

# Biochemistry (BCH)

## **BCH 101/MB 101 Introduction to Microbiology and Biochemistry Laboratory Practices** (3 credit hours)

Curricular bridge between high school and college for high school and transitional students. A "hands on" introduction to fundamentals in Microbiology and Biochemistry. Bacterial isolation, identification and growth using aseptic technique, microscopy, and metabolic analysis. Experiments with DNA isolation and analysis, protein isolation, and purification, and enzyme kinetics. Lectures and readings on background, theory and applications of these techniques. Field trips to university and industry research laboratories. This course is part of the Summer College in Biotechnology and Life Sciences (SCIBLS) as well as other pre-college, transitional and early-college programs and is offered as 4 week intensive course. Applicants should have completed high school courses in biology and chemistry. Students must have completed no more than 30 credit hours. Departmental approval is required for current NCSU students.

*Typically offered in Summer only*

## **BCH 103 Introduction to Biochemistry** (1 credit hours)

Introduction to curriculum and career requirements for biochemistry and being a successful student at NCSU. Emphasis is placed on curricular requirements, interactions with faculty and students in the Department of Molecular and Structural Biochemistry, introduction to key resource programs on campus, exposure to research opportunities and ongoing career planning. Enrollment is limited to new or transfer Biochemistry majors with less than 45 hours.

*Typically offered in Fall only*

## **BCH 220 Role of Biotechnology in Society** (3 credit hours)

Role of Biotechnology in Society is an introductory science course that takes a semi-technical look at the emerging role of biotechnology in human society. Expectations are that students will gain an appreciation for biotechnology and gain the ability to understand how biotechnology works. Offered only in Poland through Study Abroad Program (4-week course).

Prerequisite: BIO 181, CH 101

*GEP Interdisciplinary Perspectives*

*Typically offered in Summer only*

## **BCH 330 Physical Biochemistry** (3 credit hours)

This course provides a descriptive survey of the concepts of physical chemistry with emphasis on their use in applications designed to characterize and manipulate biological molecules and systems. Topics are drawn from thermodynamics (bonding, protein folding energies, linkage, spectroscopic and differential scanning calorimetric binding measurements), kinetics (enzymatic catalysis, perturbation techniques), statistical mechanics (distributions, ensembles, molecular mechanical & dynamics calculations), electrochemistry, hydrodynamics (diffusion, friction, electrophoresis, viscosity, sedimentation, organism size and shape), quantum mechanics (wave functions operators, uncertainty principle, dipoles, orbitals and resonance energy coupling), and spectroscopy (absorbance and light scattering, fluorescence, nuclear and electronic paramagnetic resonance, MR imaging and x-ray diffraction).

P: (CH 201 or CH 203) and (BCH 351 or BCH 451) and (MA 231 or MA 241) and (PY 208 or PY 212)

*Typically offered in Spring only*

## **BCH 351 General Biochemistry** (3 credit hours)

This course is an introduction to the basic principles of biochemistry. It emphasizes biochemical structures, properties, and functions, including enzyme kinetics and major metabolic processes. It can serve as a prerequisite for BCH 452 with permission of the department. This course is designed for those students who are not majoring in Biochemistry and do not require a more comprehensive introduction to biochemistry. It is not intended for graduate students. Credit is not allowed for both BCH 351 and BCH 451. Prerequisites CH 223 (or CH 227) and BIO 183 are required. CH 201 (or CH 203) is strongly recommended, but not required.

Prerequisite: CH 223 (or CH 227), BIO 183

*Typically offered in Fall, Spring, and Summer*

## **BCH 451 Principles of Biochemistry** (4 credit hours)

Introduction to and survey of the fundamental principles of biochemistry, emphasizing the chemistry of living organisms, chemical structures, and interactions of and between biomolecules.

Prerequisite: CH 101 (or CH 103), CH 102 (or CH 104), CH 201 (or CH 203), CH 202 (or CH 204), CH 221 (or CH 225), CH 222 (or CH 226), CH 223 (or CH 227), CH 224 (or CH 228), and BIO 183

*Typically offered in Fall, Spring, and Summer*

## **BCH 452 Introductory Biochemistry Laboratory** (2 credit hours)

Laboratory experiences in this course are designed to compliment the first semester undergraduate biochemistry course, BCH 451. Basic skills to be mastered include the use of volumetric equipment, spectrophotometers, chromatography, and electrophoresis. You will also learn to assay small quantities of biological materials and analyze lab data. You will learn to manipulate biochemical materials from three of the four major subgroups: proteins, nucleic acids and carbohydrates. You will determine structural elements at a number of analytical levels and learn how to think about their functional capabilities. We will emphasize theoretical information, while discussing how the techniques work. The explanations discuss how the techniques work. We focus on how consecutive methods are interconnected to form process chains.

P: CH 101 (or CH 103), CH 102 (or CH 104), CH 201 (or CH 203), CH 202 (or CH 204), CH 221 Organic Chemistry I (or CH 225), CH 222 (or CH 226), CH 223 (or CH 227), CH 224 (or CH 228), BIO 183 and BCH 451 (may serve as corequisite or prerequisite).

*Typically offered in Fall and Spring*

## **BCH 453/BCH 553 Biochemistry of Gene Expression** (3 credit hours)

Structure and function of nucleic acids and proteins. Synthesis of DNA, RNA, and proteins. Gene expression and Regulation. Methodologies of recombinant DNA research. Credit is not allowed for both BCH 453 and BCH 553.

Prerequisite: BCH 451, Corequisite: GN 311, MB 351

*Typically offered in Fall, Spring, and Summer*

## **BCH 454 Advanced Biochemistry Laboratory** (4 credit hours)

Hands on experience with the techniques of molecular biology and protein purification. Cloning and expression of a eukaryotic gene in bacteria will be performed followed by purification of the eukaryotic gene product. Microanalysis of DNA, RNA and protein.

Prerequisite: BCH 451 & BCH 452; Corequisite: BCH 453

*Typically offered in Fall and Spring*

**BCH 455/BCH 555 Proteins and Molecular Mechanisms** (3 credit hours)

Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.

Prerequisite: BCH 451, BCH 453/553

*Typically offered in Fall and Spring*

**BCH 492 External Learning Experience** (1-6 credit hours)

A learning experience in agriculture and life sciences within an academic framework that utilizes facilities and resources which are external to the campus. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and academic dean prior to the experience.

Prerequisite: Sophomore standing

*Typically offered in Fall, Spring, and Summer*

**BCH 493 Special Problems in Biochemistry** (1-6 credit hours)

A learning experience in agriculture and life sciences within an academic framework that utilizes campus facilities and resources. Contact and arrangements with prospective employers must be initiated by student and approved by a faculty adviser, the prospective employer, the departmental teaching coordinator and the academic dean prior to the experience.

Prerequisite: Sophomore standing

*Typically offered in Fall, Spring, and Summer*

**BCH 495 Special Topics in Biochemistry** (1-5 credit hours)

Offered as needed to present materials not normally available in regular BCH departmental courses or for new BCH courses on a trial basis.

Prerequisite: Junior standing.

*Typically offered in Fall, Spring, and Summer*

**BCH 552 Experimental Biochemistry** (3 credit hours)

An advanced laboratory to give students practical experiences in purification and quantitative characterization of enzymes and nucleic acids. Studies with carbohydrates and membrane lipids. Credit may be applied toward biotechnology minor.

Prerequisite: BCH 452; BCH 453

*Typically offered in Fall and Spring*

**BCH 553/BCH 453 Biochemistry of Gene Expression** (3 credit hours)

Structure and function of nucleic acids and proteins. Synthesis of DNA, RNA, and proteins. Gene expression and Regulation. Methodologies of recombinant DNA research. Credit is not allowed for both BCH 453 and BCH 553.

Prerequisite: BCH 451, Corequisite: GN 311, MB 351

*Typically offered in Fall, Spring, and Summer*

**BCH 555/BCH 455 Proteins and Molecular Mechanisms** (3 credit hours)

Principles of protein structure and function, protein folding, enzymology, ligand binding, protein transport, and metabolic pathways.

Prerequisite: BCH 451, BCH 453/553

*Typically offered in Fall and Spring*

**BCH 560 Molecular Biology for Teachers** (3 credit hours)

Introduction to molecular biology for teachers. Emphasis will be on developing basic laboratory skills applicable to middle or high school biology classes. Teachers will develop their own labs during the last week of class. This is an intensive three-week class, five hours per day. Students should have at least one biotechnology course before enrolling in this course. Prior secondary school teaching experience preferred.

*Typically offered in Summer only*

*This course is offered alternate even years*

**BCH 571/ANS 571 Regulation of Metabolism** (3 credit hours)

Study of hormonal, enzymatic and molecular-genetic regulation of carbohydrate and lipid metabolism; emphasis on mammalian species.

Prerequisite: BCH 451, GN 311, a course in physiology, cell biology

*Typically offered in Fall only*

*This course is offered alternate odd years*

**BCH 590 Special Topics in Biochemistry** (1-6 credit hours)

The study of topics of special interest by small groups of students instructed by members of the faculty.

Prerequisite: BCH 451

*Typically offered in Fall, Spring, and Summer*

**BCH 601 Macromolecular Structure** (1 credit hours)

Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.

Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended

*Typically offered in Fall only*

**BCH 610 Special Topics** (1-6 credit hours)

The study of topics of special interest by small groups of students instructed by members of the faculty.

Prerequisite: BCH 451

*Typically offered in Fall, Spring, and Summer*

**BCH 615 Special Topics In Biochemistry** (1-6 credit hours)

Critical study of special problems and selected topics of current interest in biochemistry and related fields.

Prerequisite: Graduate standing in BCH

*Typically offered in Fall, Spring, and Summer*

**BCH 670 Laboratory Rotations** (1 credit hours)

Performance of highly directed research by biochemistry students in one or more laboratories of student's choice prior to beginning thesis research. Each laboratory experience lasts 5 weeks and given 1 hr. of credit. No more than 4 credits earned in BCH 692.

Prerequisite: BCH 451

*Typically offered in Fall and Spring*

**BCH 685 Master's Supervised Teaching** (1-3 credit hours)

Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Master's student

*Typically offered in Fall and Spring*

**BCH 690 Master's Examination** (1-9 credit hours)

For students in non-thesis master's programs who have completed all other requirement of the degree except preparing for and taking the final master's exam.

Prerequisite: Master's student

*Typically offered in Spring only*

**BCH 693 Master's Supervised Research** (1-9 credit hours)

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Master's student

*Typically offered in Fall, Spring, and Summer*

**BCH 695 Master's Thesis Research** (1-9 credit hours)

Thesis research

Prerequisite: Master's student

*Typically offered in Fall, Spring, and Summer*

**BCH 696 Summer Thesis Research** (1 credit hours)

For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Master's student

*Typically offered in Summer only*

**BCH 699 Master's Thesis Preparation** (1-9 credit hours)

For students who have completed all credit hour requirements and full-time enrollment for the master's degree and are writing and defending their thesis.

Prerequisite: Master's student

*Typically offered in Fall, Spring, and Summer*

**BCH 701 Macromolecular Structure** (3 credit hours)

Introduction to the current understanding and methods used for the study of structures, thermodynamics and conformational dynamics of proteins, nucleic acids and membranes.

Prerequisite: BCH 453 or BCH 553; a course in physical chemistry highly recommended

*Typically offered in Fall only*

**BCH 703 Macromolecular Synthesis and Regulation** (3 credit hours)

Biochemistry of DNA replication, transcription, RNA processing and translation. Development of key concepts, techniques and applications relating to mechanisms and regulation of these processes by analysis of primary literature.

Prerequisite: BCH 453 or BCH 553

*Typically offered in Spring only*

**BCH 705 Molecular Biology Of the Cell** (3 credit hours)

Regulation of cellular processes, membrane structure and function, signal transduction, protein trafficking/sorting, secretion, photosynthesis and nitrogen fixation.

Prerequisite: BCH 701 or BCH 703

*Typically offered in Fall only*

**BCH 710 Biological Scanning Electron Microscopy** (2 credit hours)

On demand. Theory and application of scanning electron microscopy, including specimen preparation, microscope alignment and operation, performance evaluation, interpretation of problems and darkroom technique. (Limited to 8 students with prior approval of instructor.)

Prerequisite: Graduate standing with some biological background

*Typically offered in Spring only*

**BCH 751 Biophysical Chemistry** (3 credit hours)

Fundamental and practical aspects of biological macromolecular structure, thermodynamics, hydrodynamics, kinetics and spectroscopy with emphasis on mechanisms in functionally important structural transformations.

Prerequisite: BCH 451; one sem. of physical chemistry

*Typically offered in Fall only*

*This course is offered alternate years*

**BCH 760 Protein Crystallography and Macromolecular Modeling** (3 credit hours)

Basic principles and practice of protein crystallography and the application of molecular dynamics to evaluate structural models. The computer lab provides hands-on experience in structure determination, refinement, model building, and molecular dynamics using CHARMM.

Prerequisite: BCH 455 or BCH 555 or equivalent

*Typically offered in Fall only*

*This course is offered alternate odd years*

**BCH 761/GN 761/PB 761 Advanced Molecular Biology Of the Cell** (3 credit hours)

An advanced graduate class involving integrated approaches to complex biological questions at the molecular level, encompassing biochemistry, cell biology and molecular genetics. The course will focus on an important, current area of research in eukaryotic biology using the primary scientific literature, and will involve class discussions, oral presentations, and a written research proposal.

*Typically offered in Spring only*

*This course is offered alternate years*

**BCH 763 Biochemistry Of Hormone Action** (3 credit hours)

Study of well-defined models of steroid and protein hormone action via lectures, assigned readings and discussions. Students add breadth to the course and depth to their own understanding by searching the literature and writing or lecturing about a particular hormone of their own choosing.

Prerequisite: BCH 705 or GN 757

*Typically offered in Spring only*

*This course is offered alternate years*

**BCH 768/GN 768 Nucleic Acids: Structure and Function** (3 credit hours)

An advanced treatment involving integrated approaches to biological problems at the molecular level, encompassing biochemistry, cell biology and molecular genetics. Broad, multidisciplinary approaches to solving research problems in biology and the critical study of primary scientific literature, the development of a research proposal, oral presentations and class discussions.

Prerequisite: BCH 701 and 703

*Typically offered in Spring only*

*This course is offered alternate years*

**BCH 770 Enzyme Kinetics and Mechanisms** (3 credit hours)

An advanced course in enzyme kinetics and mechanisms with particular emphasis on experimental design and interpretation. The first half of the course covers the derivation and application of single and multisubstrate kinetic equations, inhibition and pre-steady state kinetics. The second half of the course covers fundamental chemical and physical principles of enzyme catalysis and specificity.

Prerequisite: BCH 451 and BCH 455/555 or equivalent.

*Typically offered in Spring only*

*This course is offered alternate even years*

**BCH 801 Seminar In Biochemistry** (1 credit hours)

Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers.

*Typically offered in Fall and Spring*

**BCH 810 Special Topics** (1-6 credit hours)

The study of topics of special interest by small groups of students instructed by members of the faculty.

Prerequisite: BCH 451

*Typically offered in Fall, Spring, and Summer*

**BCH 815 Advanced Special Topics** (1-6 credit hours)

Critical study of special problems and selected topics of current interest in biochemistry and related fields.

Prerequisite: Graduate standing in BCH

*Typically offered in Spring only*

**BCH 870 Laboratory Rotations** (1 credit hours)

Performance of highly directed research by biochemistry students in one or more laboratories of student's choice prior to beginning thesis research. Each laboratory experience lasts 5 weeks and given 1 hr. of credit. No more than 4 credits earned in BCH 692.

Prerequisite: BCH 451

*Typically offered in Fall only*

**BCH 885 Doctoral Supervised Teaching** (1-3 credit hours)

Teaching experience under the mentorship of faculty who assist the student in planning for the teaching assignment, observe and provide feedback to the student during the teaching assignment, and evaluate the student upon completion of the assignment.

Prerequisite: Doctoral student

*Typically offered in Fall and Spring*

**BCH 890 Doctoral Preliminary Examination** (1-9 credit hours)

For students who are preparing for and taking written and/or oral preliminary exams.

Prerequisite: Doctoral student

*Typically offered in Spring only*

**BCH 893 Doctoral Supervised Research** (1-9 credit hours)

Instruction in research and research under the mentorship of a member of the Graduate Faculty.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**BCH 895 Doctoral Dissertation Research** (1-9 credit hours)

Dissertation research

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*

**BCH 896 Summer Dissertation Research** (1 credit hours)

For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

Prerequisite: Doctoral student

*Typically offered in Summer only*

**BCH 899 Doctoral Dissertation Preparation** (1-9 credit hours)

For students who have completed all credit hours, full-time enrollment, preliminary examination, and residency requirements for the doctoral degree, and are writing and defending their dissertations.

Prerequisite: Doctoral student

*Typically offered in Fall, Spring, and Summer*