BIOCHEMISTRY (BIOCHEM)

BIOCHEM 100 – BIOCHEMISTRY FRESHMAN SEMINAR
1 credit.

Introduction to the discipline of biochemistry, to the UW Biochemistry Department, to some of the research projects the faculty are pursuing, to the University, and to the career options open to an individual with a biochemistry background.
Requisites: None
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM 104 – MOLECULES TO LIFE AND THE NATURE OF SCIENCE
3 credits.

Introduction to how life works at a molecular level and the evolutionary paths that led to the great diversity of life on our planet. With this foundation, discuss current topics in the news such as: exploring the human genome to understand our species' history and to diagnose and treat disease; genetic engineering of crops in relation to foods safety and effects on ecosystems; gene editing of insects and mammals including humans; how to determine whether herbal remedies, vaccines, etc. are effective and safe; and current trends in biotechnology and what might be on the horizon. Focus on appreciating the nature of science and becoming better equipped to explore and evaluate scientific topics of interest.
Requisites: None
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Elementary
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Understand the nature of science and what science can tell us.
Audience: Undergraduate

2. Gain an appreciation for the beauty of biology and the remarkable diversity of life on earth.
Audience: Undergraduate

3. Discuss fundamentals of the evolutionary process and the molecular basis of how cells and organisms operate.
Audience: Undergraduate

4. Appreciate the range of how science is presented and sometimes misrepresented in the media.
Audience: Undergraduate

5. Equip students with the ability to inform their own decision making as they encounter scientific topics that may influence their daily life.
Audience: Undergraduate

BIOCHEM 289 – HONORS INDEPENDENT STUDY
1-2 credits.

Research work for Honors students under direct guidance of a Biochemistry faculty member. Students are responsible for arranging the work and credits with the supervising instructor.
Requisites: Consent of instructor
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2016

BIOCHEM 299 – INDEPENDENT STUDY
1-3 credits.

Research work for students under direct guidance of a Biochemistry faculty member. Students are responsible for arranging the work and credits with the supervising instructor.
Requisites: Consent of instructor
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM 301 – SURVEY OF BIOCHEMISTRY
3 credits.

Explore the basic chemical properties of proteins, lipids, carbohydrates, and nucleic acids. Topics to be discussed include protein structure and function, the chemical logic of metabolism, and the mechanisms of DNA replication, DNA transcription, DNA repair, and gene expression. Understand principles and themes in biochemistry that relate to metabolic diseases, drug design, virus infection and vaccination, and gene therapy. Does not cover the foundational material necessary to succeed in additional biochemistry coursework, and is not likely to be acceptable for medical or veterinary school admission.
Requisites: CHEM 104, 109, or 116. Not open to students with credit for BIOCHEM 501.
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Apply basic concepts of protein and enzyme structure and function
Audience: Undergraduate

2. Differentiate structures of lipids and their biochemical roles
Audience: Undergraduate

3. Differentiate structures of carbohydrates and their biochemical roles
Audience: Undergraduate

4. Differentiate structures of nucleic acids and their biochemical roles
Audience: Undergraduate

5. Apply chemical concepts involved in both anabolic and catabolic pathways
Audience: Undergraduate

6. Explain basics of gene expression and regulation
Audience: Undergraduate

7. Describe fundamentals of cancer and certain viral diseases
Audience: Undergraduate

BIOCHEM 375 – SPECIAL TOPICS
1-4 credits.

Examines various special topics in biochemistry. Topics and content will vary each semester and by section of the course.
Requisites: None
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM 399 – COORDINATIVE INTERNSHIP/COOPERATIVE EDUCATION
1-8 credits.

An internship under guidance of a faculty or instructional academic staff member in Biochemistry and internship site supervisor. Students are responsible for arranging the work and credits with the faculty or instructional academic staff member and the internship site supervisor.
Requisites: Consent of instructor
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Workplace - Workplace Experience Course
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2020

BIOCHEM 400 – STUDY ABROAD IN BIOCHEMISTRY
1-6 credits.

Provides an area equivalency for courses taken on Madison Study Abroad Programs that do not equate to existing UW courses. Enrollment in a UW-Madison resident study abroad program
Requisites: None
Repeatable for Credit: Yes, unlimited number of completions

BIOCHEM 501 – INTRODUCTION TO BIOCHEMISTRY
3 credits.

Chemistry, nutrition, and metabolism of biological systems.
Requisites: (CHEM 341, 343, or concurrent enrollment), or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM 507 – GENERAL BIOCHEMISTRY I
3 credits.

Chemistry of biological materials, intermediary metabolism and protein structure.
Requisites: CHEM 345
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM 508 – GENERAL BIOCHEMISTRY II
3-4 credits.

Biosynthesis of biological molecules, signal transduction mechanisms, chemistry and metabolism of nucleic acids, protein synthesis, and molecular and cellular biology.
Requisites: BIOCHEM 507
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM/NUTR SCI 510 – NUTRITIONAL BIOCHEMISTRY AND METABOLISM
3 credits.

Lectures in nutrition with a substantial background in biochemistry. Emphasis on biochemical and physiological fundamentals of nutrition. Discussion of protein, fat, carbohydrate, energy, minerals and vitamins and their roles and interrelationships in nutrition and metabolism.
Requisites: BIOCHEM 301, 501, 507, BMOLCHEM 503, or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Understand nutrient metabolism in normal and disease states
Audience: Both Grad & Undergrad

2. Integrate the regulation of metabolism of nutrients under normal and disease state conditions.
Audience: Both Grad & Undergrad

3. Understand the biochemical and molecular functions of nutrients we consume
Audience: Both Grad & Undergrad

4. Apply how nutrients affect pathogenesis and health
Audience: Graduate

5. Think critically about nutrient claims and fads using your knowledge of nutritional biochemistry.
Audience: Both Grad & Undergrad

6. Integrate current research in the area of metabolism and micronutrient function into existing knowledge and formulate new hypotheses to guide future research
Audience: Graduate

BIOCHEM 551 – BIOCHEMICAL METHODS
4 credits.

Introduction to modern biochemical laboratory techniques and current biochemical literature. Includes student seminar presentations based upon scientific literature that parallels experiments performed in the lab.
Requisites: BIOCHEM 501, 507, or concurrent enrollment
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM/NUTR SCI 560 – PRINCIPLES OF HUMAN DISEASE AND BIOTECHNOLOGY
2 credits.

Covers basic and applied biochemical principles related to human disease. Topics such as: cancer, including cell cycle regulation, oncogenes and tumor suppressors, and cellular metabolism; metabolic disorders, including cardiovascular disease, metabolic syndrome, and diabetes; biotechnology, including metabolomics, CRISPR-based genetic screens, and experimental models of human disease.
Requisites: BIOCHEM 501, 507, or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Critically evaluate, and accurately describe findings from primary research publications
Audience: Both Grad & Undergrad

2. Analyze how genetic and cell cycle perturbations contribute to cancer progression
Audience: Both Grad & Undergrad

3. Identify how genetic and environmental factors impact altered cellular metabolism in cancer
Audience: Both Grad & Undergrad

4. Describe biochemical mechanisms that contribute to cardiovascular disease, metabolic syndrome, and diabetes
Audience: Both Grad & Undergrad

5. Explain biochemical techniques, engineering strategies, and state-of-the-art technologies used in biomedical research
Audience: Both Grad & Undergrad

6. Collaborate with peers in a small group
Audience: Both Grad & Undergrad

7. Apply knowledge of biochemical principles and biotechnology to solve research and disease treatment related problems
Audience: Both Grad & Undergrad

8. Execute written critical evaluation of primary research literature related to the molecular basis of human diseases and advances in biotechnology.
Audience: Graduate

BIOCHEM 570 – COMPUTATIONAL MODELING OF BIOLOGICAL SYSTEMS
3 credits.

Introduction to the mathematical and computational tools needed to model biological systems spanning from molecules to ecosystems. Topics include protein folding and dynamics, gene regulation, biomolecular networks, and population dynamics. Teaches the fundamentals in quantitative thinking and analytical reasoning about complex biological systems.
Requisites: (MATH 217 or 221) and BOTANY/BIOLOGY/ZOOLOGY 151, ZOOLOGY 153, BIOCORE 381, or (ZOOLOGY/BIOLOGY 101, 102 and BOTANY/BIOLOGY 130), or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Perform scientific computations in the Python programming language
Audience: Both Grad & Undergrad

2. Design, simulate, and analyze mathematical models of biological systems
Audience: Both Grad & Undergrad

3. Understand how to model biological systems across different scales
Audience: Both Grad & Undergrad

4. Think critically about model assumptions/validity
Audience: Both Grad & Undergrad

5. Communicate scientific findings in oral and written form
Audience: Both Grad & Undergrad

6. Integrate current research in the area of computational modeling of biological systems into existing knowledge and formulate new hypotheses to guide future research.
Audience: Graduate

BIOCHEM/M M & I 575 – BIOLOGY OF VIRUSES
2 credits.

Broad coverage of animal virology taught at molecular level. Topics include virus structure, viral replication/lifecycle, aspects of pathogenesis and prevention.
Requisites: (BIOCORE 381 and 382), ZOOLOGY/BIOLOGY/BOTANY 151, M M & I 301, or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Identify and recognize fundamental members of the predominant families of RNA and DNA viruses that affect animals (humans included) by causing viral diseases, including AIDS, cancer, flu, and COVID-19
Audience: Both Grad & Undergrad

2. Describe and demonstrate the basic concepts of virus particle structure and the biochemical mechanisms for entry and multiplication of diverse RNA and DNA viruses
Audience: Both Grad & Undergrad

3. Recognize and apply the basic principles of virus transmission and viral pathogenicity, combined with the factors that contribute to virus emergence and evolution, to situations involving virus outbreaks that affect global health
Audience: Both Grad & Undergrad

4. Identify and evaluate individual steps in a virus' replication cycle that can be effectively targeted by anti-viral drugs for pharmaceutical intervention of virus diseases
Audience: Both Grad & Undergrad

5. Design effective strategies for a) prevention of infection through development of viral vaccines and b) treatment of diverse human diseases by gene therapy through the design and administration of genetically engineered virus vectors
Audience: Both Grad & Undergrad

6. Use knowledge gained in lecture to critically assess primary literature and data presented in the weekly Molecular Virology Seminar Series
Audience: Graduate

BIOCHEM 601 – PROTEIN AND ENZYME STRUCTURE AND FUNCTION
2 credits.

Protein structure and dynamics. Protein folding. Physical organic chemistry of enzymatic catalysis. Analysis of enzyme kinetics and receptor-ligand interactions. Enzymatic reaction mechanisms.
Requisites: CHEM 345 and (BIOCHEM 501 or 507) or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

BIOCHEM/B M I/BMOLCHEM/MATH 609 – MATHEMATICAL METHODS FOR SYSTEMS BIOLOGY
3 credits.

Provides a rigorous foundation for mathematical modeling of biological systems. Mathematical techniques include dynamical systems and differential equations. Applications to biological pathways, including understanding of bistability within chemical reaction systems, are emphasized.
Requisites: MATH 415 and (MATH 320, 340, 341, or 375) or graduate/professional standing or member of the Pre-Masters Mathematics (Visiting International) Program
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Recall and state the formal definitions of the mathematical objects and their properties in systems biology (e.g., reaction networks, reaction rate equations, mass-action kinetics models, detailed balanced and complex balanced systems, Lyapunov functions, etc.).
Audience: Both Grad & Undergrad

2. Use such definitions to argue that a mathematical object does or does not have the condition of being a particular type or having a particular property (e.g., reversible, weakly reversible, mass-action, detailed balanced, complex balanced, globally stable, oscillatory, persistent, permanent, etc.).
Audience: Both Grad & Undergrad

3. Recall and state the standard theorems of the field (e.g., the Horn-Jackson theorem, the deficiency zero theorem, theorems on characterization of mass-action systems, theorems on persistence and permanence, theorems on dynamical equivalence, etc.) and recall the arguments for these theorems and the underlying logic of their proofs.
Audience: Both Grad & Undergrad

4. Construct mathematical arguments related to the above definitions, properties, and theorems, including the construction of examples and counterexamples.
Audience: Both Grad & Undergrad

5. Convey arguments using English and appropriate mathematical terminology, notation and grammar.
Audience: Both Grad & Undergrad

6. Model real biological systems by means of systems of differential equations, and be able to use software (such as Matlab) for visualization of their dynamics. Example models could include: (i) Enzymes, substrates and saturating kinetics, (ii) Glycolytic oscillations, (iii) Cell cycle control, budding yeast cell cycle models, (iv) Activator-inhibitor and positive feedback systems.
Audience: Both Grad & Undergrad

7. Identify applications of course content in current areas of research.
Audience: Graduate

BIOCHEM/GENETICS/MICROBIO 612 – PROKARYOTIC MOLECULAR BIOLOGY
3 credits.

Molecular basis of bacterial physiology and genetics with emphasis on molecular mechanisms; topics include nucleic acid-protein interactions, transcription, translation, replication, recombination, regulation of gene expression.
Requisites: (BIOCHEM 501 or 507) and (MICROBIO 470, GENETICS 466 or 468) or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Access and evaluate original research literature.
Audience: Undergraduate

2. Demonstrate problem solving practices.
Audience: Undergraduate

3. Identify enzyme mechanisms responsible for transcription, translation, gene regulation, and replication in bacteria.
Audience: Graduate

4. Compare the structural bases for the mechanisms.
Audience: Graduate

5. Evaluate the experiments that led to our understanding of theses mechanisms.
Audience: Graduate

6. Deconstruct how these enzymes respond to nutritional and environmental signals in cells.
Audience: Graduate

7. Outline the evolutionary basis and selection pressure for these mechanisms in vivo.
Audience: Graduate

BIOCHEM/NUTR SCI 619 – ADVANCED NUTRITION: INTERMEDIARY METABOLISM OF MACRONUTRIENTS
3 credits.

Discuss metabolic control; gastrointestinal physiology, nutrient absorption; molecular, cellular, organismal aspects of glucose transport, metabolism, regulation; fuel sensing; molecular regulation of fatty acid, lipid metabolism; cellular, organismal aspects of protein metabolism; hormonal control of metabolism; experimental approaches for studying metabolism.
Requisites: NUTRI SCI 510, BIOCHEM 507, 508, or BMOLCHEM 503 or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM/GENETICS/MD GENET 620 – EUKARYOTIC MOLECULAR BIOLOGY
3 credits.

Focuses on the basic molecular mechanisms that regulate DNA, RNA, and protein metabolism in eukaryotic organisms.
Requisites: BIOCHEM 501, 508 or graduate/professional standing
Course Designation: Level - Intermediate
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024
Learning Outcomes: 1. Recall core principles that govern the structure and function of DNA, RNA, and protein.
Audience: Both Grad & Undergrad

2. Describe techniques for quantifying the expression, interaction, and cellular localization of specific molecules and for determining their necessity and sufficiency in molecular processes.
Audience: Both Grad & Undergrad

3. Explain how molecular processes that control the synthesis, decay, interactions, localization, folding, and modification of molecules are silenced, initiated, maintained, and terminated.
Audience: Both Grad & Undergrad

4. Describe how information is transferred between molecules to alter cellular activity in response to developmental and environmental signals.
Audience: Both Grad & Undergrad

5. Critique and weigh the credibility of existing molecular data.
Audience: Both Grad & Undergrad

6. Develop and draw hypotheses that use existing data to account for as yet unexplained molecular processes in eukaryotic organisms.
Audience: Both Grad & Undergrad

7. Design discovery/observation, loss-of-function, and gain-of-function experiments to test molecular hypotheses.
Audience: Both Grad & Undergrad

8. Implement problem solving strategies in thesis research project.
Audience: Graduate

BIOCHEM/BOTANY 621 – PLANT BIOCHEMISTRY
3 credits.

Biochemistry of photosynthesis, respiration, cell walls, and other metabolic and biosynthetic processes in plants.
Requisites: BIOCHEM 501, 507, or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023

BIOCHEM 625 – MECHANISMS OF ACTION OF VITAMINS AND MINERALS
2 credits.

Emphasizes the importance of coenzyme and cofactors of enzymes (i.e., vitamins and minerals) in biochemistry. All aspects of the biochemistry of coenzymes will be covered, including their biosynthesis as far as is known, the biochemical reactions they catalyze, their chemical and spectroscopic properties, and the mechanisms by which they facilitate biochemical reactions.
Requisites: CHEM 345 and (BIOCHEM 501, 507, or concurrent enrollment), or graduate/professional standing
Course Designation: Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM/GENETICS 631 – PLANT GENETICS AND DEVELOPMENT
3 credits.

Covers the basic concepts of genetics and genomics as applied to plants and their development, including discussions on breeding systems (modes of reproduction, sex determination, self incompatibility and crossing barriers), linkage analysis, genome structure and function (structure, function and evolution of nuclear and organellar chromosomes; haploidy and polyploidy; expression regulation and epigenetics), along with a description of current methodologies used in the analysis of these processes within the context of plant development. The objective is to instigate a broader knowledge and understanding of the principles and methodologies used in plant genetics and their applications in investigations of the molecular mechanisms that modulate plant development.
Requisites: GENETICS 466, 468, BIOCORE 587, or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Identify the genetic and molecular mechanisms that modulate breeding systems in plants including sex determination, self-incompatibility, crossing barriers and apomixis.
Audience: Undergraduate

2. Explain the concepts of recombination, linkage and expression regulation, and apply them to map genes and identify examples of segregation distortion and gene drive.
Audience: Undergraduate

3. Describe the techniques used in forward genetics, reverse genetics, mosaic analysis and reverse breeding, and implement them in studies of plant growth, development, reproduction and environmental responses.
Audience: Undergraduate

4. Recognize examples of organellar genetics in plants, and discuss their importance in plant-breeding and crop-improvement programs.
Audience: Undergraduate

5. Discuss the structure of plant chromosomes and their behaviors in aneuploids.
Audience: Undergraduate

6. Examine the genetic basis of quantitative traits, and identify contributing loci using genome-wide association studies.
Audience: Undergraduate

7. Compare and contrast published experimental data that address specific biological questions in plants, use the corresponding information to develop novel hypotheses, and design experiments that test these hypotheses.
Audience: Undergraduate

BIOCHEM/NUTR SCI 645 – MOLECULAR CONTROL OF METABOLISM AND METABOLIC DISEASE
3 credits.

Examination of various physiological states and how they affect metabolic pathways. Discussion of a number of special topics related to the unique roles of various tissues and to metabolic pathways in disease states, including adipocyte biology, beta-cell biology, epigenetics, inflammation, and aging related diseases.
Requisites: BIOCHEM 501, 508 or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: No
Last Taught: Fall 2023

BIOCHEM 681 – SENIOR HONORS THESIS
2-4 credits.

First semester of individual study for undergraduate students in an Honors program completing a thesis in the area of Biochemistry, as arranged with a Biochemistry faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM 682 – SENIOR HONORS THESIS
2-4 credits.

Second semester of individual study for undergraduate students in an Honors program completing a thesis in the area of Biochemistry, as arranged with a Biochemistry faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Honors Only Courses (H)
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM 691 – SENIOR THESIS
2 credits.

First semester of individual study for undergraduate students completing a thesis in the area of Biochemistry, as arranged with a Biochemistry faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

BIOCHEM 692 – SENIOR THESIS
2 credits.

Second semester of individual study for undergraduate students completing a thesis in the area of Biochemistry, as arranged with a Biochemistry faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM 699 – SPECIAL PROBLEMS
1-4 credits.

Provides academic credit for research, library, and/or laboratory work under direct guidance of a faculty member. Students are responsible for arranging the work and credits with the supervising faculty member.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM/BMOLCHEM 701 – RESPONSIBLE CONDUCT IN BIOSCIENCE RESEARCH
2 credits.

Introductory training in the practical aspects of being a graduate-level scientist and the professional standards and expectations of ethical researchers. Covers a wide variety of professional development topics, including choosing a research laboratory and a thesis mentor, transitioning to self-education, managing stress in graduate school, and the importance of diversity in science. Ethics topics include conflicts of interest, the protection of human subjects, the welfare of laboratory animals and workers, safe laboratory spaces, mentor and mentee responsibilities, collaborative research, peer review, data acquisition and data management practices, research misconduct, responsible authorship and publication, contemporary ethical issues in biomedical research, and the roles of responsible scientists in society. Covers all NIH-recommended topics for Responsible Conduct of Research, thus meeting the requirements for trainees involved in NIH-sponsored research programs.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Evaluate and apply fundamental concepts and best practices in bioscience research conduct and research ethics
Audience: Graduate

2. Identify and meet individual and professional responsibilities and obligations to society
Audience: Graduate

3. Explore and implement activities for professional skills development and career management
Audience: Graduate

BIOCHEM/CHEM 704 – CHEMICAL BIOLOGY
3 credits.

Chemistry and biology of proteins, nucleic acids and carbohydrates; application of organic chemistry to problems in cell biology, biotechnology, and biomedicine.
Requisites: Declared in Biochemistry or Chemistry graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Be able to describe the chemical basis for replication, transcription, translation and how each of these central processes can be expanded to include new chemical matter.
Audience: Graduate

2. Develop skills to critically read the literature and effectively communicate research in a peer setting.
Audience: Graduate

3. Describe the substance and importance of chemical biology research in the format of a cover letter to a journal editor, and an original figure.
Audience: Graduate

4. Demonstrate knowledge of chemical biology by designing an original research project that focuses on answering a biological question or solving a biomedical problem.
Audience: Graduate

BIOCHEM 719 – FROM ATOMS TO MOLECULES
3 credits.

Topics covered include protein structure and folding, protein dynamics, biological catalysis, membrane structure and assembly, nucleic acid structure and folding, and bioenergetics. Each topic includes discussion of the primary literature, hypothesis generation, experimental design, data, analysis and interpretation underlying the facts in the textbook. Supports transition from undergraduate consumers of knowledge to graduate students and future independent scientists who will discover and add new knowledge.
Requisites: Declared in Biochemistry PhD program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Understand the chemical principles underlying the structure, dynamics, interaction, and function of biological molecules
Audience: Graduate

2. Design experiments to test a particular hypothesis using various techniques
Audience: Graduate

3. Analyze, interpret, test, and share experimental data
Audience: Graduate

4. Understand how biochemical principles are derived from primary experimental data and practice developing broader biochemical insights from experimental data
Audience: Graduate

BIOCHEM 721 – BIOCHEMICAL COMMUNICATION
2 credits.

Introduction to written and visual communication of biochemical research, both to other scientists and to general audiences, including: how to recognize and adapt work to different audiences; how to construct a scientific argument and the different strategies used for research reports, reviews, and proposals; and how to create figures and posters that clearly convey scientific data and concepts. Learn about the peer review process and revision of scientific writing. An intensive writing component, which requires multiple written and visual documentation on topics related to thesis research.
Requisites: Declared in Biochemistry PhD program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2023
Learning Outcomes: 1. Differentiate different types of scientific writing, including the goals, audience and components of research papers, review articles, and proposals
Audience: Graduate

2. Analyze the structure of scientific arguments
Audience: Graduate

3. Write about their own research and field of science, both retrospectively (research papers and review articles) and prospectively (proposal), utilizing the strategies previously identified to synthesize data or the literature, organize the work, and construct a convincing scientific argument at the appropriate level for the target audience to demonstrate mastery of these concepts
Audience: Graduate

4. Create figures that clearly, accurately, and concisely convey scientific information to support the written words
Audience: Graduate

5. Revise their scientific writing to improve clarity, organization, language, and to better achieve the rhetorical goals of the piece
Audience: Graduate

6. Develop a scientific poster to visually and orally communicate scientific data and results
Audience: Graduate

7. Compose one piece targeted to non-scientists
Audience: Graduate

BIOCHEM 729 – ADVANCED TOPICS
1-3 credits.

Specialized subjects of current interest.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM 800 – PRACTICAL NUCLEAR MAGNETIC RESONANCE THEORY
2 credits.

Multiple pulse Nuclear Magnetic Resonance (NMR), off-resonance effects, composite and shaped pulses, product operators, coherence transfer, one- and two-dimensional NMR, phase cycling, multiple quantum coherence, and cross relaxation.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

BIOCHEM 801 – BIOCHEMICAL APPLICATIONS OF NUCLEAR MAGNETIC RESONANCE
2 credits.

Survey of current solution-state nuclear magnetic resonance techniques used in biochemical research; the emphasis will be on how data are acquired and on practical applications.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2020

BIOCHEM/BOTANY/GENETICS 840 – REGULATORY MECHANISMS IN PLANT DEVELOPMENT
3 credits.

Molecular mechanisms whereby endogenous and environmental regulatory factors control development; emphasis on stimulus perception and primary events in the signal chain leading to modulated gene expression and cellular development.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2020

BIOCHEM/CHEM 872 – SELECTED TOPICS IN MACROMOLECULAR AND BIOPHYSICAL CHEMISTRY
1-3 credits.

Various selected topics in contemporary macromolecular or biophysical chemistry.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM/NUTR SCI 901 – SEMINAR-NUTRITION AND METABOLISM (ADVANCED)
1 credit.

Presentation of original research results; discussion of recent articles in animal metabolism and nutrition.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

BIOCHEM 906 – TOPICS IN MODELING FOR BIOCHEMICAL SYSTEMS
1 credit.

Discuss topics relevant to predictive modeling of bioenergy systems. Present talks and lead brainstorming sessions intended to sharpen skills at cross-disciplinary communication. Modeling microbes and plants at the genetic, molecular and systems level is emphasized.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2016

BIOCHEM 909 – SEMINAR-ENZYMOLOGY (ADVANCED)
1 credit.

Research reports, special topics, and reports from recent literature in enzymology and enzyme mechanisms.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2016

BIOCHEM 910 – SEMINAR-MOLECULAR VIROLOGY (ADVANCED)
1 credit.

Research reports, special topics, and reports from recent literature in molecular virology.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

BIOCHEM 912 – SEMINAR-MOLECULAR MECHANISMS OF DEVELOPMENT
1 credit.

Classical and current papers concerning molecular and genetic mechanisms of eukaryotic development will be presented and discussed.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2018

BIOCHEM/BMOLCHEM 913 – SEMINAR-RIBOGROUP (ADVANCED)
1 credit.

Student-led discussions of RNA-related problems.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Develop an understanding of current research questions in the field of RNA biology
Audience: Graduate

2. Become familiar with the approaches used to study RNA and its interactions with proteins
Audience: Graduate

3. Build a professional network with other RNA biologists on campus
Audience: Graduate

4. Develop techniques for presenting complex concepts to a diverse audience
Audience: Graduate

BIOCHEM/BMOLCHEM/M M & I 914 – SEMINAR-MOLECULAR BIOSCIENCES (ADVANCED)
1 credit.

During the fall semester, molecular biosciences trainees who have not achieved dissertator status will present seminars based primarily on literature related to their projects. During the spring semester, molecular biosciences trainees with dissertator status will present seminars based upon their own research.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2020
Learning Outcomes: 1. Identify and summarize key aspects of scientific rigor and reproducibility, including determination of sample size, statistical significance, measures of outliers, and experimental replicates
Audience: Graduate

2. Describe the features of high quality presentations and best practices in scientific data/information interpretation
Audience: Graduate

3. Apply and demonstrate best practices in the effective presentation of complex data/information to diverse scientific audiences
Audience: Graduate

BIOCHEM/B M E/B M I/CBE/COMP SCI/GENETICS 915 – COMPUTATION AND INFORMATICS IN BIOLOGY AND MEDICINE
1 credit.

Participants and outside speakers will discuss current research in computation and informatics in biology and medicine. This seminar is required of all CIBM program trainees.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Discuss how methods from computer science, statistics, information science and engineering are applied to problems in biology, medicine and population health
Audience: Graduate

2. Recognize and be able to define applications in translational bioinformatics, clinical informatics and public health informatics
Audience: Graduate

BIOCHEM 916 – CELLULAR MECHANISMS OF PROTEIN BIOGENESIS AND TRAFFICKING
1 credit.

Recent literature relating to cellular aspects of the regulation of protein biogenesis including protein synthesis, folding, modification, degradation and trafficking, as well as function of molecular chaperones, will be presented and discussed.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2019

BIOCHEM/MICROBIO 917 – REGULATION OF GENE EXPRESSION (ADVANCED SEMINAR)
1 credit.

Analysis of recent literature in topics related to prokaryotic and eukaryotic gene regulation, including regulation of transcription, translation, and genome organization.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2024

BIOCHEM/CHEM 918 – SINGLE MOLECULE APPROACHES TO BIOLOGY
1 credit.

A combination of recent literature and original research presentations relating to the use of single molecule techniques in biochemistry including fluorescence microscopy, tethered particle motion, patch-clamping, cryo-electron microscopy, optical trapping, magnetic tweezers, and super resolution microscopy.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

BIOCHEM 919 – SYNTHETIC BIOLOGY SEMINAR
1 credit.

Synthetic biology is a burgeoning field encompassing understanding and designing biological systems spanning from biomolecules to ecosystems. It builds on advances in molecular and cellular technologies to revolutionize biological engineering in the same way that organic synthesis transformed chemistry and integrated circuit design transformed computing. Synthetic biology has the potential to address many of society's grand challenges including: understanding human disease, sustainable biomanufacturing, medical diagnostics and therapeutics, programming mammalian cell behaviors, engineering living materials, information storage, carbon sequestration, and energy generation. Latest advances in the field will be reviewed by covering literature including but not limited to biomolecular design, sequence-structure-function relationship, regulatory and signaling networks, metabolic engineering, interactions in microbial communities, cell-based therapeutics and genome design.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Critically analyze data and conclusions reported in current literature on synthetic biology
Audience: Graduate

2. Summarize and present the findings of a scientific article
Audience: Graduate

3. Lead and contribute productively to discussions of current research in the field
Audience: Graduate

BIOCHEM 924 – MEMBRANE PROTEIN STRUCTURE AND FUNCTION
1 credit.

Membrane proteins comprise over a fourth of proteins encoded in any given genome, providing many vital functions to all cells. For example, ion channels and pumps modulate the membrane potential and help conduct information via nerves and other long distance conducting tissue. Transporters mediate the uptake and secretion of molecules. Receptors, such as G protein coupled receptors and receptor protein kinases, transfer information about the environment to the inside of the cell. Membrane proteins also contribute to the shape of the cell, the structure of the membrane and a myriad of other functions. Structure/function relationships for this critical class of proteins are discussed, addressing questions such as "how do membrane proteins fold?", "how do certain important classes of membrane proteins work?", "what are the challenges in studying membrane proteins" and "what methods are available for studying their biophysical properties?"
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024
Learning Outcomes: 1. Synopsize recent and classic research literature about membrane proteins structure and function, including relevant methods, biological systems, or general principles.
Audience: Graduate

2. Critically analyze data and conclusions presented in research literature, present it with clarity and discuss it with peers.
Audience: Graduate

BIOCHEM/CBE 932 – BIOTECHNOLOGY TRAINING PROGRAM SEMINAR
1 credit.

Biotechnology Training Program trainees will present their research for critical review by audience.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024

BIOCHEM/CHEM 945 – SEMINAR-CHEMICAL BIOLOGY (ADVANCED)
1 credit.

Presentations and discussions of recently published research in chemical biology and related areas.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Fall 2023

BIOCHEM 990 – RESEARCH
1-12 credits.

Independent laboratory research in preparation of a graduate thesis or dissertation under supervision of a faculty member.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2024