

# MICROBIOLOGY AND CELL SCIENCE

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## **BSC 6438 R for Functional Genomics 3 Credits**

**Grading Scheme:** Letter Grade

Introductory course to the basics of the R language and to state of the art methods for functional genomics data analysis. Students will learn how to write R scripts, choose appropriate statistical tools and how to use linux environments to analyse high-throughput genomics data.

**Prerequisite:** BSC2010 or BSC2011 or MCB3020 or MCB3023 or BCH4024 or CHM3218 or equivalent AND STA6166 or STA6167 or equivalent.

## **BSC 6459 Fundamentals of Bioinformatics 3 Credits**

**Grading Scheme:** Letter Grade

An introduction to the basic bioinformatics tools used in computational biology for life science research. The course will use web-based resources that analyze gene and protein sequences as pertinent data examples.

## **BSC 6895C AI in Agricultural and Life Sciences 3 Credits**

**Grading Scheme:** Letter Grade

Artificial intelligence (AI) is used to solve problems in research and industry. This course provides students with an understanding of AI systems and how they can be applied to answer challenging questions in life sciences. Through online study materials and hands on exercises, students will obtain the skills and knowledge they need to use AI to solve real world life sciences problems.

## **MCB 5205 Microbiology of Human Pathogens 3 Credits**

**Grading Scheme:** Letter Grade

Surveying advanced topics and current scientific literature related to human host-pathogen interactions and microbial pathogenesis, focusing on emerging bacterial and viral pathogens as agents of human disease, biosecurity, molecular identification methods, spread of multi-drug resistance among bacterial pathogens, drug discovery and alternative treatment research.

## **MCB 5252 Microbiology, Immunology, and Immunotherapeutics 4 Credits**

**Grading Scheme:** Letter Grade

Microbiology and immunology for pharmacy students. Microorganisms and infection, control with antimicrobials, host immune response, immune disorders.

**Prerequisite:** CHM 2210, 2211, and consent of instructor.

## **MCB 5270 Antimicrobial Resistance (AMR) 3 Credits**

**Grading Scheme:** Letter Grade

Covers content related to antimicrobial resistance: the origins of antimicrobial resistance, dissemination, mechanisms, therapeutics, and impact on healthcare, agriculture, and the environment, concentrating on resistance in bacteria; will also discuss other organisms, including viruses, parasites, fungi, and cancer.

**Prerequisite:** Bachelor's Degree.

## **MCB 5305L Microbial Genetics and Biotechnology Laboratory 2 Credits**

**Grading Scheme:** Letter Grade

Methods for mutagenesis, gene transfer and genetic mapping, plasmid isolation, restriction enzyme use, construction of chimeric (recombinant) plasmids, phage isolation and preparation.

**Prerequisite:** MCB 3023/3023L and 4303 or PCB 4522 with grade of C or higher.

## **MCB 5505 General Virology 3 Credits**

**Grading Scheme:** Letter Grade

Basic information on families of viruses from humans, plants, insects, animals, and bacteria. Medical, clinical, diagnostic, biotechnological, and molecular aspects of these viruses.

**Prerequisite:** MCB 3020/3020L and 4203 with grade of C or higher.

## **MCB 5705 Astrobiology 3 Credits**

**Grading Scheme:** Letter Grade

Astrobiology examines the origin, evolution, and future of life in our solar system. Topics will include: planet and star formation, biosphere formation, evolutionary processes biogeochemistry, microbial adaptation to extreme environments, planetary habitability, and microbiology on the International Space Station.

**Prerequisite:** MCB 6656 Environmental Microbiology.

## **MCB 6095 Careers for Impact in Microbiology and Cell Science 1 Credit**

**Grading Scheme:** Letter Grade

Prepares students with connections into a variety of Microbiology and Cell Science careers. Essential networking and communication skills will be honed through practical application exercises. A portfolio will be created to identify and obtain suitable experiential learning and career opportunities.

## **MCB 6096 Innovation Project Management for Life Sciences 1 Credit**

**Grading Scheme:** Letter Grade

Empowers students with practical tools to manage innovation projects typical of life science research development. Challenges and methodologies associated with developing objectives, preparing project plans, establishing metrics, defining responsibilities, as well as mitigating risks and dealing with uncertainties will be discussed. Skills for strategic prioritization, time management, meeting facilitation, and communication will be strengthened to promote an innovative culture.

## **MCB 6151 Prokaryotic Diversity 3 Credits**

**Grading Scheme:** Letter Grade

An introduction to the diversity of Bacteria and Archaea. Discussions will provide a conceptual and historical framework for understanding their 1) origin and evolution; 2) morphological, metabolic, and molecular characteristics; 3) genetic and physiological diversity; 4) importance in human/animal/plant health; and 5) roles in elemental cycling.

## **MCB 6317 Molecular Biology of Gene Expression 1 Credit**

**Grading Scheme:** Letter Grade

Synthesis, processing, transport, and translation of RNA in microorganisms and eukaryotes. Additional topics include epigenetic regulation of gene expression.

## **MCB 6318 Comparative Microbial Genomics 2 Credits**

**Grading Scheme:** Letter Grade

Methods to allow experimental scientists to efficiently use genomic and post-genomic data that is publicly available. Examples taken primarily from the field of microbial metabolism and regulation.

**Prerequisite:** PCB 4522 and a working knowledge of basic bioinformatic tools.

## **MCB 6326 Computational Genomics and Epigenomics 3 Credits**

**Grading Scheme:** Letter Grade

Genomics and epigenomics utilize high-throughput sequencing technologies in understanding biology questions. The primary goal of this course is to introduce history, theory, latest advances, and computational approaches in (epi)genomics for conducting large-scale genomic analyses. Course topics include sequence alignment, genome assembly and annotation, variant identification, transcriptomics, small RNAs, DNA methylation, histone modification, open chromatin region, and 3D chromatin interaction.

**MCB 6355 Microbial/Host Defense 1 Credit****Grading Scheme:** Letter Grade

Principles of host defense to microbial invasion in a context of cellular biology involving both plants and animals.

**Prerequisite:** MCB 4203 and PCB 5235: Immunology or equivalents, with the minimum grade of a C.**MCB 6407 Prokaryotic Cell Structure and Function 3 Credits****Grading Scheme:** Letter Grade

This course explores the structure and physiology of prokaryotic cells. We review the principles of energy and biosynthesis in aerobic and anaerobic microorganisms and current research topics in microbiology, including chemotaxis, antimicrobial resistance, and adaptations of microbes to extreme environments. One of the emphases of this course is scientific writing.

**Prerequisite:** CHM 2211 with a minimum grade of C and (MCB 3020 or MCB 3023 with minimum grades of C) or equivalent.**MCB 6417 Microbial Metabolism and Energetics 1 Credit****Grading Scheme:** Letter Grade

Principles of energy and biosynthetic metabolism in aerobic and anaerobic microorganisms. Current biotechnology which incorporates these principles.

**Prerequisite:** MCB 4403 and BCH 4024 or CHM 3218 or equivalent.**MCB 6424 Probiotics 3 Credits****Grading Scheme:** Letter Grade

Covers the use of microorganisms to promote a healthy status in the host. This course will provide a conceptual background in microbiology and immunology for the use of microorganisms for the prevention or treatment of animal and human diseases.

**MCB 6457 Metabolic Regulation 1 Credit****Grading Scheme:** Letter Grade

Environmental sensing and mechanisms of microbial response. Molecular signaling, regulation of genetic information at posttranscriptional and transcriptional levels, effects on metabolism and physiology.

**Prerequisite:** MCB 4403 and BCH 4024 or CHM 3218 or equivalent.**MCB 6458 Post Translational Modifications of Proteins in Microbiology 2 Credits****Grading Scheme:** Letter Grade

Students will learn about post-translational modifications (PTMs) in microbiology. Topics will include: i) the different types, functions, and mechanisms of PTM, ii) the methods used to identify PTMs, and iii) the impact PTMs have on cell biology, human health, and biotechnology.

**MCB 6465 Microbial Metabolic Engineering 1 Credit****Grading Scheme:** Letter Grade

Principles of anaerobic fermentation and its role in production of fuels and chemicals from various feedstocks including lignocellulosic biomass. Evaluation of methods of depolymerization of complex carbohydrate feedstocks to simple sugars for fermentation.

**Prerequisite:** MCB 4403 and BCH 4024 or CHM 3218 or equivalent.**MCB 6485 Advanced Techniques in Microbiology and Cell Science 2-4 Credits, Max 4 Credits****Grading Scheme:** Letter Grade

Application of advanced techniques to experimental research in biochemistry, cell biology, and microbiology.

**Prerequisite:** consent of instructor.**MCB 6656 Environmental Microbiology 3 Credits****Grading Scheme:** Letter Grade

Overview of microorganisms in the environment including: occurrence, abundance, and distribution; current research methodologies to decipher microbial processes and activities, marine microbial ecology, microbial interactions with the environment and practices of applied environmental microbiology.

**Prerequisite:** MCB 3020 or MCB 3023 with a grade of C or better.**MCB 6670C The Microbiome 3 Credits****Grading Scheme:** Letter Grade

Increase knowledge, appreciation and use of genomics pertaining to the breadth of microbial diversity across a wide variety of organisms and habitats using methods that do not require culturing of the myriad of inhabitants. Students will use tools, practice analysis and interpretation of genomic data sets to analyze different microbiomes.

**Prerequisite:** MCB 3020 or MCB 3023 with minimum grades of C.**MCB 6772 Advanced Topics in Cell Biology 1 Credit****Grading Scheme:** Letter Grade

In each semester a specific topic in cell biology with microbiological interest will be considered in a comparative discussion of animal and plant systems.

**MCB 6781 Extremophiles 3 Credits****Grading Scheme:** Letter Grade

Students will learn about the evolution, physiology, biochemistry and molecular biology of extremophiles with emphasis on archaea and their viruses. Principles of energy metabolism at the limits of life will be discussed. Research that incorporates cutting-edge techniques and biotechnology applications for using extremophiles to solve real world problems is highlighted

**Prerequisite:** CHM 2211 (C) & (MCB 3020 or 3023) (C) & (MCB 3020L or 3023L) (C).**MCB 6796 Analysis, Interpretation, and Visualization of Microbiological Data 3 Credits****Grading Scheme:** Letter Grade

Focuses on the analysis and interpretation of microbiological data using R language and other command line tools with a series of examples that range in complexity. Students will analyze various types of microbiological data, including RNAseq, 16SrRNA gene sequencing, direct and indirect microbial growth measurements, and microbial bioproducts, among others. Finally, students will use good practices for data reproducibility.

**MCB 6905 Experimental Microbiology 1-8 Credits, Max 12 Credits****Grading Scheme:** Letter Grade

Application of physical, chemical and biological techniques to experimental problems in microbiology. Individual laboratory study.

**Prerequisite:** eight credits in microbiology and cell science.**MCB 6930 Seminar 1 Credit, Max 8 Credits****Grading Scheme:** S/U

Attendance required of all graduate majors at all research presentations.

**MCB 6937 Special Topics in Microbiology 1-4 Credits, Max 12 Credits****Grading Scheme:** Letter Grade

Contemporary research in a particular aspect of general microbiology.

**MCB 6940 Supervised Teaching 1-5 Credits, Max 5 Credits****Grading Scheme:** S/U

Supervised Teaching

**MCB 6971 Research for Master's Thesis 1-15 Credits****Grading Scheme:** S/U

Research for Master's Thesis

**MCB 7922 Journal Colloquy 1 Credit, Max 8 Credits**

**Grading Scheme:** Letter Grade

Critical presentation and discussion of recent original articles in the microbiological literature. Attendance required.

**MCB 7979 Advanced Research 1-12 Credits**

**Grading Scheme:** S/U

Research for doctoral students before admission to candidacy. Designed for students with a master's degree in the field of study or for students who have been accepted for a doctoral program. Not appropriate for students who have been admitted to candidacy.

**MCB 7980 Research for Doctoral Dissertation 1-15 Credits**

**Grading Scheme:** S/U

Research for Doctoral Dissertation

**PCB 5136L Techniques in Microbial and Cell Biology 3 Credits**

**Grading Scheme:** Letter Grade

A laboratory in experimental bacteriology and cell biology. Emphasis on experimental approaches and techniques used in study of cells and microorganisms. Experiments in microscopy, cell fractionation, metabolism, physiology, genetics, and regulation.

**Prerequisite:** B grade or higher in MCB 3020L, CHM 3120/3120L.

**PCB 5235 Immunology 3 Credits**

**Grading Scheme:** Letter Grade

Immune system of vertebrate animals. The cellular and molecular events involved in immune responsiveness and resistance to infectious diseases.

**Prerequisite:** C grade or higher in MCB 3020L.

**PCB 6667 Human Genomics 3 Credits**

**Grading Scheme:** Letter Grade

Increasingly, researchers and health care providers are mining the genome to uncover the basis of disease susceptibility and treatment. Genome-based strategies are used for the detection, treatment, and prevention of many diseases. This course will discuss the field of genomics, how genome sequence data is obtained and analyzed, and most importantly, what can be learned from an individual's genome.

**Prerequisite:** MS or PhD student in life sciences