

XIV. List of Courses

First-Year Fall Semester Core Curriculum

CBIO 453. Cell Biology (4)

Designed to give students an intensive introduction to prokaryotic and eukaryotic cell structure and function. Topics include membrane structure and function, mechanisms of protein localization in cells, secretion and endocytosis, the cytoskeleton, cell adhesion, cell signaling and the regulation of cell growth. Important methods in cell biology are also presented. Suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation.

Prereq: BIOC 307 or BIOC 407

Instructor: Snider, M.

Offered: Fall

CBIO 455. Molecular Biology (4)

Designed to give students an intensive introduction to prokaryotic and eukaryotic molecular biology. Topics include protein structure and function, DNA and chromosome structure, DNA replication, RNA transcription and its regulation, RNA processing, and protein synthesis. Important methods in molecular biology are also presented. Suitable for graduate students entering most areas of basic biomedical research. Undergraduate courses in biochemistry, cell and molecular biology are excellent preparation.

Prereq: BIOC 307 or BIOC 407

Instructor: Snider, M.

Offered: Fall

BSTP 400. Research Rotations (1)

Core Courses for the Pathology PhD Program

PATH 416. Fundamental Immunology (4)

Introductory immunology providing an overview of the immune system, including antigen-antibody reactions, immunologically important cell surface receptors, cell-cell interactions, cell-mediated immunity and basic molecular biology of B and T lymphocytes lectures and analysis of current literature stressing interpretation of experimental data.

Prereq: Consent of Instructor, Biol 210

XLIST: Biol 416, CLBY 416

Instructors: Nedrud, J.G., Levine, A.

Offered: Spring

PATH 510. Basic Pathophysiologic Mechanisms (4)

An interdisciplinary introduction to the fundamental principles of molecular and cellular biology as they relate to the pathologic basis of diseases. Lectures, laboratories, conferences.

Prereq: Consent of Instructor

Instructor: Anderson, J.M.

Offered: Spring

PATH 520+521. Basic Cancer Biology and the Interface with Clinical Oncology (4)

Cancer influences the lives of one in three people in the U.S. Cancer is multi-staged and is a series of diseases within every organ of the body. Recent rapid advances in the fundamental causes, treatment, and prevention of cancer make research in this area important and interesting, not just to students interested in cancer, but to those interested in other fields such as DNA Repair, Cell Cycle Regulation,

Hormonal Regulation, Gene Regulation, Angiogenesis, and basic Molecular and Cellular Biology. This team-taught lecture/seminar course is an introduction to the genetics, prevention, and treatment of cancers and represents a survey covering: DNA damage and repair; cancer genetics; chemical carcinogenesis and prevention; signal transduction; cell cycle checkpoint regulation; hormonal regulation; chemotherapy and apoptosis. Includes an examination of the pathology of cancer and cancer epidemiology and biostatistics, in addition to the cellular and molecular biology of cancer. Note: PATH 521 (1 credit) must be taken simultaneously with PATH 520 (3 credits) to constitute the entire coordinated 4-credit course.

Prereq: Consent of Instructor

Instructor: Danielpour, D.

Offered: Spring

Longitudinal Requirements for All PhD Students

PATH 511. Experimental Pathology Seminar I (1)

Weekly discussions of current topics and research by students, staff and distinguished visitors.

Prereq: Consent of Instructor

Coordinator: Petersen, R.

Offered: Fall

PATH 512. Experimental Pathology Seminar II (1)

Weekly discussions of current topics and research by students, staff and distinguished visitors.

Prereq: Consent of Instructor

Coordinator: Petersen, R.

Offered: Spring

Research Courses (All Tracks)

PATH 601. Special Problems (1-8)

Research on the nature/causation of disease and host factors which tend to protect against disease. Special courses/tutorials in subspecialties of general and/or systemic anatomic and/or clinical pathology.

Prereq: Consent of Instructor

Offered: Spring and Fall

PATH 651. Thesis (MS) (1-9)

PATH 701. Dissertation (PhD) (1-9)

Track Electives: Molecular and Cellular Basis of Disease

NOTE: PATH 520 + 521 counts as a Track Elective for MCBDTP students. See Core Courses section.

PATH 410. Aging and the Nervous System (1)

Lectures and discussion on aspects of neurobiology of aging in model systems; current research on Alzheimer's, Parkinson's, and Huntington's diseases.

Prereq: Consent of Instructor

Instructor: Perry, G.

Offered: Spring

PATH 412. Theories of Aging and Longevity (1)

Insight into current theories of aging of molecules, cells, extracellular elements and their relationship to lifespan in human beings and other vertebrates. Lecture/journal club format.

Prereq: Consent of Instructor

Instructor: Monnier, V.M.

Offered: Spring

PATH 415. Cytoskeleton and Disease (1)

Discussion of recent papers that have added to knowledge of normal cytoskeletal functions and their alterations in disease.

Prereq: Consent of Instructor

Instructor: Smith, M.A.

Offered: Fall, Spring

PATH 420. The Rhetoric Of Science (3)

Prereq: Completion of the first year of the BSTP Program, Consent of Instructor

Instructor: Kaplan, D.

Offered: Fall

PATH 425. Stem Cell Biology and Therapeutics (3)

Provides a broad overview of various fetal and adult stem cells and their potential application in regenerative medicine. At the heart of regenerative medicine in cancer is the continually evolving practice of stem cell transplantation. New uses of stem cells as delivery vehicles for cancer treatment and gene therapy for cancer are also being developed and moving toward clinical trials. For example, genetic modification of the stem cells in patients receiving stem cell transplants can be used to protect the bone marrow from the dose-limiting toxicity of DNA damaging agents, allowing dose-escalation. Mesenchymal stem cells [MSC] are being used to suppress graft-vs.-host disease and promote hematopoietic stem cell engraftment in cancer patients. An additional ability of MSCs to track to tumors provides a unique mode of tumor-targeted therapy.

Prereq: Consent of Instructor

Instructor: Bunting, K.

Offered: Spring

PATH 430. Oxidative Stress and Disease Pathogenesis (1)

Oxidative stress and free radicals are implicated in a number of disease processes including aging, arthritis, emphysema, Alzheimer disease and cancer. During this lecture course recent studies will be discussed concerning the formation and destructive mechanisms of free radicals in the context of various disease processes. Students will be expected to read assigned papers to discuss in class.

Prereq: Consent of Instructor

Instructors: Zhu, X. and Smith, M.A.

Offered: Spring, Fall

PATH 435. Tissue Engineering and Regenerative Medicine (3)

XLIST: EBME 408

This course will provide advanced coverage of tissue engineering with a focus on stem cell-based research and therapies. Topics of note include stem cell biology and its role in development, modeling of stem cell function, controlling stem cell behavior by engineering materials and their microenvironment, stem cells' trophic character, and state-of-the-art stem cell implementation in tissue engineering and other therapeutic strategies. Undergraduate background in cell/molecular biology, partial differential equations, engineering mechanics (solid), and natural and synthetic biomaterials is recommended.

Prereq: EBME 325 (or equivalent), graduate standing, or permission of instructor

Instructors: Alsberg, E. and Dennis, J.

Offered: Spring

PATH 444. Neurodegenerative Diseases: Pathological, Cell Molecular Perspectives (3)

This course, taught by several faculty members, encompasses the full range of factors that contribute to the development of neurodegeneration. Subjects include pathological aspects, neurodegeneration, genetic aspects, protein conformation and cell biology in conditions such as Alzheimer Disease, Parkinson

disease, amyotrophic lateral sclerosis and prion diseases. Students will read assigned primary literature and present and discuss these in class.

Prereq: Consent of Instructor, CBIO 453, CBIO 454, CBIO 455, CBIO 456

Instructor: Smith, M.A., Petersen, R.B.

Offered: Spring

PATH 487. Cell Biology of the Nucleus (3)

Discussion of current cell biology research on the structure/functions of the nuclear envelope, the matrix and chromatin.

Prereq: CBIO 453, CBIO 454, CBIO 455, CBIO 456 or consent of instructor

XLIST: CLBY 487 and PHRM 487

Instructor: Tartakoff, A.M.

Offered: Even Springs

PATH 488. Yeast Genetics and Cell Biology (3)

Discussion of contemporary literature exemplifying the unique accessibility of yeasts as model eukaryotes.

Prereq: CBIO 453, CBIO 454, CBIO 455, CBIO 456 or consent of instructor

XLIST: MBI0 488, CLBY 488, GENE 488

Instructor: Tartakoff, A.M.

Offered: Even Falls

PATH 516. Experimental Pathology (3)

Lecture series in cell injury, inflammation, degenerative and aging processes. Morphologic and biochemical considerations. Emphasis on investigational approaches and current work.

Prereq: Consent of Instructor

Instructor: Anderson, J.M.

Offered: Odd Falls

PATH 522. Skeletal Biology (3)

This is an advanced, graduate-level course for students interested in the morphogenesis, structure, function and maintenance of the skeletal system taught jointly by faculty from CWRU, Cleveland Clinic and the Northeastern Ohio Universities College of Medicine. It will meet twice per week for 90 minutes per session. The format will include an overview of the topic by the responsible faculty, followed by a discussion of important papers on the topic. The students will be expected to discuss the papers for each session and grading will be based on those discussions. The intent of the course is to enable students to understand the important problems in skeletal biology and both classical and modern approaches for solving them.

Prereq: Consent of Instructor

Instructor: Greenfield, E.

Offered: Spring

PATH 523. Histopathology of Organ Systems (3)

First half of this course is in pathophysiology of disease covering general pathology and pathophysiology, followed by systemic pathology and pathophysiology (systems approach).

Prereq: Histology course, Consent of Instructor

Instructor: Ziats, N.P.

Offered: Spring

PATH 525. Transport and Targeting of Macromolecules in Health and Disease (3)

This is a graduate-level seminar course that familiarizes the students with human diseases resulting from aberrant protein biosynthesis, processing, transport, recycling, and turnover. Specific examples include but are not limited to diseases resulting from alterations at the plasma membrane (familial hypercholesterolemia), endoplasmic reticulum (cystic fibrosis), lysosomes (Krabbe disease), mitochondria, and peroxisomes (Adrenoleukodystrophy). Heavy metal mis-metabolism, especially of iron and copper (hemochromatosis, Wilson's disease) will also be covered. Other diseases will be included on popular demand. Major emphasis will be on cellular and biochemical basis of disease, not clinical presentation or treatment. The class will meet once every week and discuss key publications in each area. Students will be expected to submit a short summary of their understanding of each section, and prepare and present a small grant proposal of ~ 6 pages for their final exam.

Prereq: None

Instructor: Singh, N.

Offered: Fall

PATH 555. Advanced Cell Regulation (3)

This course is focused on the recent major developments in the field of cell signaling and their impact on our understanding of the signaling pathways. The class structure is based on lectures as well as on student presentation of assigned papers. The discussion will be led by the students.

Prereq: CBIO 453, CBIO 454 or consent of instructor

XLIST: CLBY 555, BIOC 555

Instructor: Pimplikar, S.W., Kao, H.-Y.

Offered: Spring

Track Electives: Immunology Training Program

NOTE: PATH 520 + 521 counts as a Track Elective for ITP students. See Core Courses section.

PATH 417. Cytokines: Function, Structure and Signaling (3)

Regulation of immune responses and differentiation of leukocytes is modulated by proteins (cytokines) secreted and/or expressed by both immune and non-immune cells. Will examine the function, expression, gene organization, structure, receptors, and intra-cellular signaling of cytokines. Topics include regulatory and inflammatory cytokines, colony stimulating factors, chemokines, cytokine and cytokine receptor gene families, intra-cellular signaling through STAT proteins and tyrosine phosphorylation, clinical potential, and genetic defects. The course includes lectures using texts, scientific reviews and research articles.

Prereq: PATH 416, Biol 210, or equivalent

XLIST: BIOL 417, CLBY 417

Instructor: Levine, A.D.

Offered: Odd Falls

PATH 465. Advanced Immunobiology (3)

Advanced immunology topics course covering the most important and recent advancements in specific areas of immunobiology. Course organization will include lectures by the faculty to give an overview of each topic emphasizing the recent advancements in that area, followed by student presentations of important papers and discussion on related topics. Course will also include participation in an immunology journal club (literature review/discussion session).

Prereq: PATH 416

XLIST: MBIO 465

Instructor: Pelfrey, C.M.

Offered: Inactive, TBA

PATH 467. Advanced Molecular Immunology (3)

In-depth study of biochemistry and molecular biology of immunologically important molecules and physiochemical aspects of antigen-antibody interactions. Lectures and student presentations of current research.

Prereq: PATH 416, BIOC 307 or 407, CBIO 455, or consent of instructor

Instructor: Staff

Offered: Inactive, TBA

PATH 477. Cellular and Molecular Basis of Immune Dysfunction (3)

Lectures and student presentation will focus on immunologic mechanisms of tissue injury, disorders of the immune response and diseases of immunocompetent cells. Hypersensitivity, allergy, immune complex disease, immune deficiency, lymphoma and multiple myeloma discussed from chemical, cellular and physiological perspectives. Consent of instructor required.

Prereq: PATH 416, introductory immunology course or consent of instructor

Instructor: Emancipator, S.N.

Offered: Odd Springs

PATH 480. Logical Dissection of Biomedical Investigations (3)

Upper-level graduate course encompassing discussion and critical appraisal of both published and pre-published research papers, book chapters, commentaries and review articles. Emphasis will be placed on evaluating the logical relationships connecting hypotheses to experimental design and experimental data to conclusions drawn. Thus, the course will aim to develop students¹ capacities for independent thinking and critical analysis. Half of the course will be devoted to an analysis of fundamental conceptual issues pertaining to Immunology, but this material will be applicable to a wide variety of fields. The other half of the course will be devoted to the analysis of papers that have been submitted for publication (with the students acting as primary reviewers of these papers). Our expectation is that this course will have practical relevance for students by providing them with methods to review their own pre-publication manuscripts and eliminate common errors. It should also give students the tools to question widely held beliefs in diverse biomedical fields.

Prereq: Completion of C3MB curriculum and 2nd-year or beyond graduate school training.

Instructor: Greenspan, N.S. and Abbott, D.

Offered: Even Falls

PATH 481. Immunology of Infectious Diseases (3)

Lectures and discussion on the immune response to infectious organisms, including bacteria, viruses and parasites. Emphasis on human responses but includes discussions of animal models. Other topics will include vaccines and infections in immunocompromised hosts.

Prereq: PATH 416, introductory immunology course or consent of instructor

XLIST: MVIR 481

Instructor: Nedrud, J.G.

Offered: Even Falls

PATH 486. HIV Immunology (3)

This course will examine the unique immunology of HIV disease. Content includes the study of HIV pathogenesis, immune control, immune dysfunction, HIV prevention and immune restoration. Students are expected to attend lectures and participate in class discussions. Strong emphasis placed on reviewing scientific literature. Students will be asked to help organize/administer an HIV immunology journal club and to prepare a written proposal in the area of HIV immunology.

Prereq: Fundamental immunology or consent of instructor.

XLIST: MBIO 486

Instructor: Sieg, S.

Offered: Spring

Track Electives: Cancer Biology

NOTE: PATH 416 counts as a Track Elective for CBTP students. See Core Courses section.

PATH 417. Cytokines: Function, Structure and Signaling (3)

Regulation of immune responses and differentiation of leukocytes is modulated by proteins (cytokines) secreted and/or expressed by both immune and non-immune cells. This course examines the function, expression, gene organization, structure, receptors, and intra-cellular signaling of cytokines. Topics to be covered include regulatory and inflammatory cytokines, colony stimulating factors, chemokines, cytokine and cytokine receptor gene families, intra-cellular signaling through STAT proteins and tyrosine phosphorylation, clinical potential, and genetic defects. The course includes lectures using texts, scientific reviews and research articles.

Prereq: PATH 416, Biol 210, or equivalent

XLIST: BIOL 417, CLBY 417

Instructor: Levine, A.D.

Offered: Odd Falls

PATH 418. Tumor Immunology (2)

Interactions between the immune system and tumor cells. Topics include the historical definition of tumor specific transplantation antigens, immune responses against tumor cells, the effects of tumor cell products on host immune responses, molecular identification of tumor specific transplantation antigens and recent advances in the immunotherapy of human cancers.

Prereq: PATH 416 or equivalent

Instructor: Sy, M.-S.

Offered: Inactive, TBA

PATH 425. Stem Cell Biology and Therapeutics Course (3)

This course provides a broad overview of various fetal and adult stem cells and their potential application in regenerative medicine. At the heart of regenerative medicine in cancer is the continually evolving practice of stem cell transplantation. New uses of stem cells as delivery vehicles for cancer treatment and gene therapy for cancer are also being developed and moving toward clinical trials. For example, genetic modification of the stem cells in patients receiving stem cell transplants can be used to protect the bone marrow from the dose-limiting toxicity of DNA damaging agents, allowing dose-escalation. Mesenchymal stem cells [MSC] are being used to suppress graft-vs.-host disease and promote hematopoietic stem cell engraftment in cancer patients. An additional ability of MSCs to track to tumors provides a unique mode of tumor-targeted therapy.

Prereq: Consent of Instructor

Instructor: Bunting, K.

Offered: Spring

PATH 477. Cell and Molecular Basis of Immune Dysfunction (3)

Lectures and student presentations focus on immunologic mechanisms of tissue injury, disorders of the immune response and diseases of immunocompetent cells. Hypersensitivity, allergy, immune complex disease, immune deficiency, lymphoma and multiple myeloma are discussed from chemical, cellular and physiological perspectives.

Prereq: PATH 416 or equivalent

Instructor: Steven Emancipator

Offered: Fall

PATH 555. Advanced Cell Regulation (3)

This course is focused on the recent major developments in the field of cell signaling and their impact on our understanding of the signaling pathways. The class structure is based on lectures as well as on student presentation of assigned papers. The discussion is led by the students.

Prereq: CBIO 453, CBIO 454, or consent of instructor

XLIST: CLBY 555, BIOC 555

Instructor: Pimplikar, S.W.

Offered: Spring

BIOC 408. Genes and Genetic Engineering (4)

This course will give an in-depth understanding of the flow of genetic information from DNA to RNA to protein. Topics will include: nucleic acid structure; mechanisms and control of DNA, RNA, and protein biosynthesis; recombinant DNA; and RNA processing and modification. Eukaryotic and prokaryotic systems will be compared. Special topics will be yeast as a model organism, molecular biology of cancer, and molecular biology of development. Course will also include the discussion of current literature and introduction to techniques of genetic engineering.

Prereq: BIOC 207, BIOC 307

Instructor: Samols, D.

Offered: Spring

BIOC 420. Mol. Genetics of Cancer (3)

The molecular basis of cancer is covered in lectures and discussion of the scientific literature. The principal topics covered in this course are cellular mechanisms of carcinogenesis through the perspective of viral oncogenes and tumor suppressors. Their identification, function, role in cellular transformation, and contribution to malignant progression in humans and in animal model systems are emphasized.

Prereq: CBIO 453, CBIO 454, CBIO 455, CBIO 456

Instructor: Stavnezer, E.

Offered: Fall, alternate years

BIOC 618. The Biology and Mathematics of Microarray Studies (3)

This hands-on computer-based course will enable participants to conduct meaningful analyses of microarray data. Participants will gain a thorough understanding of the principles underlying available micro-array technologies, including: theory of sample preparation, sample processing on microarrays, familiarity with the use of Affymetrix MAS [Microarray Suite] software including algorithms, generation of micorarray data sets, an ability to move and globally manipulate and pre-package data. The students will gain an understanding of the theory and practice of clustering. Data from cancer cells are compared to normal cells, and compared to cancer cells following therapeutic doses of anticancer agents. Participants will become knowledgeable about the rationale behind the choice of normalization and data filtering strategies, distance metrics, and use of appropriate clustering choices.

Prereq: BIOC 406

Instructor: Leahy, P.

Offered: Spring

BIOC 620. Transcription and Gene Regulation (3)

This course will cover fundamental mechanisms of transcription as well as general principals of gene regulation in both prokaryotes and eukaryotes. Topics to be covered include: 1) structure and function of RNA polymerases; 2) RNA polymerase-specific accessory factors involved in initiation, elongation, and termination; 3) steps and regulation of transcriptional processes; 4) transcriptional coactivators and corepressors; 5) regulation of transcription factor activity; 6) coupling of transcription and RNA processing. The overall objectives of this course are to develop a solid understand of basic mechanisms involved in the regulation of gene expression in biological processes, and to also develop critical thinking in experimental design and evaluation of journal articles.

Instructor: Chiang, C-M.

XLIST: MBIO 620

Offered: Spring

EPBI 473. Integrative Cancer Biology (3)

This is a project-focused research level course in integrative cancer biology, an emergent field in which mathematical models and computer simulations are used to synthesize various forms of cancer data to yield experimentally testable scientific hypotheses. The course is designed for oncologists and cancer biologists who are interested in learning how to apply mathematics and a high level programming language [the freeware R] to analyses of cancer research data. Data on all levels will be considered, ranging from epidemiological datasets to DNA microarray datasets.

Prereq: BIOC 407, EPBI 432, or consent of instructor

Instructor: Radivoyevitch, T.

Offered: Fall

EVHS 401B. Fundamentals of Environmental Health: Effects of Exposure to Environmental Mutagens (1.5)

This course provides an introduction to toxic agents found in the environment and presents an overview of chemical and physical agents which adversely affect human health. Cancer is the primary disease endpoint. Toxicity, mutagenicity, carcinogenicity and teratogenicity of the agents are examined, as well as the potential for human exposure through environmental, occupational and medicinal routes.

Prereq: EVHS 402A

Instructor: Veigl, M.

Offered: Spring

EVHS 402A. Fundamentals of Environmental Health: Risk Assessment (1.5)

In this course an overview of the scientific approaches used to determine whether environmental agents are potentially dangerous to people is presented. Criteria utilized for establishing exposure limits are presented and short term assays, design of epidemiology studies and protocols for clinical trials, which are used to assess the impact of environmental exposure on normal and genetically susceptible individuals, are discussed.

Instructor: Veigl, M.

Offered: Spring

EVHS 502. DNA Damage and Repair (3)

This course provides In-depth consideration of agents that alter DNA directly or indirectly through effects on its synthesis. It also examines the mechanisms and repair processes through which cells respond to this damage. Topics include fidelity of DNA replication, excision repair, mismatch repair, transcription-linked repair, SOS repair and recombinational repair. Other DNA damage responses controlling decision points between DNA repair and apoptosis are considered. Agent-specific DNA damage, such as that caused by agents leading to bulky adducts, AP sites, base-base mismatches and damage to DNA bases are considered in the context of specific repair processes responding to these DNA insults in prokaryotes and eukaryotes.

Prereq: CBIO 453, CBIO 454, or consent of instructor

Instructor: Sedwick, D. and Veigl, M.

Offered: Spring

GENE 521. Chromatin Structure & Transcription (3)

A critical review of selected topics and current literature on the role of chromatin structure in the regulation of gene expression.

Instructor: Harte, P. and Stavnezer, E.

XLIST: BIOC 521

Offered: Spring

MBIO 518. Signaling Via Cell Adhesion (3)

This course emphasizes current advances in cell-cell and cell-substrate interactions including molecular mechanisms by which cells interact with and are regulated by extracellular matrices and other cells. There is an emphasis on aberrant adhesion in cancer.

Prereq: CBIO 453, CBIO 454, or consent of instructor

XLIST: NEUR 518, CBIO 518, CLBY 518

Instructor: Brady-Kalnay, S. and Culp, L.

Offered: Spring

PHRM 413. Molecular and Genetic Pharmacology (3)

The primary goal of this seminar style course is the development of a critical approach to the evaluation and design of research in the broad context of the interaction of receptors with endogenous ligands and with drugs, including steroid hormones, growth factors and chemotherapeutic agents used to treat cancer, and the determination of the polygenetic basis of disease states and inter-individual variation in responsiveness to drugs. Lectures and/or journal article presentation will illustrate the application of fundamental principles of chemistry, biochemistry, thermodynamics, genomics, and pharmacology to experimental problem solving. Students and faculty participate as discussion leaders.

Prereq: Consent of instructor

Instructor: Berdis, A.

Offered: Spring

PHRM 423. Drug Action and Biodistribution (3)

Mechanisms of therapeutic action and adverse side effects for major drug classes leading to a rational approach to drug choice using a problem-solving approach based on selected disease states. A team approach is taken to teaching with a clinician paired with a basic scientist, to couple issues associated with practical application of drugs with fundamental mechanisms of drug action and biodistribution. Included are sessions devoted to the management of breast cancer, led by Beth Overmoyer, MD, and management of lymphoid malignancies, led by Clark Distelhorst, MD.

Prereq: Consent of Instructor

Instructor: John Mieyal, Ph.D., Professor

Offered: Spring

PHRM 434. Mechanisms of Drug Resistance (3)

This course focuses on and compares the drug resistant mechanisms selected by viruses, bacteria, parasites, fungi, and tumor cells. Topics include anti-retroviral resistance [e.g., AZT and protease inhibitors], antibiotic resistance [e.g., B-lactams], resistance to chemotherapeutic agents, and resistance to anti-malarial drugs [e.g., chloroquinone]. Experts in the field at both CASE and from other institutions across the US provide the comprehensive lectures. The journal, [Drug Resistance Updates](#) is provided as a support text.

Prereq: Consent of Instructor

Instructor: Arts, E.

Offered: Spring

XLIST: MBIO 424, MVIR 434

Undergraduate Courses

Note: Undergraduates may also take some of the 400 level courses listed above.

PATH 390. Undergraduate Research in Cancer Biology, Immunology or Pathology (1-3)

Students undertake a research project directly related to ongoing research in the investigator's/instructor's laboratory. Written proposal outlining research topic, a schedule of meetings and format and length of final written report is to be prepared prior to registration for credit.

Prereq: One year of college chemistry and consent of instructor

Instructor: Staff

Offered: Fall, Spring

PATH 395. Selected Readings in Immunology, Cancer Biology or Pathology (1-3)

Relevant readings and literature search on particular immunology, cancer biology or pathology topic(s) chosen by student and directed by the instructor. Written proposal outlining chosen topic, type of work to be done, a schedule of meetings and format and length of final written report is to be prepared prior to registration for credit.

Prereq: Consent of Instructor

Instructor: Staff

Offered: Fall, Spring

Summer Program in Undergraduate Research (SPUR) (no credit but stipend of \$3,500 + \$1,000 housing allowance)

The program, funded by the Howard Hughes Foundation, supports a stipend for 10 weeks of work in the summer. The faculty mentor provides funds for the research effort as related to his/hers laboratory's interest. Students are matched with appropriate mentors and participate in seminars and are expected to write a short paper describing the summer research project as well as present a poster at the conclusion of the session.

Prereq: Consent of Instructor

Instructor: Ziats, N.P. and Staff

Off