contracts/CTF-Young-Investigator-Award/
• Pre-doctoral Training Fellowship (Epilepsy Foundation)  
  http://www.epilepsyfoundation.org/research/grant-and-fellowship-opportunities.cfm
• Pre-doctoral Fellowship (Ford Foundation)  
  http://sites.nationalacademies.org/PGA/FordFellowships/PGA_047958
• Dissertation Fellowships (Ford Foundation)  
  http://sites.nationalacademies.org/PGA/FordFellowships/PGA_047959
• Pre-doctoral Fellowships in Health Outcomes (The Pharma Foundation)  
  http://www.phrmafoundation.org/
• Pre-doctoral Fellowships in Pharmacology/Toxicology, Informatics and Pharmaceutics (The Pharma Foundation)  
  http://www.phrmafoundation.org/
• UNCF - Merck Science Initiative Graduate Science Research Dissertation Fellowship (United Negro College Fund (UNCF))  
  http://umsi.uncf.org/index.php
• Harold Weintraub Graduate Student Award (Requires program nomination)  
  https://www.fhcrc.org/en/labs/basic-sciences/weintraub-award.html

GOVERNMENT
• NHLBI Ruth L. Kirschstein National Research Service Awards for Individual Predoctoral MD/PhD Fellows (F30) NIH PA-11-125 (NHLBI)  
• Ruth L. Kirschstein National Research Service Awards for Individual Predoctoral Fellowships to Promote Diversity in Health-Related Research (Parent F31 - Diversity) (NIH)  
• NINDS Ruth L. Kirschstein National Research Service Awards for Individual Predoctoral Fellows in M.D.-Ph.D. Programs (F31) (NIH/NINDS)  
• Ruth L. Kirschstein National Research Service Awards for Individual Predoctoral MD/PhD and Other Dual Doctoral Degree Fellows (Parent F30) NIH PA-11-110 (NIH/NRSA)  
• Ruth L. Kirschstein National Research Service Awards for Individual Predoctoral Fellows (Parent F31) (NIH/NRSA)  
• Graduate Research Fellowship Program (GRFP) (NSF)  

RACKHAM
Direct Application
• Rackham International Research Awards  
  http://www.rackham.umich.edu/funding/from_rackham/student_application/international_research_awards/
• Rackham Graduate Student Emergency Funds  
  http://www.rackham.umich.edu/funding/from_rackham/student_application/graduate_student_emergency_funds/
• Rackham Graduate Student Research Grant  
  http://www.rackham.umich.edu/funding/from_rackham/student_application/graduate_student_research_grant/
• Rackham Conference Travel Grant
  http://www.rackham.umich.edu/funding/from_rackham/student_application/rackham_conference_travel_grant/

• Harold and Vivian Shapiro/John Malik/Jean Forrest Awards
  http://www.rackham.umich.edu/funding/from_rackham/student_application/shapiro_malik_forrest/

• Lurcy Fellowship For Study In France
  http://www.rackham.umich.edu/funding/from_rackham/student_application/lurcy_fellowship/

• German Academic Exchange (DAAD)
  http://www.rackham.umich.edu/funding/from_rackham/student_application/german_academic_exchange_daad/

• CIC Smithsonian Institute Fellowship (Rackham/Smithsonian Institute)
  http://www.cic.net/Home/Students/SmithsonianFellowship.aspx

Program Nomination
• Howard Hughes Medical Institute (HHMI) International Ph.D. Student Research Fellowship
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/howard_hughes/

• Barbour Scholarship
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/barbour_scholarship/

• Rackham Predoctoral Fellowship Program
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/predoctoral_fellowship_program/

• Susan Lipschutz, Margaret Ayers Host and Anna Olcott Smith Awards for Rackham Graduate Students
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/lipschutz_host_smith/

• Rackham Merit Fellowship Program
  http://www.rackham.umich.edu/funding/from_rackham/student_application/rackham_merit_fellowship/

• Rackham One Term Dissertation Fellowship
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/one_term_dissertation_fellowship/

• Yossi Schiff Memorial Scholarship Fund
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/yossi_schiff_memorial_scholarship_fund/

• Rackham International Student Fellowship and the Chia-Lun Lo Fellowship
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/chia-lun_lo_fellowship/

• Rackham Non-Traditional Fellowships
  http://www.rackham.umich.edu/funding/from_rackham/program_nomination_or_allocation/non-traditional_fellowships/

• Rackham Outstanding GSI Awards
  http://www.rackham.umich.edu/faculty_staff/awards/student_funding/outstanding_graduate_student_instructor_awards/
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<td>• CEW Scholarship Program (Center for Education of Women)</td>
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## N. HUMAN GENETICS FACULTY

### 1. RESEARCH AREAS

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<tr>
<th>Cancer Genetics</th>
<th>Medical Genetics</th>
<th>Developmental Genetics</th>
<th>DNA Recombination &amp; Repair</th>
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<td>Stephanie Bielas</td>
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<td>Santhi Ganesh</td>
<td>Sue Hammond</td>
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<td>David Ginsburg</td>
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## 2. CONTACT INFORMATION

The contact information for Human Genetics primary, joint and emeritus faculty, and research investigators is listed in the table below. Only primary and joint faculty members can serve as dissertation mentors to Ph.D. and Master’s students.

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Direct</th>
<th>Lab</th>
<th>Title</th>
<th>Email</th>
<th>Lab Website</th>
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<tbody>
<tr>
<td>Antonellis, Anthony, Ph.D.*</td>
<td>7-4058</td>
<td>7-2507</td>
<td>Associate Professor</td>
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<td><a href="http://hg.med.umich.edu/labs/antonellis/">http://hg.med.umich.edu/labs/antonellis/</a></td>
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<tr>
<td>Arlt, Martin, Ph.D.</td>
<td>3-6169</td>
<td></td>
<td>Res. Investigator</td>
<td><a href="mailto:Arltm@umich.edu">Arltm@umich.edu</a></td>
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<tr>
<td>Bielas, Stephanie, Ph.D.*</td>
<td>7-8890</td>
<td>7-8852</td>
<td>Assistant Professor</td>
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<tr>
<td>Boyle, Alan P., Ph.D.</td>
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<td>Assistant Professor</td>
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<tr>
<td>Burke, David T., Ph.D.*</td>
<td>7-3823</td>
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<td>Professor</td>
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<td>Burmeister, Margit, Ph.D.</td>
<td>7-2186</td>
<td>4-6125</td>
<td>Professor</td>
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<td><a href="http://www.mbni.med.umich.edu/mbni/faculty/burmeister/burmeister.html">http://www.mbni.med.umich.edu/mbni/faculty/burmeister/burmeister.html</a></td>
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<td>Camper, Sally A., Ph.D.*</td>
<td>5-4185</td>
<td>4-4434</td>
<td>Professor &amp; Chair</td>
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<td><a href="http://www.hg.med.umich.edu/labs/camper/">http://www.hg.med.umich.edu/labs/camper/</a></td>
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<td>Carethers, John M., M.D.</td>
<td>5-1717</td>
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<td>Professor &amp; Chair, Internal Medicine</td>
<td><a href="mailto:Jcarethe@umich.edu">Jcarethe@umich.edu</a></td>
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<td>Cheung, Vivian, M.D.</td>
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<td>Douglas, Julie, Ph.D.*</td>
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<td>Gelehrter, Thomas D., M.D.</td>
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<td><a href="http://www.hg.med.umich.edu/faculty/sue-hammoud-phd">http://www.hg.med.umich.edu/faculty/sue-hammoud-phd</a></td>
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<td><a href="http://www.hg.med.umich.edu/faculty/jeffrey-w-innis-md-phd">http://www.hg.med.umich.edu/faculty/jeffrey-w-innis-md-phd</a></td>
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<td>Kitzman, Jacob, Ph.D.*</td>
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<td>Kohrman, David, Ph.D.</td>
<td>3-9653</td>
<td>3-9703</td>
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<td>Koppera, Hiura, Ph.D.</td>
<td>5-0456</td>
<td>3-3784</td>
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<td>Kwan, Kenneth, Ph.D.*</td>
<td>5-2444</td>
<td>3-3597</td>
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<td>Li, Jun, Ph.D.*</td>
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<td>Clinical Asst. Prof.</td>
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**Legend**

- Primary Faculty*
- Joint Faculty
- Primary Research Faculty
- Emeritus Faculty
O. USEFUL RESOURCES

1. CAMPUS RESOURCES

**CENTER FOR STATISTICAL CONSULTATION AND RESEARCH (CSCAR)**
The Center for Statistical Consultation and Research (CSCAR) provides free statistical consulting to all UM faculty, staff, and graduate students with the design, planning, analysis, and presentation of research studies. CSCAR also presents workshops on statistical methods, statistical software, qualitative data analysis and geographic information systems. Fall, Winter and Spring workshop offerings include SAS, SPSS, Stata, SEM and Statistics Review.

Visit the CSCAR web page for current offerings [www.umich.edu/~cscar/workshops/](http://www.umich.edu/~cscar/workshops/) for additional information. Information and Registration (734)764-7828

Center for Statistical Consultation and Research (CSCAR)
3550 Rackham Building West
Ann Arbor, Mi 48109

**CENTRAL STUDENT GOVERNMENT AIRBUS**
Leaving town and need a ride to/from the airport, but don't want to break the bank in doing so? The CSG Airbus program is a fairly priced and convenient alternative to a taxi or other shuttle services. It runs during Fall break, Thanksgiving break, Winter break and Spring break
[https://csg.umich.edu/airbus/](https://csg.umich.edu/airbus/)

**COMPUTING ON CAMPUS**
The website below will help orient you to all of the computing options students have on campus. Here you can locate information ranging from the location of computer labs to computer sales for personal use. [http://www.umich.edu/computing.php](http://www.umich.edu/computing.php)

- **MPrint** is U-M's Web-based printing service, which allows campus community members to print from their Internet-enabled on-or off-campus computer to any networked campus printers. Whether you're using a desktop or laptop computer, you can print to MPrint. [http://mprint.umich.edu/](http://mprint.umich.edu/)
- **Virtual Sites** allows you to use the software on Campus Computing Sites Windows workstations remotely from any Mac or Windows computer with an internet connection. [http://virtualsites.umich.edu/](http://virtualsites.umich.edu/)
- **Web File Managing** gives you secure access to your U-M IFS space from any computer with an internet connection. [http://mfile.umich.edu/](http://mfile.umich.edu/)
- **Webmail** provides secure access to your U-M e-mail from any computer with internet access. [http://www.mail.umich.edu/](http://www.mail.umich.edu/)
- **Registering your laptop**. The University of Michigan Department of Public Safety offers a free Laptop Registration Program to members of the campus community to deter theft or assist in the recovery of stolen property. Once you register, you'll receive two stickers to place on your laptop. These stickers will help serve as a theft deterrent. Additionally, if your laptop is found or recovered, the registration record will help DPS return your laptop to you. The program is intended for the University community. You will need a uniqname and UMich

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS)
Counseling and Psychological Services (CAPS) is committed to creating an environment based on our values of multicultural, multi-disciplinary and multi-theoretical practices that allow our diverse student body to access care, receive high quality services and take positive pathways to mental health.

Every day, CAPS is involved in activities and services that strengthen our campus to be supportive, engaged and, ultimately, connected around student mental health. Our work revolves around clinical service delivery, prevention and education, mental health wellness, research and data work, and training a new generation of professionals. And, our work involves information, services, and tools to help students, staff, faculty, and family members. Together, we can achieve a campus climate of mental ‘health’ where each student can engage thoughtfully as an active community member and to help their fellow students.

The following list are some of the services we provide:

- Brief individual and couples counseling
- Group Opportunities and drop-in workshops
- Crisis Services
- Psychiatric Evaluations and Medication Management
- Wellness Zone
- MiTalk-a self-help interactive website especially for students
- ADHD Screenings and Support
- Eating Patterns Screening and Support
- Substance Abuse Screenings and Support
- Referral Services-assistance with referrals to other mental health resources
- Outreach and Education
- QPR suicide prevention program
- Campus Crisis Response Team

DEPARTMENT OF PUBLIC SAFETY (DPS)
The DPS website contains information about police services as well as other units such as parking enforcement, Communications Center and Criminal Investigations. http://police.umich.edu/

EMERGENCY PREPAREDNESS & ALERT
The Office of Emergency Preparedness provides resources, guidance, and training to the University community in matters related to emergency preparedness, response, and recovery. http://www.umemergencypreparedness.umich.edu/index.shtml

UM Emergency Alert <http://www.umemergencyalert.umich.edu/>is a mass, urgent notification system, comprised of a variety of methods by which the University can notify students, faculty and staff of an active, major campus emergency. In order to receive these urgent notification alert messages students may register two telephone or cell phone numbers and a device to receive text messages. Additionally, the University automatically will register all student umich email addresses. You can register your
contact information via Wolverine Access: https://wolverineaccess.umich.edu/, under Student Business.

**MULTI-ETHNIC STUDENT AFFAIRS (MESA)**
The Office of Multi-Ethnic Student Affairs and the William Monroe Trotter Multicultural Center serve as a resource and support for diverse student populations in our campus community. They strive to engage and empower students in all of their identities by implementing programs that foster intercultural leadership and strengthen community development. http://mesa.umich.edu/

**OFFICE OF THE OMBUDS**
The Ombuds office is a place where student questions, complaints and concerns about the functioning of the University can be discussed confidentially in a safe environment. The Office offers informal dispute resolution services, provides resources and referrals, and helps students consider options available to them. The Office operates independently as a supplement to existing administrative and formal dispute resolution processes and has no formal decision–making authority. The Office is not an advocate for either side in a dispute. Instead, the Ombuds Office is an impartial advocate for fair and consistent treatment. http://www.umich.edu/~ombuds/index.html

**OFFICE OF STUDENT CONFLICT RESOLUTION (OSCR)**
OSCR provides a variety of programs and services designed to support a safe, just and peaceful community, and to help Michigan students learn how to manage and resolve conflict peacefully. http://oscr.umich.edu/

**SAFERIDE:**
If you find yourself without a safe way home at night, call SafeRide (734-647-8000) and listen to all of the menu options below to pick the appropriate option for your time and location. Riders may use the SafeRide services once per evening and they must present a valid U-M ID.

- Option 1: For students at the Duderstadt Center, Shapiro Undergrad Library or the Cancer Center between the hours of 2 AM – 7 AM.
- Option 2: For students everywhere else on campus between 10 PM – 3 AM.
- Option 3: For Night Ride, a $5 shared taxi that takes students throughout the greater Ann Arbor area from 11 PM - 6 AM during the week, and between 7 PM - 7:30 AM on the weekends.

**SERVICES FOR STUDENTS WITH DISABILITIES (SSD)**
University of Michigan takes great pride in the academic and personal achievements of its many students with disabilities. The University is committed to providing equal and integrated access for students with disabilities. http://www.umich.edu/~sswd/

**SEXUAL ASSAULT PREVENTION AND AWARENESS CENTER (SAPAC)**
SAPAC provides educational and supportive services for the University of Michigan community related to sexual assault, dating and domestic violence, sexual harassment, and stalking. http://www.umich.edu/~sapac/
SPECTRUM CENTER
With sexual orientation, gender identity and gender expression as their framework, the Spectrum Center is committed to enriching the campus experience and developing students as individuals and as members of communities.
http://spectrumcenter.umich.edu/

STUDENT EMPLOYMENT
Looking for work while you are in school? Visit the student employment site and apply for part-time Work-Study and regular (non-Work-Study) jobs.
https://www.studentemployment.umich.edu/Cmx_Content.aspx?cpld=11

STUDENT LEGAL SERVICES (SLS)
Student Legal Services (SLS), a unit of The Division of Student Affairs, is a full-service law office available to currently enrolled students at the University of Michigan - Ann Arbor campus. Student Legal Services is staffed by attorneys who are licensed to practice in the State of Michigan as well as the United States District Court and the Sixth Circuit Court of Appeals. http://www.studentlegalservices.dsa.umich.edu/

UNIVERSITY HEALTH SERVICES (UHS)
UHS is a health care clinic located on the central campus of the University of Michigan. With approximately 70,000 visits per year, UHS is a highly utilized campus resource, part of the Division of Student Affairs. Please note that UHS is not the UM Health System (hospitals and clinics). http://www.uhs.umich.edu/

2. ONLINE RESOURCES

The following on-line resources will be invaluable for students during their time as Ph.D. students in the Human Genetics Program.
- Graduate Student Handbook Policies and Procedures, Horace H. Rackham School of Graduate Studies http://www.rackham.umich.edu/policies/academic_policies/
- Gradtools - Rackham (www.gradtools.umich.edu) This is a special set of on-line tools in the CTools environment to help Rackham doctoral students as they work toward their degrees. Included is a Dissertation Checklist. Students are encouraged to make use of this helpful resource.