CELLULAR, MOLECULAR, AND DEVELOPMENTAL BIOLOGY (GS04)

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GS04 1011 Workshop for Experimental Training in Mouse Cancer Biology (1 Credit)
Prerequisite: Prospective students must be on an approved existing mouse animal protocol and have consent of instructor (approval code needed for registration). The laboratory mouse is widely used in cancer biology research. This lecture and laboratory-based workshop is designed to provide students with a basic working knowledge of using and handling laboratory mice in the setting of cancer biology research. Topics covered include basic research regulations and guidelines for rodents, including mice. Mouse husbandry, genetics, colony management as well as basic mouse handling, restraint, injection, surgery, euthanasia, necropsy and tissue biopsy will be covered in both lecture and laboratory settings. At the end of the workshop, students, even those with no prior experience working with laboratory mice, will be able to properly handle and restrain mice, perform injections, become familiar with surgery, euthanasia, post-mortem tissue collection and processing as well as tissue biopsy. While this workshop is intended primarily for students in the Cancer Biology Program, other GSBS students are encouraged to apply as the laboratory mouse is also an important tool in a wide variety of biomedical research settings. Pass/Fail

GS04 1051 Fluorescence and Electron Microscopy: Imaging Cells and Molecules (1 Credit)
Prerequisites: General knowledge of microbiology and biochemistry and consent of instructor. Fluorescence and electron microscopes permit the examination of cellular features at high magnification. This laboratory-based course is designed to provide the theory, fundamental operating principles, specimen preparation techniques of fluorescence microscopy, transmission electron microscopy, and cryo-electron microscopy. At the end of the course, students with no prior experience will be able to prepare specimens, operate the instruments, and collect and interpret data. In addition, students will also learn how to write part of manuscripts. While this course is intended for students in the Microbiology and Infectious Diseases Program, other GSBS students are encouraged to enroll as these advanced microscopic techniques are broadly used. Pass/Fail

GS04 1073 Developmental Biology (3 Credits)
Prerequisite: Permission of instructor. Developmental Biology is one of the fundamental modern biological disciplines. This course provides an in-depth examination of the basic cellular, molecular, and genetic mechanisms by which a fertilized zygote transforms into an organism with fully differentiated and functioning tissues and organs. Topics covered will include cell-to-cell communication, embryo patterning, tissue morphogenesis, cell differentiation, progenitor cells, advantages and disadvantages of classical and genetic model organisms for analyzing development, postembryonic development and regeneration, and the profound implications of developmental biology for medicine. The course is divided into hands-on lab modules, utilizing primary model organisms to examine the basic principles of development biology and will discuss current debates and recent findings that have yet to be simplified for textbook presentation. Letter Graded

GS04 1081 Stem Cells in Biomedicine (1 Credit)
Prerequisite: Permission of instructor. A stem cell is a cell from the embryo, fetus, or any adult organ, that has the ability to reproduce itself for long periods of time, and at a given signal, give rise to many specialized cell types in the body. Apart from embryonic stem cells, adult stem cells maintain this capability throughout the life of an organism. In recent years, scientific advances have suggested that stem cells could be of great potential use in the treatment of a variety of diseases. The objective of this graduate school course is to provide the students with information about stem cell origin, their role in early development, their isolation and therapeutic promises for the future. The course will also offer students a great opportunity to take part in recent and ground breaking advances in stem cell biology. All in all, the material presented is intended to evoke more interest in the field of stem cell biology, both for the student, the layman, as well as for the bench scientist. Ultimately, the long term goal is to encourage future research in finding alternative therapeutic modalities in stem cell-related diseases, such as cancer, Parkinson's, diabetes, atherosclerosis, congenital diseases, and Alzheimer's disease. This course is taught by a group of high profile scientists with a broad expertise in stem cell biology, biochemistry, clinical applications, and ethics. Letter Graded

GS04 1093 The Biology of Cancer Metastasis (3 Credits)
Prerequisite: Consent of instructor. This is a didactic introductory-level course entirely dedicated to the study of the cellular biological processes that underpin cancer metastasis. This course will cover basic, translational, and clinical knowledge, with specific emphases on the metastatic cascade: seed and soil hypothesis, organ-specific metastasis, cell cycle and metastasis, multiple therapies for various metastatic cancers, and will address the process of taking basic research to the clinic ("bench-to-bedside") for major metastatic human cancers. This is a prerequisite course for Cancer Biology Program students in the Cancer Discovery track. Letter Graded

GS04 1103 Principles of Therapeutics (3 Credits)
Prerequisite: Undergraduate-level biochemistry and biology. This course establishes a foundation of therapeutic principles from understanding disease pathophysiology to the whole pipeline of drug discovery and moving a drug from laboratory to regulatory filing and clinical implementation. This course includes didactic lectures from >35 experts including 1/3 basic research faculty, 1/3 clinical faculty and 1/3 pharma/biotech industry veterans. It starts with discussions on disease processes, through therapy development, then to clinical translation. The course is grouped into a series of general topics. The first topic includes disease mechanisms in microbial, viral, fungal, neurodegenerative, and malignant settings in order to better understand the nature of the problems. The second topic focuses on the development of lead molecules and drug design, including x-ray crystallography, molecular modeling, hit identification, lead optimization, and pharmacokinetic/pharmacodynamics studies. The third topic puts emphasis on drug screening methodologies, including high-throughput/content technologies and molecular imaging as well as in vitro and in vivo preclinical model systems. The fourth topic covers different therapeutic modalities and improved drug delivery systems. It also describes the latest development of immunotherapy, cell therapy, gene therapy, and stem cell transplantation. The fifth topic focuses on the identification of novel molecular targeting strategies and efforts toward individualization of therapy with state-of-the-art-omics technologies and biomarker development. The final topic group focuses on translating therapeutic strategies to the clinic, including the phases of preclinical studies, clinical trial design and execution, and regulatory considerations. Letter Graded

GS04 1213 Mechanisms Cancer Therapeutics (3 Credits)
Prerequisite: Basic understanding of biochemistry and cell biology. This course will establish a foundation of the principles of cancer therapy, including pharmacologic rationales, consideration of biological targets, and mechanism-based approaches to combinations. A major emphasis will be placed on agents that damage DNA, and the response of tumor cells to such insults. In depth presentations will consider all classes of chemotherapeutic agents, their metabolism, and mechanisms of action, and the resistance mechanisms of tumor cells. Mechanistic rationales for other therapeutic modalities used for cancer treatment such as radiotherapy, gene therapy, and immunotherapy will also be covered. Students will have the opportunity to learn to identify novel therapeutic targets, and the procedures used to develop new agents for clinical evaluation. Letter Graded

GS04 1235 Basic and Translational Cancer Biology (5 Credits)
Prerequisite: None. This Cancer Biology Core course aims to consolidate essential knowledge of human cancer biology, providing insights into disease development, multifaceted molecular signatures, diagnostics, and therapeutics. It will utilize seminal articles in the field of cancer biology, primary research publications, and incorporate the expertise of GSBS faculty to convey foundational information and the latest advancements in basic, translational, and clinical cancer research. Auditing this is permitted with Course Directors' approval. Letter Graded

GS04 1253 Principles in Genetics and Epigenetics (3 Credits)
Prerequisites: GS21 1017/18: Foundations of Biomedical Research (GSBS Core course) or equivalent. (Please contact one of the course directors to confirm prior equivalents). The Principles in Genetics and Epigenetics (PIGE) class is designed for students who have a major interest in the aspects of experimental and human genetics, epigenetics, and genomics as they relate to human disease, including Mendelian disorders, complex diseases, cancer, and experimental model systems. Students are required to have completed the core course (or equivalent). This class will provide in-depth instruction in three areas: 1) Experimental genetics, 2) Human genetics and genomics, and 3) Epigenetics and epigenomics. The class will be held two times a week for one and a half hours. Students are expected to actively participate in the course by initiating discussions, asking questions, and providing constructive comments, as well as completing weekly homework assignments based on the material covered in the lectures of the preceding week. Students will be evaluated by attendance, participation, completion of assigned exercises, and overall performance on the assigned homework. As a foundational course, this course is designed to introduce students to the basic principles in genetics and epigenetics and prepare the student to generate novel hypothesis-driven projects as part of their own research in the areas of genetics and epigenetics inside and outside of G&E laboratories. The course emphasizes active learning through a combination of didactic lectures and selected application lectures. Auditing this course is permitted with Course Directors' approval. Letter Graded

GS04 1263 Cancer Epidemiology (3 Credits)
Prerequisite: GS21 1017: Foundations of Biomedical Research or Consent of Instructor. This primarily introductory-level course reviews the causes of cancer and the epidemiology of cancer by anatomical site. The course will introduce seminal studies and current issues in cancer epidemiology and will cover basic concepts pertinent to cancer epidemiology research including biology, pathology, statistics, classic and novel risk factors, prevention, and genetics. Selected publications from epidemiologic literature provide an opportunity for student-faculty discussion. This course is cross-listed at UTHealth Houston School of Public Health (PH 2745). Pass/Fail

GS04 1273 Advanced Microscopy: Live Imaging and Technologies (3 Credits)
This is an updated course description. The Advanced Fluorescence Microscopy course provides a comprehensive understanding of both fundamental and advanced principles of fluorescence microscopy, with a strong emphasis on live imaging and cutting-edge technologies. Students will explore basic concepts, including fluorescence spectroscopy, spectral analysis and unmixing, microscope architecture and adjustments, sample preparation, and the selection of appropriate fluorophores, endogenous probes, and biosensors. The course will cover wide-field versus optical sectioning microscopy, with an in-depth examination of confocal microscopy. Advanced microscopy modalities will include super-resolution techniques (SIM, STED, SoRa, STORM) and the latest innovations in confocal super-resolution microscopy. The course will introduce Total Internal Reflection Fluorescence (TIRF) microscopy, with applications in single-molecule studies and live imaging, with a particular focus on protein dynamics in tissues, cells, and small organisms, such as actin cytoskeleton remodeling. Live imaging techniques will include spinning disk microscopy with SoRa super-resolution, light-sheet microscopy, dual-camera systems, multiphoton imaging and high-content imaging. Students will also gain hands-on experience with advanced technologies such as ratiometric imaging (e.g., calcium, pH, NADH), ablation techniques, fluorescence recovery after photobleaching (FRAP), Förster resonance energy transfer (FRET), and fluorescence lifetime imaging microscopy (FLIM)¿all taught by experts in their respective fields. Beyond imaging, the course will emphasize proper image analysis and visualization in alignment with current microscopy guidelines to ensure data quality and reproducibility. By the end of the course, students will be equipped to integrate state-of-the-art microscopy techniques into their research, generate hypothesis leveraging these technologies, and produce high-quality microscopy data that adhere to rigor and reproducibility standards. Letter Graded

GS04 1751 Design and Delivery of Advanced Research Seminar (1 Credit)
Prerequisite: None. This course has two major objectives. The first objective is to familiarize students with current research in regulatory biology, with particular emphasis on molecular mechanisms of cell regulation and signaling. The second objective is to teach students how to give outstanding research seminars. Weekly 90-minute meetings involve alternate faculty and student presentations on current problems in regulatory biology. Faculty presentations introduce each topic and provide a broad and critical overview of approaches used to tackle research problems. Student presentations cover recent articles from leading journals on the same topic. Students are instructed in the preparation of slides/overheads, seminar organization and techniques of oral presentation and are given detailed feedback by faculty and fellow students following their presentations. Three to four topics are covered each year and the topics discussed vary annually. Students can, and often do, register for the course multiple times during their graduate careers. Pass/Fail

GS04 1792 Pragmatic Bioinformatics for Bench Scientists (2 Credits)
Prerequiste: None. Bioinformatics is becoming essential in the genomic era. Witnessing both the power and the complexity of bioinformatics, bench scientists, despite providing most of the biological insights, often feel left out as simply data generators, and frustrated when collaborating with data analyzers. This course, taught by bench scientists who have published on specific bioinformatics topics, aims to empower bench scientists with valid statistical and computational methods to be able to explore data and communicate with computational scientists. It is pragmatic because it covers as-needed theoretical background and teaches usable, instead of efficient, programming in the format of a dry-lab protocol that generates publication-quality figures. It consists of 9 modules covering basic coding, principles, RNA, DNA, protein, images, network analysis, and freeware. Letter Graded

GS04 1811 G & E Scientific Writing (1 Credit)
Prerequisites: Permission of instructor and student must be at least in their second year to take this course. This course is designed for second-year students who have already chosen their thesis lab. Students will be taught how to write scientific papers. The goal of this class will be for each student to write a review of the literature of their field of research for submission and publication. This course satisfies the GSBS Scientific Writing requirement. Pass/Fail

GS04 1813 History of Biology and Cancer Science (3 Credits)
Prerequisite: Consent of instructor. This course is designed to have students experience the history of biology and cancer science as it evolved. Seminal papers in the last 100 years will be reviewed in a chronological fashion to have students appreciate seminal discoveries that advanced our fundamental understanding of human biology and the disease called cancer. Through this journey, students will be able to experience how techniques and tools to study biology evolved and how such knowledge was applied to understand and unravel new information about cancer. The course will highlight how such fundamental biology helped translate science and help generate drugs to combat cancer. Pass/Fail

GS04 1821 G&E Scientific Presentations (1 Credit)
Prerequisites: GS21 1017: Foundations of Biomedical Research and student must be at least in their second year to take this course. The G&E Scientific Presentation class is designed for second year students who have chosen their thesis lab and are preparing for their candidacy exam. The students will use their thesis project as a template to develop a 20-minute scientific presentation. All aspects of the presentation will be covered including title and introduction slides, organizing your data into a story, model slides and conclusions and answering questions. In addition to the 20-minute presentation, students will also give two 90-second elevator talks, one to a scientific group and one to a non-scientists group. Students will also present a 10-minute chalk talk based on the research plan that is based on the data from their 20-minute talk. This course is designed to prepare the student for the oral defense portion of their candidacy exam and to prepare the student to present their work in both short and long format platform presentations. Pass/Fail