

# BIOCHEMISTRY AND MOLECULAR BIOLOGY

Biochemistry, the central scientific discipline linking the chemical, physical and biological sciences, exerts a profound influence on the progress of medicine and agriculture. By applying concepts and methods of chemistry and physics to the fundamental problems of biology, biochemists have made great progress in their effort to understand the chemistry of living organisms. Major discoveries concerning the biochemistry of genetic material provide the tools of molecular biology that are essential to contemporary life sciences research.

Biochemists and molecular biologists are concerned with living things and thus must be fluent in the concepts of biological sciences. Since a biochemist's tools include many techniques derived from the physical sciences, they must receive sound education in mathematics, physics and chemistry. Our academic programs are designed to integrate these disciplines, preparing students for a wide range of professional careers.

Challenging positions for well-trained biochemists and molecular biologists are available in colleges and universities, state and federal laboratories, research institutes, medical centers and in an increasing number of industrial organizations, particularly in the pharmaceutical and food industries. Biochemists are involved with research on the chemistry of processes occurring in plants, animals and various microorganisms, and with the discovery and development of antibiotics, vitamins, hormones, enzymes, insecticides and molecular genetics techniques.

The Department of Biochemistry and Molecular Biology administers two BS degree options in Biochemistry and Molecular Biology through the College of Agricultural Sciences and Natural Resources. In 2023, the two BS degree options administered through the College of Agricultural Sciences and Natural Resources became accredited by the American Society of Biochemistry and Molecular Biology. This provides students taking these degree options an opportunity to take the American Society of Biochemistry and Molecular Biology certification exam. An honors program is also available in undergraduate degree plans. Also available is a 4+1 Year Masters by Coursework program. The undergraduate curriculum provides a broad background in chemistry and the biological sciences and permits flexibility to meet particular interests of the student. Courses in biochemistry are based on general, organic and analytical chemistry. The undergraduate curriculum also provides students with sufficient background in the basic sciences of mathematics, physics, chemistry and biology needed for graduate study in most disciplines of contemporary science of agriculture or medicine and other allied health subjects, and is excellent for pre-professional students. The Department's research activities provide opportunities for part-time employment of undergraduate majors to improve their professional competence.

## Minor in Biochemistry and Molecular Biology

This minor is designed to give students a firm background in the fundamentals of Biochemistry and Molecular Biology and to develop critical thinking skills for the interpretation of new findings in these disciplines. Students will gain primary knowledge in modern biochemistry through two lecture courses (BIOC 3713 (<http://catalog.okstate.edu/search/?P=BIOC%203713>) Biochemistry I and BIOC 3813 (<http://catalog.okstate.edu/search/?P=BIOC%203813>) Biochemistry II). Hands-on training with experimental tools of these disciplines will be

emphasized during the Biochemistry and Molecular Biology laboratory course (BIOC 3723 (<http://catalog.okstate.edu/search/?P=BIOC%203723>) Biochemistry and Molecular Biology Laboratory). The knowledge gained by this minor gives a science educator, a laboratory technician, an industrial employee or a life sciences researcher the ability to apply these disciplines. This minor will also demonstrate competency in these disciplines to post-graduate health institutions.

## Courses

### BIOC 1113 Drugs, Medications and Human Well-Being (N)

**Description:** Influence of medications and illegal drugs on our health. Explores the medications used to treat cancers, diabetes, microbial infections, heart and mental diseases. Abused drugs, such as alcohol, caffeine, opioids and cannabis and their effects are also covered. Course is designed for non-majors.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**General Education and other Course Attributes:** Natural Sciences

### BIOC 1990 Freshman Research in Biochemistry and Molecular Biology

**Description:** An introduction to biochemical research through guided work on a relevant experimental problem. Offered for variable credit, 1-2 credits, max 2.

**Credit hours:** 1

**Contact hours:** Lab: 2 Contact: 2

**Levels:** Undergraduate

**Schedule types:** Lab

**Department/School:** Biochem & Molecular Biology

### BIOC 2101 The Experiments Behind the Facts of Real Science

**Prerequisites:** BIOL 1114 or (BIOL 1113 and BIOL 1111) and CHEM 1515.

**Description:** Introduction to research through the study of primary research papers.

**Credit hours:** 1

**Contact hours:** Lecture: 1 Contact: 1

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

### BIOC 2202 Medicine and Molecules

**Description:** Examination of specific diseases at all scales, from the biology of the causal agent to global impacts. The molecular biology of the agent, interactions with the human body, and the etiology, epidemiology, history and current state of the disease, ethical considerations, and prospects and cures.

**Credit hours:** 2

**Contact hours:** Lecture: 2 Contact: 2

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 2344 Chemistry and Applications of Biomolecules****Prerequisites:** CHEM 1225 or CHEM 1515.**Description:** A descriptive survey of organic functional groups and biomolecules. Mode of formation and function of these molecules in microorganisms, plants and animals as they relate to biotechnology, environmental sciences and health related issues. A terminal course for students in applied biological science education. Not recommended for pre-professional students or students planning graduate study in biological sciences.**Credit hours:** 4**Contact hours:** Lecture: 3 Contact: 4 Other: 1**Levels:** Undergraduate**Schedule types:** Discussion, Combined lecture & discussion, Lecture**Department/School:** Biochem & Molecular Biology**BIOC 2352 Fundamental Biochemistry****Prerequisites:** BIOC 1114 and CHEM 1515.**Description:** Connect knowledge of organic chemistry to biochemistry to better understand and appreciate the chemical principles in forming bimolecular structures and functions.**Credit hours:** 2**Contact hours:** Lecture: 2 Contact: 2**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 3003 Hypothesis-Driven Undergraduate Research****Prerequisites:** Consent of instructor.**Description:** Directed research projects with faculty members in biochemistry and molecular biology. Identify a research question, develop a hypothesis, experimental approach, perform the experiments, and summarize their results in oral and written forms.**Credit hours:** 3**Contact hours:** Lab: 6 Contact: 6**Levels:** Undergraduate**Schedule types:** Lab**Department/School:** Biochem & Molecular Biology**BIOC 3153 Synthetic Biology****Prerequisites:** BIOL 1114 or (BIOL 1113 and BIOL 1111) and (CHEM 3013 or CHEM 3053).**Description:** Engineering of living systems at the molecular, cellular, and organismal levels: Origin of cellular life; reading and writing DNA; enzyme evolution; metabolic engineering. Applications to current and future biotechnologies in agriculture and medicine: Food and drug synthesis; biofuels; vaccines. This course is designed for both majors and non-majors of biochemistry and molecular.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 3223 Physical Chemistry for Biologists****Prerequisites:** CHEM 1515, (MATH 2123 or MATH 2144), and (PHYS 1114 or PHYS 2014) or consent of instructor.**Description:** Classical and statistical thermodynamics with applications to pure systems, solutions and electrochemistry; transport; chemical and enzyme kinetics, quantum chemistry of structure and chemical bond; and spectroscopy all with emphasis on biological applications. Previously offered as BIOC 4224 and BIOC 3224.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 3523 Biochemistry of Disease at the Cellular Level****Prerequisites:** BIOC 3653 or BIOC 3713 and MICR 3033 and BIOL 3023 or ANSI 3423 or PLNT 3554 or consent of instructor.**Description:** The biochemistry of fundamental processes in normal and disease states of eukaryotic cells. Explores the cell and molecular, and biochemical mechanisms of intracellular protein trafficking, cytoskeleton, cell adhesion, mitosis, cell cycle, cytokinesis, cellular stress responses, and apoptosis and in a variety of diseases including cancers, progeria (premature aging), Alzheimer's, Amyotrophic lateral sclerosis (ALS), high cholesterol, and diabetes. May not be used for Degree Credit with BIOC 5523. Previously offered as BIOC 4523.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 3653 Survey of Biochemistry****Prerequisites:** CHEM 3013 or CHEM 3053.**Description:** An introduction to the chemistry of living systems. Chemical properties of the constituents of living organisms. Modes of formation, reactions and function of these compounds in microorganisms, plants and animals. Intended for non-majors.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 3713 Biochemistry I****Prerequisites:** CHEM 3053.**Description:** Biochemistry of nucleic acids, proteins, amino acids, carbohydrates, and lipids with an emphasis on the kinetics, thermodynamics, catalytic and regulatory strategies of biochemical reactions and bioenergetics. Designed for biochemistry majors.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Undergraduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology

**BIOC 3723 Biochemistry and Molecular Biology Laboratory**

**Prerequisites:** BIOC 3653 or BIOC 3713 or concurrent enrollment.

**Description:** Integrated lecture-laboratory course on fundamental theories and techniques in biochemical, forensic, and clinical research. Hands-on experience in mass spectrometry, DNA analysis, metabolic assays, kinetic assays, and protein purification. Previously offered as BIOC 3720.

**Credit hours:** 3

**Contact hours:** Lecture: 1 Lab: 6 Contact: 7

**Levels:** Undergraduate

**Schedule types:** Lab, Lecture, Combined lecture and lab

**Department/School:** Biochem & Molecular Biology

**BIOC 3813 Biochemistry II**

**Prerequisites:** BIOC 3713.

**Description:** Continuation of Biochemistry I with focus on metabolic pathways, cycles, and control mechanisms. This course will cover bioenergetics and metabolism of carbohydrates, lipids, amino acids and nucleotides. Designed for biochemistry majors.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4013 Biotechnology Development and Implementation**

**Prerequisites:** BIOC 3653 or BIOC 3713 or consent of instructor.

**Description:** An overview of emerging biotechnology in medicine and agriculture including gene therapy, immunotherapy, antibody-drug conjugates, and genome-editing technologies. Also includes an introduction to the global biotechnology industry, idea generation, intellectual property protection, finance, and regulation and policies within the industry. May not be used for degree credit with BIOC 5013.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4023 Molecular Biology and Stress Response of Plants**

**Prerequisites:** BIOL 1113 or BIOC 3713 or PLNT 3554

**Description:** Topics cover the cutting-edge research areas including second messengers, phytohormones, signal transduction, microbiome, plant-microbe interactions, plant responses to climate change with focus on plant molecular biology and plant responses to biotic and abiotic stresses and their application in solving agricultural problems.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4113 Molecular Biology**

**Prerequisites:** BIOC 3653 or BIOC 3713 and BIOL 3023 or ANSI 3423 or PLNT 3554.

**Description:** Applications of biochemistry, molecular biology and genetic engineering with emphasis on protein structure and function, regulation of cell function, metabolism and disease processes. May not be used for Degree Credit with BIOC 5113.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4213 Disease and Metabolism**

**Prerequisites:** BIOC 3653 or BIOC 3713.

**Description:** Introduction to the causes, preventions and treatments for human diseases including obesity, diabetes, atherosclerosis, cancer and aging. Emphasis on the pathogenesis and the cross-talks between metabolic pathways at system level. May not be used for degree credit with BIOC 5213.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4313 Cancer Immunology and Immunotherapy**

**Prerequisites:** BIOC 3713 or BIOC 3653 or consent of instructor

**Description:** Interaction between cancers and the immune system and current immune based biotechnology tools for treatments. Basic immunology and cancer biology, interactions between the immune system and cancers and current immunological therapies in cancers. Functioning of the immune system, genesis and development of cancers, and links between these two systems.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4413 Plant and Soil Microbiomes Can Help Feed the World**

**Prerequisites:** (BIOC 3653 or BIOC 3713) and BIOL 3023 or consent of instructor

**Description:** Introduction and profiling of plant and soil microbiomes; identifying microbes with agronomic traits that improve crop productivity and support food production; nutrient cycling; and bioremediation.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4723 Introduction to Bioinformatics**

**Prerequisites:** BIOL 1114 or (BIOL 1113 and BIOL 1111) and MATH 1513.

**Description:** Providing an introduction to programming for those intending to work with large biological datasets. This course covers the basics of Shell programming, scripting languages and examples of using software and packages. May not be used for Degree Credit with BIOC 5723.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4883 Senior Seminar in Biochemistry**

**Prerequisites:** BIOC 3813 or concurrent enrollment or consent of instructor and senior standing.

**Description:** A senior capstone course for the development of scientific verbal and written communications and assessment of cumulative abilities. Focus is on problem solving, group discussion, primary literature review, oral presentation, and writing.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Undergraduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 4990 Undergraduate Research**

**Description:** Training in independent work, study of relevant literature and experimental investigation of an assigned problem. Offered for variable credit, 1-6 credit hours, maximum of 10 credit hours.

**Credit hours:** 1-6

**Contact hours:** Contact: 1-6 Other: 1-6

**Levels:** Undergraduate

**Schedule types:** Independent Study

**Department/School:** Biochem & Molecular Biology

**BIOC 5000 Research**

**Description:** For MS thesis. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

**Credit hours:** 1-6

**Contact hours:** Contact: 1-6 Other: 1-6

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biochem & Molecular Biology

**BIOC 5002 Research Compliance and Biochemistry Graduate Colloquium**

**Prerequisites:** Graduate standing.

**Description:** Introduction to graduate research. Policies for laboratory safety, research compliance, and ethical conduct of scientific research are presented.

**Credit hours:** 2

**Contact hours:** Lecture: 2 Contact: 2

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5013 Biotechnology Development and Implementation**

**Prerequisites:** (BIOC 3653 or BIOC 3713) and BIOL 3023 or consent of instructor.

**Description:** An overview of emerging biotechnology in medicine and agriculture including gene therapy, immunotherapy, antibody-drug conjugates, and genome-editing technologies. Also includes an introduction to the global biotechnology industry, idea generation, intellectual property protection, finance, and regulation and policies within this industry. May not be used for degree credit with BIOC 4013.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5102 Molecular Genetics**

**Prerequisites:** BIOC 3653 or MICR 3033 and one course in genetics or consent of instructor.

**Description:** An introduction to molecular genetics on the graduate level. Same course as GENE 5102.

**Credit hours:** 2

**Contact hours:** Lecture: 2 Contact: 2

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5112 Articulation of Research Logic**

**Prerequisites:** BIOC 5753 or equivalent or permission of instructor.

**Description:** Techniques for effective communication of scientific reasoning, logic, and critical thinking. Explanation of rationale, hypotheses, and experimental design. Public presentations as logical arguments. The course focuses on biomolecular systems.

**Credit hours:** 2

**Contact hours:** Lecture: 2 Contact: 2

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5113 Molecular Biology**

**Prerequisites:** BIOC 3653 or BIOC 3713 and BIOL 3023 or ANSI 3423 or PLNT 3554.

**Description:** Applications of biochemistry, molecular biology and genetic engineering with emphasis on protein structure and function, regulation of cell function, metabolism and disease processes. May not be used for degree credit with BIOC 4113.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5120 Biochemistry and Molecular Biology Graduate Research Colloquium**

**Prerequisites:** Graduate standing.

**Description:** Students will provide presentations to demonstrate their mastery of research literature, new research results, explanations for research roadblocks, and their ability to synthesize new knowledge and draw conclusions. Offered for variable credit, 1-6 credit hours, maximum of 6 credit hours.

**Credit hours:** 1-6

**Contact hours:** Lecture: 1-6 Contact: 1-6

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5213 Disease and Metabolism**

**Prerequisites:** Graduate standing.

**Description:** Introduction to the causes, preventions and treatments for human diseases including obesity, diabetes, atherosclerosis, cancer and aging. Emphasis on the pathogenesis and the cross-talks between metabolic pathways at system level. May not be used for degree credit with BIOC 4213.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5313 Cancer Immunology and Immunotherapy**

**Prerequisites:** BIOC 3713 or BIOC 3653 or consent of instructor  
**Description:** Interaction between cancers and the immune system and current immune based biotechnology tools for treatments. Basic immunology and cancer biology, interactions between the immune system and cancers and current immunological therapies in cancers. Functioning of the immune system, genesis and development of cancers, and links between these two systems.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5523 Biochemistry of the Cell**

**Prerequisites:** BIOC 3653 or BIOC 3713 and MICR 3033 and BIOL 3023 or ANSI 3423 or PLNT 3554 or consent of instructor.

**Description:** The biochemistry of fundamental processes in normal and disease states of eukaryotic cells. Primary literature based experimental approaches to the mechanisms of intracellular protein trafficking, cytoskeleton, cell adhesion, mitosis, cell cycle, cytokinesis, and apoptosis. May not be used for degree credit with BIOC 4523.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5553 Agricultural Biochemistry**

**Prerequisites:** CHEM 3153 or equivalent.

**Description:** Organism function at the biochemical level and how this relates to the more complex biological systems of plants and animals.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5723 Introduction to Bioinformatics**

**Prerequisites:** BIOL 1114 or (BIOL 1113 and BIOL 1111) and MATH 1513.

**Description:** Providing an introduction to programming for those intending to work with large biological datasets. This course covers the basics of Shell programming, scripting languages and examples of using software and packages. May not be used for degree credit with BIOC 4723.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5753 Biochemical Principles**

**Prerequisites:** CHEM 3153 or equivalent.

**Description:** Chemistry of cellular constituents; introduction to the chemical processes in living systems. The first in a series of courses for graduate students in biochemistry and related fields.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5824 Biochemical Laboratory Methods**

**Prerequisites:** BIOC 4113 or BIOC 5753.

**Description:** Lecture and laboratory course in basic biochemistry and molecular biology methods for separation and analysis of biological materials, including chromatography, electrophoresis, centrifugation, use of radioisotopes, molecular cloning and DNA sequencing.

**Credit hours:** 4

**Contact hours:** Lab: 8 Contact: 8

**Levels:** Graduate

**Schedule types:** Lab

**Department/School:** Biochem & Molecular Biology

**Additional Fees:** Biochem Consummable Mat fee of \$50 applies.

**BIOC 5853 Molecular and Integrative Metabolism**

**Prerequisites:** BIOC 5753 or BIOC 4113.

**Description:** Reaction sequences and cycles in the enzymatic transformations of fats, proteins and carbohydrates; energy transfer, biosynthesis and integration in the metabolic pathways.

**Credit hours:** 3

**Contact hours:** Lecture: 3 Contact: 3

**Levels:** Graduate

**Schedule types:** Lecture

**Department/School:** Biochem & Molecular Biology

**BIOC 5930 Advanced Biochemical Techniques**

**Prerequisites:** BIOC 5753, BIOC 5824 or concurrent registration, and consent of instructor.

**Description:** Lecture and laboratory course in advanced research techniques, designed to supplement BIOC 5824. In subsequent semesters, individual research problems pursued in laboratories of department faculty for six weeks and one credit hour each. Offered for variable credit, 1-4 credit hours, maximum of 10 credit hours.

**Credit hours:** 1-4

**Contact hours:** Contact: 1-4 Other: 1-4

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biochem & Molecular Biology

**BIOC 6000 Research**

**Description:** For PhD dissertation. Offered for variable credit, 1-15 credit hours, maximum of 60 credit hours.

**Credit hours:** 1-15

**Contact hours:** Contact: 1-15 Other: 1-15

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biochem & Molecular Biology

**BIOC 6110 Seminar**

**Description:** Maximum 2 for PhD or 1 for MS candidates. Offered for variable credit, 1-2 credit hours, maximum of 2 credit hours.

**Credit hours:** 1-2

**Contact hours:** Contact: 1-2 Other: 1-2

**Levels:** Graduate

**Schedule types:** Independent Study

**Department/School:** Biochem & Molecular Biology

**BIOC 6663 Molecular Plant-Microbe Interactions****Prerequisites:** PLP 3343 and BIOC 3653.**Description:** Focused on the biochemistry, molecular biology and molecular genetics of pathogenic and symbiotic interactions between microbes and plants to explain the mechanisms by which microbe's infection and activation of plant immunity and symbiosis signaling pathways. Same course as PLP 5723.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 6723 Signal Transduction****Description:** Classical signal transduction mechanisms including MAP kinase signaling cascades, Protein kinase A, Protein kinase C pathways, JAK/STAT pathways, calcium signaling, the cell cycle, programmed cell death, and cell signaling in cancer. Strong focus on the primary literature and experimental strategies used in modern cell biology.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 6733 Functional Genomics****Prerequisites:** BIOC 3653 or BIOC 3713 and BIOC 3813 or BIOC 5753 or consent of instructor.**Description:** Principles and techniques of genomics technologies and their applications in basic science and applied animal and plant research. Genome sequencing, variation detection, transcriptomics, proteomics, metabolomics, metagenomics, systems biology, forward and reverse genetics.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 6740 Physical Biochemistry****Prerequisites:** One semester each of biochemistry, calculus and physical chemistry.**Description:** Two independent modules dealing with applications of physical chemistry and math to biological phenomena: 1) numerical analyses and selected spectroscopic methods, and 2) thermodynamics and transport properties. Modules may be taken together as two credits or individually for one credit. Offered for variable credit, 1-2 credit hours, maximum of 2 credit hours.**Credit hours:** 1-2**Contact hours:** Contact: 1-2 Other: 1-2**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biochem & Molecular Biology**BIOC 6753 Epigenetics****Prerequisites:** BIOC 5102 or BIOC 5753 or consent of instructor.**Description:** Principles underlying heritable changes in gene expression caused by mechanisms other than changes in the DNA sequence. The roles of chromatin structure, DNA and histone modification, and small RNAs in plant and animal development and disease. Applications of epigenetic-based therapeutics and the use of RNA interference in plants and animals.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 6763 Nucleic Acids and Protein Synthesis****Prerequisites:** BIOC 4113 or BIOC 5753.**Description:** Structure and biological function of nucleic acid containing structures with emphasis on recombinant DNA methodologies, information content, nucleic acid-protein interaction, regulation and rearrangement.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 6773 Protein Structure and Enzyme Function****Prerequisites:** BIOC 4113 or BIOC 5753.**Description:** Theory of and methods for studying the physical and chemical basis of protein structure and function; and the enzyme catalysis, including kinetics, chemical modification and model studies. Examples from current literature.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 6783 Biomembranes and Bioenergetics****Prerequisites:** BIOC 5853 or consent of instructor.**Description:** Components, organization and biosynthesis of plasma, mitochondrial and photosynthetic membranes, emphasizing structure-function relationships. Mechanism of metabolites, protons and electrons transport. Energy conservation in bioenergetic apparatus such as mitochondria, chloroplasts or bacterial chromatophores.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology**BIOC 6793 Plant Biochemistry****Prerequisites:** BIOC 4113 or BIOC 5753.**Description:** Biochemistry of processes and structures of special importance to plants, such as photosynthesis, cell walls, nitrogen fixation, secondary metabolites and storage proteins. Previously offered as BIOC 6792.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology

**BIOC 6820 Selected Topics in Biochemistry****Prerequisites:** BIOC 5853.**Description:** Recent developments in biochemistry. Subject matter varies from semester to semester; students should inquire at the department office before enrolling. Same course as ITOX 6820. Offered for variable credit, 1-3 credit hours, maximum of 15 credit hours.**Credit hours:** 1-3**Contact hours:** Contact: 1-3 Other: 1-3**Levels:** Graduate**Schedule types:** Independent Study**Department/School:** Biochem & Molecular Biology**BIOC 6823 Quantitative Methods in Omics****Prerequisites:** BIOC 1114 and MATH 1513.**Description:** Statistical, computational and algorithmic components applied in genomics technologies including theories in quantitative genetics in QTL mapping and Genome-wide Association studies (GWAS), differential analysis based on read-count information and multi-dimensional module/network analysis, graph theories, hidden Markov Models and deep learning.**Credit hours:** 3**Contact hours:** Lecture: 3 Contact: 3**Levels:** Graduate**Schedule types:** Lecture**Department/School:** Biochem & Molecular Biology

## Undergraduate Programs

- Biochemistry and Molecular Biology, BSAG (<http://catalog.okstate.edu/ferguson-college-agriculture/biochemistry-molecular-biology/bsag/>)
- Biochemistry and Molecular Biology: Biotechnology, BSAG (<http://catalog.okstate.edu/ferguson-college-agriculture/biochemistry-molecular-biology/biotechnology-bsag/>)
- Biochemistry and Molecular Biology: Pre-Medical or Pre-Veterinary Science, BSAG (<http://catalog.okstate.edu/ferguson-college-agriculture/biochemistry-molecular-biology/pre-medical-pre-veterinary-science-bsag/>)

## Graduate Programs

Many career opportunities in biochemistry require advanced coursework, and so part of the Department of Biochemistry and Molecular Biology's curriculum is focused on its graduate program leading to the MS or PhD degree. This graduate program is also an integral part of the extensive basic research activities supported by the Oklahoma Agricultural Experiment Station.

## Prerequisites

Students with a Bachelor's degree in Biochemistry, Molecular Biology and Chemistry or with strong backgrounds in other biological or physical science disciplines are eligible to apply to the graduate programs in Biochemistry and Molecular Biology. Individuals should have at least two semesters of organic chemistry and one semester of biochemistry, molecular biology, calculus, analytical and physical chemistry. Students may be required to take appropriate undergraduate courses if major deficiencies are identified.

## Degree Requirements

A more detailed description of the graduate study program in Biochemistry and Molecular Biology is available on the Department's website: <https://agriculture.okstate.edu/departments-programs/>

[biochemistry/graduate-program/](https://agriculture.okstate.edu/departments-programs/biochemistry/graduate-program/). The requirements listed below complement the general graduate requirements described in the "Graduate College" section of the Catalog. All Biochemistry and Molecular Biology graduate students are expected to attend and participate in the Department's Graduate Student Association Journal Club and the Department's Seminar Series throughout the academic year.

## The Master of Science Degree

Twenty-four (24) credit hours of formal graduate courses are required, including:

Code	Title	Hours
BIOC 5002	Research Compliance and Biochemistry Graduate Colloquium	2
BIOC 5753	Biochemical Principles	3
BIOC 5112	Articulation of Research Logic	2
BIOC 5120	Biochemistry and Molecular Biology Graduate Research Colloquium	1
BIOC 5853	Molecular and Integrative Metabolism	3
BIOC 5930	Advanced Biochemical Techniques	1-4

In addition, a student must present an acceptable research thesis (six hours of BIOC 5000 (<http://catalog.okstate.edu/search/?P=BIOC%205000>) Research) and pass a final oral examination covering their thesis work and related material. Research advisors are selected at the end of the student's first semester.

A non-thesis Master of Science degree is also available. It does not require a research thesis, but requires a report and extensive technical training in the laboratory. The non-thesis MS plan requires thirty (30) credit hours of coursework and two (2) hours of research. The non-thesis MS is not recommended for students wishing to pursue a PhD.

A formal "Plan of Study" with the credit hours of graduate coursework and research listed above must be approved by the student's advisory committee and submitted to the OSU Graduate College before completing 17 credit hours of graduate study.

The Doctor of Philosophy Degree. The PhD program course requirements are determined with the assistance and approval of the student's advisory committee and are based on whether a BS or MS has previously been earned:

1. a minimum total of (60) graduate credits are required if a student enters the PhD program having earned an MS in a related discipline, with a minimum of 15 credit hours of coursework and a minimum of 15 credit hours of research being required.
2. a minimum total of ninety (90) graduate credits are required if a student enters the PhD program having earned not higher than a BS in a related discipline, with a minimum of 30 credit hours of coursework and 15 credit hours of research being required.

A formal "Plan of Study" with the credit hours of graduate coursework and research listed above must be approved by the student's advisory committee and submitted to the OSU Graduate College before completing 28 credit hours of graduate study.

The student's advisory committee is selected at the end of the student's second semester. All graduate students must maintain a B-average in their graduate coursework. A grade of C in a single graduate course can place the student on academic probation.

The Department offers research experience in a variety of areas. Formal PhD program graduate coursework includes all of the courses listed for the MS degree, at least four of the advanced graduate courses in biochemistry (6000-level) including BIOC 6740 (<http://catalog.okstate.edu/search/?P=BIOC%206740>) Physical Biochemistry, and additional courses and lab experience appropriate to the student's interests. Each student will take a series of preliminary examinations in their third semester. January if admitted in the fall; or May, if admitted in the Spring.

Each student also presents and defends their research thesis proposal sometime in their 4th-5th semester, and at the end of their program presents their research and defends their dissertation in a final oral examination. The doctoral dissertation must contain a substantial original contribution to the discipline of biochemistry and molecular biology.

## Bioinformatics Graduate Certificate Program

The Department of Biochemistry and Molecular Biology also offers the Bioinformatics Graduate Certificate Program—a multi-disciplinary program that involves faculty in Departments across the University. This Program's mission is to train post-baccalaureate students in the techniques required to generate, analyze and interpret complex biologically-derived data sets. The Graduate Certificate in Bioinformatics requires completion of 16 credit hours of coursework eligible for graduate credit. A minimum of 12 credit hours must be at the 5000-level or above. Required courses include 9 credit hours from the core areas of life sciences, statistics and computer sciences. Additional information on this Certificate Program is available online: <http://www.bioinformatics.okstate.edu/>.

## Review Process for Admission

The Department's Graduate Studies Committee reviews all eligible applications for the graduate program in Biochemistry and Molecular Biology. To be eligible for committee review, each applicant must submit an application for admission to the Graduate College, along with transcripts of all academic records, and TOEFL scores if their undergraduate education was in a language other than English. Applicants must submit to the Department three reference letters, a current resume and a statement of purpose.

## Minors

- Biochemistry (BIOC), Minor (<http://catalog.okstate.edu/ferguson-college-agriculture/biochemistry-molecular-biology/biochemistry-minor/>)

## Faculty

John E. Gustafson, PhD—Professor and Head

**Regents Professor:** Robert L. Matts, PhD

**Professors:** Randy D. Allen, PhD; Patricia Canaan, PhD; Junpeng Deng, PhD; Kiran Mysore, PhD; Ramanjulu Sunkar, PhD

**Associate Professors:** Charles Chen, PhD; Donald Ruhl, PhD; Kevin Wilson, PhD

**Assistant Professors:** Yong Cheng, PhD; Kelly Craven, PhD; Feng Feng, PhD; Xia Lei, PhD; Ashley Mattison, PhD

**Research Associate Professor:** Steve Hartson, PhD

**Research Assistant Professors:** Naichong Chen, PhD; Kashif Mahmood, PhD; Poonam Sharma, PhD; Xuejuan Tan, PhD

**Instructor:** Judy A. Hall, MS

**Adjunct Faculty:** Robert L. Burnap, PhD; Kitty Cardwell, PhD; Richard A. Dixon, PhD; Udaya DeSilva, PhD; Darren Hagen, PhD; Haobo Jiang, PhD; Veronique A. Lacombe, PhD; Jerry R. Malayer, PhD; Kenneth L. McNally, PhD; Smita Mohanty, PhD; Rolf A. Prade, PhD; Carey Pope, PhD; Kay Scheets, PhD; William Schneider, PhD; Lloyd Sumner, PhD; Million Tadege, PhD; Guolong (Glenn) Zhang, PhD

**Professors Emeriti:** Andrew Mort, PhD; Chang-An Yu, PhD; Margaret Essenberg, PhD; Richard Essenberg, PhD; Ulrich Melcher, PhD; Sharon Ford, PhD; Robert Gholson, PhD; Peter Hoyt, PhD