



Boston University School of Medicine

Division of Graduate Medical Sciences

List of Courses

2011-2012

(updated 08/15/11)

Anatomy and Neurobiology

GMS AN 700 (MED MS 123) Medical Histology

Prereq: consent of instructor. Study of cell, tissue, organ, and system histology. Emphasis is on functional morphology at the light and electron microscope levels. Computer-based virtual microscopy in laboratory exercises and discussions supplements companion lectures. This is the BUSM I Medical Histology course and it is designed to coincide with the Medical Physiology, Medical Endocrinology, and the Medical Immunology courses with which it runs concurrently. Two fall semester medical school lectures are included in this course. A laptop computer that meets BUSM standards is required. *Vaughan, staff.* 6 cr, Spring sem.

GMS AN 700S Medical Histology

Prereq: consent of instructor. Study of cell, tissue, organ, and system histology. Emphasis is on functional morphology at the light and electron microscope levels. Computer-based virtual microscopy in laboratory exercises and discussions supplement companion lectures. This course is similar in content and staff to GMS AN 700. A laptop computer that meets BUSM standards is required. *Vaughan, staff.* 6 cr, Summer sem. Begins in June (offered only if minimum enrollment levels are met).

GMS AN 701 Gross Anatomy

Prereq: consent of instructor. Human anatomy in three units: back and limbs; thorax, abdomen and pelvis; and head and neck. *Zumwalt, staff.* Var cr, Fall sem. Begins in August.

GMS AN 702 Neurobiology of Learning and Memory

Prereq: consent of instructor. This course covers the neurobiological bases of learning and memory from the cellular to the systems level. Initial sessions cover the behavioral aspects of learning and memory – how it is operationally defined and what are the different theoretical concepts from cognitive psychology that are current. Subsequent sessions investigate the neurophysiological, neuroanatomical, and neurochemical mechanisms of memory at the cellular level and then move on to the study of systems that function at the level of the whole organism. Concentration is on studies in mammals, particularly primates. *Moss, Rosene.* 2 cr, Spring sem.

GMS AN 703 Medical Neurosciences

Prereq: consent of instructor. This course will cover, in an integrated fashion, basic information from all of the disciplines needed to gain a comprehensive understanding of the structure and function of the human central nervous system. This course encompasses a wide variety of Neuroscience disciplines, including Neuroanatomy, Neurophysiology, Neurochemistry, Neuropsychology and Clinical Neurology. This reflects the fact that the study of the brain is an extraordinarily broad field, encompassing many issues and disciplines. The course is comprised of approximately 54 lectures, 7 laboratory sessions and 5 electrophysiology discussion sections. *Luebke, staff.* 4 cr. This is a full-time course that runs from the first week in December to the third week in January.

GMS AN 704 Experimental Design and Statistical Methods

Prereq: consent of instructor. This course provides a working understanding of experimental design and statistical analyses. Each class consists of lectures, examples of problems and discussion of theoretical issues underlying a particular experimental design. Both parametric and non-parametric approaches to data analysis will be explored. *Joseph.* 2 cr, Spring sem.

GMS AN 705 Medical Histology A

Prereq: consent of instructor. Study of basic cells and tissues followed by study of the histology of the circulatory system, integument, and the gastrointestinal system and its associated glands. Emphasis is on functional morphology at the light and electron microscope levels. Computer-based virtual microscopy in laboratory exercises and discussions supplements

companion lectures. This course is similar in content and staff to GMS AN 700, except that it is taught as a two-semester course to be followed by GMS AN 706 (Histology B). This course is designed to coincide with GMS Physiology A course topics, but may be taken without the Physiology course. All students are required to have a laptop computer that meets BUSM standards. *Toth, staff.* 3 cr, Fall sem.

GMS AN 706 Medical Histology B

Prereq: GMS AN 705. Includes study of the histology of respiratory, lymphoid, and renal systems, male and female reproductive systems, cartilage and bone, and endocrine organs. Emphasis is on functional morphology at the light and electron microscope levels. Computer-based virtual microscopy in laboratory exercises and discussions supplements companion lectures. This course is similar in content and staff to GMS AN 700, except that it is taught as a two-semester course with GMS AN 705. This spring-semester histology course is designed to coincide with GMS Physiology B and GMS Endocrinology topics, but may be taken without these two courses. All students are required to have a laptop computer that meets BUSM standards. *Toth, staff.* 3 cr, Spring sem.

GMS AN 707 Neurobiology of Aging

Prereq: consent of instructor. With growing awareness of an accelerating increase in the size of the elderly population, there has been increasing interest in the neuropsychology of normal aging. Similarly, since aging is a major risk factor for many dementia states, interest has also focused on the neuropsychology of age-related disorders such as Alzheimer's disease, Parkinson's disease and the Dementias of the frontal lobe type. This course summarizes what is known about cognitive and related changes associated with normal aging and age-related disease. Topics are divided into two major sections. The first considers the cognitive and neurobiological changes associated with normal aging; the second deals with several of the most common age related diseases. *Moore.* 2 cr, Spring sem.

GMS AN 708 Clinical Anatomy

Prereq: Gross Anatomy. An advanced anatomy course consisting of both guided laboratory dissection and related lectures on clinical anatomy by physicians in a variety of clinical specialties. Laboratory dissections are based on actual surgical approaches; whenever possible, and the relationship between gross anatomy radiographic anatomy is continually emphasized. *Van Houte, Hoyt.* 2 cr, Spring sem.

GMS AN 709 Neural Development and Plasticity

Prereq: GMS MS 703 or consent of instructor. Lectures, discussion, and readings on current issues relating to prenatal development, postnatal plasticity, and senescence of the brain. Emphasis is placed on comparative neuroscience, and correlations between development and evolution. Cellular and systems physiology underlying human learning and teaching (i.e. in children and adults) is also emphasized. Students conduct literature reviews and present primary journal articles with guidance from faculty and guest lecturers. *Toth.* 2 cr, Fall sem.

GMS AN 711 Introduction to Neurobiology

Prereq: consent of instructor. This course surveys the biological basis of behavior starting at the level of the neuron and synapse and building to the cortical integration of the human mind. It provides an introduction to the issues, problems and current research findings that related the form and function of the nervous system. *TBA.* 2 cr, Fall sem.

GMS AN 712 Biostatistics

This course will provide you with a working understanding of experimental design and statistical analyses that are appropriate for various types of relatively small sample based experiments such as those used in the biological, medical, pharmacological, psychological, and social sciences in general. *Joseph.* 4 cr, Spring sem.

GMS AN 713 Autism: Clinical and Neuroscience Perspectives

Prereq: consent of instructor and neuroscience background. This course will provide an overview of the clinical feature of autism; review current research on genetic and other causes of the disorder, and the neurobiological basis of the main behavioral and cognitive symptoms, and will briefly explore different treatments currently available. *Joseph.* 4 cr, Fall sem.

GMS AN 714 Human Reproduction and Sexuality

Various aspects of reproduction are addressed include male and female anatomy, reproductive hormonal control, sex and the brain, contraception, abortion, reproductive cancers, sexually transmitted diseases, and infertility. *TBA.* 3 cr, Spring sem.

GMS AN 715 Professional Skills for Students in the Biomedical Sciences

Prereq: consent of instructor. This course discusses many of the professional skills and ethical issues that are part of an academic biomedical career. Some of the topics include funding mechanisms, determination of authorship, intellectual

property, conflict of interest, human and animal subject protection, reviewing responsibilities and mentoring. *Zucker*. 2 cr, Spring sem.

GMS AN 716 Developmental Cognitive Neuroscience

Prereq: background in neuroscience. This course will provide an overview of the current literature on the neurobiological underpinnings of cognitive development. Several domains will be explored (e.g., visual perception, knowledge of objects and faces, language acquisitions and theory of mind) using evidence from a variety of populations. *Joseph*. 4 cr, Spring sem.

GMS AN 718 Methods in Neuroscience

Prereq: Systems Neuroscience and consent of instructor. This course will provide a general overview of major techniques and methods used in contemporary neuroscience research. It is designed to provide students with knowledge to understand methods to probe the brain from molecules to behavior. *Luebke, Soghomonian*. 4 cr, Spring sem.

GMS AN 720 Introduction to the Neurobiology of Education

Prereq: consent of instructor. This introductory course surveys the basic neurology of learning. Brain structure and function will be discussed and neural system principles will be applied to the problems of learning in the classroom and in the developing mind of K-college students and education. *Bergethon, Moss*. 2 cr, SS I.

GMS AN 721 The Neurobiology of Trauma

This course provides the neurobiological basis in stress and trauma and is a prerequisite for the purpose of designing treatment and prevention programs, at both the individual and national levels in the event of catastrophic disasters. *Staff*. 2 cr, Fall sem.

GMS AN 722 Cellular Organization of Tissues

Study of the basic types of tissues, followed by application to understanding the cellular organization of organs, and the anatomical basis for their function. Emphasis is on functional morphology at the light and electron microscope levels. Basic concepts in embryology and pathology are introduced where relevant. Computer-based virtual microscopy in laboratory exercises and discussions supplements companion lectures. This course is an introductory version of MS 123 Medical Histology, specially designed to complement GMS curricula. All students are required to have a laptop computer that meets BUSM standards. *Toth, staff*. 4 cr, Fall sem.

GMS AN 801, 802 Seminar: Research Colloquium

Oral presentation and discussion by students and staff members of topics of interest in anatomy and allied fields. *TBA*. 2 cr each, Fall & Spring sem.

GMS AN 803, 804 Special Topics in Anatomy

Presentation of problems of current interest in anatomical science offered to small groups of students at the instigation of either interested faculty or students. Examples of topics that might be discussed are: differentiation; aging in specific areas of the brain; electron microscopy; fine structure of neurons; biology of the lung; and retinal biology. *Rushmore*. 2 cr each, Fall & Spring sem.

GMS AN 805 Vesalius Module Teaching Practicum

Prereq: GMS AN 804. Students, putting theory into practice, work in collaboration with a selected faculty mentor in one of the following formats: large lecture, small lecture or seminar, or proposing a new course. Students may enroll in this course multiple times for different mentored experiences. *Vaughan*. Var cr, Fall & Spring sem.

GMS AN 807 Neurobiology of the Visual System

Prereq: GMS MS 703 or consent of instructor. This seminar is open to graduate students in all departments who have had a basic neuroscience course. Current research in visual anatomy and neurophysiology is discussed with an emphasis on how that research informs other areas of neuroscience, especially those fitting the interests of the students. Past topics have included: use of visual stimuli in fMRI, visual experiments to probe the physiology of cognition & consciousness, biological basis of computer vision. Students conduct literature reviews and present primary journal articles with guidance from faculty and guest speakers. *Toth*. 2 cr, Fall sem.

GMS AN 808 Neuroanatomical Basis of Neurologic Disorders

Prereq: Medical Neuroscience course or equivalent, and consent of instructor. Localization of specific anatomical changes in the brain in developmental and neurological disorders. Taught in modules with a specific focus. *Blatt, Kemper*. 2 cr, Spring sem.

GMS AN 810 Systems Neurobiology

Prereq: consent of instructor; undergraduate course in biological aspects of neuroscience (neuro-physiology and neuro-anatomy) or GMS MS 703. This course will cover the major sensory, motor, regulatory, and associative/integrative neural systems in depth from the basic cellular, neurophysiological, and neurochemical properties of the each to their overall function. *Rosene*. 4 cr, Fall sem.

GMS AN 811 Cognitive Neuroscience

Prereq: consent of instructor. This course will cover topics in the various domains of higher cortical function, including attention, language, visuospatial abilities, memory and executive function. It will also cover topics in learning, sleep, addiction, and behaviors under the influence of circadian rhythms. *Moss*. 4 cr, Spring sem.

GMS AN 820S Introduction to Interdisciplinary Systems Science: Dynamic Modeling

Prereq: consent of instructor. This course in interdisciplinary science will provide students with a hands-on experience in the development and use of systems dynamic and computer based models to study biological systems in research areas such as neurobiology. *Bergetho, Hallock*. 2 cr, SS.

GMS AN 901, 902 Anatomy Research

Var cr, Fall & Spring sem.

GMS AN 904 Research Practicum

Varied topics. *Staff*. 2 cr, Spring sem.

Behavioral Neuroscience

GMS BN 775 Human Neuropsychology I

Prereq: consent of instructor. This course emphasizes the relationship of the field of neuropsychology to other medical and scientific disciplines. Includes electrical activity of the brain, the study of consciousness and emotions, cerebral dominance, pathologies of language, sleep and its disorders, and traumatic brain injuries. *Oscar-Berman, staff*. 4 cr, Fall sem.

GMS BN 776 Human Neuropsychology II

Prereq: consent of instructor. Relationship of the field of neuropsychology to other medical and scientific disciplines. Includes psychiatric aspects of neurological disease and the pathologies of memory, intelligence, perception, and motor function. *Oscar-Berman, staff*. 4 cr, Spring sem.

GMS BN 777 Basic Neurosciences

Fall Semester: Overview to include neurophysiology, neurochemistry, neuroanatomy, neurobehavior, and neuropsychopharmacology. Processes occurring at the cellular and physiological levels are related to known central nervous system dysfunction. **Spring Semester:** Review of brain function and selected topics such as Parkinson's disease, schizophrenia, neurotoxicology, aphasia, sleep electrophysiology, and neuroimaging. This course is the same as GMS BN 778 (4 cr) and GMS BN 779 (2 cr), providing students with 32.5 hours of required course time. May not be taken concurrently with GMS BN 778 or 779. *Oscar-Berman, Zucker, staff*. 3 cr, Fall or Spring sem.

GMS BN 778 Basic Neurosciences Survey

Prereq: consent of instructor. **Fall Semester:** Overview to include neurophysiology, neurochemistry, neuroanatomy, neurobehavior, and neuropsychopharmacology. Processes occurring at the cellular and physiological levels are related to known central nervous system dysfunction. **Spring Semester:** Review of brain function and selected topics such as Parkinson's disease, schizophrenia, neurotoxicology, aphasia, sleep electrophysiology, and neuroimaging. This course is the same as GMS BN 777 (3 cr) and GMS BN 779 (2 cr), providing students with 50 hours of required course time. May not be taken concurrently with GMS BN 777 or 779. *Oscar-Berman, Zucker, staff*. 4 cr, Fall & Spring sem. (2 sem. course)

GMS BN 779 Beginning Basic Neurosciences

Fall Semester: Overview to include neurophysiology, neurochemistry, neuroanatomy, neurobehavior, and neuropsychopharmacology. Processes occurring at the cellular and physiological levels are related to known central nervous system dysfunction. **Spring Semester:** Review of brain function and selected topics such as Parkinson's disease, schizophrenia, neurotoxicology, aphasia, sleep electrophysiology, and neuroimaging. This course is the same as GMS BN 777 (3 cr) and GMS BN 778 (4 cr), providing students with 25 hours of required course time. May not be taken concurrently with GMS BN 777 or 778. *Oscar-Berman, Zucker, staff*. 2 cr, Fall or Spring sem.

GMS BN 780 Behavioral and Biological Aspects of Stress and Trauma

Prereq: consent of instructor. This course provides an overview of theory and research on stress and trauma, with attention to biological, psychological, and social factors. Special emphasis placed on gender issues, developmental factors, psychopathology, and physical health. *Keane, staff.* 2 cr, on demand.

GMS BN 782 Forensic Practice in Neuropsychology and Neuroscience

Prereq: Human Neuro-psychology course or some other introduction to the study of brain-behavior relations; consent of instructor. This course is taught by neuroscientists, physicians, lawyers, and judges, in an informal, collaborative atmosphere. Instruction will provide students with an introduction to the emerging role of psychology, neuropsychology, psychiatry, and behavioral neurology in the law and judicial proceedings. Topics covered are malingering; competency to stand trial, testify, and be executed; eyewitness identification; sociopathy; insanity defense; criminal culpability in children, and biological basis and treatment of violence. *Oscar-Berman, Spiers, Greenberg, staff.* 4 cr, Spring sem.

GMS BN 791, 792 Directed Studies in Behavioral Neuroscience

Staff. Var cr.

GMS BN 793 Adult Neurologic Communication Disorders

Prereq: consent of instructor. An overview of acquired, adult neurologic communication disorders for purposes of identification and differential diagnosis. Discussion of the neuronatomical bases for communication (within a cognitive framework) will be followed by a review of aphasia, dysarthria, apraxia, alexia, agraphia, stuttering, palilalia, and mutism, as well as disorders associated with right hemisphere strokes, closed head injury, and progressive diseases. *Albert.* 4 cr, Fall sem. On demand.

GMS BN 794 Brain Asymmetry: Functional and Structural Differences Between Hemispheres

Prereq: consent of instructor. The distinctive roles of the left and right hemispheres are reviewed; first by examining alterations in language and nonverbal behavior under conditions of brain damage; and second, by examining techniques used to investigate functional asymmetry in the normally intact brain. *Prather.* 2 cr, Spring sem.

GMS BN 795 Neuropsychology of Perception and Memory

Prereq: consent of instructor. The study of normal and abnormal perception and memory is related to brain structure and function. This seminar covers theoretical and clinical issues about how abilities change in normal and abnormal (e.g., Alzheimer's disease) conditions, using a variety of methods. *Albert, Brady.* 4 cr, Spring sem. On demand.

GMS BN 796 Neuropsychological Assessment I

Prereq: consent of instructor. Overview of structure and function of the central nervous system. Emphasis on quantitative and qualitative analyses of standardized and experimental tests of cognitive functions useful in differential diagnosis of neurological syndromes with an emphasis on the Boston Process Approach to neuropsychological evaluation. *Krengel.* 4 cr, Fall sem.

GMS BN 797 Neuropsychological Assessment II

Continuation of GMS BN 796 Neuropsychological Assessment I. *Krengel.* 4 cr, Spring sem.

GMS BN 798 Functional Neuroanatomy in Neuropsychology

Prereq: consent of instructor. Overview of central nervous system, structure and function; basic understanding of neuro-behavioral symptoms and their relationship to neuropathology, neuroepidemiology, including vascular infections, and congenital, degenerative, and toxic insults to the central nervous system, and will include laboratory examination of a specimen of a human brain. Appropriate for psychologists, speech pathologists, or other students in the behavioral sciences. *LaVecchia.* 4 cr, Fall sem.

GMS BN 821 Seminar in Neuroimaging

Prereq: consent of instructor. Overview of neuroimaging techniques available as adjuncts to neuropsychological measures of human brain damage. Intended for students with limited background in the application of neuroimaging techniques for the study of neuropsychiatric illnesses. Techniques, including PET, SPECT, MEG, MRI, fMRI, DTI and MRS, will be covered with relevance to selected neuropsychiatric diseases. *Oscar-Berman, Silveri.* 2 cr, Spring sem.

GMS BN 891, 892 Case Studies in Neuropsychology

Prereq: consent of instructor. Individual patients with perceptual/cognitive/affective symptomatology concomitant with brain damage are examined intensively through the use of a variety of behavioral assessment procedures. Test results are reviewed for the differential diagnosis of neurological syndromes. Emphasis on qualitative and quantitative analyses of standardized and experimental tests. *Verfaellie, Milberg.* 2 cr, Fall & Spring sem.

GMS BN 893 Child Clinical Neuropsychology

Prereq: consent of instructor. Covers general theoretical issues (e.g., intrauterine and postnatal development of the brain, handedness and lateralization of function, and recovery of function and neurobehavioral plasticity); diagnostic entities (e.g., attention deficit disorder, effects of early brain damage, developmental language disorders, dyslexia, and effects of malnutrition); and assessment and treatment (development of attention, social, spatial abilities, and language). *Prather*. 4 cr, on demand.

GMS BN 991, 992 Research in Behavioral Neuroscience

Staff. Var cr.

Biochemistry

GMS BI 751 Biochemistry and Cell Biology

Prereq: consent of instructor. Basic principles and concepts of medical school-level biochemistry and cell biology in a one-semester course. Topics include protein structure and function mechanisms of enzyme action nutrition and metabolism membrane structure and receptor signaling cell cycle regulation DNA and RNA structure and function regulation of gene expression and techniques in molecular medicine. Clinical correlations are provided throughout the course. *Offner*. 6 cr

GMS BI 755/756 Biochemistry A, B

Prereq: organic chemistry or equivalent, and consent of instructor. This two-semester course provides the biochemical foundation for advanced studies in basic and clinical sciences. Topics presented in the first semester include the structure and function of macromolecules, bioenergetics, protein structure and function, the mechanisms of enzyme action, DNA/gene structure and replication, RNA structure, transcription and translation. The second semester continues with sugar, lipid and amino acid metabolism with emphasis on the control of metabolic processes the function of hormones. Sessions on research methods or discussions of assigned readings are provided throughout the courses. *Kandrór, Polgar*. 4 cr

GMS BI 759 Integrative Biochemistry

Prereq: BI 755, BI756, MS 753, and BI782 or equivalent and permission of instructor. This course is an advanced course to follow the first year basic courses. The goal is to present an integrated view of biochemistry and the control of cellular and organismal functions with regard to nutrient utilization. Obesity and diabetes are epidemics in most of the world and these have occurred largely in the last 2 decades. Understanding the how and the why of this is the goal of the course, which focuses on the molecular events of metabolic regulation at numerous levels. *Pilch*. 4 cr

GMS BI 776 Gene Targeting in Transgenic Mice

Prereq: BI 755, 756; MS 753; and consent of instructor. Introduction to the basic theory and practice of an approach applicable to many cell biology problems. The following topics are covered: early mouse development gene targeting into mouse embryos homologous recombination in embryonic stem cells review of practical aspects of the transgenic technology review of selected studies employing transgenic mice and chimeric (gene knockout) mice. Offered alternate years. *Ravid*. 2 cr

GMS BI 777 Techniques in Biochemistry, Cell, and Molecular Biology

Prereq: Consent of instructor. Successful basic science research in Biochemistry, Cell, and Molecular Biology requires proposing, developing and testing a novel hypothesis. The generation of a novel hypothesis in turn requires the ability to apply the scientific method and then implement the appropriate techniques to address the experimental question. This course will complement the Foundations in Biomedical Sciences (FIBS) curriculum by providing students with a comprehensive understanding of the experimental methods used in Biomedical research. By the end of this course students will master the concepts behind a wide range of experimental techniques and technologies and then be prepared to apply the most appropriate experimental system to a given biological question. Biochemical knowledge regarding "how things work" will enable students to develop their own experimental research strategies. This course will be offered for 1st year PhD students and will use a traditional lecture approach, problem sets, and discussions. Course materials will include classic papers from the literature, laboratory protocols, and problem sets. A comprehensive final written assignment is designed to test the students' mastery of the subject matter. *Layne*. 2 cr, Fall sem.

GMS BI 778 Molecular Mechanisms of Cardiovascular Disease

The course deals with research topics relevant to cardiovascular disease including lipoproteins, atherosclerosis, oxidative stress, diabetes, hypertension, congenital heart abnormalities, gene therapy, stem cell therapies and others. Emphasis is placed on molecular and cellular mechanisms of normal vascular function and of vascular dysfunction leading to disease. Each session is taught by an expert in the field. The faculty includes several visitors from other US universities. Each student presents an original paper assigned by the instructors and writes and presents a review. *Zannis*. 2 cr

GMS BI 782 Molecular Biology

Prereq: GMS BI 755, 756 or equivalent and consent of instructor. An advanced molecular biology course that places emphasis on the current literature and relevant research techniques. Topics include DNA/RNA/protein synthesis and function analysis of genetic disorders, gene therapy, molecular biology of important cellular processes, and regulation of gene expression. *Farmer, Kirsch*. 4 cr

GMS BI 786 Biochemical Mechanisms of Aging

Prereq: consent of instructor. Current issues and key research advances in the understanding of the biochemical processes involved in aging of mammals are discussed. Theories on aging are analyzed, and age-related changes in gene structure and expression are presented. Alterations in the function of the neuroendocrine and immune systems with aging are also discussed. Offered alternate years. *Polgar*. 2 cr

GMS BI 787 Molecular Mechanisms of Growth and Development

Prereq: GMS BI 755, 756 or equivalent and consent of instructor. Examines the most recent advances in the molecular mechanisms involved in regulation of cell proliferation, differentiation, and development. Control of the cell cycle and regulation of the expression of differentiated function are discussed. The role of extracellular growth factors and nuclear transcriptional regulatory proteins are explored. Students present and actively discuss recent primary research articles. Offered alternate years. *Smith, Symes*. 2 cr

GMS BI 789 Methods and Modeling in Molecular Biochemistry

Prereq: GMS BI 755, 756 or equivalent and consent of instructor. This course teaches the concepts and approaches necessary to model and treat molecular/cellular processes using physical tools and methods including computational strategies. Competence in research methods and modeling approaches enabling exploration and quantification of biological systems is the course goal. *Bergethon*. 2 cr

GMS BI 793 Mass Spectrometry, Proteomics and Functional Genomics

Prereq: BI 755, 756 or equivalent and permission of instructor. The application of mass spectrometry to protein, glycoconjugate and carbohydrate structures has propelled developments in proteomics and functional genomics. This course describes how to use mass spectrometry to answer structural and functional questions in biomedical research. The course explores the background necessary to effectively design mass spectrometric (MS) experiments and interpret data. Students gain a full understanding of modern MS and its effective use in their research. Lectures are devoted to instrumentation, ionization methods and applications to proteins, lipids, carbohydrates, glycoconjugates, nucleic acids and uses of the technology in proteomics, biotechnology and medicine. *Costello*. 2 cr

GMS BI 851, 852 Special Topics in Biochemistry

Prereq: GMS BI 755, 756 or equivalent and consent of instructor.

GMS BI 854 Biochemistry Student Seminar

Required for all Department of Biochemistry MA, PhD and MD/PhD students. Students present and discuss the current literature in molecular and cellular biochemistry. The objective of this course is to develop oral presentation and critical thinking skills. *Abraham, Yaglom*. 2 cr

GMS BI 951 Research in Biochemistry

Var cr

Bioimaging

GMS IM 600 Bioimaging Foundations

Prereq: consent of instructor. The physical, mathematical, and experimental foundations of bioimaging are studied with historical context and are presented in the following sequence: bioimaging, principles, bioimaging mathematics, and bioimaging physics, leading to the study of the different bioimage generation techniques (modalities). *Jara*. 4 cr

GMS IM 610 Magnetic Resonance: Principles, Methods, and Applications in Biomedical Research

Prereq: consent of instructor. This course will provide an overview of the underlying principles of nuclear magnetic resonance (NMR) and the various methodologies used in magnetic resonance imaging (MRI) and magnetic resonance spectroscopy (MRS) with emphasis on methods applied in biomedical research. The course will emphasize the connection between the basic manipulation of the spin system via the sequence of RF and gradient pulses (the pulse sequence) and the information that can be retrieved from the observed object, be it a solution of an isolated protein of the human brain. *TBA*. 4 cr

GMS IM 620 Bioimaging Theory & Imaging Processing

Prereq: consent of instructor. The main theoretical aspects of bioimaging are studied, including image meaning, image generation, image quality (analysis, improvement, and limits), image information content (generation and extraction), and image assisted modeling of biologic systems. Mathematical foundations and basic techniques for digital image processing are studied theoretically as well as in a hands-on approach in the Image Processing Laboratory. Studied topics include linear and matrix algebra, calculus, image processing techniques for image enhancement, image manipulation for structural analysis (segmentation, quantification and measurement), and for three-dimensional visualization and exploration. *Jara*. 4 cr

GMS IM 630 Methods of Functional Imaging of the Brain

Prereq: consent of instructor. This course will provide an overview of the various existing methods for detecting and mapping brain function *in vivo*. A brief introduction will provide the necessary background to brain physiology: electrical activity, synaptic transmission, cell metabolism and haemodynamic response associated with neuronal activity. *TBA*. 2 cr

GMS IM 640 Post-processing Images of the Brain

Prereq: consent of instructor. Over the past decade, there has been an exponential use of non- to minimally-invasive imaging procedures used in research studies. The techniques used to analyze these data has evolved from rather crude measurements drawn by hand to highly sophisticated computerized procedures. As these sophisticated procedures have gotten more complex it is important for the user to understand the basic theories that underlie them to use them properly. In this class the students will be given an overview of a number of the currently available tools for processing images acquired of the brain *in vivo*. Those students taking the lab with the lecture course will be asked to work in small groups, using sample imaging data to gain hands-on experience with a set of these tools. Students will be required to read review papers on each technique on a weekly basis in preparation for class. *Killiany*. 2 cr

GMS IM 650 Bioimaging Practicum

Prereq: consent of instructor. Students participate directly in day-to-day imaging activities including clinical (radiology daily noon conferences) as well as research activities (hands-on imaging experiments with phantoms and animals). *Jara*. 4 cr

GMS IM 651 Statistical Analysis of Neuroimaging Data

Prereq: consent of instructor. This course is designed to give the student a working knowledge of the parametric and non-parametric statistical procedures that are commonly used to analyze data generated from *in vivo* imaging techniques such as CT, MRI, PET and SPECT. *Killiany*. 2 cr

GMS IM 660 Radiation Protection & Ethics

Prereq: consent of instructor. Many of the established and state-of-the-art modalities in diagnostic imaging rely upon radiation as the imaging agent. However, radiation in itself is considered a hazard that must be controlled. This course will introduce the fundamentals of understanding radiation, the risks of radiation exposure, and the methods of minimizing its harmful potential while maximizing its beneficial qualities. *Norbash*. 2 cr

GMS IM 670 Special Topics in Bioimaging

Prereq: consent of instructor. Imaging has come to increasingly serve as a substrate and necessary ingredient for progressively more complex diagnoses and therapy. The increasing significance of the imaging components has been classically appreciated in fields such as radiation therapy, where planning of treatment based on images is integral to the therapy itself, and has spread beyond the boundaries of such disciplines to numerous surgical fields such as neurosurgery, orthopedics, and ear, nose, and throat surgery. *TBA*. 2 cr, on demand.

GMS IM 680 Professional Development

Prereq: consent of instructor. This is a preparatory course for students making the transition from a formal academic program into the dynamic work place. It will cover those fundamental skills required to facilitate searching, locating, and qualifying for the job of one's choice. It will cover topics such as building a portfolio, networking, resume writing, and interviewing skills. Speakers in the various fields of imaging will be invited to discuss how he or she made the transition into the workplace and students will have the opportunity to discuss and discover the various pitfalls on the paths of entry into the field of his or her choice. *Moss, Norbash*. 2 cr

GMS IM 690 Imaging of Neurological Disorders of the Brain

Prereq: consent of instructor. This course will look at the role played by modern, minimally invasive imaging techniques in the detection, management, research and testing of treatment efficacy of various neurological diseases that affect the brain. Each week a different disorder will be presented. *Killiany*. 2 cr

GMS IM 700 Thesis Research I

Prereq: consent of instructor. First phase of a four-semester directed research project, the MBI project in the field, select a faculty member in the greater Boston area who will agree to serve as an thesis advisor, identify a line of research and define the specific objectives of a project to be conducted in the following three semesters. *Jara*. 2 cr

GMS IM 710 Thesis Research II

Prereq: consent of instructor. Second phase of a four-semester thesis research project in the field of bioimaging during which students postulate a hypothesis, design an experimental protocol to test the hypothesis, acquire data (pilot and final). *Jara*. 2 cr

GMS IM 730 Thesis Research III

Prereq: consent of instructor. Third phase of a four-semester thesis project in the field of bioimaging during which students finish data analysis and primarily concentrate on writing a comprehensive technical report describing in detail their work in Phases I and II. *Jara*. 2 cr

Biomedical Forensics

GMS FS 700 Criminal Law and Ethics

Prereq: consent of instructor. An overview of legal, ethical and practical issues of forensic science, the impact of forensic science on the justice system and a discussion of traditional and emerging admissibility standards involving forensic science evidence is given. The curriculum will include a description of the roles law enforcement, attorneys and forensic scientists, professional standards for the practice of criminalistics and ethical issues in forensic pathology, psychiatry and crime scene investigation. *Breen*. 2 cr

GMS FS 701 Crime Scene Investigation

Prereq: consent of instructor. This combination hands-on and lecture based course will provide students with an in-depth review of crime scene assessment and management. Methods of identifying, documenting, collecting and packaging physical evidence from various types of crime scenes are discussed. A hands-on component will be employed in areas such as crime scene sketching, photography and evidence collection. *Brodeur*. 3 cr

GMS FS 702 Forensic Biology

Prereq: consent of instructor. This lecture-based course will introduce students to the biological aspects of forensic evidence including biochemical and physical attributes of blood and other body fluids. Common methods of body fluid identification utilized in forensic laboratories will be discussed at length. Other topics include guidelines for thorough evidence examination, screening, documentation and report writing. *Brodeur*. 3 cr

GMS FS 703 Forensic Chemistry

Prereq: consent of instructor. This lecture-based course will provide an introduction to chemical principles and instrumental techniques associated with the following areas of the field: controlled substances, toxicology, ignitable liquids and explosives. A review of organic and analytical chemistry as they relate to forensic investigations will be discussed. *Hall*. 3 cr

GMS FS 704 Forensic Biology Laboratory

Prereq/Concurrent: Forensic Biology. This laboratory-based course will give students an opportunity to apply the principles of forensic biology to actual samples. Techniques utilized will include screening tests, methods used to confirm antibody interactions, gel diffusion and microscopic identification of cellular material. *Brodeur*. 2 cr

GMS FS 706 Pattern Evidence Analysis

Prereq: Crime Scene Investigation. This combination lecture and lab-based course will provide students with overview of various types of pattern evidence with an emphasis on the systematic approaches to pattern evidence comparison and analysis. The history of fingerprint identification, fingerprint processing and comparison techniques, footwear and tire impression analysis, toolmark analysis, and the importance of photography in pattern evidence documentation will be discussed. Development of pattern evidence using mechanical, chemical and visual techniques is incorporated. *Brodeur*. 2 cr

GMS FS 707 Trace Evidence Analysis

Prereq: consent of instructor. This lecture-based course will provide an overview of the principles and concepts on which trace evidence analysis is based. Proper collection, preservation, identification and comparison of items such as glass, paint, hairs and fibers, using standard methods and instruments used in crime scene laboratories will be discussed. *Reynolds*. 3 cr

GMS FS 708 Forensic Instrumental Analysis Laboratory

Prereq: GMS FS 703. This course will provide an introduction to a variety of instrumentation and equipment utilized in the forensic laboratory and detail the methods used by forensic scientists for chemical and trace evidence analysis. *Hall*. 2 cr

GMS FS 709 Medicolegal Death Investigation

Prereq: consent of instructor. This lecture-based course will provide the student with an overview of the basic principles of medicolegal death investigations. Specific lectures will cover the procedures and skills necessary to conduct a thorough medicolegal investigation of death, knowledge of various types of traumatic injuries, the knowledge necessary to understand the characteristics that differentiate the manners of death and the skills to conduct an appropriately directed investigation. The curriculum will prepare the students to take the national certification examinations offered by the American Board of Medicolegal Death Investigators. A general knowledge of anatomy is recommended prior to enrollment. *Laposata*. 2 cr

GMS FS 712 Forensic Pathology

Prereq: consent of instructor. This lecture-based course will provide the student with an overview of the role of the medical examiner as it relates to death investigations. Specific lectures will cover autopsy procedures in the investigation of gunshot wounds, sharp and blunt trauma, drowning, asphyxia, child deaths, motor vehicle accidents and time since death determination. A general knowledge of anatomy is recommended prior to enrollment. *Laposata*. 3 cr

GMS FS 713 Bloodstain Pattern Analysis

Prereq: GMS FS701 Crime Scene Investigation. This lecture and lab-based course will provide students with fundamental knowledge in the area of bloodstain pattern analysis including the scientific principles and practical applications of bloodstain pattern analysis for forensic casework. The procedures and methods for recognition, documentation and evaluation of bloodstain patterns will be covered. Additionally, the principles of physics, blood dynamics and the geometric significance of bloodstain patterns will be explored. *Brodeur, Martin*. 2 cr

GMS FS 716 Homicide Investigation

Prereq: consent of instructor. This lecture-based course will provide the student with an overview of the art and science of homicide investigation, with an emphasis on the "art". An actual murder investigation and subsequent trial will be used to highlight the investigatory and legal issues an investigator may face, as well as the social and political context in which homicide investigations take place. *Harrington*. 2 cr

GMS FS 720 Forensic DNA Analysis

Prereq: consent of instructor. This lecture-based course will discuss theory and application of human genetics and molecular biology to testing of biological evidence. DNA structure and organization of the human genome and types of genetic variation occurring in humans will be covered. Other topics include the history of DNA analysis and current PCR based methods for testing of autosomal STR loci, Y chromosome STR loci and mitochondrial DNA. Lecture material will also cover commonly encountered artifacts in PCR testing, DNA profile interpretation and statistical analysis of results. *Cotton*. 3 cr

GMS FS 721 Forensic DNA Analysis Laboratory

Prereq/Concurrent: GMS FS 720 Forensic DNA Analysis. This lab-based course will provide theory and practice in procedures used in forensic DNA analysis. Sessions will include use of several DNA extraction techniques, clean technique for contamination prevention, real time PCR for human DNA quantitation, PCR amplification of STR loci and DNA profile analysis. *Grgicak*. 2 cr

GMS FS 730 Advanced Topics in Forensic DNA Analysis

Prereq: GMS FS 720 and FS 721. This course will build on topics presented in the Forensic DNA Analysis course and laboratory. Students will gain experience interpreting STR data from compromised and mixed source samples, and will understand the theory behind DNA profile frequency calculations. An in-depth review of techniques and methodology used in a forensic DNA laboratory and the roles that accreditation, validation and quality assurance play will be discussed. *Cotton*. 2 cr

GMS FS 735 Analysis of Ignitable Liquids and Explosives

Prereq: GMS FS 703. This course will expose students to an in-depth treatment of the analysis of ignitable liquids and explosives. Practical and theoretical aspects of qualitative and quantitative measurements using current methodologies such as GC/MS and UV-VIS will be discussed. *Hall*. 2 cr

GMS FS 740 Analysis of Controlled Substances

Prereq: Forensic Chemistry. This lecture-based course will provide information on the important methods of analysis of most commonly abused illicit substances including marijuana, cocaine, opiates, hallucinogens and amphetamines. Addi-

tionally, the production, distribution and history of these commonly abused drugs will be covered. Laboratory accreditation requirements will also be discussed. *Hall*. 2 cr

GMS FS 800 Criminal Law II – Mock Court

Prereq: Criminal Law and Ethics. This interactive course builds upon the material discussed in Criminal Law and Ethics regarding the criminal trial process, the role of the forensic witness and the presentation of scientific testimony and physical evidence in court. Students will actively participate in presenting testimony as well as critiquing the performance of others in a mock court setting. Instructors may utilize reports and projects prepared in other courses to provide the subject matter for the students' testimony. *Breen*. 2 cr

GMS FS 803 Advanced Forensic Chemistry

Prereq: FS 703 Forensic Chemistry. This lecture-based course will provide students with an understanding of advanced analytical techniques utilized by modern state and national forensic laboratories. Lecture topics will include: Tandem techniques such as GC/MS-MS and LC/MS-MS, high resolution techniques such as FT-MS and ICP-MS, Raman, Ion Mobility, and Energy Dispersive Spectroscopy and X-Ray Fluorescence. *Hall*. 2 cr

GMS FS 806/GMS FA 805 Advanced Crime Scene Investigation

Prereq: GMS FS 701 Crime Science Investigation. This hands-on and lecture-based course will provide students with methods and underlying theories related to specialized aspects of crime scene processing. Topics will include techniques and principles utilized in search and recovery of human remains. Forensic entomology, mechanisms of human decomposition, use of ground penetrating radar, soil composition, excavation, telltale disturbances in flora and the presence of animal activity will be examined. A semester-long practical exercise will include the search and recovery of mock remains and the reconstruction of events. *Brodeur, Martin*. 2 cr

GMS FS 807 Trace Evidence Analysis Laboratory

Prereq: GMS FS 707 Trace Evidence Analysis. This laboratory-based course will provide hands-on experience with the methods, techniques and instruments used to analyze trace evidence, such as glass, paint, hairs and fibers, with the ultimate goal of identifying and comparing known trace evidence materials with questioned samples. *Reynolds*. 2 cr

GMS FS 830 Forensic Toxicology

Prereq: GMS FS 703 Forensic Chemistry. This lecture based course will provide an overview of the pharmacology, pharmacokinetics and toxicology of common drugs of interest to the forensic toxicologist. An emphasis will be placed on applying the principles of pharmacokinetics to the interpretation of drug blood and urine levels, and on developing an understanding of how drugs (including ethanol) interact with the biology and physiology of the human body. Students will also acquire knowledge of the chemical structure of common drugs. *Laposata*. 2 cr

GMS FS 870 Directed Studies in Biomedical Forensic Sciences

Students will register for this course in preparation for conducting a library- or laboratory based thesis project. With direction from the student's thesis research committee, the student will investigate his/her thesis topic, develop a research plan including an outline of the project, become familiar with quality control and quality assurance issues and begin data collection. *Grgicak*. 2 cr

GMS FS 871 Internship in Biomedical Forensic Sciences

An internship in a forensic setting is encouraged, and may be approved for academic credit depending on the number of hours and the nature of the work completed during the internship. With prior approval from the student's thesis advisors and the internship site supervisor, work completed at an internship may be used as the basis of the student's thesis. A completed evaluation from the internship supervisor describing the nature of the work completed and the quality of the student's performance will be required. In addition, the student will be required to write a summary of his/her internship experiences and responsibilities. *Grgicak*. 2 cr

GMS FS 970 Research in Biomedical Forensic Sciences

Each student must complete a program of laboratory or library research of which will be incorporated into a thesis of publishable quality. The thesis clearly states a hypothesis or scientific question and presents the author's findings to support the stated proposition. Thesis topics are developed in conjunction with a research committee consisting of faculty members and/or other qualified individuals. Registration for this course should be during the semester in which the student anticipates graduation from the program. *Grgicak*. 2 cr

Cell & Molecular Biology

GMS CM 753 Cell Biology

Prereq: consent of instructor. Principles of cell biology are covered in lectures. Discussion of papers related to lectures occurs on Friday sessions. Topics covered include: Receptors and signaling pathways, endocytic pathway, vesicles, exocytosis, ubiquitin/proteasome system, communication between cells, cellular responses to extra cellular matrices, development and notch and wnt signaling, the cytoskeleton and critical proteins, cell cycle, differentiation and stem cells. *Trinkaus-Randall*. 4 cr, Fall sem.

GMS CM 761, 762 Critical Thinking in Cell and Molecular Biology

The purpose of this course is to train students in the art of reasoning and critical thinking in the pursuit of answers to biological questions. The goal of 761 is to examine a field of science and evaluate/understand how it developed at critical branch points. The goal of 762 is to use the framework of the scientific literature to develop Critical Thinking Skills to generate novel hypotheses in any area of Cell and Molecular Biology. Critical Thinking skills will be used to examine research findings and theories to uncover inconsistencies, bias, or faulty logic. The student will be expected to build on their careful evaluation and analysis of the papers to create a new hypothesis. *Brecher, Layne*. 2 cr, Fall and Spring sem.

GMS CM 764 Cell and Molecular Biology Professional Presentation Skills

The course is designed for first year graduate students. The goal of this course is to teach students how to present their research in written and oral form. Students will give multiple short oral presentations and be critiqued. They will also give one longer presentation. Students will learn to give presentations with and without slides. Students will also begin to acquire written skills in preparation for the Proposal writing course in the second year. The course will meet weekly. *Trinkaus-Randall*. 2 cr. Fall sem.

GMS CM 765, 766 Mini-Courses in Cell and Molecular Biology

Prereq: consent of instructor. Two six-week courses are presented. I. Imaging of Biological Systems: The goal is to discuss and demonstrate principles of fluorescence microscopy. There is both a classroom and hands on component. If time permits a small independent project may be conducted by students to enhance familiarity with instrumentation. II. Proposal Writing: The goal is for students to learn how to write the components of a proposal. Sessions include evaluation of writing. The culminating project is a proposal on their work. In the past a member of the NRSA study section has been invited to answer questions. *Trinkaus-Randall*. 2 cr, Spring sem.

Clinical Investigation

GMS CI 631 Clinical Trials Management

Prereq: consent of instructor. This course is an integrative learning experience, combining a comprehensive review of the good clinical practice core principles with explanation and analysis of selected portions of the Code of Federal Regulations (CFR), applicable to clinical research during the new drug development process. The case study approach is used in this course since the drug development industry translates these regulations into both written and unwritten standards, practices, and guidelines. Each session will use activities to expand the interpretation of the regulations, into an operational and organizational focus, further integrating real-life issues into the classroom. In order to ensure that classroom learning is linked with the students' work experiences, there will be an outside project required which will incorporate the course work with the simulated on-the-job situations, and a final presentation to share the learning with the entire class. *Halloran, Roth*. 4 cr, Spring sem.

GMS CI 640 Regulatory and Compliance Issues

Prereq: Premedical course requirements and consent of instructor. Course explains the regulatory requirements for health-care products, that is, drugs, biologics, and devices. Intended for those interested in regulatory affairs or the clinical evaluation, development, manufacture, testing and/or commercialization of these products. Provides an in-depth review of pertinent FDA regulations and guidance and links these to the scientific and logistical activities involved in taking a medical product from research to market. Content and preparation of regulatory submissions, including an Investigational New Drug Application (IND), an Investigational Device Exemption (IDE), a New Drug Application (NDA), a Biologic License Application (BLA), a Pre-Market Approval Application (PMA), and a 510K Pre-Market Notification are described. *Gloff*. 4 cr, Fall sem.

GMS CI 660 Good Clinical Practices in Clinical Research

Prereq: consent of instructor. This course introduces students to the regulatory responsibilities of sponsors, monitors, and investigators conducting clinical trials. Practical information and exercises are designed to demonstrate GCP compliance from an industry perspective as well as from an academic perspective. Topics Include: Human protection in clinical trials, institutional review boards, selecting and qualifying investigators, consenting subjects, initiating, monitoring and closing out sites successfully and safety monitoring in clinical trials. Group discussions and exercises help students learn practical skills. *Oommen*. 4 cr, Summer sem.

GMS CI 670 Biostatistics with Computer

Prereq: consent of instructor. This course is designed for students with no prior experience with statistics who want to utilize computer software in performing statistical analysis. Topics include the collection, classification, and presentation of descriptive data; the rationale of hypothesis testing; t-tests and chi-square tests; correlation and regression analysis; sample size calculations, and analysis of contingency tables. Laboratory course. *Travison*. 4 cr, Fall sem.

GMS CI 675 Designing Clinical Research Studies

Prereq: consent of instructor. This course covers important scientific and epidemiologic principles necessary for designing clinical research studies. Topics include bias, confounding, developing the research question, defining an appropriate study population, choosing outcome measures, clinical research ethics and regulation, sample size determination, and statistical analysis issues. Students will design and present a clinical research study during the course. *Fish, McNair*. 4 cr, Fall sem.

GMS CI 680 Legal and Ethical Issues in Clinical Research

This course examines evolving ethical and legal issues in the biosciences. Students will study the legal and ethical issues pertaining to work with human subjects both existing and historical. They will go through the historical background that set the standard for today's existing regulations and how those regulations are still in flux. Each student will do a presentation on a topic that relates to his or her own interest or existing research. Legal cases that have come from clinical research (such as *Moore v. Regents of CA*) will also be covered. Class discussions, student presentations, case analyses and in-class lectures will be supplemented with online activities as well as the composition of a legal brief. *Yashon*. 2 cr, Summer sem.

GMS CI 691, 692 Directed Studies in Clinical Investigation

Directed study provides the opportunity for students to explore a special topic of interest identified by the student under the direction of a MACI faculty member. Students may register after the MACI faculty member has agreed to work with the student on a specific project. 2-4cr, all sem.

GMS CI 790 Seminar in Clinical Investigation

Prereq: CI 675. The goal of this course will be to provide students experience in the reading and evaluation of recent basic science literature that may be pertinent to the origination and design of clinical research. The course will be a seminar format. It will consist of the evaluation of assigned readings of recent literature which may be relevant to the treatment of human diseases and which might be expected to lead to further animal experiments and to culminate in human trials. This format will provide an opportunity to learn to critically evaluate basic science literature and to develop oral presentation skills essential to function as a manager of clinical trials. *Fish, Hess Pino*. 2 cr, Spring sem.

GMS MS 961, 962 Clinical Investigation Practicum

The goal of the practicum experience is to provide the student hands-on exposure to clinical research. The student will work with a research mentor and will be actively involved in the development, execution, and evaluation of a clinical research project or project(s). During the practicum, it is expected that the student will be exposed to: clinical research planning, protocol preparation, interaction with Institutional Review Boards, regulatory requirements, selection of subjects/consent process, data collection, study monitoring, and data analysis. These various activities will most likely require involvement in more than one research project. Var cr, all sem.

Forensic Anthropology

GMS FA 705 Forensic Anthropology Techniques

Prereq: consent of instructor. This course will provide students with a detailed history of forensic anthropology, including pioneers in the field, bone growth and development, and an extensive knowledge of protocols, methods, and procedures used by forensic anthropologists, to include distinguishing osseous from non-osseous material, distinguishing human from non-human remains, and estimating the biological profile. Students will be provided hands on experience in casework and will prepare several forensic anthropology case. *Prince Zinni*. 3 cr, Fall sem.

GMS FA 706 Forensic Anthropological Procedures

Prereq: Forensic Anthropology and Osteology. This course provides in-depth knowledge of the protocols, methods, and procedures used by forensic anthropologists and entomologists in the recovery of human skeletal material, identification of human skeletal remains and to identify and analysis of types of bone and soft tissue trauma and the stages and processes of human decomposition. In addition, students will have gained experience in the identification and classification, timing and nature of trauma to bones and the estimation of time since death. *Prince Zinni*. 3 cr, Fall sem.

GMS FA 709 Medicolegal Death Investigation

This lecture based course will provide the student with an overview of the basic practices and principles of medicolegal death investigations. Specific lectures will cover the procedures and skills necessary to conduct a thorough medicolegal

investigation of death, knowledge of various types of traumatic injuries, the knowledge necessary to understand the characteristics that differentiate the manners of death and the skills to conduct an appropriately directed investigation. The curriculum will prepare the students to take the national certification examinations offered by the American Board of Medicolegal Death Investigators. A general knowledge of anatomy is recommended prior to enrollment. *Laposata*. 2 cr

GMS FA 710 Topics in Forensic Anthropology

Prereq: consent of instructor. Students registered in this course will participate in weekly discussion sections based on peer-reviewed journal articles. At the completion of this course, students will have had the opportunity to gain knowledge and experience in analytical skills and critical evaluation of published research findings and projects. Students will also gain knowledge of current and past research in forensic anthropology. *Prince Zinni*. 2 cr, Fall sem.

GMS FA 711 Forensic Pathology

This lecture based course will provide the student with an overview of the role of the medical examiner as it relates to death investigations. Specific lectures will cover autopsy procedures in the investigation of gunshot wounds, sharp and blunt trauma, drowning, asphyxia, child deaths, motor vehicle accidents and time since death determination. A general knowledge of anatomy is strongly suggested. *Laposata*. 3 cr

GMS FA 712 Osteology

This course is designed to provide the student with an overview of basic human osteology with an emphasis on structure and function of various bones typically used by forensic anthropologists in human identification and in the investigation of traumatic and sudden deaths. At the completion of this course the student will be well versed in the anatomy, growth, landmarks and surface anatomy of all bone in the human skeleton. They will have completed hands-on experience with handling, measuring and identifying real human skeleton components. In addition, the methods of recovery and preservation of human skeletal remains will be practiced. *Siwek*. 4 cr, Fall sem.

GMS FA 716 Expert Witness Testimony for Forensic Anthropologists

Prereq: consent of instructor. This course is in expert witness testimony of scientific evidence by forensic anthropologists. The purpose of this course is to give graduate students in the M.A. in Forensic Program an introduction to the United States criminal justice system, an overview of some of the unique challenges that scientific evidence present in the system and experience with providing expert witness testimony. *Powers*. 2 cr, Spring sem.

GMS FA 718 Special Topics in Forensic Anthropology: Outdoor Crime Scene

Prereq: consent of instructor. This course will provide students with an overview of physical evidence found at outdoor crime scenes of buried or scattered human remains. Focus will involve the recognition, documentation, and collection of physical evidence and the review of real cases in which human remains have been recovered and how physical evidence was used to help solve the crime. *L'Italian*. 3 cr, Fall sem.

GMS FA 720 Forensic Anthropology Internship

Prereq: consent of instructor. Students registered in this course will be expected to complete an approved internship in an anthropology or archaeology field school, forensic, or medicolegal setting. *Faculty*. 2 cr, on demand.

GMS FA 722 Anatomical Sciences for the Forensic Anthropologist

Prereq: consent of the instructor. The central emphasis of this course will be on the gross morphological features of the human body with a modest treatment of function. Although forensic anthropologists typically deal with soft tissues post-mortem and/or skeltonized remains, this course will expose students to preserved tissues and the "normal" appearance of these tissues. *Siwek, Moore*. 4 cr, Fall sem.

GMS FA 740 Seminar in Forensic Anthropology

Prereq: FA 705, FA 710 and consent of instructors. This course will provide students with an extensive knowledge of past and current research within the field of forensic anthropology. In addition, this course will foster critical thinking skills for students and include discussions of ethics and professional standards. *Prince Zinni*. 2 cr, Spring sem.

GMS FA 755 Directed Studies in Forensic Anthropology

Prereq: consent of the instructor. Students will have the opportunity to develop a directed study in a specialized area of forensic anthropology or archaeology that is of particular interest. *Faculty*. 4 cr, all sem.

GMS FA 760 Research in Forensic Anthropology

Prereq: consent of instructor. This course is designed to facilitate the students' thesis research. *Faculty*. Var cr, Fall and Spring sem.

GMS FA 800 Field Methods in Forensic Anthropology

This course will provide students with a sound basis for archaeological methods applied to a variety of forensic settings. Students will learn core concepts from academic archaeology and how forensic archaeology differs from traditional methods. *Prince Zinni*. 2 cr

GMS FA 802 Applied Forensic Anthropology

Students will gain extensive experience in forensic anthropological casework, to include experience in generating analytical notes and report preparation. Students will be exposed to a variety of casework situations that forensic anthropologists encounter in medical examiner offices, international realms, government laboratories and field situations. *Prince Zinni*. 3 cr

GMS FA 804 Experimental Design and Statistics for Forensic Anthropologists

The goal of this course is to provide a working understanding of experimental design and statistical analyses that are appropriate for various types of anthropological based experiments and for the analysis of skeletal remains for unknown individuals. *Killiany*. 2 cr

GMS FA 805/GMS FS 806 Advanced Crime Scene Investigation

Prereq: GMS FS 701 Crime Science Investigation. This hands-on and lecture-based course will provide students with methods and underlying theories related to specialized aspects of crime scene processing. Topics will include techniques and principles utilized in search and recovery of human remains. Forensic entomology, mechanisms of human decomposition, use of ground penetrating radar, soil composition, excavation, telltale disturbances in flora and the presence of animal activity will be examined. A semester-long practical exercise will include the search and recovery of mock remains and the reconstruction of events. *Brodeur, Martin*. 2 cr

GMS FA 806 Advanced Human Osteology

This course builds on the topics covered in GMS FA 712 Human Osteology by exploring human osteology in greater depth and will include lectures and extensive experience with radiographical material. *Siwek*. 4 cr

Foundations Curriculum

GMS FC 701 Foundations in Biomedical Sciences I: Protein Structure, Catalysis and Interaction

The first module of the Foundations in Biomedical Science course "Protein structure, catalysis and interactions" will provide students with a quantitative understanding of protein structure, function, posttranslational modification and the turnover of proteins in the cell. In addition, students will gain facility with thermodynamics, catalysis, kinetics and binding equilibria as they apply to proteins and also to other molecules in biological systems (e.g. nucleic acids, lipids, vitamins, etc.). This course is part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete, progressive sequence. *McKnight, Nugent*. 2 cr, Fall sem.

GMS FC 702 Foundations in Biomedical Sciences II: Structure and Function of the Genome

The second module of the Foundations in Biomedical Sciences course will focus on the mechanisms of biological processes that influence the inheritance, regulation, and utilization of genes. Genetic and genomic, molecular, cell biological, and biochemical experimental approaches to understanding these processes will be explored. In addition, we will discuss the possibilities of utilizing these technologies in medical treatments. This course is part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete, progressive sequence. *Dasgupta, Viglianti*. 2 cr, Fall sem.

GMS FC 703 Foundations in Biomedical Sciences III: Architecture & Dynamics of the Cell

The third module of the Foundations in Biomedical Sciences course will focus on the movement of proteins and membranes with the cell, the secretory process, the cytoskeletal framework of the cell and the resulting cell-cell interaction and communication with the matrix. Molecular, cell biological, and biochemical experimental approaches to understanding these processes will be explored. In addition, we will discuss the possibilities of utilizing these technologies in medical treatments. This course is part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Science. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete, progressive sequence. *Trinkaus-Randall, Zoeller*. 2 cr, Fall sem.

GMS FC 704 Foundations in Biomedical Sciences IV: Mechanisms of Cell Communication

The fourth module of the Foundations in Biomedical Sciences course will focus on the mechanisms of cell communication. This module will begin by discussing overarching concepts before examining the specific types of molecules that initiate and transduce signals. Examples of cell signaling and subsequent cellular responses will then be considered in different

contexts to provide a framework on which future learning can be applied. As the module progresses, the complexity of the systems explored will increase from individual cells to multicellular environments such as tissues, organs, and organisms. In addition, normal processes as well as the dysregulation of cell-cell communication is disease will be studied. This course is part of a series of four core integrated courses and additional elective courses aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The four cores will be integrated in content and structure, and therefore are intended to be taken as a complete progressive sequence. *Symes, Hsu. 2 cr, Spring sem.*

Genetic Counseling

GMS GC 600 Genetic Diagnosis & Laboratory Methods

This interactive course will provide students with the opportunity to learn laboratory techniques and methodologies in a hands-on setting. It will combine didactic lectures with observational rotations in the cytogenetic, molecular, mass spectrometry, maternal serum screening, and research laboratories. *Flynn, Basran.*

GMS GC 601 Professional Issues in Genetic Counseling

This two-semester course addresses topics related to the development of a competent genetic counselor. Instructional content, combined with group discussions and student presentations, will cover the history and development of the profession, care across the lifespan, and ethical/social issues. *Campion.*

GMS GC 602 Clinical Genetics

This course will provide information regarding etiology, features, testing, and treatment for a variety of genetic conditions. The topics are arranged by organ system to expand on the material covered in GMC GC603. Clinical case studies and presentations will supplement. *Milunsky.*

GMS GC 603 Embryology, Teratology, and Prenatal Genetics

This course will review human embryology, the teratogenic factors leading to abnormal development, and the common indications for prenatal genetic counseling, including advanced maternal age, abnormal serum screening, ultrasound anomalies, diagnostic procedures, and prenatal complications. *Campion, Krepkovich.*

GMS GC 604 Cancer Genetic Counseling

This course introduces students to the subspecialty of cancer genetics, through topics such as the biology of cancer, current statistics and technology, inherited cancer syndromes, cancer risk assessment, testing for cancer susceptibility genes, treatment options, and ethical/legal issues. *Flynn.*

GMS MS 605 Clinical Applications in Human Genetics

This course will introduce students to the basic concepts and principles of human genetics and their clinical applications. Topics include the chromosomal, molecular, and biochemical basis of disease, prenatal diagnosis, genetic counseling, bioinformatics, and congenital anomalies. *Milunsky.*

GMS GC 711 Advanced Genetic Counseling

This two-semester course will cover advanced topics in genetic counseling, including research project design and implementation, personal growth, and professional development. It will build upon the students' previous course work and clinical training to enhance their growing skill set as genetic counselors. *Campion.*

GMS GC 712 Metabolic Genetics/Advanced Risk Assessment

Section A covers screening, prevention, diagnosis, recurrence risk, treatment and prognosis for biochemical genetic disorders. Section B emphasizes mathematical techniques necessary for accurate genetic counseling, including empiric risk, probability, linkage, mapping, and Bayesian analysis. *Flynn, Campion.*

GMS GC 714 Advanced Topics in Medical Genetics

This course will build from the basic genetic concepts covered in GMS GC 605. Some of the topics addressed include mitochondrial disorders, immunogenetics, microdeletions and duplications, trinucleotide repeats, methylation, imprinting, and pharmacogenetics. *Milunsky, Jamal.*

GMS GC 700, 702S, 703, 704 Genetic Counseling Clinical Rotation I, II, III, and IV

The clinical rotations will provide student interaction with a wide array of genetic specialists. Direct patient contact in prenatal, pediatric, adult, cancer, and specialty genetics clinics will allow students to acquire cases for ABGC certification. *Flynn.*

Genetics and Genomics

GMS GE 701 Principles of Genetics and Genomics

Prereq: consent of instructor. This course will serve as a foundation for understanding the heritable basis of numerous biological traits, the relationships among genes, and the regulation of their expression. Focus on the ability to use genetic systems to probe these problems, and therefore will heavily explore the experimental aspects of these investigations. Includes discussion of the impact of the genome sequences' availability on the practice of modern science. Use of case study approach to investigate the rich variety of scientific insights gained through genetic studies of cell-cell communication, aging, addiction, obesity, and others. *Dasgupta*. 4 cr, Fall sem.

GMS GE 702 Advanced Topics in Genetics

Prereq: GMS GE 701 or consent of instructor. This course will focus on the mechanisms of biological processes that influence the inheritance and regulation of genes. In particular, the molecular details of genetic, epigenetic, and genomic processes will be explored in the context of cancer, stem cell biology, and others. In addition we will discuss the translational science of utilizing these technologies in medical treatments. *Dasgupta*. 4 cr, Spring sem.

GMS GE 703 Genetics and Genomics Colloquium I

Prereq: consent of instructor. The Genetics and Genomics Colloquium will be a highly participatory journal club where the students will be asked to give presentations on cutting edge research with the focus on communication skills rather than scientific content. This approach will allow students to become more comfortable with public speaking while developing the skills necessary for effective communication of scientific ideas. *Dasgupta*. 2 cr, Fall sem.

GMS GE 704 Genetics and Genomics Colloquium II

Prereq: consent of instructor. The Genetics and Genomics Colloquium will be a highly participatory journal club where the students will be asked to give presentations on cutting edge research with the focus on communication skills rather than scientific content. This approach will allow students to become more comfortable with public speaking while developing the skills necessary for effective communication of scientific ideas. *Dasgupta*. 2 cr, Spring sem.

GMS GE 705 Critical Thinking in Genetics and Genomics

Prereq: consent of instructor. This class is designed to chronologically follow the development of a field of study, to allow students to explore the logical evolution of a coherent line of scientific inquiry. The individual meetings build on the background studies discussed in previous meetings, examine apparent discrepancies in experimental results, critique the approaches employed by the authors, and consider the logical follow-through experiments for the results at hand. *TBA*. 2 cr, Spring sem.

GMS GE 900, 901 Research in Genetics and Genomics

Var cr, Fall and Spring sem.

Healthcare Emergency Management

GMS BC 600 Biology, Chemistry and Physics of Natural and Man-made Hazards

This course provides a broad overview of physical, chemical and biological aspects of man-made and natural hazards. Hazards range from the everyday-thunderstorms, winter, chemical spills, disease clusters-to the extraordinary-powerful hurricane, earthquakes, dirty bombs, and pandemic. This course will teach details essential to every healthcare emergency manager to prepare for known and emerging threats, including threats to the infrastructure essential to healthcare delivery. Emphasis will be placed on the increasing number of technological hazards, both those that may be intentionally introduced to those created because of the international connectivity provided by airplanes. Discussion will include the short, medium and long term impact to human populations and infrastructures of the various hazards and the impacts on triage and triage decision making processes. *Thomas*. 3 cr

GMS BC 610 Medical Consequences of Natural and Man-Made Hazards

This course provides a broad overview of medical consequences of man-made and natural hazards. Hazards can directly impact people's lives, as well as indirectly by damaging an area's health infrastructure. This course will teach details essential to every healthcare emergency manager to prepare for known and emerging threats, including discussing external and internal hazards to healthcare emergency management. Emphasis will be placed on human population effects, and the wide range of multiple interdependent aspects of social, cultural and physical infrastructures. Discussion will include the short, medium and long term impact on healthcare delivery, including the importance of psychological concerns such as morale and post-event counseling. *Thomas*. 3 cr

GMS BC 620 Psychology and Sociology of Disasters and Methods of Risk Communication

This course surveys psychological and social factors affecting community and individual responses to disasters. Emphasis is placed on groups who may experience greater impact as a result of disability, social, economic, or racial disparities. This course explores the methods of risk communications to diverse audiences including considerations of subjectivity of

risk, translating complex concepts into clear concise informative messages, and recognizing time sensitivity of information. *Thomas*. 3 cr

GMS BC 630 Ethical & Policy Issues in Health and Medical Services Emergency Management

This course explores the complex issues surrounding ethical, legal and policy issues concerning health and health care delivery under crisis conditions. Issues evaluated include end-of-life decision making, implications of triage, medical malpractice, insurance company regulation and liability. Additionally, the interrelationships of the various levels, and often competing branches, of government will be evaluated. *Thomas*. 3 cr

GMS BC 640 Experimental Design and Statistics

This course will explore various methods of experimental design and systems thinking applications for students to use in management and resource allocation modeling activities. We will review various methods of data collection and use, standard mathematical and statistical methods for assigning estimators, and the resulting application of these elements in systems modeling activities. The purpose of this course is to make students aware of methods and practices for analyzing complex systems. The outcome of these types of analysis aid in planning and management of ongoing crisis or disaster contingency and operations. *Thomas*. 2 cr

GMS BC 650 Community Health and Emergency Management

Public Health is a multidisciplinary field that aims to prevent disease and death and to promote a healthy quality of life. Public Health surveillance, intervention, and evaluation intervene at the population and societal level, taking on the effort to advance the health and safety of the greatest amount of people. This course will explore the multiple concentrations of public health, focusing on epidemiology and environmental health. In order to understand what public health is and how it should be applied during an emergency, this course will discuss specific epidemiological disasters in history, the scientific and statistical perspective associated with collecting, analyzing, interpreting and utilizing data, and the interconnectedness that is required to rapidly evaluate and manage disasters. *Thomas*. 3 cr

GMS BC 700 The Disaster Lifecycle

This course focuses on examining health needs and health care delivery methods to prepare for, respond to, recover from, and mitigate impacts of crises. Preparedness consists of being ready for any kind of emergency no matter what the source of the disaster. Practically this means looking at preparedness from an all-hazards perspective and developing the complicated array of policies, methods and programs. Disaster response is a complicated multi-institutional operation requiring sophisticated planning, logistics and communications. Response planning emphasizes the interface and coordination requirements of the National Response Framework. Recovery involves all the necessary actions to reinstate normal operations including reconstitution of necessary data, hardware, software, personnel, supplies and facilities. Recovery actions are focused on issues and decisions that occur after immediate response needs are addressed. Current and proposed Federal, state, local and private nonprofit disaster recovery methods are discussed. This course addresses these issues through discussion of the cycle of planning, training, equipping, exercising and mission continuity processes and reviewing case studies of current and past governmental and private methods. *Thomas*. 3 cr

GMS BC 710 Methods and Practices of Incident Command

This course examines command and control processes, including Incident and Unified Command Structures, under crisis and disaster management situations for health and medical services. Use of simulations tools will be accomplished (such as Incident Commander: A Crisis Training Simulation) to provide training of community management level incident command actions, based on the Federal Emergency Management Agency (FEMA) mandated command structures articulated in the National Incident Management System. Additionally, decision making under uncertainty and emerging social and operational network theory will be evaluated and discussed. *Thomas*. 3 cr

GMS BC 730 Principles, Methods, and Practices of Modeling and Simulation

This course involves instructing students in various methods and practices of modeling and simulation with specific focus on applicability to biomedical health and medical services crisis management. Using estimates and probability of events students will design dynamic simulation modeling support tools to aiding in measures to be taken to prevent, mitigate, and recover from a disaster. Specific modeling applications to be performed will be through a unique hands-on experience in the development and use of computer-based models to study policy- and decision making. The STELLA™ software system will be used in the course *Thomas*. 3 cr

GMS BC 971 Research Practicum and Thesis I – Designing Crisis Management Research

This is the first phase of a directed research and development project in biomedical crisis management. During this course students identify an area of the crisis management process on which to perform research and design a modeling and simulation exercise. *TBA*. 2 cr

GMS BC 972 Research II

This is the capstone course for the Program. Utilizing the base of knowledge gained throughout the previous year, and applying learned methods in modeling and simulation, this practicum provides the student with an opportunity to perform a guided research activity focused on health care under crisis. *TBA*. 2 cr

Medical Anthropology & Cross Cultural Practice

GMS MA 605 A Social History of Medical Pluralism in the United States

This course explores issues in the social history of medical pluralism in the United States. It examines relations between medical concepts, therapies, and currents in social thought, including the roles of class, race, and gender. Begins with the colonial period, and follows through the present, with discussions of different meanings of complementary and alternative medicine. Primary source materials, as well as sources from history, medicine, and medical anthropology. *Barnes*. 4 cr, Spring sem.

GMS MA 610 Reading Ethnography in Medical Anthropology

This seminar will read medical anthropological ethnographies analytically. Starting with a review of the debates, going through selected classic ethnographic studies, the seminar will explore ethnographies that address different cultural meanings of human experiences of suffering and affliction, including illness and violence. Students will engage in studying the methodology, theoretical underpinnings, writing, and social positions represented in these ethnographies. *Laird*. 3 cr, Fall sem.

GMS MA 620 World Religions and Healing

An introduction to approaches to healing integral to Hindu, Buddhist, Jewish, Christian, Muslim, African, African-descended, Latin American, Chinese, Native American traditions, and to some of the outcomes of their interactions, in relation to the experience of affliction and suffering. *Barnes*. 4 cr, Fall sem.

GMS MA 621 Theory and Methods in Religion and Healing

An examination of the aim, function, justification and critique of classical and contemporary "theories" of religious traditions (social-scientific, psychological, phenomenological, theological, historical) using, as an organizing focus, the cross-cultural study of healing traditions. *Barnes*. 3 cr, Spring sem.

GMS MA 622 Religion and Public Health

This course will explore relationships between religion and health in the context of public health projects. We will examine historical developments, examples of faith-based public health organizations, and current research on "religious health assets," both locally and internationally. *Laird*. 3 cr, Spring sem.

GMS MA 624 Ethnographies of Immigrants and Immigration

Prereq: Consent of instructor. This course presents different ways of studying cultural pluralism in the United States through ethnographies. We will analyze transformations of ethnicity, gender, race and national identity that have marked both historical and contemporary migrations of people to the United States. *Laird*. 3 cr, Spring sem.

GMS MA 630 Medical Anthropology and the Cultures of Biomedicine

This course examines biomedicine as a cultural system with local and national variations worldwide, all of which have undergone changes over time. Topics include acculturation, medicalization, the patient-doctor relationship, understandings of interventions, and chronicity. *Barnes*. 3 cr, Spring sem.

GMS MA 640 The Cultural Formation of the Clinician: Its Implications for Practice

This course will provide a context for exploring and reflecting on one's own cultural formation in relation to such topics as gender, sexual orientation, race, class, religion, body size, and other areas where there are the greatest risks for health disparities through unexamined bias. The course examines the values one brings into one's practice as a care provider, and how the interaction of both influence one's personal and professional life, including responses to diverse patient cultures. Offered through M.A. program in Medical Anthropology. *Barnes*. 3 cr

GMS MA 650 Society, Healthcare, and the Cultures of Competence

This course examines the history and current policies of health education, beginning with the notion of "competencies" as a basis for biomedical training and the development of a model that has been exported to other fields. Focuses on the conceptual formation of key "professional competencies" in medicine, acupuncture, and pastoral care. Readings include autobiographical accounts of medical students, physicians, chaplains, and acupuncturists. Offered through MA program in Medical Anthropology. *Laird*. 3 cr, Spring sem.

GMS MA 677 Topics in Medical Anthropology: TBA

This seminar develops a critique of topics in medical anthropological theory. It revisits significant legacies from classic anthropology, joining them with insights from current theory and ethnography, to analyze selected issues in medical anthropology. *TBA*. 3 cr, Spring sem.

GMS MA 680 Culture, Migration, and Mental Health

Prereq: consent of instructor. This course explores the historical intersections of cultural anthropology and psychiatry. Drawing on this heritage, the course examines contemporary issues in the development of programs for treatment of refugee and immigrant mental health. *Laird*. 3 cr, Fall sem.

GMS MA 682 Islamic Medicine and Healing

Explores the social history of medicine and healing traditions among Muslims: the role of the Prophet Muhammad as model and source of health and medicine; the emergence of classical Islamic medicine as synthesis of and innovation on Greek traditions; the influence of legal/moral traditions in regulating and preserving public health; the development of hospitals in the Muslim world; the influence of Sufi philosophy, practices, and the proliferation of shrines on healing traditions; the effects of emerging biomedical practice introduced from the West; the "revival" of Islamic medicine, and the emergence of alternative medicines. *Laird*. 3 cr, Fall sem.

GMS MA 684 Social History of Chinese Medicine and Healing Traditions

Explores intersections between the therapeutic, the medical, and the religious, through the study of healing traditions in China. Includes the role of shamans and the persistence of traditions involving gods, ghosts, and ancestors; the emergence of classical medicine and canonical texts, together with the role played by Scholar-Physicians; the influences of Daoist approaches to healing, longevity, and alchemy; the introduction of Buddhist and Indian healing practices; the effects of an emerging biomedical practice brought in from the West; and the meanings of the revival of Traditional Chinese Medicine in the People's Republic of China. *Barnes*. 3 cr, Fall sem.

GMS MA 691-A1 Directed Study in Medical Anthropology

Prereq: Permission of instructor *Directed Study*. *Laird*. Var cr, Fall sem.

GMS MA 691-B1 Directed Study in Medical Anthropology

Prereq: Permission of instructor *Directed Study*. *Barnes*. Var cr, Fall sem.

GMS MA 691-C1 Directed Study in Medical Anthropology

Prereq: Permission of instructor *Directed Study*. *Weiner*. Var cr, Fall sem.

GMS MA 692-A1 Directed Study in Medical Anthropology

Prereq: Permission of instructor *Directed Study*. *Laird*. Var cr, Spring sem.

GMS MA 692-B1 Directed Study in Medical Anthropology

Prereq: Permission of instructor *Directed Study*. *Barnes*. Var cr, Spring sem.

GMS MA 692-C1 Directed Study in Medical Anthropology

Prereq: Permission of instructor *Directed Study*. *Weiner*. Var cr, Spring sem.

GMS MA 700 History and Theory of Medical Anthropology (Part I)

This course introduces the history of the field of medical anthropology and of theoretical orientations related to understanding and analyzing health and medicine in society and culture. Readings will exemplify interpretive strategies applied to health-related experiences, discourse, knowledge, and practice. *Laird*. 3 cr, Fall sem.

GMS MA 701 History and Theory of Medical Anthropology (Part II)

Prereq: Permission of the instructor. This course will address theoretical traditions in medical anthropology, focusing on orientations developed and applied within the field over the past two decades to interpretations of health-related phenomena. *Laird*. 3 cr, Spring sem.

GMS MA 710 Medical Anthropology & Qualitative Research Methods and Design

Introduction to methodology for ethnographic field research in medical anthropology, and qualitative research methods. This course examines issues in designing anthropological research, and reviews theoretical approaches to research ethics, designing research, framing questions and questionnaire design, and data collection techniques. *Weiner*. 3 cr, Fall sem.

GMS MA 732 Applied Anthropology

Prereq: Permission of instructor. Anthropology as a field has a long history of anthropologists applying their scholarship directly to addressing social issues and problems. This seminar will train students to engage in research, teaching and the practice of applied anthropology in academic and non-academic settings. It will review the history, methods, and approaches to this subfield. It will also examine the self-reflective and “engaged” dimensions, as well as related ethical challenges that are likely to arise as one undertakes the synthesis of theory and practice. Because approximately half of professional medical anthropologists serve in applied contexts, the seminar will also address the kinds of roles one might play outside of the academy.

GMS MA 742 Medical Anthropological and Qualitative Data Analysis

Prereq: Permission of instructor. Examines strategies for analyzing anthropological data deriving from interviews and documents. In addition to reviewing different coding strategies and the rationales underlying them, the course will discuss topics such as approaches to managing textual data; the selection and application of epistemological and theoretical frameworks; narrative and discourse analysis; cognitive anthropology theory and methods; the use of grounded theory. Emphasizes the application of these strategies to the analysis and interpretation of data collected by the students as part of the course process. *Barnes*. 3 cr, Fall sem.

GMS MA 770 IRB Proposal Development and Writing

Students will learn to write a medical anthropology research proposal and related Institutional Review Board Proposal, through the structure provided by the IRB of BUSM. We will address theory and methods related to the design and review process. *Weiner*. 3 cr, Spring sem.

GMS MA 786 Final Project Writing Seminar

Prereq: Consent of instructor. This seminar will train learners in the theory and practice of writing up medical anthropology research findings, and of writing ethnography. The course emphasizes analytical writing. Students will learn to identify and employ rhetorical and stylistic strategies and genre conventions. The class is structured as a seminar, emphasizing class discussion, workshops and peer- group work. *Barnes*. 3 cr, Spring sem.

Medical Nutrition Sciences

GMS NU 620 Research, Clinical and Public Policy Applications in Medical Nutrition Sciences (Name to be changed to Clinical Nutrition)

Prereq: Human Physiology, or equivalent, consent of instructor. The course will focus on disease states related to nutrition and diet, with a major focus on clinical nutrition research. It will: 1. Acquaint students with current concepts and methods in clinical nutrition research, familiarize students with clinical research and how investigators approach nutrition-related questions in their specific fields to answer questions related to disease states, 3. Evaluate the role of nutrition as it relates to development, prevention and therapy of major diseases, including cardiovascular, diabetes, gastrointestinal, osteoporosis, obesity, and cancer. *Apovian*. 4 cr, Fall sem.

GMS NU 700 Medical Nutrition Sciences Seminar

Students develop and present a research seminar. *Fried, Moore*. 2 cr, Fall and Spring sem.

GMS NU 755 Molecular, Biochemical and Physiologic Bases of Nutrition I: Energy Balance and Micronutrients

Prereq: at least one semester each of Biochemistry and Physiology, or equivalent, and permission of the instructor. This is the first semester of a 2 semester sequence (that can be taken in either order) that focuses on the Physiological, Biochemical and Molecular Bases of Nutrition. This semester will cover concepts of essential nutrients and methods for determining their requirements (DRIs), body composition, nutrition and growth, energy expenditure, regulation of energy intake, vitamins and macro-mineral metabolism (Ca, P) and micronutrients. Functions and roles of micronutrients in signaling from gene to whole organism will be discussed. Implications for nutrient requirements through the life cycle and in health and disease will be addressed. A discussion session will teach students to critically evaluate cutting-edge and seminal papers addressing each topic, and introduce students to state of the art research approaches and methodologies – basic (cell and molecular), clinical and epidemiological. Weekly writing assignments on the papers will provide experience and hone skills with scientific writing. *Fried*. 4 cr, Fall sem.

GMS NU 756 Molecular, Biochemical and Physiologic Bases of Nutrition: Macronutrients

Prereq: at least one semester each of Biochemistry and Physiology and permission of the instructor. Regulation of lipid, carbohydrate, and protein digestion, absorption, transport, tissue and cellular metabolism. Integration of macronutrient metabolism in response to alteration in nutritional status (e.g. starvation, obesity) on a whole body and tissue-specific basis. Mechanism regulating macronutrient metabolism in response to stresses such as exercise and aging and disease. A discussion session will teach students to critically evaluate research papers, provide knowledge of seminal papers in the field, and introduce students to research approaches and state of the art methods (e.g. assessment of metabolic flux using stable isotopes, euglycemic clamps, metabolomics). *Fried*. 4 cr, Spring sem.

GMS NU 804 Directed Studies in Medical Nutrition

TBA. 4 cr, Spring sem.

GMS NU 901, 902 Research in Medical Nutrition Sciences

TBA. Var cr, Fall and Spring sem.

Medical Sciences

GMS MS 506S Clinical Laboratory Genetics I

Prereq: Biology or Genetics course. Advanced course designed for those considering a clinical or research career in human genetics. Emphasis is on clinical cytogenetics (chromosome testing). Course will cover types of chromosome abnormalities, methodology, nomenclature and clinical significance in pregnancy, birth defects, and cancer. Laboratory work will include basic blood culture, chromosome preparation, banding, identification and karyotyping. Provides updated review of latest cytogenetic methodology and applications, such as FISH, comparative genomic hybridization (CGH) and array CGH. *Wyand.* 4 cr, SS I.

GMS MS 610 Ethico-legal Issues of Bioscience

This course examines evolving ethical and legal issues in medicine and genetics. Students will study existing laws, legal cases pertaining to topics such as genetic testing, gene therapy, medicine, drug development and politics. Class discussions, student presentations, case analyses and in-class lectures will be supplemented with online activities as well as the composition of a legal brief. Open to all students registered in GMS programs, including health law students. *Yashon.* 4 cr, Fall sem.

GMS MS 620 Technology Commercialization

The subject of this course is the innovative transformation of knowledge into commercial products and services. Cross-disciplinary teams of students will assess real technologies for their commercial potential in terms of licensing and/or for venture development. Offered in alternate years (not offered in 2010). *Stevens.* 4 cr, Fall sem.

GMS MS 621 Bench-to-Bedside—Translating Biomedical Innovation from the Laboratory to the Marketplace

This course covers intellectual property, licensing, and the core aspects of planning, creating, funding, and building new entrepreneurial ventures. Cross-disciplinary teams are formed to evaluate current BU translational research projects and their potential as the basis for a start-up company. *Gupta.* 4 cr, Fall sem.

GMS MS 640 Introduction to Biomedical Information

(Required course for M.A. in Medical Sciences students). This course teaches how to find, use, and contribute to biomedical literature while supporting the graduate thesis through lectures and hands-on instruction. Topics include the retrieval, evaluation and management of information, Evidence Based Medicine, and the ethical use of research. *Davies, Flynn.* 2 cr, Spring sem.

GMS MS 642 Current Issues in Assisted Reproduction and Infertility

A steady rise in infertility has forced medical science to develop Assisted Reproductive techniques. Discussion of cases, media involvement and medical intervention will be part of this course. A comparison of regulations in the US and UK as well as other countries is emphasized. It will look closely at the legal and ethical questions raised by assisted reproduction and infertility as well as look toward the future. Class discussions, student presentations, case analyses and in-class lectures will be supplemented with online activities as well as the composition of a legal brief. Open to all students registered in GMS programs, including health law students. *Yashon.* 2 cr, Spring sem.

GMS MS 700 Elementary Biostatistics for the Biomedical Sciences

Topics include collection, classification, and presentation of descriptive data; the rationale of hypothesis testing; experimental design; t-tests; simple correlation analysis; and analysis of contingency tables. Special attention is directed to the ability to recognize and interpret statistical procedures in articles from current literature. *Joseph.* 2 cr, Fall & Spring sem.

GMS MS 703 Neuroscience

Prereq: consent of instructor. Integrated treatment of anatomy and physiology of the nervous system. In anatomy classes, brains and spinal cords are dissected and microscope slides examined to study cytology and projections of neurons. Other practical classes and demonstrations cover physiology, neurology, ophthalmology and otolaryngology. *Rosene.* 4 cr, Spring sem.

GMS MS 711 Research Seminar in Medical Informatics

Prereq: consent of instructor. The goal of this course will be to provide students with experience in the reading and evaluation of recent scientific publications that may be pertinent to the development and assessment of computer applications for health care and biomedicine. The course will be in a seminar format. It will consist of the evaluation of assigned readings of recent literature that may be relevant to the field of medical informatics that might be expected to lead to further computer use in medicine and biology. This format will provide an opportunity to learn to critically evaluate medical informatics literature and to develop oral presentation skills essential to function as a leader in medical informatics projects. *Bickmore*. 2 cr, Fall sem.

GMS MS 783 Molecular Basis of Neurologic Diseases

Molecular mechanisms of stroke, multiple sclerosis, Huntington's disease, Alzheimer's disease, amyotrophic lateral sclerosis, muscular dystrophy, and neoplasia are considered. Fundamentals and current research of molecular biology are reviewed. Current publication seminar discussion is held with student participation. Distinguished guest speakers give keynote lectures monthly. *Abraham*. 2 cr, Fall sem.

GMS MS 790 Fundamentals of Medical Biotechnology

Medical biotechnology is emerging as one of the fast growing and dominant technologies of the 21st century. It represents a bridging of innovation between physical, biological and medical sciences and depends on entrepreneurship and public acceptance. Medical biotechnology involves the rapid and prudent transformation of basic scientific and medical discoveries into products for the marketplace. This fast-paced transformation creates an urgent need for qualified, capable individuals to promote and manage the rapidly-evolving innovative technologies in a highly complex and competitive ethical, legal, and regulatory environment. Professionals who aspire to become leaders and managers in the emerging field of medical biotechnology must develop a profound understanding of the complexity of medical biotechnology and acquire the needed tools to steer it to a successful outcome.

GMS MS 791 Essential Readings in Translational Research

The goal of this course is to provide students with tools, skills and experience in critically reading and evaluation of current advances in basic and clinical sciences published in the literature which are pertinent to understanding the basis of disease mechanisms and treatment. Acquisition of knowledge and skill in critical analysis, statistical inference and experimental design will provide students with the ability to read the medical and scientific literature and to examine it critically to achieve life-long learning. The course format will be based on presentation of chosen topics. It will consist of evaluation of assigned readings of recently published articles in basic and clinical sciences which are relevant to diseases. This format will provide students an opportunity to learn how to critically read and evaluate basic and clinical skill literature and be able to present their critical analysis for discussion by peers. This is an important skill needed for their future endeavors in medical research and clinical settings. *Broitman, Franzblau, Traish*. 3 cr, Spring sem.

Medical Sciences – Oral Health Sciences

GMS OH 730 Physiology A/Dental

Prereq: Consent of instructor; must be in Oral Health track. This course presents the physiology of cells, tissues, organs and integrated body functions, including the physiological basis for the understanding of clinical conditions. An integrated approach is taken to endocrinology and reproduction. Hormonal aberrations and their end results in human are presented in clinical correlations. *Lehman*. 6 cr, Fall sem.

GMS OH 731 Physiology B/Dental

Prereq: GMS OH 730 and consent of instructor; must be in Oral Health track. This course is a continuation of GMS OH 730. Students will be given the same grade for each course upon completion of both courses. *Lehman*. 2 cr, Spring sem.

GMS OH 740 Microbiology and Immunology

Prereq: Consent of instructor; must be in Oral Health track. The overall goals of this course are to provide students with: (1) a basic background in microbiology, including the nomenclature, structure, physiology, genetics, mechanisms of pathogenesis, and clinical manifestations associated with the major pathogenic microorganisms (bacteria, fungi and viruses); (2) an understanding of how the basic principles of microbiology are integral to effective diagnosis, treatment and prevention of infectious disease, and (3) a basic background in immunology including the functions and disorders of the immune system. *Oberhaus*. 4 cr, Spring sem.

GMS OH 750 Prevention and Health Promotion in Dentistry

Prereq: Consent of Instructor; must be in Oral Health track. Introduces the concepts and techniques of dental public health, disease prevention and health promotion in dentistry and health. Emphasizes caries, periodontal diseases, and oral cancer prevention in the individual and community. *B-hoopathi*. 3 cr, Spring sem.

GMS OH 751 Biochemistry/Dental

Prereq: Consent of Instructor; must be in Oral Health track. This course is designed to acquaint the student with the basic principles of modern biochemistry. The topics to be covered include an introduction to biochemistry and its importance to understanding oral health as well as proteins, enzymes, DNA, RNA and protein synthesis, sugar and lipid metabolism, hormones and second messengers and connective tissue biochemistry. In addition to the traditional lecture format, students participate in case-based presentations designed to integrate clinical cases with the material presented in class. *Schreiber*. 6 cr, Fall sem.

Mental Health Counseling and Behavioral Medicine

GMS MH 701 Counseling Theory

Prereq: consent of instructor. This course will provide an overview of major theoretical approaches to counseling, including psychoanalytic, Person-Centered, cognitive-behavioral, and Solution-Focused theories. Students will develop a working knowledge of these approaches and begin to explore applications to counseling. *TBA*. 3 cr, Fall sem.

GMS MH 702 Professional Orientation & Ethics

Prereq: consent of instructor. This course provides an overview of professional ethics governing the field of counseling, to include ethical decision-making, confidentiality and informed consent, competence, malpractice, and medical ethics. The course will include a careful review of the American Counseling Association Code of Ethics. The emphasis of the course is on application of ethical principles to ethical dilemmas commonly encountered in the field of counseling. *Berger-Greenstein*. 3 cr, Spring sem.

GMS MH 703 Counseling Techniques

Prereq: consent of instructor. This course provides an overview of the skills and styles needed for building a healthy and therapeutic helping relationship, as well as techniques specific to a variety of psychological disorders and problems with living. Emphasis is placed on experiential exercises and skills-building. *Berger-Greenstein, Brady*. 3 cr, Fall sem.

GMS MH 704 Group Work Dynamics & Process

Prereq: consent of instructor. This course provides an overview of the basic principles of group treatment/counseling including the conception and design of group interventions, methods for recruiting and intervening with group members, and modalities through which groups are often conducted (i.e. psychodynamic, behavioral, support groups, and skills-based groups for special populations). *Brown*. 3 cr, Fall sem.

GMS MH 705 Psychopathology

Prereq: consent of instructor. This course provides students with an introduction to the etiology, presentation, and treatment of major mental health disorders as classified in the Diagnostic and Statistical Manual of Mental Disorders. Students will become familiar with identifying and differentiating diagnoses across a range of clinical presentations. In addition, there will be discussion of strategies that may be applied when working with a variety of patients, beginning with the first contact and including the therapeutic process and treatment planning. *Furlong*. 3 cr, Fall sem.

GMS MH 706 Social & Cultural Foundations

Prereq: consent of instructor. This course provides an overview of the social, cultural, and spiritual foundations of helping relationships, in order to enable students to work effectively with people from varied racial, cultural and class backgrounds. The course is organized around the ethical responsibility of practitioners to provide clients across a wide range of identities with meaningful and relevant clinical services. A contemporary body of professional literature is explored, with an emphasis on self-awareness, knowledge of others, and multicultural counseling skills acquisition. *Brown*. 3 cr, Spring sem.

GMS MH 707 Research & Evaluation

Prereq: This course emphasizes the conceptualization of research problems based on critical reviews of the literature. Landmark studies and current articles are used to illustrate applications of quantitative, qualitative and theoretical approaches to inquiry. The language, logical major concepts, strengths, and limitations of these approaches are noted. Students develop critical thinking skills for examining research information and its use for asking questions that extend knowledge, and for planning studies to address new questions. *Freeburg*. 3 cr, Spring sem.

GMS MH 708 Human Growth & Development

Prereq: consent of instructor. This course provides an overview of biological, psychological, and sociocultural aspects of human development from conception through elder adulthood. The course is taught from perspectives of cognitive science and behavioral systems as well as sociological, cultural, life span developmental, and comparative approaches. The focus of the course is on normative development; developmental disorders are used to elucidate normative developmental

and adaptive processes in language, cognition, and behavioral self-regulation that will serve to introduce students to behaviors and concepts relevant to clinical practice with both children and adults. *Joseph, Brady*. 3 cr, Fall sem.

GMS MH 709 Neuroscience for Mental Health Professionals

Prereq: consent of instructor. The general objective of this course is to provide a foundation in the understanding of central nervous system structure and function and the relationship of brain and behavior tailored to the mental health professional. Special emphasis is on the neurobiology of mental illness and neurologic disease. The course is divided into two parts: Part I covers primarily the organization, structure and function of the nervous system, and Part II covers primarily the neurobiology of mental illness, normal aging, and age-related disease. *Joseph*. 3 cr, Spring sem.

GMS MH 710 Basic Mental Health Assessment

Prereq: consent of instructor. This course is designed to provide an overview of principles and applications of mental health assessment. The primary objectives of this course are to facilitate students' understanding of the basic methods of assessment in counseling, to include evaluating, selecting, and using appropriate techniques and standardized testing methods, and to conduct a thorough, culturally sensitive, and ethically responsible assessment. Methods for dissemination of assessment results will also be reviewed. *Bennasar*. 3 cr, Fall sem.

GMS MH 712 Child & Family Therapy

Prereq: consent of instructor. This course will help students gain a basic conceptual understanding of the theory, process and practice of family systems therapy. In addition, students will begin to develop skills and strategies for the assessment and treatment of family systems approaches within mental health systems and to practice these skills during in-class role-play exercises. *Kates*. 3 cr, Fall sem.

MH 713 Human Sexuality

Prereq: consent of instructor. This course explores physiological, psychological, and socio-cultural aspects of human sexuality, focusing on trends in the field, including teen sexuality, pregnancy, and early sexual experiences, sexual assault, HIV/AIDS and other sexually-transmitted diseases, sex addiction, sexuality across the lifespan, and ethics. *Kates*. 3 cr, Spring sem.

GMS MH 714 Behavioral Medicine and Applied Health Psychology

Prereq: consent of instructor. This course is designed to provide a broad overview of the central concepts of adult behavioral medicine, utilizing a biopsychosocial approach. The emphasis of the course is on primary, secondary, and tertiary prevention of illness as well as practical application and the ways in which information can and should be utilized in multi-disciplinary care. Theory and content will be applied to specific health conditions, including cardiovascular disease, HIV/AIDS, chronic pain and cancer. *Berger-Greenstein*. 3 cr, Spring sem.

GMS MH 716 Career and Vocational Counseling

Prereq: consent of instructor. This course will provide an overview of the history and theories of career development; students will learn how to conduct a career interview and review and discuss the influence of developmental, ethnic, racial and gender differences for career counseling. Students will also complete and review several career tests and present their personal career development plan. *Brady*. 3 cr, Spring sem.

GMS MH 810 Psychopharmacology

Prereq: consent of instructor. This course provides an overview of psychopharmacology for the non-medical mental health provider. There will be an overview of the neurobiology of mental health disorders and the medications commonly used in their treatment. *Erdos*. 3 cr, Fall sem.

GMS MH 812 Addictions

Prereq: consent of instructor. The aim of this course is to provide the necessary knowledge base for understanding and treating addiction. This course places emphasis on acquiring clinically useful knowledge and skills for recognizing and treating substance use disorders. Topics covered in this course include: recognizing drug intoxication and withdrawal, assessment of substance use disorders, Community Reinforcement Approach, Family Systems Treatment Models, Motivational, Enhancement Therapy, Cognitive-Behavioral/Skills Building approaches, 12-Step Recovery/Mutual Support Groups, and Addiction Medicine. *Devine*. 3 cr, Fall sem.

GMS MH 814 Clinical Research Field Work Seminar

Prereq: consent of instructor. This course is designed to provide students with knowledge and experience in the conduct of clinical trials. Students enrolled in this practicum will become part of a clinical research team investigating the efficacy of clinical and/or medication management of a discrete mental health and/or medical disorder. Students will choose a clinical research site of interest from a list of sites currently conducting trials and able to supervise students, to include an addictions medicine research clinic, an HIV risk reduction research clinic, and other medical and/or mental health disorders

of interest. Training will include readings, presentations, observation, web-based training, and direct experience working with research participants. *Devine, Berger-Greenstein*. Var cr, Fall & Spring sem.

GMS MH 901 Clinical Practicum I.

Prereq: consent of instructor. This course is a process-oriented course with an emphasis on personal and professional development as it pertains to the training needs and preparation to assume a professional role in a practicum setting. The focus of the course will also include developing clinical and professional skills to help facilitate adjustment to and preparation for a practicum. Skill development in the areas of assessment, treatment, appreciation of cultural complexities in the clinical environment, balancing professional and personal roles, and understanding the role of a mental health counselor in a behavioral health setting will be discussed throughout the seminar. *Levy-Bell*. 3 cr, Fall sem.

GMS MH 902 Clinical Practicum II

Prereq: consent of instructor. The practicum is a supervised clinical experience that provides direct mental health service work for clientele. Supervision during the practicum will include direct observation or review of audiotapes/videotapes of sessions by an approved faculty member/supervisor. In addition, there will be group supervision with other trainees in the program. *Levy-Bell, Furlong, Livshits*. 3 cr, Spring sem.

GMS MH 921, 922 Internship

Prereq: consent of instructor. This course is a distinctly defined clinical experience during the 2nd year of the program. Students provide 600 hours of clinical experience, of which 250 are direct clinical care of clients. Students are placed in a wide variety of clinical settings throughout the greater Boston area. In addition to clinical supervision received on site, students meet for group supervision with a faculty member and other student trainees in the MHBM program. *Levy-Bell, Berger-Greenstein, O'Hern*. Var cr, Fall & Spring sem.

GMS MH 971, 972 Directed Studies in Mental Health Counseling and Behavioral Medicine

Var cr, Fall & Spring sem.

Microbiology

GMS MI 700 Concepts in Microbiology

Prereq: consent of instructor. This course provides a fundamental understanding of the world of microbes and the concepts and mechanisms involved as microbes interact/adapt in changing environments. Lectures are taught in an interactive manner and are supplemented through discussions and analyses of the primary literature. *Fisher*. 4 cr, Fall sem.

GMS MI 701 Concepts in Virology

This course is designed to provide a fundamental understanding of viruses and their relationship with their host. It will involve an introduction to virus replication cycles and focus in detail on mechanisms that viruses with different genome structures use to transcribe and replicate them. It will also include lectures on the ways that viruses take advantage of the host translation machinery and subvert antiviral defenses. Aspects of virus pathogenesis and epidemiology will be explored with emphasis in HIV pathogenesis, viral persistence, and the emergence of new viruses. The course will be aimed towards first year Ph.D. students in the Division of Graduate Medical Sciences. The classes will be taught by Microbiology Department faculty with expertise in virology. The content will include a combination of traditional lectures and discussion of primary research papers. Reading materials will include primary literature and suggested review articles, as well as handouts provided by the faculty. Students will be evaluated on their discussion of papers and in a final examination designed to test the students' critical thinking and analytical skills. *Connor, Gummuluru, Oberhaus, Zamansky, Fearn*s. 2 cr. Fall sem.

GMS MI 702 Concepts in Bacterial Evolution and Genetics

This course is designed to provide a fundamental understanding of how bacteria evolve and the mechanisms they use to adapt to changing environments. Course is taught as a combination of traditional and interactive lectures as well as discussion of reading from the primary literature. The emphasis is on what we know and why. Topics to be covered include phenotypic and phylogenetic classification of bacteria and their viruses, traditional and genomic approaches for analyzing gene expression, and mechanisms of gene transfer and regulation in bacteria. *Fisher*. 2 cr, Spring sem.

GMS MI 713 Comprehensive Immunology

Prereq: consent of instructor. Comprehensive introduction to immunologic principles and applications. This course consists of both interactive lectures and discussion sessions. Emphasis is placed on analysis and interpretation of data from the primary literature. Prior coursework in genetics and biochemistry is strongly recommended. *Ganley-Leal*. 4 cr, Fall sem.

GMS MI 715 Immunological Basis of Disease

Journal article-based survey of mechanisms underlying diseases caused by abnormal immune system function. Emphasis will be on normal vs. pathological immune system processes towards reinforcing how basic immunological concepts have immediate clinical significance, *Nikolajczyk*. Var cr, Spring sem.

GMS MI 718 Virology

Prereq: consent of instructor. Journal article based. Survey of current topics in virology are discussed. An emphasis is placed on the regulation of viral gene transcription and other processes of the viral replicative cycle. *Viglianti, Zamansky*. 4 cr, Fall sem.

GMS MI 811, 812 Microbiology Seminar

Presentation and discussion of problems of current interest. *Corley*. 2 cr, Fall & Spring sem.

GMS MI 823 Special Topics in Microbiology

TBA. Var cr, Spring sem.

GMS MI 911, 912 Research Microbiology

Var cr

Molecular Medicine

GMS MM 701 Genetics and Epidemiology of Disease

Prereq: consent of instructor. This course will address the genetic basis of human disease and the techniques for investigation within this area of research. Topics will include molecular genetics, genetic linkage analysis, candidate gene and genome wide association studies, model organism genetics, cancer genetics, and mitochondrial genetics from the perspective of research study design and disease mechanisms. *Farrer*. 2 cr, Fall sem.

GMS MM 703 Cancer Biology and Genetics

Prereq: consent of instructor. This course will begin with an historical perspective; review the major mechanistic pathways relating to oncogenes, antioncogenes, cell cycle control, repair, and apoptosis; discuss standard and experimental principles of cancer treatment; and conclude with a discussion of cancer epidemiology and health policy issues that affect all basic and translational cancer research. *Seldin, Dasgupta*. 2 cr, Fall sem.

GMS MM 705 Immunity and Infection

Prereq: consent of instructor. The Immunity and Infection course is designed to highlight the application of basic immunological concepts and molecular mechanisms that underlie conditions of immune dysfunction and immune responses to specific microorganisms and viruses. Measurements of immune system integrity that provide the basis for diagnosis will be examined in detail. Immunotherapies that encompass vaccine strategies, cytokine administration, bone marrow transplantation, peptide administration, oral tolerance, anti-idiotypic treatment, and gene therapy will be discussed. *Genco*. 2 cr, Fall sem.

GMS MM 707 Organ System Diseases

Prereq: consent of instructor. The Organ System Diseases block is devoted to an exploration of contemporary research on the molecular basis of diseases that do not clearly fit into the rubrics of the first three blocks. *Cohen*. 2 cr, Fall sem.

GMS MM 710 Molecules to Molecular Therapeutics

Prereq: consent of the instructor. This course is designed to provide instruction in all aspects of the translation of basic research observations into clinical applications, using a case study model. The first case study will focus on sickle cell anemia. The second general area for study is diseases of protein folding. Lectures will review the molecular genetics of the disease and explore animal models for study of sickle cell anemia and will include laboratory exercises as appropriate. The course will address treatment strategies for sickle cell disease, including pharmacologic manipulation of globin gene expression, structural biology and rational drug design, and gene therapy. Additional topics related to clinical trials development will be covered including ethical issues, regulatory affairs, statistical considerations in clinical research, and outcome analysis. Required of all molecular medicine graduate students. *Seldin, Steinberg*. 4 cr, Spring sem.

GMS MM 730 Biological Core Technologies

Prereq: GMS CM 753 or BI 755 or BI 782 or consent of instructor. The major goal of this course is to provide an overview of the principles and applications of modern techniques, which are regularly employed in academia and industry as tools for biomolecular and biomedical investigation. This course will focus on technologies which are available at BUSM. Specific technologies include microscopy, FACS, IHC, qPCR, genomic (next gen sequencing and microarrays), proteomics techniques, HTS, fluorescence molecular tomography, ultrasound and metabolic phenotyping techniques. Offered alternate years. *Ravid, Haigh, Molina*. 2 cr, Fall sem.

Oral Biology

GMS OB 700 Biostatistics

Introduces the concepts and techniques of biostatistics used in dental research. Emphasizes the fundamentals of statistical logic and presents the basic principles of experimental design, statistical inference, and probability. Examples from current basic sciences research, survey research, and clinical trials augment the presentation of statistical theory. *TBA*. 2 cr, Fall sem.

GMS OB 761 Oral Microbiology

Distribution, ecology, and pathogenic potential of oral microbiota. Pathogenicity of components of bacterial plaque and their role in the development of oral diseases. Mechanisms of local and systematic resistance to pathogenic oral microbiota. *Hughes*. 2 cr, Spring sem.

GMS OB 763, 764 Basic Processes in Oral Biology

An introductory survey course that examines biological processes at the cellular and molecular levels. Provides a basis to understand the events that regulate inflammation; wound healing; bone formation and resorption; salivary proteins and physiology; tooth development, eruption, and movement; and fluoride action. *Mochida*. 2 cr each, Fall & Spring sem.

GMS OB 800 Advanced Oral Biology

Prereq: GMS OB 763 and 764; GMS BI 755 and 756. This advanced course will explore in-depth current topics in oral biology research. The format of the course consists primarily of formal didactic lectures, but students will also be challenged to analyze experimental approaches and methods from current literature in a group-discussion "journal" club format in which papers from current literature are assigned and discussed. This course is designed to provide students with basic knowledge and to develop critical thinking abilities. Topics will include host molecular, cellular, and genetic bases of periodontal diseases; microbiology of periodontal diseases; molecular events in inflammation, wound healing, and periodontal tissue regeneration; molecular components and function of the periodontal ligament, cementum, and attachment structures; extracellular matrix accumulation and turnover in mineralized and non-mineralized tissues; the etiology and complications of diabetes, with emphasis on oral tissue pathology and mechanisms, biosynthesis and functions of oral mucins, endocrine-dependent periodontal changes, effects of growth factors on periodontal tissues and cells, biosynthesis and structure of salivary proteins, and mechanisms of non-immune antibacterial processes in the oral cavity. *Trackman*. 4 cr, Fall sem.

GMS OB 805, 806 Oral Biology Seminar

All PhD candidates will attend a weekly seminar series organized by the Department of Oral Biology. Faculty and invited speakers will give seminars, as will students nearing completion of their thesis research projects. Students will be encouraged to suggest invited speakers. Enrollment in this course will be required for two years (2 credits per semester, for a total of eight credits). All PhD candidates are required to attend all seminars for their entire period of study. *Helmerhorst, Leone*. 2 cr each, Fall & Spring sem.

Pathology and Laboratory Medicine

GMS PA 510/MED MS 131 Medical Immunology

Prereq: Biochemistry. Basic principles of immunology, with emphasis on their medical relevance, presented through lectures and small group discussion sessions. Course co-taught with that offered to the first-year medical students. *Sharon*. 2 cr, Spring sem.

GMS PA 600 Introduction to Pathology and Pathophysiology of Disease

Prereq: consent of instructor. Lectures, discussion sessions and interactive auto-tutorial case studies presenting the basic morphologic and functional changes of major disease processes: cell injury and death, inflammation, cell and tissue response to microbial organisms, atherosclerosis, cancer, etc. *Christensen, Flomenbaum*. 4 cr, Spring sem.

GMS PA 700 Basic and Experimental Pathology

Prereq: GMS BI 755 or equivalent. Basic principles of pathology are presented through lectures (students attend the GMS PA 600 lectures), and computer-assisted instruction. Related research articles and basic histology are discussed in small group session that complement the lectures. *Christensen, Flomenbaum, Blusztajn*. 4 cr, Spring sem.

GMS PA 710 Principles of Basic and Applied Pathology

This course will serve as 1) an introduction to the methods used in the practice of pathology to study disease and pathophysiology; and 2) a survey of research currently conducted in the field of pathology. There are two separate activities for this course; the first is a weekly 90 minute lecture\discussion where research concepts will be presented by pathology

faculty followed by a review of an assigned paper(s) from the basic literature. The second activity will be attendance at the weekly research seminar series in the Department of Pathology and Laboratory Medicine. The students will provide a written evaluation of four of the research seminars. *Remick, Stearns-Kurosawa*. 2 cr, Fall sem.

GMS PA 800 Pathology Seminar

Weekly research seminar presented by faculty, students, and guests. Prior to each seminar, research papers authored by the speaker will be sent to graduate students and faculty to provide additional background material. *Slack*. 2 cr, Fall & Spring sem.

GMS PA 801 Special Topics in Pathology

Detailed examination of one specific area of research each term, presented in readings, discussions, and lectures. Presents significant background information, current knowledge, research approaches, and laboratory methodology in each area. *Pathology faculty*. 2 cr, Fall & Spring sem.

GMS PA 900 Laboratory Rotations in Pathology

Var cr

GMS PA 901 Research in Pathology

Var cr

Pharmacology and Experimental Therapeutics

GMS PM 700 Molecular Neurobiology and Pharmacology

Prereq: consent of instructor. Examines a spectrum of topics ranging from the regulation of gene expression in the nervous system to the structure and function of receptors and ion channels. Emphasis is placed on theoretical foundations of pharmacological methods in neurobiology. *Gibbs*. 4 cr, Spring sem.

GMS PM 710 Laboratory Techniques in Modern Pharmacology

Prereq: consent of instructor. Supervised laboratory rotation emphasizing modern research techniques in molecular, cellular, and behavioral pharmacology. Problems of collection, summary, and interpretation of data are addressed. *Russek, staff*. 2 cr, Fall & Spring sem.

GMS PM 730 Introduction to Medical Pharmacology

Prereq: Premedical courses in the sciences. Principles of pharmacology are covered and several major classes of therapeutic agents, with attention to their mechanisms of action. Issues of current and future concern in medical pharmacology are addressed including problems of drug abuse, the ethics of human experimentation, the pricing of new drugs, and new biotechnological approaches to drug design and development. *Walsh*. 4 cr, Fall sem.

GMS PM 800 Advanced General Pharmacology

Prereq: consent of instructor. Lectures and discussions on the major classes of pharmacologic agents, with special attention to molecular, cellular, and physiological mechanisms of therapeutic effects. *Wolozin*. 2 cr, Fall sem.

GMS PM 810 Current Topics in Pharmacological Sciences

Prereq: consent of instructor. Given in conjunction with the weekly seminar program of the department. Students present and discuss research papers with the visiting scientist working on the cutting edge of pharmacology. *Leeman*. 2 cr, Spring sem.

GMS PM 820 Behavioral Pharmacology

Prereq: consent of instructor. Examines the interaction between behavior and classes of drugs that affect the central nervous system. Emphasis is given to how behavioral studies assist understanding of mental disorders, including addictions, pain syndromes, and dementia. Faculty overview of a topic is followed by student-led discussion of an assigned research paper. *Cottone, Kumaresan, Sabino, Walsh*. 2 cr, Fall sem.

GMS PM 830 Principles of Pharmacokinetics

Prereq: consent of instructor. Lectures and discussion on basic factors determining absorption, distribution, biotransformation, and excretion of drugs. Includes methods of analysis and interpretation of pharmacokinetic data. *Walsh*. 2 cr, Spring sem.

GMS PM 832 Pharmacogenomics

Prereq: consent of instructor. Focuses on genetic differences among individuals and the relevance to drug discovery and development and pharmacotherapies. Biomarkers and technologies used to identify genetic variation will be discussed.

Students will develop an understanding of the potential of personalized medicine based on genetically determined phenotypes. *Martin, Walsh*. 2 cr, Fall sem.

GMS PM 840 Neuroendocrine Pharmacology

Prereq: consent of instructor. Covers the basic principles of neuroendocrinology with special emphasis on pharmacologic aspects. Topics include the biochemistry, physiology, and pharmacology of the neural hormones, as well as selected topics in the interrelationship of neurohormones and the immune system. *Leeman*. 2 cr, Fall sem.

GMS PM 843 Pharmacologic Intervention in Inflammatory Responses

Prereq: consent of instructor. Although acute inflammation is a fundamental physiologic response of multicellular organisms to infection and injury, unresolved and chronic inflammation can have significant pathophysiologic consequences. This course examines the cellular components, inflammatory mediators and their mechanisms of action, and therapeutic modulation of inflammation. The format includes lectures on inflammatory components of selected diseases and student-led discussions of review and research papers. *Leeman*. 2 cr, Spring sem.

GMS PM 850 Biochemical Aspects of Neurotransmitters and Chemical Mediators

Prereq: consent of instructor. Lectures and discussions on biosynthesis, inactivation, receptors, and signaling mechanisms of neurotransmitters and chemical mediators including GABA, glutamate, acetylcholine, catecholamines, purines, peptides, prostaglandins, and histamines. *Staff*. 2 cr, Spring sem.

GMS PM 860 Electrophysiology and Pharmacology of the Synapse

Prereq: GMS PM 700, MS 703, PH 742, or consent of instructor. Examines electrophysiologic, pharmacologic, and optical studies of transmission at central synapses. Lectures and discussions based on research publications will cover basic and more novel concepts in synaptic transmission. Emphasis will be placed on critical evaluation of journal articles and on scientific writing skills. *Staff*. 2 cr, Spring sem.

GMS PM 880 Gene Regulation and Pharmacology

Prereq: consent of instructor. Focuses on fundamental aspects of gene control with emphasis on the dual role of RNA as both an informational and a catalytic molecule. Topics range from discussions of gene transcription and RNA splicing, to discussions of ribozymes as therapeutic agents. The relevance of these topics to the understanding, and potential treatment of disorders that result from altered patterns of gene expression is stressed. *Russek*. 2 cr, Fall sem.

GMS PM 881 Drug Discovery and Development

Prereq: consent of instructor. This course will address the discovery and development process for small molecule and protein drug products. Topics will include target identification and validation, lead optimization and selection of drug candidates for clinical testing, and the objectives and design of clinical trials. *Williams, Farb*. 2 cr, Spring sem.

GMS PM 892 Molecular and Neural Bases of Learning Behaviors

Prereq: consent of instructor. Lectures and student presentations on literature in learning and memory research with special emphasis on integrated approaches from molecular, genetic, pharmacological levels to circuitry, systems, computational, and behavioral levels. *Staff*. 2 cr, Spring sem.

GMS PM 931, 932 Research in Pharmacology

Var cr

Physiology & Biophysics

Physiology

GMS PH 730 Human Physiology A

Prereq: consent of instructor. Cellular and organ physiology. Lectures and discussions examine the function of nerves, muscles, blood and the cardiovascular and digestive systems. Emphasis is placed on the regulation of organ function and on integrative aspects of human physiology. *Garcia-Diaz, staff*. 4 cr, Fall sem.

GMS PH 731 Human Physiology B

Prereq: GMS PH 730 or consent of instructor. Lectures, laboratories and discussions examine function and regulation of the respiratory and renal systems with emphasis on integrative aspects. *Garcia-Diaz, staff*. 2 cr, Spring sem.

GMS PH 740 (MED MS 134) Medical Physiology

This course covers transport mechanisms, molecular biology and mechanics of muscle, blood, and the function and regulation of the cardiovascular, gastrointestinal, respiratory and renal systems, with emphasis on integrative aspects. We use

a lecture format, a few laboratory sessions and numerous small group discussions of problems and clinical cases that encourage conceptual understanding of course material. *Saide, staff.* 6 cr, Spring sem.

GMS PH 741 [Experimental Methods in Physiology I](#)

Prereq: consent of instructor. Current research methods in cellular and molecular physiology, as applied to the study of macromolecular function, motility, ligand binding phenomena, and membrane function. Develops problem-solving skills and awareness of current approaches to research problems. *Staff.* 2 cr, Fall sem.

GMS PH 742 [Experimental Methods in Physiology II](#)

Prereq: consent of instructor. A practical approach to electrophysiology techniques. *Garcia-Diaz, staff.* 2 cr, Spring sem.

GMS PH 745, 746 [Special Topics in Physiology](#)

Prereq: consent of instructor. Current and classical papers in a given area of physiology are assigned for reading and later discussion with students. Topics include mechanics of muscle, cell motility, membrane transport, sensory physiology, and instrumentation in physiological research. *TBA.* Var cr, Fall & Spring sem.

GMS PH 748 (MED MS 128) [Endocrinology](#)

Prereq: biochemistry or physiology, and consent of instructor. This is an integrated treatment of human endocrinology: biosynthesis of hormones, regulation, receptor interactions, and physiological effects. The course is presented in lecture format and in small group discussion sessions where clinical cases are used to exemplify the mechanisms of endocrine function. *Head.* 2 cr, Spring sem.

GMS PH 750 [Endocrinology](#)

Prereq: biochemistry or physiology, and consent of instructor. This is an integrated treatment of human endocrinology: biosynthesis of hormones, regulation, receptor interactions, and physiological effects. The course is presented in lecture format and in small group discussion sessions where clinical cases are used to exemplify the mechanisms of endocrine function. *Head.* 2 cr, Spring sem.

GMS PH 841, 842 [Physiology Seminar](#)

Students present seminars on their research and/or review literature related to their research. Students attend the seminars presented by staff and other students. *Levy, staff.* 2 cr each, Fall & Spring sem.

GMS PH 843, 844 [Cellular Physiology I and II](#)

Prereq: consent of instructor. Lectures and discussion on: (1) membrane transport, thermodynamic and kinetic analysis; (2) electrophysiology of cell membranes, excitable membrane properties, electrical coupling, synaptic transmission; and (3) cell motility, molecular mechanism, and regulation of contraction of muscle and other cells; mechanisms of transduction of photoreceptors. *Garcia-Diaz, staff.* 4 cr, Fall & Spring sem.

GMS PH 941, 942 [Research Physiology](#)

Var cr

Biophysics

GMS BY 760 [Foundations of Biophysics and Structural Biology](#)

Prereq: consent of instructor. The course provides thorough grounding in theory and practice of the major, fundamental methods of biophysics and structural biology. The course covers thermodynamics, spectroscopy, electron microscopy, x-ray diffraction and crystallography, and nuclear magnetic resonance from the standpoint of modern molecular and structurally based research. *Atkinson.* 4 cr, Spring sem.

GMS BY 771 [Biophysics of Macromolecular Assemblies](#)

Prereq: GMS BI 751 or GMS BI 755, 756, and consent of instructor. Advanced course. Assembly of biomacromolecules, their structure and stabilizing forces; biological function as related to structure, with examples drawn from assemblies of proteins, lipids, lipoprotein systems, and membranes. *Shipley.* 4 cr, Spring sem.

GMS BY 772 [Nuclear Magnetic Resonance Spectroscopy and Imaging in Biology and Biochemistry](#)

Prereq: consent of instructor. An introduction to the basic theory and the fundamental measurements of NMR spectroscopy using the predominant biological nuclei, ^1H , ^2H , ^{13}C , and ^{31}P , and applications to structure and metabolism; NMR and MRI studies of pathological processes. *Hamilton.* 2 cr, Spring sem.

GMS BY 774 [Metabolism and Cellular Functions of Complex Lipids](#)

Prereq: consent of instructor. In-depth description of selected areas of lipid metabolism. Emphasis on functional roles of specific lipid species in cellular processes (e.g., cell activation, protein transport and function). Use of timely articles to discuss newly developed techniques and concepts. *Zoeller*. 2 cr, Spring sem.

GMS BY 871, 872 Biophysics Special Topics/Student Seminar

A weekly program in which first and second year students present seminars on assigned or selected current topics in biophysics and structural biology. Emphasis is placed on class participation by all students. *Atkinson, members of the department*. 2 cr, Fall & Spring sem.

GMS BY 945, 946 Research Biophysics

Var cr