Genetics, Genomics and Bioinformatics Graduate Program (GGB)

Prospective students should use this checklist (http://www.uab.edu/graduate/images/acrobat/checklist/GGSchecklist.pdf) to obtain specific admissions requirements on how to apply to Graduate School.

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Theme Information

Objectives
The main goal of the Genetics, Genomics and Bioinformatics Graduate Program (GGB) is to provide students with an outstanding, flexible, didactic training experience to prepare them for independent and innovative careers in research. The Program emphasizes a broad approach to the fundamental principles of genetics and genomics, and offers a large pool of mentors with expertise in a wide variety of areas. The GGB offers close day-to-day interactions between students and faculty, both in the classroom and the laboratory.

The research interests of our program faculty span the fields of genetics, genomics, cancer, biochemistry, cell biology, and developmental biology. Modern molecular approaches are used to study gene structure, expression, and function in diverse experimental systems including humans, mice, Drosophila, C. elegans, and other organisms such as bacteria. The GGS is also designed to permit close collaborations during the Ph.D. training period between graduate students, postdoctoral fellows, and faculty, while also encouraging full participation in the larger community of biological scientists at UAB.

Admission Requirements
Students are admitted into UAB Graduate Biomedical Sciences (GBS) umbrella program and indicate a theme preference. Applicants to the UAB Graduate School are reviewed by the GBS Admissions Committee and will be evaluated on the basis of their undergraduate performance (both the curriculum and grade point average), letters of recommendation, GRE scores, a personal statement of research interests, performance in other graduate programs or research activities and, if possible, a personal interview. Although students select a theme on admission into the GBS program, they may change theme affiliation at anytime; however changes that occur late in the doctoral program may require additional fundamental course work related to the specific theme. Acceptance into GGB requires a bachelor's degree including undergraduate coursework in calculus, general chemistry, organic chemistry, and at least one introductory course in zoology or biology by the time of entrance. Doctoral students will receive financial aid in the form of a stipend/fellowship plus full payment of tuition, fees, and their insurance premium. Current stipend/fellowships are $29,000 per year for 2015-2016 entering students. Our entering students also receive a one-time relocation payment of $1,500.

The GGB theme invites applications from individuals committed to obtaining a graduate education in fields related to genetics, genomics and bioinformatics. We recommend that applicants take prior courses covering basic concepts in genetics and biochemistry if possible; however, this is not required for admission. Applications are strongly encouraged from individuals with previous research experience, a master's degree in related area, or a professional degree such as the M.D. or D.V.M. Once accepted into GBS, students must complete the GBS core curriculum and three scientific research rotations in GBS laboratories. GGB students will then begin coursework in areas related to his/her research interests and training needs determined through the advice of faculty mentors and staff.

Overview of the GGB Program
The GGB theme is comprised of over 90 primary and secondary faculty members with appointments in many of the academic departments and Centers at UAB including Genetics, Cell, Developmental and Integrative Biology, Microbiology, Biochemistry, Neurobiology, Medicine, Pathology, Epidemiology, Biostatistics, Nutrition Sciences, Vision Sciences and others. The scientific interests of the faculty are very diverse and interdisciplinary in nature. As such, the GGB theme can provide students an individually tailored, comprehensive training program in genetics and genomics through use of modern tools and approaches in a wide range of model organisms. The research conducted by GGB faculty addresses fundamental cellular and molecular questions that provide the basis for understanding and treating human disease.

In the first semester, all students accepted into the GBS program will complete a 14-week core course covering fundamentals in biochemistry, metabolism, genetics, molecular and cellular biology. After completion of the core GBS curriculum, GGB students will then take the Principles of Genetics course that will cover Mendelian and nonmendelian inheritance mechanisms, cytogenetics and chromosome disorders, and basic epigenetic concepts. Students are also expected to attend a weekly journal club and seminar series, such as those offered by the Department of Genetics, during all years of their graduate training. These weekly events generally start in September and run through May of each academic year.

In addition, starting early in the first semester each student will obtain research experience through three laboratory rotations that will be completed by the end of the first year. Laboratory rotations are for ten weeks and are an integral part of the first year curriculum. They are highly structured and allow the student to become acquainted with the laboratory and the mentor, gain practical experience in a variety of the techniques, and to learn about the different scientific questions being investigated within the GGB theme. At the end of each rotation, the students will present their research in the form of a poster presentation that is open to the GBS community. After completion of all three rotations, students choose a mentor and laboratory for their dissertation research.

In the second semester, GGB students will complete a series of one month modules that cover a wide variety of subjects including genome structure and function, linkage and association analyses, bioinformatics, and model systems for genetic analyses. In the summer of the first year, all GGB students must complete course in Biostatistics and Bioethics and conduct non-dissertation research in their selected laboratories.

During the subsequent years of the program, GGB students will focus on their laboratory research, as well as take a small number of specialized courses related to genetics and genomic sciences, or their specific areas of investigation. At the end of the second year of graduate training,
students will assemble a thesis committee in consultation with their mentors. This committee will contain 4-6 faculty members, 3 of which should be faculty associated with the GGB theme. By the midpoint of the third year, GGB students must complete their qualifying examination consisting of a written dissertation research proposal in the format of an NIH style grant and an oral defense. The examination will evaluate whether the student has gained a sufficiently broad knowledge necessary for successful academic research. To help in this process, the third year fall curriculum will include a course in scientific writing and grantsmanship with a mock NIH grant review session. After successful completion of the exam the proposal will be submitted to a funding agency (if applicable) for possible support. After passing the qualifying exam and the necessary advanced coursework, GGB students are accepted to candidacy for the Ph.D. degree.

The curriculum of each Ph.D. candidate usually requires five years of training and is individually tailored to the interests and needs of the student by the advisor and a graduate committee chosen by the student. The Ph.D. degree is awarded upon successful defense of your dissertation, which includes an oral presentation of original, creative scientific investigations, and a written dissertation which is expected to include published manuscripts or manuscripts in preparation. The pursuit of the Ph.D. degree is a full-time activity, therefore all graduate students are supported by monetary stipends and do not have any required teaching duties. The level of activity required does not permit outside jobs or excessive extracurricular activities. Continuous registration and satisfactory academic standing during all terms is required.

Genetics, Genomics and Bioinformatics Sciences Theme Faculty

The faculty listing for the Genetics, Genomics and Bioinformatics theme is located at http://apps.medicine.uab.edu/facultydirectory/FacultySearch.asp?Entity=JHS

Additional Information

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<th>Please refer to the theme website for deadline information: <a href="http://www.uab.edu/gbs">http://www.uab.edu/gbs</a></th>
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<td>Deadline for All Application Materials to be in the Graduate School Office:</td>
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Course Descriptions for Genetics, Genomics and Bioinformatics

Required Courses

GBS 720: Genomic Structure & Function. This course will cover a wide variety of topics related to this topic, including genetic variation and polymorphisms, alternative splicing, microRNAs, and novel sequencing and microarray technologies.

GBS 722: GGS Bioinformatics. This course will cover a wide variety of different bioinformatics applications, which will be taught through use of available on-line bioinformatics resources. The topics covered will include: introductions to large-scale, generic databases at NCBI, European Bioinformatics Institute, SwissProt, PDB, UniProt and Ensembl; Sequence analysis systems such as BLAST, ORFFinder and GENSCAN, Multiple Sequence Analysis, gene identification in DNA and an introduction to the Human Genome Project; resources that are used in Microarray Data Analysis; Protein sequence analysis using Pfam, Prosite, Prints, Blocks, Protein structure analysis using SCOP, CATH; structural bioinformatics, secondary structure calculation, homology modeling, structure prediction, protein folding, protein-ligand docking and molecular dynamics.

GBS 723 : Model Systems for Genetic Analysis. The course will provide students with an in-depth knowledge of the different animal models used for analyses of gene function and genetic pathways. Topics include transgenic and knockout mouse technologies and strategies, large scale genetic screens in C. elegans and Drosophila, and modeling human genetic diseases in zebrafish.

GBS 724: Principles of Genetics. This course will address the basic principles of epigenetics and its involvement in many different biological/ pathological processes. Epigenetic regulation refers to mechanisms that regulate gene expression without altering DNA sequences. Elucidation of epigenetic regulatory mechanisms has received great attention in the post genomic era. Topics include imprinting, X-inactivation, epigenetic mechanisms of gene regulation, and cancer epigenetics.

GBS 725 : Grant Proposal Writing. The objective of the course is to teach students how to effectively write grant proposals. This course will provide hands on training in the preparation of a grant application and demonstrate effective strategies for assembling a successful proposal. With guidance from the faculty, the students will write a NIH style proposal on their dissertation research topic. After the proposal is complete, each grant will be reviewed in a mock NIH study section. Based on the comments from the study section, the student will revise the application and submit the proposal to his/her thesis committee as part of the qualifying examination for admittance into candidacy.

Elective Courses (Can be taken for advanced course credit)

GBS 726 : Advanced Medical Genetics. This course will focus on the medical application of advances in genetics and genomics. Topics include chromosome structure and function and major types of chromosomal abnormalities, cancer genetics and cytogenetics, inborn errors of metabolism, current strategies for detection of mutations associated with genetic disorders, genetic risk assessment and population genetics, and genomic approaches to diagnosis and risk stratification.
**GBS 727: Advanced Human Genomics.** This course will cover the conceptual basis, major discoveries, and unsolved problems in human genomics, with an emphasis on disease applications. The goal is to make students conversant with the structures, functions, and natural histories of human genomes, the computational and experimental methods used to establish that knowledge, the applications of genomics to medical research, and the broader impacts of genomic research on the community. Each topic will be covered by an approximately 90-minute lecture from a subject-specific PI coupled to reading of pieces of primary literature. Students will also participate in 3 student-led journal clubs in which one or more papers are discussed in detail with the help of the teaching faculty. We will also perform 3 interactive sessions to teach basic computational skills in Unix, Perl and R. Grading will be determined by: discussion interaction, computational problem sets due in weeks 4, 6, and 8, and a final project in which students perform a small but cohesive set of bioinformatic analyses to address a question of their choosing, subject to approval/discussion with the teaching faculty. Format: Each of the 7 weeks will include two, 90 minute lectures performed at UAB. In weeks 2, 4, and 6, we will convene at HudsonAlpha for four-hour sessions. Each four-hour session will include ~1 hour of paper discussion, ~1 hour of teaching on a relevant computational topic, and ~2 hours of hands-on interactive data manipulation with commonly used data types and computational tools. Course meets both on UAB Campus and at Hudson-Alpha in Huntsville.

**GBS 746: Epigenetics.** Epigenetic regulation refers to mechanisms that control gene expression without altering DNA sequences. Elucidation of epigenetic regulatory mechanisms has received great attention in the post-genomic era. This course will address the basic principles of epigenetics and its involvement in many different biological/pathological processes.

**Systems Biology.** Lectures will consider systems biology approaches in the context of the human genome project, and with an emphasis on simple model systems. Technologies, biological concepts, and the underlying motivation for this emerging area will be discussed using examples available in the literature. The central focus of systems biology is to acquire a more global and quantitative understanding of how living organisms function as complex genetic systems, and how this might provide a more complete understanding of phenotypic traits.

**Other GGB Educational Activities**

**Department of Genetics Seminar.** The Department of Genetics Seminar series meets once a week from September through May of each academic year. This is a forum in which invited speakers from other institutions, as well as UAB faculty members, postdoctoral fellows, and advanced graduate students present and discuss their research.

**Genetics, Genomics and Bioinformatics Journal Club.** Faculty, students, and postdoctoral fellows meet once a week and present papers on a wide variety of topics related to genetics and genomics.