

# BIOLOGICAL CHEMISTRY - MD (BCHEM)

BCHEM 510: Carcinogenesis and Chemoprevention

2 Credits

Mechanisms of cancer induction by environmental carcinogens and chemoprevention by natural and synthetic agents. BCHEM 510 BCHEM 510 Carcinogenesis and Chemoprevention (2) The etiology of most human cancer remains obscure even though a vast body of literature describes risk factors for certain cancers and proposes various hypotheses for cancer etiology on the basis of epidemiological and experimental studies. Tobacco smoking is an established cause of several cancers, with lung cancer remaining the first target on the list. International studies have repeatedly confirmed that people (Chinese, Japanese) migrate from their country of origin to the U.S., adopt the pattern of certain cancers within a few generations (e.g., breast and prostate) of the latter country, which is indicative of the presence of chemical carcinogens in the environment and/or changes in lifestyles. Consequently, the search for carcinogens that exist in the human environment challenges both scientists and regulatory agencies. Chronic exposure to traces of chemical carcinogens in the diet, in polluted air, or in tobacco smoke can be important in the etiology of several human cancers in the presence of host factors that favor the multi-step process of carcinogenesis. Bioassays in laboratory animals can provide important information on the role of environmental agents in the induction of particular types of cancer. Biochemical studies can lead to insights into the nature of interactions of these environmental agents with macromolecules such as DNA that are necessary, but not always sufficient for carcinogenesis. The search for optimal diets and for naturally occurring agents in routinely consumed foods that may inhibit cancer development, although challenging, constitutes a valuable and plausible approach to finding ways to control and prevent cancer. The prevention of cancer is the longstanding goal for most cancer researchers. There has been enormous gain in our understanding of carcinogenesis and cancer progression; such knowledge has provided new and promising opportunities to prevent cancer, e.g., to treat pre-cancer or inhibit carcinogenesis (a process often involving 20-30 years in human epithelial cancers), rather than waiting to treat cancer. In the early 1980's, the U.S. National Cancer Institute recognized the promise of chemoprevention research. In summary, this course will provide a better understanding of the potential contribution of environmental carcinogens in the development of certain human cancers and will provide important information on cancer chemoprevention intervention strategies. The course will cover topics that include exposure, metabolic activation, detoxification, and biomonitoring of chemical carcinogens in the human environment, carcinogen-induced DNA damage, mutagenesis and DNA repair, carcinogen-induced cellular and molecular alterations, tumorigenesis and organ specificity in laboratory animals, and factors modulating individual susceptibility to the deleterious effects on chemical carcinogens. Furthermore, this course will provide knowledge on various classes of cancer chemopreventive agents, their efficacy, safety, and mechanisms of action in preclinical studies. Course Objectives: Upon completion of this course, the students will be able to: 1. Understand the potential risk associated with human exposure to chemical carcinogens detected in the environment. 2. Describe the current assays of biomonitoring of human exposure to chemical carcinogens. 3. Learn the process of metabolic activation and detoxification of chemical carcinogens. 4. Understand the stages

of the multi-step carcinogenesis process. 5. Identify factors that govern individual susceptibility to the deleterious effects of chemical carcinogens. 6. Understand the concept of cancer chemoprevention. 7. Identify molecular and cellular targets for chemoprevention intervention at any time during the process of carcinogenesis. Grading: Grading will be determined as follows: 1. Midterm Exam 30% 2. Research Paper\* 30% 3. Class Participation 10% 4. Final Exam 30% Total 100%\* Guidelines for Research Paper: The topic will be selected following approval of the faculty member in charge. The paper should include the goals (aims) of the research project, literature background, the significance of the research topic, knowledge to be gained, gaps in existing knowledge, and the potential to propose future studies. Faculty Member Proposing: Karam El-Bayoumy

BCHEM 521: Biochemistry: Structure/Function/Regulation of Biological Molecules

3 Credits

The fundamentals of biochemistry in evaluating the forces that govern inter- and intra-molecular interactions are studied. BCHEM 521 Biochemistry: Structure/Function/Regulation of Biological Molecules (3) An overriding theme in biochemistry is that macromolecules, which are polymers of simpler molecules, interact to form structurally large and functionally complex entities that give rise to discrete structures and functions. This course focuses on intermolecular forces between the monomers of macromolecules that govern tertiary structure, as well as interactions between macromolecules that govern higher order structures. The course begins with proteins, covering the structural basis of protein functions and then moves on to simple enzyme kinetics and mechanisms. Next, the students will discover the forces that control the three dimensional structures of nucleic acids. Subsequently, the students will explore simple and complex carbohydrates and topics in glycobiology that include energy storage, framework skeleton, and specific molecular recognition. Lipid biochemistry will be examined next, in topics that include lipid chemistry, complex lipids, membrane biology, and transport systems. Finally, the analysis of higher order structures involving the interactions between protein, nucleic acids, lipids, and carbohydrates will be discussed. The course will describe various analytical, chemical, and biochemical techniques that biochemists use to interrogate biomolecular structure and interactions.

**Prerequisite:** BMS 501 , BMS 502 , BMS 503

BCHEM 522: Molecular Genetics: Genes to Genomes

3 Credits

This course focuses on concepts of molecular genetics and genomics, and DNA- protein interactions and their functions within macromolecular complexes. BCHEM 522 Molecular Genetics: Genes to Genomes (3) This course focuses on the principles and concepts of molecular genetics and genomics and DNA-protein interactions and their functions within macromolecular complexes. Special emphasis is placed on the aspects of eukaryotic genome organization, chromatin and chromosome structural and epigenetic changes, and DNA-protein interactions that regulate expression of genetic information and change the process of inheritance in normal and disease models and affect genome stability. This course contains three major sections. Section I includes principles of recombinant DNA technologies used in the analysis of DNA sequences and genome structure. Section II covers genetic interactions and macromolecular assembly and provides links between the studies of molecular interactions and equilibrium with in vivo and genetic approaches. Section III covers genome stability, epigenetics, and medical

applications involving mis-regulation of the molecular mechanisms involved in these processes. This part builds on material presented in the BMS 503 course of the core curriculum and provides students an in-depth understanding of the molecular mechanisms of genome alterations and their biomedical significance.

**Prerequisite:** BMS 501 , BMS 502 , BMS 503

BCHEM 581: Enzymology: Structure, Energetics, and Function-A. Structural Biology

1 Credits

Structural biology: NMR spectroscopy and X-ray crystallography. BCHEM 581 BCHEM 581 Enzymology: Structure, Energetics, and Function-A. Structural Biology (1) The objectives of this course are to provide students with a solid background to critically interpret X-ray crystallographic and NMR experiments. Topics will be covered in the X-ray crystallography lectures will include crystal growth, diffraction, phasing and refinement to determine the structure. Topics in NMR spectroscopy will include basic principles, multidimensional experiments, and assignments of atoms to resonances, structure determination and dynamics of ligand binding to proteins. The students will learn the basic principles of protein structure determination by NMR and X-ray crystallography.

BCHEM 582: Enzymology: Structure, Energetics, and Function-B. Practical Enzymology

1 Credits

Practical aspects to study protein-ligand binding and substrate-enzyme reaction. BCHEM 582 BCHEM 582 Enzymology: Structure, Energetics, and Function-B: Practical Enzymology (1) The objectives of this course are to provide students with a solid background in practical enzymology.

BCHEM 583: Enzymology: Structure, Energetics, and Function-C. Mechanisms of Enzyme Reactions

1 Credits

Molecular basis for enzyme specificity and catalysis. BCHEM 583 BCHEM 583 Enzymology: Structure, Energetics, and Function - C. Mechanisms of Enzyme Reactions (1) The objectives of this course are to provide students with the wherewithal to interpret and design experiments aimed at elucidating the mechanisms of enzyme catalyzed reactions. Selected mechanisms of enzyme catalyzed reactions will be surveyed using primary literature. The rationale for the chemical, kinetic, molecular biological, spectrophotometric, thermodynamic tools that are used to investigate these reactions will be discussed. Topics that will be discussed include (a) principles of enzyme catalysis, (b) electrostatic catalysis (c) acid/base catalysis, (d) phosphates (e) Schiff base formation. Cofactors that will be discussed include pyridyl pyrophosphate, thiamine, biotin, tetrahydrofolate, NAD, FAD, S-adenoxyl methionine, and vitamin K and B12.

BCHEM 590: Colloquium

1-3 Credits/Maximum of 3

Continuing seminars which consist of a series of individual lectures by faculty, students, or outside speakers.

BCHEM 596: Individual Studies

1-9 Credits/Maximum of 9

Creative projects, including nonthesis research, which are supervised on an individual basis and which fall outside the scope of formal courses.

BCHEM 597: Special Topics

1-9 Credits/Maximum of 9

Formal courses given on a topical or special interest subject which may be offered infrequently.

BCHEM 600: Thesis Research

1-15 Credits/Maximum of 999

No description.

BCHEM 601: Ph.D. Dissertation Full-Time

0 Credits/Maximum of 999

No description.

BCHEM 611: Ph.D. Dissertation Part-Time

0 Credits/Maximum of 999

No description.