MOLECULAR, CELLULAR, AND DEVELOPMENTAL BIOLOGY (MCDB)

* MCDB 050a, Immunity and Microbes  Paula Kavathas
Introduction to the immune system and its interaction with specific microbes. Microbes that cause illness such as influenza, coronaviruses, HIV, and HPV are discussed as well as how we live in harmony with microbes that compose our microbiome. Readings include novels and historical works on diseases such as polio and AIDS. Enrollment limited to first-year students. Preregistration required; see under First-Year Seminar Program. sc

* MCDB 065a, The Science and Politics of HIV/AIDS  Robert Bazell
Study of the basic virology and immunology of HIV/AIDS, along with its extraordinary historical and social effects. Issues include the threat of new epidemics emerging from a changing global environment; the potential harm of conspiracy theories based on false science; and how stigmas associated with poverty, gender inequality, sexual preference, and race facilitate an ongoing epidemic. For all first-year students regardless of whether they are considering a science major. Prerequisite: AP Biology or equivalent. Enrollment limited to first-year students. Preregistration required; see under First-Year Seminar Program. sc

MCDB 105a / MB&B 105a, Biology, the World, and Us  Staff
Biological concepts taught in context of current societal issues, such as emerging diseases, genetically modified organisms, green energy, and the human brain and its disorders. Emphasis on biological literacy to enable students to evaluate scientific arguments. sc 0 Course cr

MCDB 202a, Genetics  Staff
An introduction to classical, molecular, and population genetics of both prokaryotes and eukaryotes and their central importance in biological sciences. Emphasis on analytical approaches and techniques of genetics used to investigate mechanisms of heredity and variation. Topics include transmission genetics, cytogenetics, DNA structure and function, recombination, gene mutation, selection, and recombinant DNA technology. Prerequisite: BIOL 103 or equivalent performance on the corresponding biological sciences placement examination. sc 0 Course cr

* MCDB 203La, Laboratory for Genetics  Amaleah Hartman
Introduction to laboratory techniques used in genetic analysis. Genetic model organisms—bacteria, yeast, Drosophila, and Arabidopsis— are used to provide practical experience with various classical and molecular genetic techniques including cytogenetics; complementation, epistasis, and genetic suppressors; mutagenesis and mutant analysis, recombination and gene mapping, isolation and manipulation of DNA, and transformation of model organisms. Concurrently with or after MCDB 202. sc 0 Course cr

MCDB 221La, Laboratory for Foundations of Biology  Maria Moreno
This lab complements the BIOL 101-103 series. An introduction to research and common methodologies in the biological sciences, with emphasis on the utility of model organisms. Techniques and methods commonly used in biochemistry, cell biology, genetics, and molecular and developmental biology; experimental design; data analysis and display; scientific writing. With permission of instructor or concurrently with or after BIOL 101, 102 or 103. wr, sc 0 Course cr

MCDB 231La, RNAseq Analysis/Intro to Bioinformatics  Josien van Wolfswinkel
This course is about learning to analyze High-throughput sequencing data. This requires insight in what the data represents, as well as the ability to perform basic computational analysis. We approach this by using various scripting languages, to organize and modify the data for further analysis, and use the High Performance Computing Cluster and R to obtain new insights. No prior experience with coding is required, but access to a laptop and an internet connection is essential. Prerequisites: BIOL 101-104, and one 200 level course, or instructor permission. sc

* MCDB 301La or b / MB&B 251La or b, Laboratory for Biochemistry  Aruna Pawashe and Staff
An introduction to current experimental methods in molecular biology, biophysics, and biochemistry. Limited enrollment. Prerequisite: BIOL 101. sc ½ Course cr

* MCDB 310a / BENG 350a, Physiological Systems  W. Mark Saltzman and Stuart Campbell
Regulation and control in biological systems, emphasizing human physiology and principles of feedback. Biomechanical properties of tissues emphasizing the structural basis of physiological control. Conversion of chemical energy into work in light of metabolic control and temperature regulation. Prerequisites: CHEM 165 or 167 (or CHEM 113 or 115), or PHYS 180 and 181; MCDB 120, or BIOL 101 and 102. sc 0 Course cr

MCDB 329a / NSCI 329a, Sensory Neuroscience Through Illusions  Damon Clark and Michael O’Donnell
Animals use sensory systems to obtain and process information about the environment around them. Sensory illusions occur when our sensory systems provide us with surprising or unexpected percepts of the world. The goal of this course is to introduce students to sensory neuroscience at the levels of sensor physiology and of the neural circuits that process information from sensors. The course is centered around sensory illusions, which are special cases of sensory processing that can be especially illustrative, as well as delightful. These special cases are used to learn about the general principles that organize sensation across modalities and species. Prerequisites: BIOL 101-104; NSCI 160 or NSCI 320 or permission of instructor. sc
MCDB 330A / BENG 230A / MB&B 330A / NSCI 324A, Modeling Biological Systems I  Staff

Biological systems make sophisticated decisions at many levels. This course explores the molecular and computational underpinnings of how these decisions are made, with a focus on modeling static and dynamic processes in example biological systems. This course is aimed at biology students and teaches the analytic and computational methods needed to model genetic networks and protein signaling pathways. Students present and discuss original papers in class. They learn to model using MatLab in a series of in-class hackathons that illustrate the biological examples discussed in the lectures. Biological systems and processes that are modeled include: (i) gene expression, including the kinetics of RNA and protein synthesis and degradation; (ii) activators and repressors; (iii) the lysogeny/lysis switch of lambda phage; (iv) network motifs and how they shape response dynamics; (v) cell signaling, MAP kinase networks and cell fate decisions; and (vi) noise in gene expression. Prerequisites: MATH 115 or 116, BIOL 101-104, or with permission of instructors. This course also benefits students who have taken more advanced biology courses (e.g., MCDB 200, MCDB 310, MB&B 300/301).  QR, RC, SC

MCDB 342L, Laboratory in Nucleic Acids I  F Kenneth Nelson

A project from a research laboratory within the MCDB department, using technologies from molecular and cell biology. Laboratories meet twice a week for the first half of the term. Concurrently with or after MCDB 202, 205, or 300. Enrollment limited. Special registration procedures apply; students should contact the instructor during January of the year you intend to take the course.  SC o Course cr

MCDB 343L, Laboratory in Nucleic Acids II  F Kenneth Nelson

Continuation of MCDB 342L to more advanced projects in molecular and cell biology, such as microarray screening and analysis, next-generation DNA sequencing, or CRISPR/Cas editing of genes. Laboratories meet twice a week for the second half of the term. 0.5 Yale College course credit(s) Enrollment limited. Special registration procedures apply; students should contact the instructor during January of the year you intend to take the course. Prerequisite; MCDB 342L or permission of instructor.  SC o Course cr

MCDB 355A, The Cytoskeleton, Associated Proteins, and Disease  Surjit Chandhoke

In-depth discussion of the cytoskeleton, proteins associated with the cytoskeleton, and diseases that implicate members of these protein families. Preference given to seniors in the MCDB major. Prerequisites: BIOL 101-104 and at least one MCDB 200-level course.  SC

MCDB 364A / MB&B 364A, Light Microscopy: Techniques and Image Analysis  Mark Mooseker

A rigorous study of principles and pertinent modalities involved in modern light microscopy. The overall course learning objective is to develop competencies involving advanced light microscopy applications common to multidisciplinary research. Laboratory modules coupled with critical analysis of pertinent research papers cover all major light microscope methods—from the basics (principles of optics, image contrast, detector types, fluorescence, TIRF), to more recent advances, including: superresolution, lightsheet, FLIM/FRET, motion analysis and force measurements. This course is capped at 8 students to promote interactions and ensure a favorable hands-on experience. Priority for enrollment is given to students who are planning on using these techniques in their independent research. Prerequisites: MCDB 205, PHYS 170/171 or above, either CHEM 161/165 or above; with CHEM 134L, 136L or permission from the instructor.  SC

MCDB 425A / MB&B 425A, Basic Concepts of Genetic Analysis  Jun Lu

The universal principles of genetic analysis in eukaryotes. Reading and analysis of primary papers that illustrate the best of genetic analysis in the study of various biological issues. Focus on the concepts and logic underlying modern genetic analysis. Prerequisite: MCDB 202 or pre-approval of instructor.  SC

MCDB 430A, Biology of the Immune System  Staff

The development of the immune system. Cellular and molecular mechanisms of immune recognition. Effector responses against pathogens. Immunologic memory and vaccines. Human diseases including allergy, autoimmunity, immunodeficiency, and HIV/AIDS. After MCDB 300.  SC o Course cr

MCDB 452B / MB&B 452B / S&DS 352B, Biomedical Data Science, Mining and Modeling  Mark Gerstein

Techniques in data mining and simulation applied to bioinformatics, the computational analysis of gene sequences, macromolecular structures, and functional genomics data on a large scale. Sequence alignment, comparative genomics and phylogenetics, biological databases, geometric analysis of protein structure, molecular-dynamics simulation, biological networks, microarray normalization, and machine-learning approaches to data integration. Prerequisites: MB&B 301 and MATH 115, or permission of instructor.  SC

MCDB 470A, Tutorial in Molecular, Cellular, and Developmental Biology  Valerie Horsley

Individual or small-group study for qualified students who wish to investigate a broad area of experimental biology not presently covered by regular courses. A student must be sponsored by a Yale faculty member, who sets the requirements. The course must include one or more written examinations and/or a term paper. Intended to be a supplementary course and, therefore, to have weekly or biweekly discussion meetings between the student and the sponsoring faculty member. To register, the student must prepare a form, which is available at http://mcdb.yale.edu/forms as well as on the course site on Classes*v2, and a written plan of study with bibliography, approved by the faculty research adviser. The form and proposal must be uploaded to Classes*v2 by the end of the second week of classes. The final paper is due in the hands of the sponsoring faculty member, with a copy to the course instructor, by the last day of classes. In special cases, with approval of the director of undergraduate studies, this course may be elected for more than one term, but only one term may count as an elective toward the major. Fulfills the senior requirement for the B.A. degree if taken in the senior year.
* MCDB 471a, Senior Seminar in Biology  Valerie Horsley
This course instructs students in developing effective writing and speaking skills required for preparation of scientific manuscripts and presentations, and communicating in the scientific world. Students will be required to prepare and present oral presentations and to submit a literature review and written grant proposal by the end of the semester.  Sc  0 Course cr

* MCDB 474a, Independent Research  Joseph Wolenski
Research project under faculty supervision taken Pass/Fail. This is the only independent research course available to underclassmen. Students are expected to spend approximately ten hours per week in the laboratory. To register, the student must submit a form, which is available at http://mcdb.yale.edu/forms as well as on the course site on Canvas@Yale, and a written plan of study with bibliography, approved by the faculty research adviser. The form and proposal must be uploaded to Canvas@Yale by the end of the second week of classes. A final research report is required at the end of the term. Students who take this course more than once must reapply each term. Guidelines for the course should be obtained from the office of the director of undergraduate studies or downloaded from the Canvas@Yale server.

* MCDB 475a, Senior Independent Research  Joseph Wolenski
Research project under faculty supervision, ordinarily taken to fulfill the senior requirement. This course is only available to MCDB seniors and they are awarded a letter grade. Students are expected to spend approximately ten hours per week in the laboratory. To register, the student must prepare a form, which is available at http://mcdb.yale.edu/forms as well as on the course site on Canvas@Yale, and a written plan of study with bibliography, approved by the faculty research adviser. The form and proposal must be uploaded to Canvas@Yale by the end of the second week of classes. The final research paper is due in the hands of the sponsoring faculty member, with a copy uploaded to Canvas@Yale, by the last day of classes. Students who take this course more than once must reapply each term; students planning to conduct two terms of research should consider enrolling in MCDB 485, 486. Students should line up a research laboratory during the term preceding the research. Fulfills the senior requirement for the B.A. degree if taken in the senior year. Two consecutive terms of this course fulfill the senior requirement for the B.S. degree if at least one term is taken in the senior year.

* MCDB 482a, Advanced Seminar in Cell Biology: Intracellular Signal Transduction  Craig Crews
Discussion of intracellular signal transduction pathways. Detailed critique of experimental approaches, controls, results, and conclusions of selected current and classic papers in this field.  Sc

* MCDB 485a, Senior Research  Joseph Wolenski
Individual two-term laboratory research projects under the supervision of a faculty member. For MCDB seniors only. Students are expected to spend ten to twelve hours per week in the laboratory, and to make presentations to students and advisers. Written assignments include a short research proposal summary due at the beginning of the first term, a grant proposal due at the end of the first term, and a research report summarizing experimental results due at the end of the second term. Students are also required to present their research in either the fall or the spring term. A poster session is held at the end of the spring term. Students should line up a research laboratory during the term preceding the research. Guidelines for the course may be obtained at http://mcdb.yale.edu/forms and on the course site on Canvas@Yale. Written proposals are due by the end of the second week of classes. Fulfills the senior requirement for the B.S. degree if taken in the senior year.

* MCDB 495a, Senior Research Intensive  Joseph Wolenski
Individual two-term directed research projects in the field of biology under the supervision of a faculty member. For MCDB seniors only. Before registering, the student must be accepted by a Yale faculty member with a research program in experimental biology and obtain the approval of the instructor in charge of the course. Students spend approximately twenty hours per week in the laboratory, and make written and oral presentations of their research to students and advisers. Written assignments include a short research proposal summary due at the beginning of the first term, a grant proposal due at the end of the first term, and a research report summarizing experimental results due at the end of the second term. Students must attend a minimum of three research seminar sessions (including their own) per term. Students are also required to present their research during both the fall and spring terms. A poster session is held at the end of the spring term. Guidelines for the course may be obtained at http://mcdb.yale.edu/forms and on the course site on Canvas@Yale. Written proposals are due by the end of the second week of classes. Fulfills the senior requirement for the B.S. degree with an intensive major. 2 Course cr