MOLECULAR GENETICS AND GENOMICS (PH.D.)

Degree Programs: The Molecular Genetics and Genomics Program offers degrees leading to the Master of Science and Doctor of Philosophy. A joint MD-Ph.D. program is also available. Inquiries about these programs should be directed to the Graduate Officer, Molecular Genetics and Genomics Program.

Admission Requirements

Admission to these programs is contingent upon admission to the Graduate School. Applicants must have:
1. a minimum grade point average of 3.0;
2. a background in mathematics, computer science and science;
3. three letters of recommendation sent directly to the Graduate Officer, Molecular Genetics and Genomics Program;
4. a personal statement; and
5. applicants should provide Graduate Record Examination scores, which must be provided.

International students must be proficient in English and demonstrate a satisfactory performance on the TOEFL English proficiency examination. Members of the admissions committee will interview select applicants.

Ph.D. students in the graduate program in molecular genetics and genomics enroll in the School of Medicine’s Interdisciplinary Biomedical Sciences (IBS) curriculum during their first year. The IBS curriculum includes:

- **Required IBS courses**
  - IBS 7015 Interdisciplinary Cell and Molecular Biology 7
  - BMS 6010 Responsible Conduct in Biomedical Research 1

- **Required courses in Molecular Genetics and Genomics**
  - FPH 7015 Biostatistics I 4
  - MGG/IBS 7030 Functional Genomics and Systems Biology 2
  - MGG 7050 Bioinformatics: theory and practice 3
  - MGG 7091 Scientific Communication 2
  - MGG 7460 Research Training in Molecular Biology and Genetics 1-8
  - MGG 7600 Advanced Human Genetics 4

- **Elective courses in Molecular Genetics and Genomics**
  - MGG 7400 Molecular Biology of Cellular Signalling 2
  - MGG 7700 Hot Topics in Molecular Medicine 2
  - MGG 8680 Advanced Topics in Molecular Biology and Genetics 1-3
  - MGG 8770 Molecular Biology of Mitochondrial Disease 2
  - BMS 7100 Introduction to the Business of Biotechnology 3

Students will select a variety of other courses in the program, should have a basic understanding of biochemistry, and are expected to become computer-literate. Advanced topics courses will be arranged to meet student needs. The program will enable the student to demonstrate a basic understanding of molecular genetics and genomics, in order to pass a general examination for candidacy for the Ph.D. degree.

**Dissertation:** Thirty credits in dissertation research are required in the Ph.D. program. The dissertation requirement is fulfilled registering for the courses MGG 9991, MGG 9992, MGG 9993, and MGG 9994 (Doctoral Dissertation Research and Direction I, II, III, and IV, respectively), in consecutive academic year semesters. The remaining credits will be assigned to research or course work in accordance with the needs of the students and the requirements in the field of concentration. At least fifteen credits in research are required beyond the minimum Ph.D. program requirements.

**Academic Scholarship:** All course work must be completed in accordance with the regulations of the Graduate School and the School of Medicine governing graduate scholarship and degrees.

- MGG 7010 Molecular Biology and Genetics Cr. 4
  - Basic aspects of molecular genetics. Offered Fall.
  - **Restriction(s):** Enrollment is limited to Graduate level students.

- MGG 7015 Introduction to Genetics Cr. 2
  - Forges a link between genotype and phenotype and covers topics in contemporary genetics, including Mendelian analysis, chromosomes, mitosis/meiosis, recombination, mutations and mutagenesis, linkage mapping, complementation, extranuclear inheritance, genetic interactions and epistasis, epigenetics, and developmental genetics. Offered Fall.
  - **Restriction(s):** Enrollment is limited to Graduate level students.

- MGG 7020 Metabolism and Disease Cr. 2
  - This course will review normal metabolic pathways and their regulation and then discuss in depth aberrant metabolism as it contributes to or causes diseases such as diabetes, cancer, and neurodegeneration. Didactic lectures will be complemented with student-based presentations of classic and current primary literature studies. Offered Fall.
  - **Restriction(s):** Enrollment is limited to Graduate level students.

- MGG 7030 Functional Genomics and Systems Biology Cr. 2
  - Exploration of several new technologies for determining gene function on a genome-wide scale and for integrating information into a systems-level view of biological processes. Offered Biannually.
  - **Prerequisite:** IBS 7010, IBS 7020, IBS 7015, IBS 7030
  - **Restriction(s):** Enrollment is limited to Graduate level students.
  - **Equivalent:** IBS 7030

- MGG 7050 Bioinformatics: theory and practice Cr. 3
  - This course will teach graduate students in the biological sciences how to use public web-based bioinformatics resources that were generated by, and after, the Human Genome Project to analyze the structure and function of protein-coding and noncoding-RNA genes. Offered Spring/Summer.
  - **Restriction(s):** Enrollment is limited to Graduate level students.

- MGG 7091 Scientific Communication Cr. 2
  - Advanced technical and grant-writing techniques related to the unique requirements in NIH grant proposals. Offered Winter.
  - **Restriction(s):** Enrollment is limited to Graduate level students.

- MGG 7400 Molecular Biology of Cellular Signalling Cr. 2
  - Molecular basis of cell-cell interactions, hormonal interactions, and interactions between different cellular compartments. Offered Biannually.
  - **Restriction(s):** Enrollment is limited to Graduate level students.
MGG 7460 Research Training in Molecular Biology and Genetics Cr. 1-8
Direct participation in laboratory research under the supervision of faculty advisor. Design and execution of experiments; analysis of laboratory data; interpretation of results and their relation to published findings. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7600 Advanced Human Genetics Cr. 4
Concepts, problems, and methods of human genetics at an advanced level. Offered Biannually.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7640 Principles of Genetic Counseling Cr. 1-4
History and evolution of genetic counseling and how it relates to clinical genetic services within the health care delivery system. Genetic counseling skills such as case preparation, interviewing techniques, and family history assessment; counseling methods. Offered Biannually.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7660 Practical Applications of Genetic Counseling Cr. 3
Provides the foundation for identifying and applying the practical aspects of genetic counseling, including genetic testing and billing and reimbursement, to the reproductive, cardiovascular, pediatric, neurogenetic and cancer genetics clinical settings. Offered Winter.
Prerequisite: MGG 7640, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7700 Hot Topics in Molecular Medicine Cr. 2
Lectures and discussion groups for graduate-level students in the biological sciences. How to go from the bench-top to the bedside by exploring the latest developments in basic biomedical research and translating them into new treatments for human disease. Offered Biannually.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7740 Theory and Practice of Genetic Counseling Cr. 3
Major theories of human behavior and application of these theories to the practice of genetic counseling. Development of interpersonal communication and psychosocial assessment skills. Offered Winter.
Prerequisite: MGG 7640, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7741 Advanced Genetic Counseling Theory and Practice Cr. 3
Cultural, social, ethical, legal, professional and health-related issues that influence delivery of genetic counseling service and patient decision-making. Application of knowledge to practice. Offered Fall.
Prerequisite: MGG 7740, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7800 Advanced Medical Genetics Cr. 3
Overview of medical genetic disorders taught at a level suitable for those preparing for certification examinations in clinical genetics specialties or for those whose research focus or clinical practice will have a strong emphasis in medical genetics. Offered Every Term.
Prerequisite: MGG 7600, with a minimum grade of C
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7830 Human Development and Teratology Seminar Cr. 1
Through lecture, self-study, exam, and oral presentation, students learn key aspects of fetal development, the embryological basis of birth defects and genetic dysmorphology syndromes, clinical teratology, and the associated medical terminology. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7850 Current Topics in Molecular Biology and Genetics Cr. 2
Current literature in molecular biology and genetics; one student makes oral presentation with student and faculty discussion. Offered Irregularly.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 4 Credits

MGG 7860 Evaluating the Health Care Literature Cr. 1
Reading and analysis of health care literature with focus on research articles. Principles of health research design and analysis; skills for critical assessment of medical literature. Offered Winter.
Restriction(s): Enrollment is limited to students with a major, minor, or concentration in Genetic Counseling, enrollment is limited to Graduate level students.

MGG 7880 Genetic Counseling Seminar Cr. 1-6
Discussion format; issues relevant to medical genetics and the genetic counseling process. Presentations by students and invited faculty. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7881 Senior Seminar in Genetic Counseling Cr. 2
Preparation for the transition to from student to practicing professional in the areas of the job search, billing and reimbursement, clinical supervision, developing effective educational programs, advocacy, and other relevant areas. Offered Winter.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 7999 Master's Research Project and Direction Cr. 1-5
Student conducts hypothesis-driven research and prepares written manuscript and oral presentation. Offered Every Term.
Restriction(s): Enrollment is limited to students with a major, minor, or concentration in Genetic Counseling, enrollment is limited to Graduate level students, enrollment limited to students in a MS in Genetic Counseling degree.
Repeatable for 5 Credits

MGG 8010 Quantitative Data Analysis for Biological and Medical Sciences Cr. 2
Covers several of the statistical concepts and data analytic skills needed to succeed in data-driven life science research, beginning with relatively basic concepts related to computing p-values and advancing to topics related to analyzing high-throughput data. Offered Fall.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 8680 Advanced Topics in Molecular Biology and Genetics Cr. 1-3
In-depth study of concepts and research in specific fields. Offered Irregularly.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 12 Credits

MGG 8770 Molecular Biology of Mitochondrial Disease Cr. 2
Mitochondrial structure and function; mitochondria as sites of phenomena such as cell death, generation of free radicals, and production of most cellular energy. Traditional mitochondrial diseases (e.g., caused by mutations in the mitochondrial DNA); more recent findings of involvement of mitochondria in pathologies such as cancer, diabetes, aging, and neurodegenerative diseases. Offered Fall.
Prerequisites: (IBS 7010 with a minimum grade of C or IBS 7020 with a minimum grade of C) AND (IBS 7015 with a minimum grade of C)
Restriction(s): Enrollment is limited to Graduate level students.
MGG 8998 Genetic Counseling Internship Cr. 1-8
Students work in variety of genetics and subspecialty clinics as well as laboratory settings, under supervision of genetic counselor/geneticist. Offered Every Term.
Restriction(s): Enrollment is limited to students with a major, minor, or concentration in Genetic Counseling, enrollment is limited to Graduate level students, enrollment limited to students in a MS in Genetic Counseling degree.
Repeatable for 8 Credits

MGG 8999 Master’s Thesis Research and Direction Cr. 1-8
Student conducts research and prepares written presentation, designed to test specific hypothesis dealing with method, concept, or data. Offered Every Term.
Restriction(s): Enrollment limited to students with a class of Candidate Masters, enrollment is limited to students with a major, minor, or concentration in Molecular Biology and Genetics, enrollment is limited to Graduate level students, enrollment limited to students in a Master of Science degree.

MGG 9990 Pre-Doctoral Candidacy Research Cr. 1-8
Research in preparation for doctoral dissertation. Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 9991 Doctoral Candidate Status I: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.

MGG 9992 Doctoral Candidate Status II: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: MBG 9991, with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

MGG 9993 Doctoral Candidate Status III: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: MBG 9992, with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

MGG 9994 Doctoral Candidate Status IV: Dissertation Research and Direction Cr. 7.5
Offered Every Term.
Prerequisite: MBG 9993, with a minimum grade of S
Restriction(s): Enrollment is limited to Graduate level students.

MGG 9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction Cr. 0
Offered Every Term.
Restriction(s): Enrollment is limited to Graduate level students.
Repeatable for 0 Credits