

# BIOCHEMISTRY AND BIOPHYSICS (BB)

## BB 100. THE MOLECULES OF LIFE. (2 Credits)

A brief introduction to molecular biology for nonspecialists. Subjects vary, but have included biochemical basis of the origin of life, biochemical genetics, biochemical aspects of memory and behavior, mutagenesis, bioenergetics and nutrition, and environmental biochemistry.

## BB 111. INTRODUCTION TO BIOCHEMISTRY AND BIOPHYSICS RESEARCH. (1 Credit)

Designed to introduce biochemistry and biophysics students to departmental research opportunities and advisors.

## BB 314. CELL AND MOLECULAR BIOLOGY. (4 Credits)

Fundamental concepts of prokaryotic and eukaryotic cell biology. Emphasizes cell structure and function at the molecular level. Lec/rec.

**Prerequisites:** (( (BI 211 with C- or better or BI 211H with C- or better) and (BI 212 [C-] or BI 212H [C-]) and (BI 213 [C-] or BI 213H [C-])) or (BI 204 [C-] and BI 205 [C-] and BI 206 [C-])) and (CH 331 (may be taken concurrently) [C-] or CH 334 (may be taken concurrently) [C-])

**Equivalent to:** BB 314H

## BB 314H. CELL AND MOLECULAR BIOLOGY. (4 Credits)

Fundamental concepts of prokaryotic and eukaryotic cell biology. Emphasizes cell structure and function at the molecular level. Lec/rec.

**Attributes:** HNRS – Honors Course Designator

**Prerequisites:** (( (BI 211 with C- or better or BI 211H with C- or better) and (BI 212 [C-] or BI 212H [C-]) and (BI 213 [C-] or BI 213H [C-])) or (BI 204 [C-] and BI 205 [C-] and BI 206 [C-])) and (CH 331 (may be taken concurrently) [C-] or CH 334 (may be taken concurrently) [C-])

**Equivalent to:** BB 314

## BB 315. MOLECULAR BIOLOGY LABORATORY. (3 Credits)

Laboratory projects exploring the transmission of genetic information from storage to function will introduce students to fundamental molecular biology concepts and techniques, including isolation of DNA, construction of recombinant plasmids, quantification of gene expression in model organisms, polymerase chain reaction, and analysis of protein expression and subcellular localization. Lec/lab. CROSSLISTED as BI 315.

**Prerequisites:** BB 314 with C- or better or BB 314H with C- or better

**Equivalent to:** BI 315

## BB 317. ^SCIENTIFIC THEORY AND PRACTICE. (3 Credits)

Teaches students the practice of biological science. Topics cover scientific theory, communications, and critical evaluation. CROSSLISTED as BI 317. (Writing Intensive Course)

**Attributes:** CWIC – Core, Skills, WIC

**Prerequisites:** BI 213 with D- or better or BI 213H with D- or better

**Equivalent to:** BI 317

## BB 331. \*INTRODUCTION TO MOLECULAR BIOLOGY. (3 Credits)

Course dealing with the molecular basis of cellular function, with emphasis upon modern developments, and the foundation for practical applications of this knowledge. The course will involve the conceptual background necessary to appreciate the applications of molecular biology. Throughout the course opportunities will be given to discuss public policy issues and questions: What are the moral and practical problems that flow from identification of an individual as being at risk for a late-appearing genetic disorder, such as Huntington's disease or certain cancers? Does the scientific or public value of knowing the entire DNA sequence of the human genome justify a situation in which individual or small-scale research cannot be supported? What issues arise when the fruits of biological research, mostly publicly funded, are commercialized? Should a novel organism be patented? How can biotechnology be applied to environmental problems? (Bacc Core Course)

**Attributes:** CSST – Core, Synthesis, Science/Technology/Society

**Prerequisites:** CH 122 with D- or better or CH 202 with D- or better or CH 222 with D- or better or CH 225H with D- or better or ((CH 232 with D- or better or CH 232H with D- or better) or (CH 262 with D- or better or CH 262H with D- or better or CH 272 with D- or better))

## BB 332. \*MOLECULAR MEDICINE. (3 Credits)

Provides students an understanding of medical advances from a rapidly evolving molecular point of view. Advances in knowledge of the human genome arising from DNA sequencing efforts and major leaps in understanding of the regulating cellular growth and division are presented in an easy-to-understand fashion appropriate for students in all majors. Course discussions and assignments will cover implications of advances in molecular medicine from ethical, economic, technical and societal standpoints. The aim of the course is to present technical material in a way that non-scientists will understand and conversely to summarize ethical, economic, and philosophical considerations in a way that the scientists understand the implications of these technologies. (Bacc Core Course)

**Attributes:** CSST – Core, Synthesis, Science/Technology/Society

## BB 350. ELEMENTARY BIOCHEMISTRY. (4 Credits)

Service course for students desiring a short introduction to biochemistry. Four lectures weekly.

**Prerequisites:** CH 331 with D- or better and CH 332 (may be taken concurrently) [D-]

## BB 360. INTRODUCTION TO NEUROSCIENCE. (3 Credits)

An introduction to the field of neuroscience. Topics include structure of neurons, outline of signaling in the central nervous system, Nernst equation, action potentials, synaptic transmission, chemical signaling in vision, disease and drugs.

**Prerequisites:** (BI 211 with C- or better or BI 211H with C- or better) and (BI 212 [C-] or BI 212H [C-]) and (BI 213 [C-] or BI 213H [C-]) and (CH 233 [C-] or CH 233H [C-]) and (CH 263 [C-] or CH 263H [C-])

## BB 399. SPECIAL TOPICS. (1-16 Credits)

**Equivalent to:** BB 399H

*This course is repeatable for 16 credits.*

## BB 399H. SPECIAL TOPICS. (1-16 Credits)

**Attributes:** HNRS – Honors Course Designator

**Equivalent to:** BB 399

*This course is repeatable for 16 credits.*

## BB 401. UNDERGRADUATE RESEARCH. (1-16 Credits)

*This course is repeatable for 16 credits.*

## BB 403. THESIS. (1-16 Credits)

*This course is repeatable for 16 credits.*

**BB 405. READING AND CONFERENCE. (1-16 Credits)****Equivalent to:** BB 405H*This course is repeatable for 16 credits.***BB 405H. READING AND CONFERENCE. (1-16 Credits)****Attributes:** HNRS – Honors Course Designator**Equivalent to:** BB 405*This course is repeatable for 16 credits.***BB 407. BIOCHEMISTRY/BIOPHYSICS SEMINAR. (1-16 Credits)**

Informal seminars presenting information about research problems and careers and research programs on campus in biochemistry or biophysics.

**Equivalent to:** BB 407H*This course is repeatable for 99 credits.***BB 407H. BIOCHEMISTRY/BIOPHYSICS SEMINAR. (1-16 Credits)**

Informal seminars presenting information about research problems and careers and research programs on campus in biochemistry or biophysics.

**Attributes:** HNRS – Honors Course Designator**Equivalent to:** BB 407*This course is repeatable for 99 credits.***BB 410. INTERNSHIP. (1-16 Credits)***This course is repeatable for 16 credits.***BB 450. GENERAL BIOCHEMISTRY. (4 Credits)**

Sequence course for students with a limited background in physical chemistry. BB 450/BB 550, three lectures and one recitation. BB 451/BB 551, three lectures.

**Prerequisites:** CH 332 with D- or better or CH 336 with D- or better**BB 451. GENERAL BIOCHEMISTRY. (3 Credits)**

Sequence course for students with a limited background in physical chemistry. BB 450/BB 550, three lectures and one recitation. BB 451/BB 551, three lectures.

**Prerequisites:** BB 450 with D- or better or BB 450H with D- or better**BB 460. ADVANCED CELL BIOLOGY. (3 Credits)**

History and theory of cell biology; microscopy and other techniques to study cells and organelles; membranes; organelles; protein import; cell signaling; cytoskeleton; polarity; cell cycle; stem cells; pattern formation; cancer biology. Offered every other fall in odd years.

**Prerequisites:** BB 314 with C- or better or BI 314 with C- or better or BI 314H with C- or better or BB 451 with C- or better or BB 492 with C- or better**BB 481. MACROMOLECULAR STRUCTURE. (3 Credits)**

An introduction to structural biology, the discipline focused on understanding the structural properties of biological macromolecules—especially proteins and nucleic acids—and relating them to their function. Introduces students to the vocabulary and tools of this discipline, covering both the fundamental physico-chemical principles governing the structure and function of biological macromolecules and a selected set of widely used experimental and theoretical approaches to their characterization. This is done through lectures, and textbook and literature readings. Graduate students receive additional experience in scientific reading, writing and presentation through a literature-based term project.

**Prerequisites:** BB 450 with D- or better or BB 490 with D- or better**BB 482. BIOPHYSICS. (3 Credits)**

Sequence professional course covering quantitative properties of biological systems and biological phenomena using concepts derived from mathematics and physics.

**Prerequisites:** BB 481 with D- or better and CH 442 [D-]**BB 483. ADVANCED BIOCHEMISTRY AND BIOPHYSICS: CAPSTONE. (3 Credits)**Covers applications of advanced biophysical techniques, and how these fit within the larger context of biochemistry, biology and society. Explores techniques and their applications to macromolecules as well as the scientific process. Techniques discussed include *in vitro*, *in vivo*, and *in silico* methods, with an emphasis on biomolecular interactions.**Prerequisites:** BB 482 with D- or better or BB 582 with D- or better**BB 484. CHROMATIN AND EPIGENETICS. (3 Credits)**

An in-depth look at "chromatin" (the complex generated by DNA, RNA and complex protein) and how it behaves during gene activation and silencing. Specific examples of long-lasting gene regulation (across cell cycles) will be used to describe the concept of "epigenetic" gene regulation by modification of DNA or proteins. The class will combine more traditional lectures with discussion periods where primary research papers will be analyzed. The target audience is third- and fourth-year students as well as graduate students.

**Prerequisites:** ((BI 314 with C- or better or BI 314H with C- or better or BB 314 with C- or better or BB 314H with C- or better) and (BI 315 [C-] or BB 315 [C-] or BB 493 [C-] or BB 493H [C-]))**BB 485. APPLIED BIOINFORMATICS. (3 Credits)**

The fundamentals of bioinformatics are presented, which will enable an understanding of the software and methods used in answering questions in bioinformatics. The student will gain a working knowledge of the bioinformatics analysis of contemporary techniques such as databases, gene and genome annotations, functional annotations, sequence alignment, motif finding, secondary structure prediction, phylogenetic tree construction, high-throughput sequence data, ChIP-Seq peak identification, transcriptome profiling by RNA-Seq, microRNA discovery and target prediction.

**Prerequisites:** BI 314 with C- or better or BI 314H with C- or better**BB 486. ADVANCED MOLECULAR GENETICS. (3 Credits)**

Combines analyses of state-of-the-art primary literature with lectures that give a historical perspective on some of the most important "model" organisms used in biology, i.e. organisms that have been widely used to decipher the general "rules for life" on the planet. These include examples among the bacteria, plants, fungi, worms, flies and mammals.

**Prerequisites:** (BI 314 with C- or better or BI 314H with C- or better or BB 314 with C- or better) and (BI 315 [C-] or BB 315 [C-]) and BB 492 [D-]**BB 490. BIOCHEMISTRY 1: STRUCTURE AND FUNCTION. (3 Credits)**

Sequence professional course to meet the requirements of majors in biochemistry and biophysics. The first course in the series, BB 490/BB 590, covers how the structure and function of biological macromolecules arises from the organic chemistry of their fundamental building blocks. The organic chemistry of biochemistry will be a focus, including the mechanisms by which enzymes catalyze biological reactions.

**Prerequisites:** CH 332 with C- or better or CH 336 with C- or better**BB 491. BIOCHEMISTRY 2: METABOLISM. (3 Credits)**

Sequence professional course to meet the requirements of majors in biochemistry and biophysics. The second course in a series, BB 491/BB 591 covers the mechanisms and regulation of the pathways by which cells break down fuel molecules, conserve some of the released energy in the form of reactive nucleotides, and use this energy to create biological building blocks from simpler metabolites.

**Prerequisites:** BB 490 with D- or better or BB 590 with D- or better

**BB 492. BIOCHEMISTRY 3: GENETIC BIOCHEMISTRY. (3 Credits)**

Sequence professional course to meet the requirements of majors in biochemistry and biophysics. The third course in the series, BB 492/BB 592 focuses on genetic biochemistry, including the synthesis of nucleotides, DNA synthesis and repair, RNA synthesis and processing, and protein synthesis and modification.

**Prerequisites:** (BB 490 with D- or better or BB 590 with D- or better) and (BB 491 [D-] or BB 591 [D-])

**BB 493. BIOCHEMISTRY LABORATORY MOLECULAR TECHNIQUES 1. (3 Credits)**

Laboratory course to accompany BB 450, BB 451 or BB 490, BB 491, BB 492. Lec/lab.

**Prerequisites:** (BB 451 with D- or better or BB 451H with D- or better) or BB 492 with D- or better

**BB 494. BIOCHEMISTRY LABORATORY MOLECULAR TECHNIQUES 2. (3 Credits)**

Laboratory to accompany BB 450, BB 451 or BB 490, BB 491, BB 492. Lec/lab.

**Prerequisites:** BB 493 with D- or better or BB 593 with D- or better or BB 315 with D- or better or BI 315 with D- or better

**BB 496. BIOCHEMISTRY LABORATORY MOLECULAR MODELING. (1 Credit)**

Introduces students from biochemistry and related fields to the fundamentals of computer-based analyses of protein structure and to hands-on manipulation of three-dimensional images.

**Corequisites:** BB 494

**BB 497. BASIC NUCLEIC ACID AND PROTEIN SEQUENCE ANALYSIS. (1 Credit)**

Techniques in computer-based analyses of nucleic acid and protein sequences. Includes some programming and practical experience with web-based and command-line tools.

**Prerequisites:** BB 493 (may be taken concurrently) with D- or better or BB 493H (may be taken concurrently) with D- or better or BB 315 (may be taken concurrently) with D- or better

**BB 498. ASBMB CERTIFICATION EXAM. (0 Credits)**

A comprehensive, standardized test administered by the American Society of Biochemistry and Molecular Biology and used as a direct assessment of the discipline specific knowledge of seniors in the majors administered by the Biochemistry and Biophysics department. A pass will be given to all students who complete the exam. Contact the Biochemistry and Biophysics Program for more information.

**BB 499. SPECIAL TOPICS. (0-16 Credits)**

Topics and credits vary.

*This course is repeatable for 16 credits.*

**BB 501. RESEARCH. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BB 503. THESIS. (1-16 Credits)**

*This course is repeatable for 999 credits.*

**BB 505. READING AND CONFERENCE. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BB 507. SEMINAR. (1-2 Credits)**

Section 1: Descriptions of campus research programs in biochemistry and biophysics, 1 credit fall. Graded P/N. Student presentations of current research literature, 1 credit winter and spring. Should be taken by all entering departmental graduate students. Section 2: Presentation of departmental research seminar, 2 credits any term. PhD candidates in biochemistry and biophysics present a departmental research seminar in the third or fourth year. One registers in the term the seminar is presented.

*This course is repeatable for 16 credits.*

**BB 550. GENERAL BIOCHEMISTRY. (4 Credits)**

Sequence course for students with a limited background in physical chemistry. BB 450/BB 550, three lectures and one recitation. BB 451/BB 551 and BB 452, three lectures.

**BB 551. GENERAL BIOCHEMISTRY. (3 Credits)**

Sequence course for students with a limited background in physical chemistry. BB 450/BB 550, three lectures and one recitation. BB 451/BB 551 and BB 452, three lectures.

**BB 560. ADVANCED CELL BIOLOGY. (3 Credits)**

History and theory of cell biology; microscopy and other techniques to study cells and organelles; membranes; organelles; protein import; cell signaling; cytoskeleton; polarity; cell cycle; stem cells; pattern formation; cancer biology.

**BB 581. MACROMOLECULAR STRUCTURE. (3 Credits)**

An introduction to structural biology, the discipline focused on understanding the structural properties of biological macromolecules—especially proteins and nucleic acids—and relating them to their function. Introduces students to the vocabulary and tools of this discipline, covering both the fundamental physico-chemical principles governing the structure and function of biological macromolecules and a selected set of widely used experimental and theoretical approaches to their characterization. This is done through lectures, and textbook and literature readings. Graduate students receive additional experience in scientific reading, writing and presentation through a literature-based term project.

**BB 582. BIOPHYSICS. (3 Credits)**

Sequence professional course covering quantitative properties of biological systems and biological phenomena using concepts derived from mathematics and physics.

**Prerequisites:** BB 581 with C or better

**BB 583. ADVANCED BIOCHEMISTRY AND BIOPHYSICS: CAPSTONE. (3 Credits)**

Covers applications of advanced biophysical techniques, and how these fit within the larger context of biochemistry, biology and society. Explores techniques and their applications to macromolecules as well as the scientific process. Techniques discussed include in vitro, in vivo, and in silico methods, with an emphasis on biomolecular interactions.

**Prerequisites:** BB 582 with C or better

**BB 584. CHROMATIN AND EPIGENETICS. (3 Credits)**

An in-depth look at "chromatin" (the complex generated by DNA, RNA and complex protein) and how it behaves during gene activation and silencing. Specific examples of long-lasting gene regulation (across cell cycles) will be used to describe the concept of "epigenetic" gene regulation by modification of DNA or proteins. The class will combine more traditional lectures with discussion periods where primary research papers will be analyzed. The target audience is third- and fourth-year students as well as graduate students.

**BB 585. APPLIED BIOINFORMATICS. (3 Credits)**

The fundamentals of bioinformatics are presented, which will enable an understanding of the software and methods used in answering questions in bioinformatics. The student will gain a working knowledge of the bioinformatics analysis of contemporary techniques such as databases, gene and genome annotations, functional annotations, sequence alignment, motif finding, secondary structure prediction, phylogenetic tree construction, high-throughput sequence data, ChIP-Seq peak identification, transcriptome profiling by RNA-Seq, microRNA discovery and target prediction.

**BB 586. ADVANCED MOLECULAR GENETICS. (3 Credits)**

Combines analyses of state-of-the-art primary literature with lectures that give a historical perspective on some of the most important "model" organisms used in biology, i.e. organisms that have been widely used to decipher the general "rules for life" on the planet. These include examples among the bacteria, plants, fungi, worms, flies and mammals.

**BB 590. BIOCHEMISTRY 1: STRUCTURE AND FUNCTION. (3 Credits)**

Sequence professional course to meet the requirements of majors in biochemistry and biophysics. The first course in the series, BB 490/BB 590, covers how the structure and function of biological macromolecules arises from the organic chemistry of their fundamental building blocks. The organic chemistry of biochemistry will be a focus, including the mechanisms by which enzymes catalyze biological reactions.

**BB 591. BIOCHEMISTRY 2: METABOLISM. (3 Credits)**

Sequence professional course to meet the requirements of majors in biochemistry and biophysics. The second course in a series, BB 491/BB 591 covers the mechanisms and regulation of the pathways by which cells break down fuel molecules, conserve some of the released energy in the form of reactive nucleotides, and use this energy to create biological building blocks from simpler metabolites.

**Prerequisites:** BB 590 with C or better

**BB 592. BIOCHEMISTRY 3: GENETIC BIOCHEMISTRY. (3 Credits)**

Sequence professional course to meet the requirements of majors in biochemistry and biophysics. The third course in the series, BB 492/BB 592 focuses on genetic biochemistry, including the synthesis of nucleotides, DNA synthesis and repair, RNA synthesis and processing, and protein synthesis and modification.

**Prerequisites:** BB 590 with C or better and BB 591 [C]

**BB 593. BIOCHEMISTRY LABORATORY MOLECULAR TECHNIQUES 1. (3 Credits)**

Laboratory course to accompany BB 450, BB 451 or BB 490, BB 491, BB 492. Lec/lab.

**BB 594. BIOCHEMISTRY LABORATORY MOLECULAR TECHNIQUES 2. (3 Credits)**

Laboratory to accompany BB 450, BB 451 or BB 490, BB 491, BB 492. Lec/lab.

**BB 599. SPECIAL TOPICS. (0-16 Credits)**

Topics and credits vary.

*This course is repeatable for 16 credits.*

**BB 601. RESEARCH. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BB 603. THESIS. (1-16 Credits)**

*This course is repeatable for 999 credits.*

**BB 605. READING & CONFERENCE. (1-16 Credits)**

*This course is repeatable for 16 credits.*

**BB 607. SEMINAR. (1-2 Credits)**

Section 1: Descriptions of campus research programs in biochemistry and biophysics, 1 credit fall. Graded P/N. Student presentations of current research literature, 1 credit winter and spring. Should be taken by all entering departmental graduate students. Section 2: Presentation of departmental research seminar, 2 credits any term. PhD candidates in biochemistry and biophysics present a departmental research seminar in the third or fourth year. One registers in the term the seminar is presented.

*This course is repeatable for 16 credits.*

**BB 650. SELECTED TOPICS IN BIOCHEMISTRY AND BIOPHYSICS. (3 Credits)**

Nonsequence courses designed to acquaint student with current research in biochemistry and biophysics. Courses include enzyme kinetics, cell cycle and cancer, neurochemistry, oxidative stress, cell adhesion and motility. Most courses offered alternate years.

*This course is repeatable for 18 credits.*

**BB 651. SELECTED TOPICS IN BIOCHEMISTRY AND BIOPHYSICS. (3 Credits)**

Nonsequence courses designed to acquaint student with current research in biochemistry and biophysics. Courses include cell surfaces, enzyme kinetics, metabolism, neurochemistry, trace element metabolism, biological oxidations, and bioenergetics. Most courses offered alternate years.

*This course is repeatable for 18 credits.*

**BB 652. SELECTED TOPICS IN BIOCHEMISTRY AND BIOPHYSICS. (3 Credits)**

Nonsequence courses designed to acquaint student with current research in biochemistry and biophysics. Courses include enzyme kinetics, metabolism, neurochemistry, trace element metabolism, biological oxidations, and bioenergetics. Most courses offered alternate years.

*This course is repeatable for 18 credits.*

**BB 699. SPECIAL TOPICS. (0-16 Credits)**

*This course is repeatable for 16 credits.*