# GGSC-Genetic and Genomic Sciences

## Courses

**GGSC 101. Your Genome. 3 Hours.**
Advances in genetics and genomics, and especially the sequencing of the human genome, are making it possible to customize medical care to the specific needs of an individual. This course will introduce students to basic concepts in genetics and genomic sciences, as well as familiarize them with the various tools available that enable personalization of healthcare. Students from a wide range of disciplines with minimum scientific background can participate, and there is no required textbook. This course is intended for non-Genetics and Genomic Sciences majors.

**GGSC 201. Research Experience in Molecular Genetics. 3 Hours.**
A course-based authentic research experience with genomic technologies such as CRISPR-Cas9 (programmable nucleases) to make genetic modifications in a model organism.

**GGSC 250. Special Topics in Genetics and Genomics Sciences. 1-3 Hour.**
Covers different topics including fundamentals and applications in the fields of genetics and genomics.

**GGSC 310. Genome Structure and Organization. 3 Hours.**
This course will cover the general concepts of genomics including gene structure and function, genomic technologies and their applications, and comparative genomics.
**Prerequisites:** BY 210 [Min Grade: C] and CH 117 [Min Grade: C] and CH 118 [Min Grade: C]

**GGSC 320. Colloquium in Genetics and Genomics Science. 1 Hour.**
Faculty-led seminar course that exposes students to cutting edge research topics and career opportunities in the fields of genetics and genomics. Students will read assigned articles and be prepared for discussion.

**GGSC 330. Principles and Practice of Precision Medicine. 3 Hours.**
Students in this CURE course (Course-Based Undergraduate Research Experiences), will participate in the work-up of real (but de-identified), active PMI cases. Starting from a genetics report, students will research possible molecular mechanisms underlying an individual's disease, write summary reports of the scientific and medical literature, and present their findings to the PMI team and potentially to the physicians responsible for making treatment decisions. Cases incorporated into the class are current active cases, and therefore will be new for every class.
**Prerequisites:** BY 210 [Min Grade: C]

**GGSC 350. Special Topics in Genetics and Genomics Sciences. 1-3 Hour.**
Covers different topics including fundamentals and applications in the fields of genetics and genomics.

**GGSC 355. Independent Study in Genetics and Genomics Sciences. 1-3 Hour.**
In-depth study of fundamentals and applications in the fields of genetics and genomics under the direct supervision of a faculty member. Permission of Instructor Only.

**GGSC 380. Undergraduate Research in Genetics and Genomics Sciences. 1-3 Hour.**
Research project for non-GGS Honors students under the supervision of a faculty sponsor. May be repeated for a total of 9 semester credit hours in a 2 or 3 semester period.

**GGSC 390. Honors Research in Genetics and Genomics Sciences. 1-3 Hour.**
Research project for GGS Honors students under the supervision of a faculty sponsor. May be repeated for a total of 9 semester credit hours in a 2 or 3 semester period.

**GGSC 410. Genetic Basis of Human Disease. 3 Hours.**
This course will focus on the medical applications of genetics and genomic technologies. Topics covered include, but are not limited to major forms of chromosomal abnormalities, mutations and genetic disorders, genetic risk assessment and population genetics, and genomic approaches to diagnosis.
**Prerequisites:** BY 210 [Min Grade: C] and CH 117 [Min Grade: C] and CH 118 [Min Grade: C] and (GGSC 310 [Min Grade: C] or BY 311 [Min Grade: C])

**GGSC 415. Aquatic Animal Models of Human Disease. 3 Hours.**
This course will cover the basic anatomy, biology, life history, husbandry, and research applications for a variety of aquatic organisms used as animal models of human disease in biomedical research. Species discussed will include zebrafish, Medaka, Xiphorous, Onchorynchus, Xenopus, and Axolotls.
**Prerequisites:** CH 117 [Min Grade: C] and CH 118 [Min Grade: C] and BY 210 [Min Grade: C] and GGSC 310 [Min Grade: C]

**GGSC 420. Applications of Bioinformatics. 3 Hours.**
Introduction to computational tools and bioinformatics databases used in the fields of genetics and genomic sciences. This course will cover a wide variety of different bioinformatics applications, which will be taught through use of available on-line bioinformatics resources. Topics covered include large-scale genomic databases, sequence analysis systems, protein sequence analysis, structural bioinformatics, protein folding, and homology modeling.
**Prerequisites:** BY 210 [Min Grade: C] and CH 117 [Min Grade: C] and CH 118 [Min Grade: C] and (GGSC 310 [Min Grade: C] or BY 311 [Min Grade: C])

**GGSC 435. Zebrafish as a Model for Biomedical Research. 3 Hours.**
This course will focus on the biology, husbandry, and management of zebrafish used as an animal model of human disease in biomedical research. Topics will include anatomy, physiology, systems design, water quality management, behavior and enrichment, spawning and larviculture, nutrition and live feeds, diseases, quarantine, biosecurity, and regulatory compliance.
**Prerequisites:** CH 117 [Min Grade: C] and CH 118 [Min Grade: C] and BY 210 [Min Grade: C] and GGSC 310 [Min Grade: C]

**GGSC 465. Research Techniques for Aquatic Animals of Human Diseases. 4 Hours.**
This course will focus on the techniques and procedures used for research with aquatic animal models of human disease. Lecture and lab approaches are used.
**Prerequisites:** GGSC 415 [Min Grade: C] or GGSC 435 [Min Grade: C]

**GGSC 470. Principles of Pharmacogenetics. 3 Hours.**
Most of the drugs that we use today were developed with the assumption that the same drug will work equally well in all the patients that have the same disease. However, there is considerable variability between individual patients - both in the therapeutic response and the adverse effects of the same drug - that is largely determined by the differences in their genotypes. Pharmacogenetics and pharmacogenomics study the genetic determinants of drug response, with the goal to identify genetic variants that can be used to predict the efficacy of a particular drug in a particular patient and to avoid adverse drug reactions. This will ultimately enable implementation of personalized treatment options, by selecting the drugs that will have the best efficacy and the least toxicity for each individual patient. This course will introduce students to the basic principles of pharmacogenetics, demonstrate examples of drug/genotype interactions, highlight the available pharmacogenetic resources, and discuss the potential benefits, as well as limitations and challenges of pharmacogenetics and personalized medicine.
**Prerequisites:** CH 117 [Min Grade: C] and CH 118 [Min Grade: C] and BY 210 [Min Grade: C] and GGSC 310 [Min Grade: C]

**GGSC 490. Model Systems for Genetics Disorders. 3 Hours.**
Invertebrate and non-human vertebrate species are commonly used in scientific research work to provide significant insights into human genetic processes and disease. This course focuses on the different methods and strategies by which researchers use these systems for genetic and genomic analyses of human biology and relevant disorders. Model organisms covered include, but are not limited to nematodes (C. elegans), fruit flies (Drosophila sp.), zebrafish (Danio rerio), and mice (Mus musculus). Capstone course (GGS majors). Students that enroll in this class as their capstone experience are expected to do writing or presentation assignments to fulfill their capstone requirement.
**Prerequisites:** BY 210 [Min Grade: C] and CH 117 [Min Grade: C] and CH 118 [Min Grade: C] and (GGSC 310 [Min Grade: C] or BY 311 [Min Grade: C])

**GGSC 491. Personalized Genomic Medicine. 3 Hours.**
Significant developments in the fields of genetics and genomics are making it possible to tailor medical care to the specific needs of patients. New diagnostic tests, up to and including whole genome sequencing, provide increasingly powerful tools for the identification of the genetic basis of both rare and common disorders. Better understanding of the causes of disease are permitting drugs to be developed that precisely target disease mechanisms, increasing the efficacy and avoiding side effects. These and other new advanced are leading to major changes in healthcare delivery and provide the consumer with new opportunities and complex choices. This course will focus on exploring state-of-the-art genetic, genomic, and informatic tools now available to enable personalization of healthcare. Capstone course (GGS majors). Students that enroll in this class as their capstone experience are expected to do writing or presentation assignments to fulfill their capstone requirement.
**Prerequisites:** BY 210 [Min Grade: C] and CH 117 [Min Grade: C] and CH 118 [Min Grade: C] and (GGSC 310 [Min Grade: C] or BY 311 [Min Grade: C])

**GGSC 492. Undergraduate Research Seminar in Genetics and Genomic Sciences. 3 Hours.**
Elective course for non-GGS Honors students who perform at least two semesters of GGSC 380. Over the course of the semester, students will learn how to develop and complete a paper or thesis on their research work while working closely with a supervising faculty member. In addition, the course will prepare them to present their research findings in a seminar format. Through these activities, students will develop effective skills in both written and oral scientific communication. Students will present a formal seminar on their research at the end of the course. This course can be taken the first semester following the completion of the research project, or alternatively can be taken concurrently with Undergraduate Research in Genetics and Genomic Sciences (GGSC 380) during the student's final semester of supervised research. Designated a Capstone course (GGS majors).

**GGSC 493. Honors Research Seminar in Genetics and Genomic Sciences. 3 Hours.**
All GGS Honors students are required to take this weekly course. Over the course of the semester, students will learn how to develop and complete a paper or thesis on their research work while working closely with a supervising faculty member. In addition, the course will prepare them to present their research findings in a seminar format. Through these activities, students will develop effective skills in both written and oral scientific communication. Students will present a formal seminar on their research at the end of the course. This course can be taken the first semester following the completion of the research project, or alternatively can be taken concurrently with Honors Research in Genetics and Genomic Sciences (GGSC 390) during the student's final semester of supervised research. Can be taken as a Capstone course (GGS majors).

**GGSC 499. GGSC Program Final. 0 Hours.**
This 0-credit hour course includes two self-paced components: One career counseling recorded video and data collection from students via CV submission and an automated exit inerview for documenting learning essentials of GGSC students towards GGSC program evaluation. Students will register for GGSC 499 during their last semester as a requirement for graduation with GGSC major. The GGSC program director(s) will be the faculty instructor(s) with assistance from the GGSC program manager and student advisor.