Legend:
Can count as one of the Core track courses or one of the Life Science track courses
Recommended prep course for the track or Life Science track courses
Pre-requisite that is not part of CaSB pre-major or major curriculum

Bioinformatics (Core)					
Course Number	**Course Name**	**Units**	**Description**	**Pre-Requisites**	**Offering Info**
COM SCI CM121	Introduction to Bioinformatics	4	(Same as Chemistry CM160A.) Lecture, four hours; discussion, two hours. Requisites: course 32 or Program in Computing 10C with grade of C- better, and one course from Civil and Environmental Engineering 110, Electrical and Computer Engineering 131A, Mathematics 170A, Mathematics 170E, or Statistics 100A. Prior knowledge of biology not required. Designed for engineering students as well as students from biological sciences and medical school. Introduction to bioinformatics and methodologies, with emphasis on concepts and inventing new computational and statistical techniques to analyze biological data. Focus on sequence analysis and alignment algorithms. Concurrently scheduled with course CM221. P/NP or letter grading.	COM SCI 32 or PIC 10C with grade of C- or better; One course from C&EE 110, EC ENGR 131A, MATH 170A, MATH 170E, or STATS 100A	AY 21-22: Winter 2022, Previously taught in Fall
COM SCI CM122	Algorithms in Bioinformatics	4	(Same as Chemistry CM160B.) Lecture, four hours; discussion, two hours. Requisites: course 32 or Program in Computing 10C with grade of C- or better, and one course from Civil Engineering 110, Electrical Engineering 131A, Mathematics 170A, Mathematics 170E, or Statistics 100A. Course CM121 is not requisite to CM122. Designed for engineering students as well as students from biological sciences and medical school. Development and application of computational approaches to biological questions, with focus on formulating interdisciplinary problems as computational problems and then solving these problems using algorithmic techniques. Computational techniques include those from statistics and computer science. Concurrently scheduled with course CM222. Letter grading.	COM SCI 32 or PIC 10C with grade of C- or better; MATH 33A; One course from C&EE 110, EC ENGR 131A, MATH 170A, MATH 170E, or STATS 100A	Typically taught in Spring
COM SCI CM124	Machine Learning Applications in Genetics	4	(Same as Human Genetics CM124.) Lecture, four hours; discussion, two hours; outside study, six hours. Requisites: course 32 or Program in Computing 10C with grade of C- or better, Mathematics 33A, and one course from Civil Engineering 110, Electrical and Computer Engineering 131A, Mathematics 170A, Mathematics 170E, or Statistics 100A. Designed for engineering students as well as students from biological sciences and medical school. Introduction to computational analysis of genetic variation and computational interdisciplinary research in genetics. Topics include introduction to genetics, identification of genes involved in disease, inferring human population history, technologies for obtaining genetic information, and genetic sequencing. Focus on formulating interdisciplinary problems as computational problems and then solving those problems using computational techniques from statistics and computer science. Concurrently scheduled with course CM224. Letter grading.	COM SCI 32 or PIC 10C with grade of C- or better; One course from C&EE 110, EC ENGR 131A, MATH 170A, MATH 170E, or STATS 100A	AY 21-22: Fall 2021, Previously taught in Winter
EE BIOL C135	Population Genetics	4	Lecture, three hours; discussion, one hour. Enforced requisite: Life Sciences 4 or 7A. Strongly recommended: course 100, Mathematics 31A, and 31B or Life Sciences 30B. Basic principles of genetics of population, dealing with genetic structure of natural populations and mechanisms of evolution. Equilibrium conditions and forces altering gene frequencies, polygenic inheritance, molecular evolution, and methods of quantitative genetics. Concurrently scheduled with course C235. Letter grading.	LIFESCI 7A; Recommended: EE BIOL 100; MATH 31A and 31B; or LIFESCI 30B	AY 21-22: Spring 2022
MCD BIO CM156	Human Genetics and Genomics	5	Same as Microbiology CM156.) Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3, 4, and 23L, or 7A, 7B, and 7C. Application of genetic principles in human populations, with emphasis on genomics, family studies, positional cloning, Mendelian and common diseases, cancer genetics, animal models, cytogenetics, pharmacogenetics, population genetics, and genetic counseling. Lectures and readings in literature, with focus on current questions in fields of medical and human genetics and methodologies appropriate to answer such questions. Concurrently scheduled with course CM256. Letter grading.	LIFESCI 7A, 7B, and 7C	Typically taught in Winter
MCD BIO 187AL	Research Immersion Laboratory in Genomic Biology	5	Lecture, three hours; laboratory, six hours. Requisites: Life Sciences 4 or 107, 23L. Course 187AL is requisite to 187BL. Limited to Molecular, Cell, and Developmental Biology majors. Introduction to cutting-edge genomic technologies and bioinformatics methods and resources for genome annotation. Students propose original research projects related to gene annotation and drive their projects using bioinformatics tools. Students are provided fragments of genome from relatively poorly studied organism that has been sequenced at UCLA. May not be repeated for credit. Letter grading.	LIFESCI 107; LIFESCI 23L	Typically taught in Spring and sometimes summer
PHYSCI 125	Molecluar Systems Biology	5	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 2, 3, 4, and 23L, or 7A, 7B, 7C, and 23L. Quantitative description of molecular systems that underlie myriad phenotypes in living cells. Topics include various -omics fields and high-throughput technologies, network biology, and synthetic biology. Introductory lectures on molecular biology, emerging bioinformatic approaches, and systems modeling integrated with discussions of their applications in disease-related research. Review of recent literature to gain overall perspectives about new science of systems biology. Letter grading.	LIFESCI 7A, 7B, 7C; LIFESCI 23L	AY 21-22: Spring 2022
STATS M254	Statistical Methods in Computational Biology	4	(Same as Bioinformatics M223 and Biomathematics M271.) Lecture, three hours; discussion, one hour. Preparation: elementary probability concepts. Requisite: course 100A or 200A or Bioinformatics M221. Introduction to statistical methods developed and widely applied in several branches of computational biology, such as gene expression, sequence alignment, motif discovery, comparative genomics, and biological networks, with emphasis on understanding of basic statistical concepts and use of statistical inference to solve biological problems. Letter grading.	STATS 100A or 200A or BIOINFO M221 (grad version of CS CM121)	AY 21-22: Winter 2022

Biological Data Sciences (Core)					
Course Number	**Course Name**	**Units**	**Description**	**Pre-Requisites**	**Offering Info**
COM SCI CM124	Machine Learning Applications in Genetics	4	(Same as Human Genetics CM124.) Lecture, four hours; discussion, two hours; outside study, six hours. Requisites: course 32 or Program in Computing 10C with grade of C- or better, Mathematics 33A, and one course from Civil Engineering 110, Electrical and Computer Engineering 131A, Mathematics 170A, Mathematics 170E, or Statistics 100A. Designed for engineering students as well as students from biological sciences and medical school. Introduction to computational analysis of genetic variation and computational interdisciplinary research in genetics. Topics include introduction to genetics, identification of genes involved in disease, inferring human population history, technologies for obtaining genetic information, and genetic sequencing. Focus on formulating interdisciplinary problems as computational problems and then solving those problems using computational techniques from statistics and computer science. Concurrently scheduled with course CM224. Letter grading.	COM SCI 32 or PIC 10C with grade of C- or better; One course from C&EE 110, EC ENGR 131A, MATH 170A, MATH 170E, or STATS 100A	AY 21-22: Fall 2021, Previously taught in Winter
OR					
COM SCI M226	Machine Learning in Bioinformatics	4	(Same as Bioinformatics M226, Biomathematics M226, and Human Genetics M226.) Lecture, four hours; outside study, eight hours. Enforced requisite: course 32 or Program in Computing 10C with grade of C- or better. Recommended: one course from Biostatistics 100A, 110A, Civil Engineering 110, Electrical and Computer Engineering 131A, Mathematics 170A, or Statistics 100A. Familiarity with probability, statistics, linear algebra, and algorithms expected. Designed for engineering students as well as students from biological sciences and medical school. Biology has become data-intensive science. Bottleneck in being able to make sense of biological processes has shifted from data generation to statistical models and inference algorithms that can analyze these datasets. Statistical machine learning provides important toolkit in this endeavor. Biological datasets offer new challenges to field of machine learning. Examination of statistical and computational aspects of machine learning techniques and their application to key biological questions. Letter grading.	COM SCI 32 or PIC 10C with grade of C- or better; Recommended: one course from BIOSTAT 100A, 110A, C&EE 110, EC ENGR131A, MATH 170A, or STATS 100A; Familiarity with probability, statistics, linear algebra, and algorithms expected	AY 21-22: Fall 2021
COM SCI CM146	Introduction to Machine Learning	4	(Same as Electrical and Computer Engineering M146.) Lecture, four hours; discussion, one hour; outside study, seven hours. Requisites: course 33, and Civil and Environmental Engineering 110 or Electrical and Computer Engineering 131A or Mathematics 170A or 170E or Statistics 100A. Introduction to breadth of data science. Foundations for modeling data sources, principles of operation of common tools for data analysis, and application of tools and models to data gathering and analysis. Topics include statistical foundations, regression, classification, kernel methods, clustering, expectation maximization, principal component analysis, decision theory, reinforcement learning and deep learning. Letter grading.	One course from: EC ENGR 131A, C&EE 110, MATH 170A, MATH 170E, or STATS 100A; COM SCI 33 (some professors may allow enrollment via PTE without CS 33)	AY 21-22: Fall 2021, Winter 2022, Spring 2022 (only EC ENGR M146 section has seats in Spring)
OR					
STATS C161	Introduction to Pattern Recognition and Machine Learning	4	Lecture, three hours. Requisites: course 100B, Mathematics 33A. Introduction to pattern analysis and machine intelligence designed for advanced undergraduate and graduate students. Concurrently scheduled with course C261. P/NP or letter grading	STATS 100B; MATH 33A	Typically taught Spring
OR					
MATH 156	Machine Learning	4	Lecture, three hours; discussion, one hour. Requisites: courses 115A, 164, 170A or 170E or Statistics 100A, and Computer Science 31 or Program in Computing 10A. Strongly recommended requisite: Program in Computing 16A or Statistics 21. Introductory course on mathematical models for pattern recognition and machine learning. Topics include parametric and nonparametric probability distributions, curse of dimensionality, correlation analysis and dimensionality reduction, and concepts of decision theory. Advanced machine learning and pattern recognition problems, including data classification and clustering, regression, kernel methods, artificial neural networks, hidden Markov models, and Markov random fields. Projects in MATLAB to be part of final project presented in class. P/NP or letter grading.	MATH 115A; MATH 164; MATH 170A or 170E or Statistics 100A; Computer Science 31 or Program in Computing 10A; Strongly recommended requisite: Program in Computing 16A or Statistics 21	21-22 AY: Fall 2021, Winter 2022, Spring 2022; Often offered Summer

COM SCI 161	Fundamentals of Artificial Intelligence	4	Lecture, four hours; laboratory, two hours; outside study, six hours. Enforced requisite: course 180. Introduction to fundamental problem solving and knowledge representation paradigms of artificial intelligence. Introduction to Lisp with regular programming assignments. State-space and problem reduction methods, brute-force and heuristic search, planning techniques, two-player games. Knowledge structures including predicate logic, production systems, semantic nets and primitives, frames, scripts. Special topics in natural language processing, expert systems, vision, and parallel architectures. Letter grading.	COM SCI 180	AY 21-22: Fall 2021, Winter 2022, Spring 2022
COM SCI 168	Computational Methods for Medical Imaging	4	Lecture, four hours; discussion, two hours; outside study, six hours. Requisites: course 32 or Program in Computing 10C with grade of C- or better, Mathematics 33A, one course from Civil and Environmental Engineering 110, Electrical and Computer Engineering 131A, Mathematics 170A, 170E, or Statistics 100A. Theory and practice of image acquisition including angiography, computed tomography (CT), and magnetic resonance (MR). Project-based course covers applied topics in medical imaging including image processing, atlasing, predictive modeling, personalized medicine, data driven and machine learning methods. Letter grading.	COM SCI 32 or PIC 10C with grade of C- or better; MATH 33A; One course from C&EE 110, EC ENGR 131A, MATH 170A, 170E, or STATS 100A	Last offered Spring 2020, not planned for 21-22 AY
COM SCI 180	Introduction to Algorithms and Complexity	4	Lecture, four hours; discussion, two hours; outside study, six hours. Enforced requisites: course 32, Mathematics 61. Designed for junior/senior Computer Science majors. Introduction to design and analysis of algorithms. Design techniques: divide-and-conquer, greedy method, dynamic programming; selection of prototypical algorithms; choice of data structures and representations; complexity measures: time, space, upper, lower bounds, asymptotic complexity; NP-completeness. Letter grading.	COM SCI 32; MATH 61	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered Summer
OR					
MATH 182	Algorithms	4	Lecture, three hours; discussion, one hour. Requisite: course 3C or 32A, and 61. Not open for credit to students with credit for Computer Science 180. Graphs, greedy algorithms, divide and conquer algorithms, dynamic programming, network flow. Emphasis on designing efficient algorithms useful in diverse areas such as bioinformatics and allocation of resources. P/NP or letter grading.	MATH 3C or 32A; MATH 61	21-22 AY: Fall 2021, Winter 2022, Spring 2022; Often offered Summer
EC ENGR C143A	Neural Signal Processing	4	Lecture, four hours; discussion, one hour; outside study, seven hours. Requisites: course 131A, Mathematics 33A. Topics include fundamental properties of electrical activity in neurons; technology for measuring neural activity; spiking statistics and Poisson processes; generative models and classification; regression and Kalman filtering; principal components analysis, factor analysis, and expectation maximization. Concurrently scheduled with course C243A. Letter grading.	EC ENGR 131A (requires EC ENGR 102)	21-22 AY: Spring 2022
EC ENGR C147	Neural Networks and Deep Learning	4	Lecture, four hours; discussion, two hours; outside study, six hours. Requisites: courses 131A, 133A or 205A, and M146, or equivalent. Review of machine learning concepts; maximum likelihood; supervised classification; neural network architectures; backpropagation; regularization for training neural networks; optimization for training neural networks; convolutional neural networks; practical CNN architectures; deep learning libraries in Python; recurrent neural networks, backpropagation through time, long short-term memory and gated recurrent units; variational autoencoders; generative adversarial networks; adversarial examples and training. Concurrently scheduled with course C247. Letter grading.	EC ENGR 131A (requires EC ENGR 102); EC ENGR 133A or 205A; COM SCI M146	21-22 AY: Winter 2022
MATH 155	Mathematical Imaging	4	Lecture, three hours; discussion, one hour. Requisites: courses 32B, 33B, 115A, Program in Computing 10A or Computer Science 31. Imaging geometry. Image transforms. Enhancement, restoration, and segmentation. Descriptors. Morphology. P/NP or letter grading.	MATH 32B (requires 32A); MATH 33B, MATH 115A; PIC 10A or COM SCI 31	21-22 AY: Winter 2022, Spring 2022
MATH 164	Optimization	4	Lecture, three hours; discussion, one hour. Enforced requisites: courses 115A, 131A. Not open for credit to students with credit for former Electrical Engineering 136. Fundamentals of optimization. Linear programming: basic solutions, simplex method, duality theory. Unconstrained optimization, Newton method for minimization. Nonlinear programming, optimality conditions for constrained problems. Additional topics from linear and nonlinear programming. P/NP or letter grading.	MATH 115A; MATH 131A	21-22 AY: Fall 2021, Winter 2022, Spring 2022; Often offered Summer
STATS 101A	Introduction to Data Analysis and Regression	4	Lecture, three hours; discussion, one hour. Requisites: one course from course 10, 12, 13, Economics 11, 41, or Psychology 100A, or score of 4 or higher on Advanced Placement Statistics Examination, and course 20. Recommended: course 102A. Applied regression analysis, with emphasis on general linear model (e.g., multiple regression) and generalized linear model (e.g., logistic regression). Special attention to modern extensions of regression, including regression diagnostics, graphical procedures, and bootstrapping for statistical influence. P/NP or letter grading.	STATS 10, 13, or score of 4 or higher on AP Statistics exam; STATS 20	21-22 AY: Winter 2022, Spring 2022; Often offered Summer
STATS 101C	Introduction to Statistical Models and Data Mining	4	Lecture, three hours; discussion, one hour. Enforced requisite: course 101B. Designed for juniors/seniors. Applied regression analysis, with emphasis on general linear model (e.g., multiple regression) and generalized linear model (e.g., logistic regression). Special attention to modern extensions of regression, including regression diagnostics, graphical procedures, and bootstrapping for statistical influence. P/NP or letter grading.	STATS 101B (requires STATS 101A)	AY 21-22: Fall 2021; Often offered summer

Dynamical Modeling (Core)					
Course Number	**Course Name**	**Units**	**Description**	**Pre-Requisites**	**Offering Info**
C&S BIO M186	Computational Systems Biology: Modeling and Simulation of Biological Systems	5	(Same as Bioengineering CM186, Computational and Systems Biology M186, and Ecology and Evolutionary Biology M178.) Lecture, four hours; laboratory, two hours; discussion, one hour. Requisites: Life Sciences 30A, 30B, Mathematics 32A or M32T, 33A, and 33B, or Mathematics 3A, 3B, and 3C, or Mathematics 31A, 31B, 32A or M32T, 33A, and 33B. Dynamic biosystem modeling and computer simulation methods for studying analyzing biological/biomedical processes and systems at multiple levels of organization. Intermediate linear and nonlinear control system, multicompartmental, epidemiological, pharmacokinetic, and other biomodeling methods applied to life sciences problems at molecular, cellular, organ, and population levels. Both theory- and data-driven modeling, with focus on translating biomodeling goals and data into dynamical mathematical models, and implementing them for simulation, quantification, and analysis. Numerical simulation, optimization, and parameter identifiability and search algorithms, with model discrimination and analysis and software exercises in PC laboratory assignments. Concurrently scheduled with course CM286. Letter grading.	MATH 31A or LS 30A; MATH 31B or LS 30B; MATH 32A or M32T; MATH 33A, 33B	AY 21-22: Spring 2022
OR					
COM SCI M182	Dynamic Biosystem Modeling and Simulation Methodology	4	(Same as Bioengineering M182.) Lecture, four hours; discussion, one hour; laboratory, two hours; outside study, five hours. Requisites: Life Sciences 30A and 30B, or Mathematics 3A and 3B, or 31A and 31B. Recommended requisite or corequisite: Mathematics 3C, 32A, or 32T. For undergraduate students in life, computational, engineering, and mathematical sciences. Active learning approach. Introduction to explicit modeling and simulation of dynamic biological systems. Basic methodology for transforming biology, biochemistry, and physiology into system diagrams, graphs, and mathematical expressions for studying their behavior. Structural models, formulated from basic conservation and mass action laws and feedback concepts, are further transformed into first-order differential equations, and implemented in simulation diagrams for quantifying and exploring biosystem properties. Examples show how to use these explicit models to gain clarity on nature of biosystem phenomena, and frame questions and explore new ideas for research. Letter grading.	LS 30A and 30B, or MATH 3A and 3B, or MATH 31A and 31B; Recommended requisite or corequisite: MATH 3C, 32A, or 32T	AY 21-22: Fall 2021, Winter 2022
EC ENGR 102	Systems and Signals	4	Lecture, four hours; discussion, one hour; outside study, seven hours. Requisite: Mathematics 33A. Corequisite: Mathematics 33B. Elements of differential equations, first- and second-order equations, variation of parameters method and method of undetermined coefficients, existence and uniqueness. Systems: input/output description, linearity, time-invariance, and causality. Impulse response functions, superposition and convolution integrals. Laplace transforms and system functions. Fourier series and transforms. Frequency responses, responses of systems to periodic signals. Sampling theorem. Letter grading.	MATH 33A; Corequisite: MATH 33B.	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered Summer
EC ENGR 113	Digital Signal Processing	4	Lecture, four hours; discussion, one hour; outside study, seven hours. Enforced requisite: course 102. Relationship between continuous-time and discrete-time signals. Z-transform. Discrete Fourier transform. Fast Fourier transform. Structures for digital filtering. Introduction to digital filter design techniques. Letter grading.	EC ENGR 102	AY 21-22: Fall 2021, Winter 2022
EE BIOL C119A	Mathematical and Computational Modeling in Ecology	4	Lecture, three hours; discussion, one hour. Requisite: Life Sciences 30B or Mathematics 3B or 31A. Recommended: courses 100, 122, Life Sciences 1 or 7B, Mathematics 3C. Introduction to modeling dynamics of ecological systems, including formulation and analysis of mathematical models, basic techniques of scientific programming, probability and stochastic modeling, and methods to relate models to data. Examples from ecology but techniques and principles applicable throughout life and physical sciences. Concurrently scheduled with course C219A. P/NP or letter grading.	LIFESCI 30B or MATH 3B or 31A; Recommended: EE BIOL 100, 122, LIFESCI 1 or 7B, Mathematics 3C	AY 21-22: Currently not scheduled; Offered every other year
EE BIOL C119B	Modeling in Ecological Research	4	Lecture, two hours; discussion, two hours. Recommended requisite: course C119A. Advanced techniques in mathematical and computational modeling of ecological dynamics and other population dynamic problems. Independent research projects developed by students. Topics include model formulation, stochastic models, fitting models to data, sensitivity analysis, presentation of model results, and other topics from current literature. Concurrently scheduled with course C219B. P/NP or letter grading.	Recommended: EE BIOL C119B	AY 21-22: Spring 2022; Offered every other year

MATH 134	Linear and Nonlinear Systems of Differential Equations	4	Lecture, three hours; discussion, one hour. Requisite: course 33B. Dynamical systems analysis of nonlinear systems of differential equations. One- and two- dimensional flows. Fixed points, limit cycles, and stability analysis. Bifurcations and normal forms. Elementary geometrical and topological results. Applications to problems in biology, chemistry, physics, and other fields. P/NP or letter grading	MATH 33B	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered Summer
OR					
MATH 135	Ordinary Differential Equations	4	Lecture, three hours; discussion, one hour. Requisites: courses 33A, 33B. Selected topics in differential equations. Laplace transforms, existence and uniqueness theorems, Fourier series, separation of variable solutions to partial differential equations, Sturm/Liouville theory, calculus of variations, two-point boundary value problems, Green's functions. P/NP or letter grading.	MATH 33A and 33B	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered Summer
MATH 136	Partial Differential Equations	4	Lecture, three hours; discussion, one hour. Requisites: courses 33A, 33B. Linear partial differential equations, boundary and initial value problems; wave equation, heat equation, and Laplace equation; separation of variables, eigenfunction expansions; selected topics, as method of characteristics for nonlinear equations.	MATH 33A and 33B	AY 21-22: Spring 2022
MATH 142	Mathematical Modeling	4	Lecture, three hours; discussion, one hour. Requisites: courses 32B, 33B. Introduction to fundamental principles and spirit of applied mathematics. Emphasis on manner in which mathematical models are constructed for physical problems. Illustrations from many fields of endeavor, such as physical sciences, biology, economics, and traffic dynamics.	MATH 32B (requires MATH 32A) MATH 33B	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered Summer
MATH 146	Methods of Applied Mathematics	4	Lecture, three hours; discussion, one hour. Requisites: courses 32B, 33B. Integral equations, Green's function, and calculus of variations. Selected applications from control theory, optics, dynamical systems, and other engineering problems.	MATH 32B (requires MATH 32A) MATH 33B	AY 21-22: Winter 2022
MATH 168	Introduction to Networks	4	Lecture, three hours; discussion, one hour. Requisites: courses 115A, 170E (or 170A or Electrical and Computer Engineering 131A or Statistics 100A). Introduction to network science (including theory, computation, and applications), which can be used to study complex systems of interacting agents. Study of networks in technology, social, information, biological, and mathematics involving basic structural features of networks, generative models of networks, network summary statistics, centrality, random graphs, clustering, and dynamical processes on networks. Introduction to advanced topics as time permits. P/NP or letter grading.	MATH 115A; MATH 170E (or 170A or EC ENGR 131A or Statistics 100A)	AY 21-22: Fall 2021, Spring 2022
MATH 171	Stochastic Processes	4	Lecture, three hours; discussion, one hour. Requisites: courses 33A, 170E (or 170A or Statistics 100A). Discrete Markov chains, continuous-time Markov chains, renewal theory. P/NP or letter grading.	MATH 33A; MATH 170E (or 170A or STATS 100A)	AY 21-22: Fall 2021, Winter 2022, Spring 2022

2 Classes from Life Sciences Courses Below:

Biochemistry

Course Number	Course Name	Units	Description	Pre-Requisites	Offering Info
CHEM 153A	Biochemistry: Introduction to Structure, Enzymes, and Metabolism	4	Lecture, four hours; discussion, one hour. Requisite: course 14D or 30B, with grade of C- or better. Recommended: Life Sciences 2, 3, and 23L, or 7A. Structure of proteins, carbohydrates, and lipids; enzyme catalysis and principles of metabolism, including glycolysis, citric acid cycle, and oxidative phosphorylation. P/NP or letter grading.	CHEM 14C and 14D, or 30A and 30B, with grade of C- or better; Recommended: Life Sciences 7A	AY 21-22: Fall 2021, Winter 2022, Spring 2022
CHEM 153B	Biochemistry: DNA, RNA, and Protein Synthesis	4	Lecture, three hours; discussion, one hour; tutorial, one hour. Requisite: course 153A or 153AH. Recommended: Life Sciences 2, 3, and 23L, or 7A and 7B. Nucleotide metabolism; DNA replication; DNA repair; transcription machinery; regulation of transcription; RNA structure and processing; protein synthesis and processing. P/NP or letter grading.	CHEM 153A or 153AH; Recommended: Life Sciences 7A and 7B	AY 21-22: Fall 2021, Winter 2022, Spring 2022

Ecology

Course Number	Course Name	Units	Description	Pre-Requisites	Offering Info
EE BIOL 100	Introduction to Ecology and Behavior	4	Lecture, three hours; discussion, one hour. Requisite: Life Sciences 1 or 7B. Not open for credit to students with credit for course 118, 122, 124A, 124B, 125, C126, 129, 132, 134B, 136, or 151B. Introduction to methods and topics in ecology and behavior. Growth and regulation of populations, organization of communities and ecosystems, biogeography, and behaviors animals use to find food, choose mates, and interact in social groups. Letter grading.	LIFESCI 1 or 7B	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered in Summer
EE BIOL 116	Conservation Biology	4	Lecture, three hours; discussion, two hours. Requisite: Life Sciences 1 or 7B. Recommended: course 100. Not open for credit to students with credit for Environment 121. Study of ecological and evolutionary principles as they apply to preservation of genetic, species, and ecosystem diversity. Discussion sections focus on interactions of science, policy, and economics in conserving biodiversity. Oral and written student presentation on specific conservation issues. Letter grading.	LIFESCI 1 or 7B; Recommended: EE BIOL 100	AY 21-22: Fall 2021, Spring 2022
EE BIOL 120	Evolution	4	Lecture, three hours; discussion, two hours. Requisites: Life Sciences 1, 2, 3, 4, and 23L, or 7A, 7B, 7C, and 23L, Mathematics 3A and 3B (or 31A or Life Sciences 30B). Not open for credit to students with credit for course 185. Designed for departmental majors specializing in environmental and population biology. Introduction to mechanics and processes of evolution, with emphasis on natural selection, population genetics, speciation, evolutionary rates, and patterns of adaptation. P/NP or letter grading.	LIFESCI 7A, 7B, 7C; LIFESCI 23L; Mathematics 3A and 3B (or 31A or Life Sciences 30B)	AY 21-22: Fall 2021
EE BIOL 129	Animal Behavior	4	Lecture, three hours; discussion, two hours. Requisites: course 100, Life Sciences 1 or 7B. Introduction to behavioral ecology. Methods and results of evolutionary approaches to study of animal behavior, including foraging strategies, social competition, sexual selection, mating systems, cooperation, and social organization. Letter grading.	EE BIOL 100; LIFESCI 1 or 7B	AY 21-22: Winter 2022
EE BIOL 161	Plant Ecology	4	Lecture, two and one half hours; discussion, one hour. Requisite: Life Sciences 1 or 7B. Introduction to ecology of terrestrial plants, covering individuals, populations, communities, and global processes. Topics include plant form and function, seed dormancy and population dynamics, life histories, disturbance and succession, community structure and dynamics, and global change. P/NP or letter grading.	LIFESCI 1, 2, 3, or 7A, 7B, 7C; LIFESCI 23L	AY 21-22: Fall 2021
EE BIOL C172	Advanced Statistics in Ecology and Evolutionary Biology	4	Lecture, two hours; laboratory, two hours. Enforced Requisite: Life Sciences 40 or Statistics 10 or 13. Overview of and application of advanced statistical methods that go beyond linear models and mean comparison, including bootstrapping, permutations, Bayesian statistics, mixed models, clustering, and network analysis. At course end students should be able to explain which statistical approaches are appropriate for different types of research questions and critically evaluate their outputs. All statistical analysis conducted in R. Concurrently scheduled with course C202. P/NP or letter grading.	LIFESCI 40 or Statistics 10 or 13.	AY 21-22: Winter 2022
EE BIOL C174	Comparative Biology and Macroevolution	4	Lecture, three hours; laboratory, three hours. Requisite: Life Sciences 1 or 7B. Recommended: one introductory statistics course. Modern comparative biology provides framework for studying broad questions in evolution--How do body shapes evolve? What are dynamics of evolutionary arms race? Why are there so many species in tropics? Why are there so many beetles and so few crocodiles? Did dinosaurs put brakes on diversification of mammals? Examination of why tree of life is essential to understanding patterns of biological diversity and how phylogenetic comparative methods are used to test macroevolutionary hypotheses. Concurrently scheduled with course C230. Letter grading.	LIFESCI 1 or 7B; Recommended: Introductory statistics course	AY 21-22: Winter 2022

Epidemiology

Course Number	Course Name	Units	Description	Pre-Requisites	Offering Info
EPIDEM 100	Principles of Epidemiology	4	Lecture, four hours; discussion, two hours. Preparation: one full biological sciences course. Introductory course to provide qualified undergraduate students with broad and comprehensive overview of concepts of epidemiology including evaluating public health problems in terms of magnitude, person, time and place; critiquing epidemiologic studies; identifying and accessing key sources of data for epidemiologic assessment; using epidemiologic methods and calculating basic epidemiology measures for operational purposes; and communicating basic principles of epidemiology such as definitions of populations, sources of bias, causation for morbidity and mortality, risk and protective factors, and basics of study design. Letter grading.	One full biological sciences course	Typically taught in Winter; Often offered in Summer
MIMG 101	Introductory Microbiolgoy	4	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3 and 4, or 7A, 7B, and 23L. Historical foundations of microbiology; introduction to bacterial structure, physiology, biochemistry, genetics, and ecology. Letter grading.	LIFESCI 7A, 7B; LIFESCI 23L	AY 21-22: Fall 2021, Winter 2022
MIMG 102	Introductory Virology	4	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3, or 7A, 7B, and 23L with grades of C- or better. Biological properties of bacterial and animal viruses, replication, methods of detection, interactions with host cells and multicellular hosts. Letter grading.	LIFESCI 7A, 7B, with grades of C- or better; LIFESCI 23L with grade of C- or better	AY 21-22: Winter 2022
MIMG 168	Molecular Parasitology	4	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3 and 4, or 7A, 7B, and 23L. Survey of parasitic protozoa not only as parasites that interact with host, but also as model systems for analysis of basic biological phenomena such as gene regulation, molecular development, cell-cell interactions, molecular evolution, and novel biochemical pathways. Letter grading.	LIFESCI 7A, 7B; LIFESCI 23L	AY 21-22: Fall 2021
MIMG C185A	Immunology	5	(Formerly numbered 185A.) Lecture, three hours; discussion, 90 minutes. Requisites: Chemistry 153A, Life Sciences 3, 4, and 23L, or 7A, 7B, 7C, and 23L. Not open for credit to students with credit for course 261. Comprehensive study of experimental immunobiology and immunochemistry; cellular and molecular aspects of humoral and cellular immune reactions. Concurrently scheduled with course C285. Letter grading.	Chemistry 153A; LIFESCI 7A, 7B, 7C; LIFESCI 23L	AY 21-22: Winter 2022, Spring 2022

Genetics & Molecular Biology					
Course Number	**Course Name**	**Units**	**Description**	**Pre-Requisites**	**Offering Info**
LIFESCI 107	Genetics	5	Lecture, three hours; discussion, 75 minutes. Requisites: courses 7C, 23L, Chemistry 14A (or 20A), 14C (or 30A). Not open for credit to students with credit for course 4. Advanced Mendelian genetics, recombination, biochemical genetics, mutation, DNA, genetic code, gene regulation, genes in populations. Letter grading.	LIFESCI 7C; LIFESCI 23L; CHEM 14A (or 20A); CHEM 14C (or 30A)	Typically taught Fall, Winter, Spring Often offered Summer
MCD BIO 100		5	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3, 4, and 23L, or 7A, 7B, 7C, and 23L. Not open for credit to Molecular, Cell, and Developmental Biology majors or to students with credit for course 165A. Analysis of cell organization, structure, and function at molecular level. Cell membranes and organelles, membrane transport, cellular signaling, cytoskeleton and cell movement, intracellular trafficking, cell energetics. Letter grading.	LIFESCI 7A, 7B, 7C; LIFESCI 23L	Not planned for AY 21-22 Typically taught in Summer
OR					
MCD BIO 165A	Biology of Cells	5	Lecture, three hours; discussion, one hour. Requisites: Chemistry 14D or 30B, Life Sciences 3, or 7A, 7B, and 7C. Not open for credit to students with credit for course 100. Molecular basis of cellular structure and function, with focus on each individual cellular organelle, as well as interaction of cells with extracellular environment and with other cells. Material presented in context of experimental questions and answers to incorporate concept of scientific method and recent advances in cell biology research. Exposure in discussions to recent scientific articles that directly relate to information examined in lectures. Letter grading.	CHEM 14C and 14D, or 30A and 30B; LIFESCI 7A, 7B, and 7C.	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered in Summer
MCD BIO 138	Developmental Biology	5	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3, 4, and 23L, or 7A, 7B, 7C, 23L, and 107. Development of understanding of fundamental molecular mechanisms and cellular activities guiding formation of complex organism from single fertilized egg. Development of model organisms to understand conserved nature of developmental decisions across animal kingdom, distinct features that lead to diversification of animal shape and form during evolution. Origin and roles of stem and progenitor cells in development and maintenance of specific organ systems. Roles of cell shape change, cell death, proliferation, and migration in generating shape of embryo, organs, and tissues. Mechanisms by which cells become different from and communicate with one another to coordinate their activities in time and space in embryo. Special emphasis on experimental approaches used to address these fundamental questions that determine how organized tissues and organs are formed and maintained throughout life of organism. Letter grading.	LIFESCI 7A, 7B, 7C; LIFESCI 23L; LIFESCI 107	Typically taught Fall, Winter, Spring Often offered Summer
MCD BIO 140	Cancer Cell Biology	5	(Same as Biological Chemistry M140.) Lecture, three hours; discussion, one hour. Requisite: course 165A. Cancer causes and genetics. Effects of cell transformation on cell growth and metabolism. Altered cell cycle, metabolism, and differentiation pathways in cancer cells. Tumor microenvironment contributions to cancer malignancy, including angiogenesis, metastasis, and immune system evasion. Letter grading.	MCD BIO 165A	AY 21-22: Winter 2022
MCD BIO 144	Molecular Biology of Cellular Processes	5	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 3, 4, and 23L, or 7A, 7B, 7C, 23L, and 107. Not open for credit to students with credit for Chemistry 153B. Development of thorough understanding of fundamentals of modern molecular biology both from perspective of known molecular mechanisms for regulating fundamental processes in cells and from theoretical applied perspective for using molecular biology as laboratory tool. Special emphasis on molecular mechanisms that relate to chromatin and histone modifications, DNA replication and repair, transposition, microRNAs, meiosis, and splicing. Application of molecular biology as tool to understand embryonic development, reprogramming, cancer, and stem cells. Development of sophisticated understanding of DNA, RNA, and protein as well as capability of designing experiments to address fundamental questions in biology and interpreting experimental data. Letter grading.	LIFESCI 7A, 7B, 7C; LIFESCI 23L; LIFESCI 107	AY 21-22: Fall 2021, Winter 2022, Spring 2022; Often offered in Summer

Neurosystems					
Course Number	**Course Name**	**Units**	**Description**	**Pre-Requisites**	**Offering Info**
NEUROSC M101A	Neuroscience: From Molecules to Mind–Cellular and Systems Neuroscience	5	(Same as Molecular, Cell, and Developmental Biology M175A, Physiological Science M180A, and Psychology M117A.) Lecture, four hours; discussion, 90 minutes. Requisites: Chemistry 14C or 30A (14C may be taken concurrently), Life Sciences 7C, Physics 1B or 1BH or 5C or 6B. Students must receive grade of C- or better to proceed to next course in series. Cellular neurophysiology, membrane potential, action potentials, and synaptic transmission. Sensory systems and motor system; how assemblies of neurons process complex information and control movement. P/NP or letter grading.	CHEM 14C or 30A (14C may be taken concurrently); LIFESCI 7C; PHYSICS 1B or 1BH or 5C or 6B	AY 21-22: Fall 2021
OR					
PSYCH 115	Principles of Behavioral Neuroscience	4	Lecture, three hours; discussion, one hour. Requisites: course 100A, Life Sciences 2 or 7A or 15. Not open to students with credit for course M117A (or Molecular, Cell, and Developmental Biology M175A or Neuroscience M101A or Physiological Science M180A). Designed for juniors/seniors. Nervous system anatomy, physiology, pharmacology, and their relationship to behavior. P/NP or letter grading.	PSYCH 100A; LIFESCI 7A or 15; *Not open to students with credit for NEUROSC M101A	Typically taught Fall, Winter, Spring Often offered in Summer
NEUROSC M101B	Neuroscience: From Molecules to Mind–Molecular and Developmental Neuroscience	5	(Same as Molecular, Cell, and Developmental Biology M175B, Physiological Science M180B, and Psychology M117B.) Lecture, four hours; discussion, 90 minutes. Requisites: course M101A (with grade of C- or better), Life Sciences 7C. Molecular biology of channels and receptors: focus on voltage dependent channels and neurotransmitter receptors. Molecular biology of supramolecular mechanisms: synaptic transmission, axonal transport, cytoskeleton, and muscle. Classical experiments and modern molecular approaches in developmental neurobiology. P/NP or letter grading.	NUEROSC M101A with grade of C- or better; LIFESCI 7C.	AY 21-22: Winter 2022
NEUROSC 102	Introduction to Functional Anatomy of Central Nervous System	4	Lecture, three hours; laboratory, 90 minutes. Requisite: Life Sciences 2 or 7C. Corequisite: course M101A. Not open to freshmen. Overview of human nervous system, brain development, anatomy and function, pathology. Introduction to brain circuits involved in fear and anxiety, memory, sensory, motor activities. P/NP or letter grading.	LIFESCI 7C; Corequisite: NEUROSC M101A	AY 21-22: Fall 2021; Often offered summer
NEURO 205	Systems Neuroscience	4	Lecture/discussion, four hours. Introduction to fundamentals of systems neuroscience, with emphasis on integration of molecular mechanisms, cellular processes, anatomical circuits, and behavioral analysis to understand function of neural systems. Letter grading.	None listed	AY 21-22: Winter 2022
NEURO 260	Introduction to Signal Processing for Neuroscientists	4	Lecture, four hours. Limited to Neuroscience graduate students. Introductory principles for handling some common types of time-varying data used to measure brain activity (spikes, local field potentials, calcium transients). Analysis of data with simple computer scripts for team-based projects. May not be repeated for credit. Letter grading.	None listed but may be limited to graduate students	AY 21-22: Winter 2022
PHYSCI C144	Neural Control of Physiological Systems	4	Lecture, four hours. Requisite: course 111B or M180B. Role of central nervous system in control of respiration, circulation, sexual function, and bladder control. Material for each section to be developed by combination of lecture and open discussion. Concurrently scheduled with course C244. Letter grading.	PHYSCI 111B or M180B (Same as NEUROSC M101B)	Typically taught in Fall
PHYSICS C186	Neurophysics: Brain-Mind Problem	4	Lecture, three hours; discussion, one hour. Requisites: courses 1A, 1B, and 1C, or 5A, 5B, and 5C, or 6A, 6B, and 6C, Chemistry 14A or 20A, Mathematics 3A, 3B, 3C, 33A. How does mind emerge from brain? Provides summary of basic biophysics of neurons, synapses, and plasticity. Introduction to commonly used experimental and theoretical techniques of measuring, quantifying, and modeling neural activity, and their relative strengths and weakness and use of them to understand link between neural circuits, their emergent neural dynamics, and behavior in example model systems. Discussion of mechanisms of interaction between neural circuits and their role in cognition, learning, and sleep. Computer laboratory component where students learn to write simple codes to quantify neural activity patterns. Concurrently scheduled with course C286. P/NP or letter grading.	PHYSICS 1A, 1B, and 1C, or 5A, 5B, and 5C, or 6A, 6B, and 6C; CHEM 14A or 20A; MATH 3A, 3B, 3C, 33A	Typically taught in Winter
PSYCH 119M	Neural Circuits of Learning and Memory	4	Lecture, three hours. Requisite: course 115. Designed for juniors/seniors. Introduction to classical and current literature on mechanisms of learning and memory from individual brain systems to circuits. P/NP or letter grading.	PSYCH 115	Confirm timing on Schedule of Classes - Offerings vary

Physiology					
Course Number	**Course Name**	**Units**	**Description**	**Pre-Requisites**	**Offering Info**
BIOENGR C102	Human Physiological Systems for Bioengineering I	4	(Formerly numbered CM102.) Lecture, three hours; laboratory, two hours. Preparation: human molecular biology, biochemistry, and cell biology. Not open for credit to Physiological Science majors. Broad overview of basic biological activities and organization of human body in system (organ/tissue) to system basis, with particular emphasis on molecular basis. Modeling/simulation of functional aspect of biological system included. Actual demonstration of biomedical instruments, as well as visits to biomedical facilities. Concurrently scheduled with course C202. Letter grading.	Preparation: human molecular biology, biochemistry, and cell biology.	AY 21-22: Spring 2022
BIOMATH 206	Introduction to Mathematical Oncology	4	Lecture, four hours; computer laboratory, two hours. Preparation: ordinary partial differential equations, one computer programming course. Deterministic and stochastic modeling of cell metabolism, colony growth, and responses to radio-, chemo-, and immunotherapeutic agents applied to carcinogenesis, therapy, emergence of resistance to therapy. Simulation, optimization methods introduced. Current literature review. S/U or letter grading.	Preparation: ordinary partial differential equations, one computer programming course	Typically taught in Spring
EE BIOL 170	Animal Environmental Physiology	6	Lecture, three hours; laboratory, six hours. Requisites: Chemistry 14D, or 30B and 30BL, Life Sciences 1, 2, 3, 4, and 23L, or Life Sciences 7A, 7B, 7C, and 23L, 30B or Mathematics 3C or 32A, Physics 1C and 4BL, or 5B or 6C or 6CH. Not open for credit to students with credit for Physiological Science 166. Designed for Ecology, Behavior, and Evolution majors. Introduction to physiology (function) of animal organs and organ systems, with emphasis on environmental interactions and ecological adaptations. Letter grading.	CHEM 14D, or 30B and 30BL; LIFESCI 7A, 7B, 7C; LIFESCI 23L; LIFESCI 30B or Mathematics 3C or 32A; Physics 1C and 4BL, or 5B or 6C or 6CH; Not open for credit to students with credit for Physiological Science 166.	AY 21-22: Spring 2022

OR					
PHYSCI 166	Animal Physiology	6	Lecture, three hours; laboratory, five hours. Requisites: Chemistry 14B and 14BL, or 20B and 30AL, 153A, Life Sciences 7A, 7B, 7C, Physics 1C and 4BL, or 5C. Not open for credit to students with credit for Ecology and Evolutionary Biology 170 or to Physiological Science majors. Introduction to physiological principles, with emphasis on organ systems and intact organisms. Letter grading.	Chemistry 14B and 14BL, or 20B and 30AL; CHEM 153A; LIFESCI 17A, 7B, 7C' Physics 1C and 4BL, or 5C; Not open for credit to students with credit for Ecology and Evolutionary Biology 170 or to Physiological Science majors.	Typically offered in Summer
PHYSCI 149	Systems Biology and Mechanisms of Major Cardiometabolic Diseases	4	Lecture, three hours; discussion, one hour. Requisites: Life Sciences 7A, 7B, 7C. Strongly recommended: Chemistry 153A. Designed for juniors/seniors. Integration of principles gained through basic science curriculum with modern systems biology concepts, approaches, and presently understood mechanisms of selected human cardiovascular disease, diabetes, and obesity. Letter grading.	LIFESCI 7A, 7B, 7C; Strongly recommended: Chemistry 153A	Typically taught in Spring