

Department of Biochemistry, Molecular Biology, Entomology and Plant Pathology

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Biochemistry and Molecular Biology Program

The Biochemistry and Molecular Biology program within the Department of BCH-EPP involves disciplines at the cutting edge of a revolution in biology. Molecular methods and the use of genetic engineering have given scientists unprecedented power to begin to understand the chemistry of life processes. The Department of BCH-EPP aims to prepare students at Mississippi State in this exciting area. In addition to the undergraduate curriculum in biochemistry and molecular biology, the department provides opportunities for an M.S. degree in Agricultural Life Sciences with a concentration in Biochemistry and a Ph.D. in Molecular Biology (See the Graduate Bulletin for description of programs and requirements for advanced degrees). For the Bachelor of Science degree in biochemistry, the objective of this curriculum is to provide the student with a strong background in science, and to prepare the student for entry into professional schools, graduate study and/or highly technical scientific careers after graduation. There are sufficient individual choices in the curriculum to allow students to tailor their programs to any of several areas of specialization by appropriate use of elective hours.

Biochemistry Minor

The Biochemistry minor is offered to allow undergraduate students in other majors to develop specific skills needed by graduates entering the science-related workforce. Students will enhance their written and oral communication skills and develop problem-solving/application skills. Students must complete 19 to 20 hours of approved coursework.

Graduate Studies Track

Students aiming for a career requiring graduate education should take Genetics and Cell Biology as technical electives. Since many graduate programs require some form of physical chemistry, it is strongly suggested that students take CH 4413/CH 4423 Quantum Mechanics and Spectroscopy or CH 4404 Biophysical Chemistry as technical electives.

Preparation for entry into an accelerated Master's Program (THESIS) in Biochemistry and Molecular Biology

This program requires careful planning by the student in order to complete the requirements for the B.S. while beginning a research program that should result in successful completion of a Master's thesis at the end of the second summer after the B.S. Only exceptional and motivated students should attempt this program. It is critical that BCH 4603 General Biochemistry be scheduled in the spring of the sophomore year. The student will be expected to begin a research project in the senior year by taking up to nine hours of Directed Individual Study courses (BCH 4000). Research will continue during the summer after completion of the B.S. degree. The student must register for BCH 8000 (3 hours), Thesis Research during the summer. In addition, the student should schedule a graduate level BCH course and ST 8114 in the spring of the senior year.

The student interested in the five year program should apply early in the undergraduate program to facilitate the scheduling of courses to conform to time constraints. In addition to applying for admission to the graduate program, the student must also take the Graduate Record Examination early enough so that the results are available by the beginning of the semester in which the student expects to graduate. The student must complete the courses required for completion of the BS degree with no more than 10 hours remaining in the semester of expected graduation.

Preparation for entry into an accelerated Master's Program (NON-THESIS) in Biochemistry and Molecular Biology

This program requires careful planning by the student in order to complete the requirements for the B.S. while initiating graduate work that should result in completion of courses leading to a Master's Degree, non-thesis concentration. This curriculum allows completion of the two degrees in a minimum of five years. Required courses and electives must be scheduled so that the student has only eight hours of undergraduate course work remaining in the spring of the senior year. The student should then schedule ST 8114 Statistical Methods and an 8000 level BCH course in that same semester. Graduate work must include BCH 8654 Intermediary Metabolism and BCH 7000 (3 hrs) Directed Individual Study (to allow completion of an independent research paper).

The student interested in the five year program should apply early in the undergraduate program to facilitate the scheduling of courses to conform to time constraints. In addition to applying for admission to the graduate program, the student must also take the Graduate Record Examination early enough so that the results are available by the beginning of the semester in which the student expects to graduate. The student must complete the courses required for completion of the B.S. Degree with no more than 10 hours remaining in the semester of expected graduation.

Preparation for entry into an accelerated Ph.D. Program in Molecular Biology

This program requires careful planning by the student in order to complete the requirements for the B.S. while beginning a research program that should meaningfully accelerate progress towards early completion of the Ph.D. degree in Molecular Biology. By initiating a research program in the senior year, a student should reduce the time to completion of the Ph.D. by a year. Only exceptional and motivated students should attempt this program. It is critical that BCH 4603 General Biochemistry be scheduled in the spring of the sophomore year.

The student will be expected to begin a research project in the senior year by taking the Directed Individual Study Courses. Research will continue during the summer after completion of the B.S. degree. The student must register for BCH 9000 Dissertation Research/ Dissertation in Biochemistry, Molecular Biology, Entomology and Plant Pathology during the summer.

The student should plan his/her complete graduate program of study in conjunction with research Director and Graduate Committee. Since the Ph.D. is primarily a research degree, ultimate time to completion will be dependent upon the period necessary to satisfy the research requirements of the Graduate Committee. This concentration allows the student to begin that research substantially earlier than usual.

BS in Biochemistry & Molecular Biology

Degree Requirements

English Composition

| | | |
|------------|----------------------------|---|
| EN 1103 | English Composition I | 3 |
| or EN 1163 | Accelerated Composition I | |
| EN 1113 | English Composition II | 3 |
| or EN 1173 | Accelerated Composition II | |

Mathematics

| | | |
|---------|-------------|---|
| MA 1713 | Calculus I | 3 |
| MA 1723 | Calculus II | 3 |

Science

| | | |
|-------------------------|--|---|
| Satisfied in major core | | 9 |
|-------------------------|--|---|

Humanities

| | | |
|---------------------------------------|--|---|
| Select from General Education courses | | 6 |
|---------------------------------------|--|---|

Fine Arts

| | | |
|---------------------------------------|--|---|
| Select from General Education courses | | 3 |
|---------------------------------------|--|---|

Social Sciences

| | | |
|--------------------------------|--|---|
| See concentration requirements | | 6 |
|--------------------------------|--|---|

Major Core

| | | |
|----------|-------------------------------------|---|
| CH 1213 | Chemistry I | 3 |
| CH 1211 | Investigations in Chemistry I | 1 |
| CH 1223 | Chemistry II | 3 |
| CH 1221 | Investigations in Chemistry II | 1 |
| CH 4513 | Organic Chemistry I | 3 |
| CH 4511 | Organic Chemistry Laboratory I | 1 |
| CH 4523 | Organic Chemistry II | 3 |
| CH 4521 | Organic Chemistry Laboratory II | 1 |
| BCH 1001 | Introduction to Biochemistry | 1 |
| BCH 3901 | Senior Seminar | 1 |
| BCH 4414 | Protein Methods | 4 |
| BCH 4503 | Scientific Communication Skills | 3 |
| BCH 4603 | General Biochemistry | 3 |
| BCH 4613 | General Biochemistry | 3 |
| BCH 4623 | Biochemistry of Specialized Tissues | 3 |
| BCH 4713 | Molecular Biology | 3 |
| BCH 4804 | Molecular Biology Methods | 4 |
| BIO 1134 | Biology I | 4 |
| BIO 1144 | Biology II | 4 |
| BIO 3304 | General Microbiology | 4 |

| | | |
|--|---------------------------------|-------|
| PH 1113 | General Physics I ¹ | 3 |
| or PH 2213 | Physics I | |
| PH 1123 | General Physics II ¹ | 3 |
| or PH 2223 | Physics II | |
| Technical Electives (concentration dependent) ² | | 21-32 |
| General Electives (concentration dependent) | | 0-10 |
| Oral Communication Requirement | | |
| CO 1003 | Fundamentals of Public Speaking | 3 |
| Writing Requirement | | |
| BCH 4414 | Protein Methods | 4 |
| BCH 4804 | Molecular Biology Methods | 4 |
| Computer Literacy | | |
| BCH 4414 | Protein Methods | 4 |
| BCH 4713 | Molecular Biology | 3 |
| BCH 4804 | Molecular Biology Methods | 4 |

Pre-Medicine Concentration (MED)

Biochemistry is an excellent preparation for medical school. In order to be better prepared for the Medical College Admissions Test (MCAT), medical school classes, and to meet medical school entrance requirements, the following courses are required in lieu of technical or general electives. These courses are also appropriate for students interested in dental school.

| | | |
|--|---|------------|
| Social Sciences (See General Education list) | | 6 |
| BIO 2103 | Cell Biology | 3 |
| or BIO 4114 | Cellular Physiology | |
| Choose one of the following: | | 4 |
| BIO 3004 | Human Anatomy | |
| BIO 3014 | Human Physiology | |
| VS 3014 | Anatomy and Physiology | |
| BIO 4514 | Animal Physiology | |
| BIO 3103 | Genetics I | 3 |
| or BIO 4133 | Human Genetics | |
| Choose one of the following: | | 3 |
| PH 1133 | General Physics III | |
| PH 2233 | Physics III (OR a technical elective if transferring 8 hours of Physics to the program) | |
| Choose one of the following: | | 3 |
| PHI 1123 | Introduction to Ethics | |
| PHI 3323 | Medical Ethics | |
| Science Elective | | |
| Technical electives | | 6 |
| General or Free electives | | 8-9 |
| Total hours | | 120 |

Pre-Dental Concentration (DENT)

Biochemistry is an excellent preparation for dental school. This concentration prepares students for the Dental Admissions Test, dental school classes, and to meet dental school requirements. The following courses are required as either Social Science core courses or in lieu of technical or general electives.

| | | |
|--|----------------------------|---|
| PSY 1013 | General Psychology | 3 |
| Social Science (See General Education courses) | | 3 |
| BIO 2103 | Cell Biology | 3 |
| or BIO 4114 | Cellular Physiology | |
| BIO 3014 | Human Physiology | 4 |
| or BIO 4514 | Animal Physiology | |
| ST 2113 | Introduction to Statistics | 3 |

| | | |
|------------------------------|---|------------|
| Choose one of the following: | | 3 |
| PHI 1123 | Introduction to Ethics ¹ | |
| PHI 3323 | Medical Ethics | |
| Science Elective | | |
| PH 1133 | General Physics III (OR Science elective if transferring 8 hours of Physics to the program) | 3 |
| Science electives | | 6 |
| General or Free electives | | 8-9 |
| Total hours | | 120 |

¹ PHI 1123 Introduction to Ethics may be used to fulfill three of the six hours of General Education Humanities requirements. Students taking this course may apply this as a humanities elective (if they so choose) and then take either PHI 3323 Medical Ethics or any other approved Science elective to fulfill this technical elective requirement.

Pre-Pharmacy Concentration (PPHR)

Pharmacy school typically requires only two to three years of college work for entry. However, four-year undergraduate programs can be of benefit to students and Biochemistry graduates have been very successful in Pharmacy School and perform well on the Pharmacy College Admissions Test. The following courses are required as either Social Science core courses or in lieu of technical or general electives.

| | | |
|---------------------------|---|------------|
| PSY 1013 | General Psychology | 3 |
| or SO 1003 | Introduction to Sociology | |
| EC 2113 | Principles of Macroeconomics | 3 |
| EC 2123 | Principles of Microeconomics | 3 |
| ST 2113 | Introduction to Statistics | 3 |
| BIO 3103 | Genetics I | 3 |
| or BIO 4113 | Evolution | |
| BIO 4405 | Pathogenic Microbiology | 5 |
| BIO 4413 | Immunology | 3 |
| BIO 4514 | Animal Physiology | 4 |
| PHI 3323 | Medical Ethics | 3 |
| PH 1133 | General Physics III (OR Science elective if transferring 8 hours of Physics to the program) | 3 |
| General or Free electives | | 4 |
| Total hours | | 120 |

Pre-Optometry Concentration (OPT)

Biochemistry is an excellent preparation for optometry school. This concentration prepares students for the Optometry Admissions Test, optometry school classes, and to meet optometry school requirements. The following courses are required as either Social Science core courses or in lieu of technical or general electives.

| | | |
|--|---|------------|
| PSY 1013 | General Psychology | 3 |
| Social Science (See General Education courses) | | 3 |
| BIO 2103 | Cell Biology | 3 |
| or BIO 4114 | Cellular Physiology | |
| BIO 3014 | Human Physiology | 4 |
| or BIO 4514 | Animal Physiology | |
| ST 2113 | Introduction to Statistics | 3 |
| Choose one of the following: | | 3 |
| PHI 1123 | Introduction to Ethics ¹ | |
| PHI 3323 | Medical Ethics | |
| Science Elective | | |
| PH 1133 | General Physics III (OR Science elective if transferring 8 hours of Physics to the program) | 3 |
| Science elective | | 6 |
| General or Free electives | | 8-9 |
| Total hours | | 120 |

- ¹ PHI 1123 Introduction to Ethics may be used to fulfill three of the six hours of General Education Humanities requirements. Students taking this course can apply this as a humanities elective (if they so choose) and then can take either PHI 3323 Medical Ethics or any other approved Science elective to fulfill this technical elective requirement.

Science Concentration (SCI)

The Science concentration provides students with core classes towards a degree in biochemistry coupled with undergraduate research and/or internship requirements. Additional coursework as technical electives concentrate on cell biology, anatomy and/or physiology, with much of the coursework remaining flexible to allow students to explore specialized subject matter or broad areas of interest in the sciences. This concentration is intended for students that may pursue graduate research after their undergraduate degree, or those seeking to tailor a specialization to their interest or intended career track. The following courses are required in lieu of technical or general electives.

| | | |
|--|---|------------|
| Social Sciences (see General Education list) | | 6 |
| BCH 4100 | Biochemistry and Molecular Biology Internship | 1-6 |
| or BCH 4000 | Directed Individual Study in Biochemistry, Molecular Biology, Entomology, and Plant Pathology | |
| Choose one of the following: | | 4 |
| BIO 3014 | Human Physiology | |
| VS 3014 | Anatomy and Physiology | |
| BIO 4514 | Animal Physiology | |
| BIO 2103 | Cell Biology | 3 |
| or BIO 4114 | Cellular Physiology | |
| Science or business technical electives | | 12 |
| General/free electives | | 8-9 |
| Total hours | | 120 |

Bioinformatics Concentration (BINF) ¹

This concentration provides the student with a B.S. in Biochemistry and Molecular Biology incorporating a strong background in the biochemical sciences along with a rigorous preparation in the field of computer science. The graduate will be able to either enter graduate school or directly enter a career requiring knowledge of bioinformatics. This exciting field applies computational and database skills to molecular biological problems. Practitioners routinely mine genomic databases for information relating to basic understanding of life processes as well as information providing clues for medical and agricultural advances. This program also constitutes a minor in computer science. Students MUST take the following courses in lieu of technical and general electives.

| | | |
|---|--|------------|
| Social Sciences (See General Education courses) | | 6 |
| CSE 1284 | Introduction to Computer Programming | 4 |
| CSE 1384 | Intermediate Computer Programming | 4 |
| CSE 2383 | Data Structures and Analysis of Algorithms | 3 |
| CSE 2813 | Discrete Structures | 3 |
| CSE 3813 | Introduction to Formal Languages and Automata | 3 |
| CSE 4613 | Bio-computing | 3 |
| CSE 4633 | Artificial Intelligence | 3 |
| CSE 4623 | Computational Biology | 3 |
| CSE 4833 | Introduction to Analysis of Algorithms | 3 |
| ST 3123 | Introduction to Statistical Inference (OR Computer Science Elective) | 3 |
| Total hours | | 121 |

- ¹ Completion of the Bioinformatics program also constitutes a minor in Computer Science from the Department of Computer Science and Engineering, and students receive a Certificate in Computational Biology from the Institute of Digital Biology. Note that students must declare to the appropriate program and/or departmental advisor to receive credit for a degree minor and/or to receive a Certificate.

Pre-MBA Concentration (PMBA)

This concentration provides the student with a B.S. in Biochemistry incorporating a strong background in science while preparing the student for immediate entry into a graduate program leading to an advanced business degree (either the Master of Business Administration or the Master of Agribusiness Management). Either program can be completed in a minimum of three semesters. Students thus educated may enter into management level positions in the biotech or agribusiness industry. The following courses are required as either Social Science core courses or in lieu of technical or general electives.

| | | |
|----------|------------------------------------|---|
| ACC 2013 | Principles of Financial Accounting | 3 |
|----------|------------------------------------|---|

| | | |
|------------------------|---|------------|
| ACC 2023 | Principles of Managerial Accounting | 3 |
| EC 2113 | Principles of Macroeconomics | 3 |
| EC 2123 | Principles of Microeconomics | 3 |
| BQA 2113 | Business Statistical Methods I | 3 |
| BQA 3123 | Business Statistical Methods II | 3 |
| MGT 3114 | Principles of Management and Production | 4 |
| MKT 3013 | Principles of Marketing | 3 |
| FIN 3123 | Financial Management | 3 |
| Computer elective | | 3 |
| General/Free electives | | 6 |
| Total hours | | 120 |

Forensic Sciences Concentration (FOSC)

This concentration provides the student with a B.S. in Biochemistry incorporating a strong background in the biochemical sciences along with a rigorous preparation in the general area of criminology and forensics. Because of the ever increasing use of molecular sciences in forensics, graduates with this specialization should be employable by crime labs or by industry using DNA profiling or other biometric techniques. Internships are encouraged. The following courses are required as either Social Science core courses or in lieu of technical or general electives.

| | | |
|------------------------------|--|------------|
| PSY 1013 | General Psychology | 3 |
| SO 1003 | Introduction to Sociology | 3 |
| Choose one of the following: | | 3 |
| CH 2313 | Analytical Chemistry I | |
| ST 2113 | Introduction to Statistics | |
| PSY 3104 | Introductory Psychological Statistics | |
| SO 3603 | Criminological Theory | 3 |
| CRM 3103 | Contemporary Issues in Criminal Justice | 3 |
| SO 3313 | Deviant Behavior | 3 |
| or PSY 3213 | Psychology of Abnormal Behavior | |
| Choose one of the following: | | 3 |
| PSY 4373 | Forensic Psychology | |
| AN 4313 | Human Osteology | |
| CSE 4273 | Introduction to Computer Forensics | |
| BIO 3103 | Genetics I | |
| BIO 2103 | Cell Biology | 3 |
| or BIO 4114 | Cellular Physiology | |
| BCH 2013 | Introduction to Forensic Science | 3 |
| BCH 4333 | Advanced Forensic Science | 3 |
| SO 4513 | Correctional Systems (OR Science elective) | 3 |
| General/free electives | | 3-4 |
| Total hours | | 120 |

Entomology Concentration (ENT)

This concentration provides a student with a B.S. in Biochemistry but incorporates a focal area in entomology. Students receive excellent training in the biochemical sciences, coupled with general and specific entomology subject areas from which the student can choose subject matter in their areas of interest. The following courses are required in lieu of technical or general electives.

| | | |
|---|--------------------------------------|-----|
| Social Sciences (see General Education courses) | | 6 |
| EPP 4154 | General Entomology | 4 |
| EPP 4164 | Insect Taxonomy | 4 |
| EPP 4263 | Principles of Insect Pest Management | 3 |
| EPP 4335 | Anatomy and Physiology of Insects | 5 |
| Choose three of the following: | | 6-8 |
| EPP 3124 | Forest Pest Management | |
| EPP 3423 | Ornamental and Turfgrass Insects | |

| | | |
|------------------------|--------------------------------------|------------|
| EPP 4173 | Medical and Veterinary Entomology | |
| EPP 4234 | Field Crop Insects | |
| EPP 4244 | Aquatic Entomology | |
| EPP 4543 | Toxicology and Insecticide Chemistry | |
| General/free electives | | |
| Total hours | | 120 |

Plant Pathology Concentration (PPTH)

This concentration provides a student with a B.S. in Biochemistry but incorporates a focal area in plant pathology. Students receive excellent training in the biochemical sciences, coupled with general and specific plant pathology subject areas in plant disease epidemiology, pathology and disease identification/diagnostics. The following courses are required in lieu of technical or general electives.

| | | |
|---|-------------------------------|------------|
| Social Sciences (see General Education courses) | | 6 |
| EPP 3124 | Forest Pest Management | 4 |
| EPP 4113 | Principles of Plant Pathology | 3 |
| EPP 4163 | Plant Disease Management | 3 |
| EPP 4214 | Diseases of Crops | 4 |
| EPP 4254 | Introduction to Mycology | 4 |
| EPP 4523 | Turfgrass Diseases | 3 |
| BIO 2113 | Plant Biology | 3 |
| or PSS 1313 | Plant Science | |
| Choose one of the following: | | 3-4 |
| PSS 4553 | Plant Growth and Development | |
| BIO 4214 | General Plant Physiology | |
| General/free electives | | 3-4 |
| Total hours needed for major | | 120 |

Pre-Veterinary Medicine Concentration (PVBC)

Biochemistry is an excellent preparation for veterinary medical school. In order to be better prepared for the Graduate Record Examination (GRE) or Veterinary College Admissions Test, veterinary medical school classes, and to meet veterinary medical school entrance requirements, the following courses are required in lieu of technical or general electives.

| | | |
|---|------------------------|------------|
| BIO 3103 | Genetics I | 3 |
| or BIO 4133 | Human Genetics | |
| VS 3014 | Anatomy and Physiology | 4 |
| or BIO 4514 | Animal Physiology | |
| BIO 2103 | Cell Biology | 3 |
| or BIO 4114 | Cellular Physiology | |
| Science or business technical electives | | 12 |
| Social Sciences (See General Education courses) | | 6 |
| General/free electives | | 8-9 |
| Total hours | | 120 |

Three year program (3+1) for early admission into the College of Veterinary Medicine

The aim of this curriculum is to allow a student to matriculate through the Department of Biochemistry and Molecular Biology for three years and then proceed into the College of Veterinary Medicine under their early admissions policy. Successful completion of the courses taken during the first year in Veterinary Medicine will satisfy the Department's requirements for technical electives and allow the University to grant the student a B.S. in Biochemistry and Molecular Biology after this period.

| | | |
|--------------------------------|--------------------------------|----|
| General Education requirements | | 30 |
| CH 1213 | Chemistry I | 3 |
| CH 1211 | Investigations in Chemistry I | 1 |
| CH 1223 | Chemistry II | 3 |
| CH 1221 | Investigations in Chemistry II | 1 |
| CH 4513 | Organic Chemistry I | 3 |

| | | |
|-------------|-------------------------------------|---|
| CH 4511 | Organic Chemistry Laboratory I | 1 |
| CH 4523 | Organic Chemistry II | 3 |
| CH 4521 | Organic Chemistry Laboratory II | 1 |
| BCH 1001 | Introduction to Biochemistry | 1 |
| BCH 4503 | Scientific Communication Skills | 3 |
| BCH 4603 | General Biochemistry | 3 |
| BCH 4414 | Protein Methods | 4 |
| BCH 4613 | General Biochemistry | 3 |
| BCH 4623 | Biochemistry of Specialized Tissues | 3 |
| BCH 4713 | Molecular Biology | 3 |
| BCH 3901 | Senior Seminar | 1 |
| BCH 4804 | Molecular Biology Methods | 4 |
| BIO 1134 | Biology I | 4 |
| BIO 1144 | Biology II | 4 |
| BIO 3304 | General Microbiology | 4 |
| PH 1113 | General Physics I | 3 |
| PH 1123 | General Physics II | 3 |
| VS 3014 | Anatomy and Physiology | 4 |
| or BIO 4514 | Animal Physiology | |
| BIO 3103 | Genetics I | 3 |
| or BIO 4133 | Human Genetics | |

95 hours required plus successful completion of the first year curriculum of the College of Veterinary Medicine

Mississippi State requires a minimum of 120 hours for the undergraduate degree. Therefore, the first year in the College of Veterinary Medicine will contribute 25 hours of technical electives to this program.

Biochemistry Minor

| | | |
|-------------|---------------------------|---|
| BCH 4603 | General Biochemistry | 3 |
| BCH 4613 | General Biochemistry | 3 |
| BCH 4414 | Protein Methods | 4 |
| or BCH 4804 | Molecular Biology Methods | |
| BCH 4713 | Molecular Biology | 3 |

Select a minimum of 6 hours (any two courses) from the following: 6-7

| | | |
|-------------|---|--|
| BCH 2013 | Introduction to Forensic Science | |
| BCH 4000 | Directed Individual Study in Biochemistry, Molecular Biology, Entomology, and Plant Pathology | |
| BCH 4100 | Biochemistry and Molecular Biology Internship | |
| BCH 4253 | Macronutrients: Human Metabolism | |
| BCH 4333 | Advanced Forensic Science | |
| BCH 4414 | Protein Methods | |
| or BCH 4804 | Molecular Biology Methods | |
| BCH 4623 | Biochemistry of Specialized Tissues | |
| BCH 4990 | Special Topics in Biochemistry, Molecular Biology, Entomology and Plant Pathology | |

Total Hours 19-20