Biochemistry

Degree Offered
Bachelor of Science

Nature of Program
The biochemistry curriculum prepares students for careers requiring a strong background in basic principles of the physical and life sciences. The program is a collaborative effort between the Division of Animal and Nutritional Sciences in the Davis College of Agriculture, Natural Resources and Design, and the Departments of Biology and Chemistry in the Eberly College of Arts and Sciences.

Students completing a biochemistry major are prepared for professional employment in the expanding fields of agricultural and environmental sciences, chemical industry, health-related industries and biotechnology-based industries. The curriculum provides students with the interdisciplinary background in biochemistry, biology, chemistry, mathematics, physics and molecular biology necessary as preparation for professional schools of human and veterinary medicine, dentistry, optometry, and pharmacy. It also provides strong preparation for graduate study in fields such as animal and plant agriculture, biochemistry, biology, molecular biology, genetics, biotechnology, chemistry, food science, nutrition and physiology. The curriculum is modeled after the American Society of Biochemistry and Molecular Biologists guidelines. The degree requirements for an American Chemical Society certified degree can be met within the framework of the program.

Performance Requirements
To maintain biochemistry major status and to graduate, students must maintain at least a 2.0 overall GPA and a 2.0 cumulative GPA in coursework in biology, chemistry, and biochemistry.

Minors
All students have the possibility of earning one or more minors; list of all available minors and their requirements (http://catalog.wvu.edu/undergraduate/minors). Please note that students may not earn a minor in their major field.

FACULTY

ANIMAL AND NUTRITIONAL SCIENCES DIRECTOR
• Robert L. Taylor - Ph.D. (Mississippi State University)
  Professor of Poultry Science, Animal physiology, Immunology

BIOLOGY CHAIR
• Richard B. Thomas
  Professor of Physiological plant ecology, Forest ecology, Global climate change

CHEMISTRY CHAIR
• Kung Wang - Ph.D. (Purdue University)
  Eberly Distinguished Professor of Chemistry, Organic chemistry, Stereoselective synthesis, Natural products

PROFESSORS
• Ashok P. Bidwai - Ph.D.
  Molecular genetic analysis of protein kinase, CK2 in Drosophila
• Kenneth P. Blemings - Ph.D. (University of Wisconsin)
  Dean of the Honors College, Protein and Amino Acid Metabolism
• Jonathan R. Cumming - Ph.D. (Cornell University)
  Environmental plant physiology, Ecophysiology of root-mycorrhizal-soil interactions, Urban ecology
• Robert A. Dailey - Ph.D. (University of Wisconsin)
  Reproductive physiology
• Stephen DiFazio - Ph.D. (Oregon State University)
  Plant genomics, Molecular ecology, Plant population genetics, Biotechnology risk assessment
• Harry O. Finklea - Ph.D. (California Institute of Technology)
  Analytical/physical chemistry, Electron transfer kinetics, Solid oxide fuel cells, Gas phase sensors
• Terry Gullion - Ph.D. (William and Mary)
  Physical chemistry, Solid State NMR, Biological Materials, Polymers
• Lisa A. Holland - Ph.D. (University of North Carolina-Chapel Hill)
Biochemistry

Analytical chemistry, Micro-separations, High-throughput drug screening

• E. Keith Inskeep - Ph.D. (University of Wisconsin)
  Reproductive physiology

• Jacek Jaczynski - Ph.D. (Oregon State University)
  Food Safety

• Charles Jaffe - Ph.D. (University of Colorado)
  Theoretical chemistry, Molecular dynamics, Chaotic systems

• P. Brett Kenney - Ph.D. (Kansas State University)
  Muscle protein functionality

• Fred L. King - Ph.D. (University of Virginia)
  Analytical chemistry, Mass spectrometry, Trace elements, Gas-phase chemistry

• Hillar Klandorf - Ph.D. (British Council for National Academic Awards)
  Oxidative stress and aging

• Gerald E. Lang
  Plant ecology, Biogeochemistry, Wetland ecology

• James B. McGraw
  Plant ecology: Evolutionary ecology of perennial plants, Conservation biology, Demography, Forest remote sensing

• Joseph S. Moritz - Ph.D. (Kansas State University)
  Effect of feed form on animal performance

• John H. Penn - Ph.D. (University of Wisconsin-Madison)
  Chemical education, On-line instruction methods in organic chemistry

• Jeffrey L. Petersen - Ph.D. (University of Wisconsin-Madison)
  Associate Chairperson, Chemistry; Physical inorganic chemistry, Electrophilic transition metal complexes, X-ray crystallography

• Kenneth Showalter - Ph.D. (University of Colorado)
  Bennett Distinguished Professor, physical chemistry, Chemical kinetics, Multi-stability and oscillating chemical systems

• Bjorn Soderberg - Ph.D. (Royal Institute of Technology, Sweden)
  Organic synthesis using transition metals

• Janet C. L. Tou - Ph.D. (University of Toronto)
  Human nutrition and foods

• Jianbo Yao - Ph.D. (McGill University)
  Functional genomics

ASSOCIATE PROFESSORS

• Kimberly M. Barnes - Ph.D. (University of Nebraska)
  Curriculum committee chair, Intercollegiate Undergraduate Program in Biochemistry; Lipid metabolism

• Suzanne Bell - Ph.D. (University New Mexico)
  Analytical chemistry, Forensic science

• Clifton P. Bishop - Ph.D. (University of Virginia)
  Molecular genetics, Developmental biology, Forensic biology

• Jonathan Boyd - Ph.D. (Texas Tech University)
  Analytical biochemistry and toxicology

• Kevin C. Daly - Ph.D. (University of Arizona)
  Associate Chair for Graduate Studies, Biology; Sensory neurobiology, Neural coding, Brain-behavior interactions, Comparative psycho-biology

• Sarah M. Farris - Ph.D. (University of Illinois at Urbana-Champaign)
  Evolution and development of the insect brain, Neuroanatomy

• Eugene E. Felton - Ph.D. (University of Missouri)
  Ruminant nutrition

• Glen Jackson - Ph.D. (West Virginia University)
  Mass spectrometry, forensic chemistry

• Marlon Knights - Ph.D. (West Virginia University)
  Reproductive physiology

• K. Marie Krause - Ph.D. (University of Wisconsin)
  Dairy science nutrition

• Justin Legleiter - Ph.D. (Carnegie Mellon University)
  Biophysical chemistry, Atomic force microscopy

• Kristen Matak - Ph.D. (Virginia Tech)
  Food science and human nutrition
• William T. Peterjohn  
  Ecosystem ecology; Effects of global change on ecosystem dynamics, Nitrogen cycling in natural ecosystems.
• Michelle Richards-Babb - Ph.D. (Lehigh University)  
  Office of Undergraduate Research; Chemical education
• Rita V.M. Rio - Ph.D. (Yale University)  
  Symbioses
• Alan M. Stolzenberg - Ph.D. (Stanford University)  
  Inorganic chemistry, Bio-inorganic chemistry, Organometallic chemistry
• Michelle D. Withers - Ph.D. (University of Arizona)  
  Biology education, Neurobiology

CLINICAL ASSOCIATE PROFESSORS
• Donna Ford-Werntz - Ph.D. (Washington University/Missouri Botanical Garden)  
  Plant systematics: Portulacaceae, West Virginia flora

TEACHING ASSOCIATE PROFESSORS
• Erin Battin - Ph.D. (Clemson University)  
  Bio-inorganic chemistry
• Megan Govidan - M.P.H., M.S., R.D. (West Virginia University)  
  Human nutrition and foods
• Margaret A. Minch - D.V.M. (The Ohio State University)  
  Veterinary medicine
• Betsy Ratcliff - Ph.D. (University of Binghamton-SUNY)  
  Physical chemistry
• Jennifer Stueckle - Ph.D. (West Virginia University)  
  Aquatic toxicology
• Mingming Xu - Ph.D. (Ohio University)  
  Analytical chemistry

ASSISTANT PROFESSORS
• Scott Bowdridge - Ph.D. (Virginia Tech)  
  Veterinary immunology
• Andrew Dacks - Ph.D. (University of Arizona)  
  Neurobiology
• Fabien Goulay - Ph.D. (University of Rennes, France)  
  Physical chemistry, Laser spectroscopy
• Jennifer Hawkins  
  Plant comparative genomics, Molecular evolution
• Jessica Hoover - Ph.D. (University of Washington)  
  Organometallics chemistry, Catalysis
• Melissa Marra - Ph.D., R.D. (Florida International University)  
  Healthy aging and nutritional prevention of chronic disease
• Joseph W. McFadden - Ph.D. (Virginia Tech)  
  Lipid metabolism and metabolomics
• Blake Mertz - Ph.D. (Iowa State University)  
  Computational biophysics and chemistry
• Melissa Olfert - Ph.D., M.S., R.D. (Loma Linda University)  
  Health and wellness
• Brian Popp - Ph.D. (University of Wisconsin-Madison)  
  Organic and organometallic chemistry, Catalysis
• Stephen Valentine - Ph.D. (Indiana University)  
  Mass spectrometric analysis of biomolecules
• Shuo Wei - Ph.D. (University of Miami)  
  Development of the nervous system
TEACHING ASSISTANT PROFESSORS

• Kevin Barry - Ph.D. (University of Maryland)
• Laura Christian - Ph.D. (The University of Texas at Austin)
• Dana Huebert-Lima - Ph.D. (University of Wisconsin-Madison)
  Associate Chair for Undergraduate Studies, Biology; Epigenetics
• Kevin Lee
  Virology, Cell and molecular biology methods
• Joshua Osbourn - Ph.D. (University of Pittsburgh)
  Organic chemistry
• Stephanie T. Young - Ph.D. (West Virginia University)
  Molecular and Forensic Biology

SENIOR LECTURERS

• Sue Raylman - Ph.D.
  Animal behavior
• Mark Schraf - M.S. (West Virginia University)
  Analytical chemistry
• Susan Studlar
  Bryology and botany
• Beth Thomas - M.S. (Clemson University)
  Invertebrate zoology

PROFESSORS EMERITI

• Charles H. Baer
• David F. Blaydes
• Roy B. Clarkson
• William E. Collins
• Dorothy C. Dunning
• Jorge A. Flores - Ph.D. (The George Washington)
  Animal physiology, endocrinology of reproduction
• Ramsey H. Frist
• Roland B. Guthrie
• Philip E. Keeting
  Molecular endocrinology, Cancer biology
• Denis W. H. MacDowell - Ph.D. (Massachusetts Institute of Technology)
  Organic chemistry
• Joseph A. Marshall
• Ethel C. Montiegel
• Robert S. Nakon - Ph.D. (Texas A&M University)
  Inorganic chemistry
• Richard P. Sutter
• Leah A. Williams
• Anthony Winston - Ph.D. (Duke University)
  Polymer chemistry

Click the appropriate link below to view the corresponding Biochemistry Track Requirements and Suggested Plans of Study.

• American Chemical Society (ACS) (p. 7)
• American Society of Biochemistry and Molecular Biology (ASBMB) (p. 8)

GENERAL EDUCATION FOUNDATIONS

Please use this link to view a list of courses that meet each GEF requirement. (http://registrar.wvu.edu/gef)

NOTE: Some major requirements will fulfill specific GEF requirements. Please see the curriculum requirements listed below for details on which GEFs you will need to select.
General Education Foundations

F1 - Composition & Rhetoric  
ENGL 101  Introduction to Composition and Rhetoric  
& ENGL 102  and Composition, Rhetoric, and Research  
or ENGL 103  Accelerated Academic Writing  

F2A/F2B - Science & Technology  
4-6  
F3 - Math & Quantitative Skills  
3-4  
F4 - Society & Connections  
3  
F5 - Human Inquiry & the Past  
3  
F6 - The Arts & Creativity  
3  
F7 - Global Studies & Diversity  
3  
F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree)  
9  

Total Hours  
31-37  

Please note that not all of the GEF courses are offered at all campuses. Students should consult with their advisor or academic department regarding the GEF course offerings available at their campus.

CURRICULUM REQUIREMENTS

• Writing Requirement: Biochemistry Bachelor of Science students fulfill the Writing and Communication Skills requirement by completing ENGL 101 and ENGL 102 (or ENGL 103), and at least two additional SpeakWrite Certified Courses™ from: BIOL 115, BIOL 117, BIOL 219, BIOL 411, CHEM 403.

University Requirements  
19  

WVUE 191  First Year Seminar  

GEF Requirements: number of credits will vary depending on overlap

Program Core Requirements  
5  

AGBI 199  Orientation to Biochemistry  
AGBI 410  Introductory Biochemistry (Minimum grade of C-)  
AGBI 412  Introduction to Biochemistry Wet Laboratory (Minimum grade of C-)

Biology Requirement  
15  

BIOL 115  Principles of Biology (Minimum grade of C-. May substitute BIOL 101-104)  
BIOL 117  Introductory Physiology (Minimum grade of C-)  
BIOL 219  The Living Cell (Minimum grade of C-)  
BIOL 310  Advanced Cellular/Molecular Biology

Chemistry Requirement  
28  

Select one set (Minimum grade of C-):

CHEM 115  Fundamentals of Chemistry  
& CHEM 116  and Fundamentals of Chemistry  
& CHEM 215  and Introductory Analytical Chemistry  

or:

CHEM 117  Principles of Chemistry  
& CHEM 118  and Principles of Chemistry  

and all of the following:

CHEM 233  Organic Chemistry (Minimum grade of C-)  
CHEM 234  Organic Chemistry (Minimum grade of C-)  
CHEM 235  Organic Chemistry Laboratory (Minimum grade of C-)  
CHEM 236  Organic Chemistry Laboratory (Minimum grade of C-)  
CHEM 341  Physical Chemistry: Brief Course  
CHEM 342  Experimental Physical Chemistry  
CHEM 462  Biochemistry 2  
CHEM 464  Biochemistry 2 Laboratory

Mathematics and Statistics Requirement  
8  

Minimum grade of C-

MATH 155  Calculus 1
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<td>MATH 153</td>
<td>Calculus 1a with Precalculus and Calculus 1b with Precalculus</td>
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<td>MATH 154</td>
<td>Calculus 2</td>
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<tr>
<td>MATH 156</td>
<td>Elementary Statistical Inference</td>
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**A track is required.**

Number of credits may vary depending on courses selected

### Biochemistry Electives

- **AEM 341** General Microbiology
- **AEM 401** Environmental Microbiology
- **AEM 408** Applied Water Microbiology
- **AEM 420** Soil Microbiology
- **AEM 445** Food Microbiology
- **AGBI 386** Undergraduate Research Experience 1
- **AGBI 486** Undergraduate Research Experience 2
- **AGBI 496** Senior Thesis
- **AGBI 497** Research
- **AGBI 498** Honors
- **AGBI 512** Nutritional Biochemistry
- **AGBI 513** Nutritional Biochemistry Laboratory
- **AGBI 514** Animal Biotechnology
- **ANPH 301** Introduction to Animal Physiology
- **ANPH 400** Growth and Lactation Physiology
- **ANPH 405** Animal Physiology Laboratory
- **ANPH 424** Physiology of Reproduction
- **A&VS 402** Values and Ethics
- **A&VS 451** Current Literature in Animal Science
- **A&VS 496** Senior Thesis
- **A&VS 497** Research
- **BIOL 302** Biometry
- **BIOL 312** Introduction to Virology
- **BIOL 313** Molecular Basis of Cellular Growth
- **BIOL 324** Molecular Genetics
& **BIOL 325** Molecular Genetics Laboratory
- **BIOL 335** Cell Physiology
- **BIOL 348** Neuroscience 1
- **BIOL 350** Plant Physiology
- **BIOL 386** Undergraduate Research
- **BIOL 410** Cell and Molecular Biology Methods
- **BIOL 411** Introduction to Recombinant DNA
- **BIOL 413** Molecular Endocrinology
- **BIOL 414** Molecular Endocrinology-Laboratory
- **BIOL 415** Epigenetics
- **BIOL 420** Genomics
- **BIOL 423** Biochemistry of Nucleic Acids and Proteins
- **BIOL 424** Protein Structure and Function
- **BIOL 425** Developmental Genetics
- **BIOL 426** Molecular Biology of Cancer
- **BIOL 432** Forensic Biology
- **BIOL 436** General Animal Physiology
- **BIOL 440** Comparative Anatomy
- **BIOL 441** Vertebrate Microanatomy
- **BIOL 453** Molecular Basis of Disease
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<td>Senior Thesis</td>
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<td>BIOL 497</td>
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<td>CHEM 310</td>
<td>Instrumental Analysis</td>
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<td>CHEM 312</td>
<td>Environmental Chemistry</td>
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<td>CHEM 339</td>
<td>Organic Syntheses</td>
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<td>CHEM 422</td>
<td>Intermediate Inorganic Chemistry</td>
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<td>CHEM 460</td>
<td>Forensic Chemistry</td>
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<td>Research</td>
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<td>CHEM 514</td>
<td>Mass Spectrometry Principles and Practices</td>
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<td>CHEM 516</td>
<td>Bioanalytical Chemistry</td>
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<td>CHEM 552</td>
<td>Biochemical Toxicology</td>
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<td>ENTO 404</td>
<td>Principles of Entomology</td>
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<td>ENTO 412</td>
<td>Pest Management</td>
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<td>FDST 445</td>
<td>Food Microbiology</td>
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<td>FDST 449</td>
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<td>GEN 371</td>
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<td>HN&amp;F 460</td>
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<td>VETS 401</td>
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<td>VETS 405</td>
<td>Parasitology</td>
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**Capstone Requirement**

**ASBMB Track**, select one of the following options:

- AGBI 386 Undergraduate Research Experience 1
- AGBI 486 and Undergraduate Research Experience 2
- A&VS 402 Values and Ethics

**ACS Track**, complete both of the following:

- CHEM 401 Chemical Literature
- & CHEM 403 and Undergraduate Seminar

**General Electives** 11

Number of electives may vary depending on course options selected

**Total Hours** 120

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**AMERICAN CHEMICAL SOCIETY (ACS) TRACK**

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<td>Chemical Literature (Minimum grade of C-)</td>
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<td>PHYS 111</td>
<td>General Physics (Minimum grade of C-)</td>
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<td>PHYS 112</td>
<td>General Physics (Minimum grade of C-)</td>
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Biochemistry Electives (See list above) 12

**Total Hours** 31
**SUGGESTED PLAN OF STUDY FOR THE AMERICAN CHEMICAL SOCIETY (ACS) TRACK**

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<td>1 CHEM 116 (GEF 8)</td>
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### Second Year

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<td>4 BIOL 310</td>
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<td>STAT 211</td>
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### Third Year

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<td>CHEM 215</td>
<td>4 CHEM 462 &amp; CHEM 464</td>
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### Fourth Year

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<td>CHEM 401 (Capstone)</td>
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Total credit hours: 120

* Students may substitute CHEM 117 and 118 for CHEM 115, 116, and 215.

**AMERICAN SOCIETY OF BIOCHEMISTRY AND MOLECULAR BIOLOGY (ASBMB) TRACK**

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<td>A&amp;VS 402</td>
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<td>BIOL 423</td>
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<td>Choose one of the following:</td>
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Senior Seminar in Biochemistry

Molecular Basis of Cellular Growth

Cell and Molecular Biology Methods

Undergraduate Research Experience 1 and Undergraduate Research Experience 2

Values and Ethics

Biochemistry of Nucleic Acids and Proteins
<table>
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**Second Year**

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<td>&amp; CHEM 235</td>
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<td>BIOL 310</td>
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<td>CHEM 234</td>
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<td>STAT 211</td>
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<td>&amp; CHEM 236</td>
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**Third Year**

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<td>GEF 6</td>
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<td>GEF 7</td>
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<td>AGBI 410</td>
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<td>BIOL 313 or 410</td>
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<td>&amp; AGBI 412</td>
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<td>CHEM 341</td>
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<td>CHEM 215</td>
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<td>Biochemistry Elective 1</td>
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<td>CHEM 462</td>
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**Fourth Year**

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<td>AGBI 401</td>
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Total credit hours: 120

* Chem 117 and 118 may be substituted for Chem 115, 116, and 215.
**Major Learning Goals**

**BIOCHEMISTRY**
1. Graduates will demonstrate a working knowledge of the basic sciences of biology, chemistry, mathematics and scientific methods.
2. Graduates will demonstrate a working knowledge of biological mechanisms, including biochemistry, biotechnology, functional genomic, nutrition, physiology and reproduction necessary for understanding of the disciplines.
3. Graduates will demonstrate the ability to write and present scientific information.
4. Graduates will demonstrate the ability to integrate knowledge and possess problem solving/critical thinking skills necessary for professional and social development and life-long learning and civic engagement.

**AGBI 199. Orientation to Biochemistry. 1,2 Hour.**
Orientation to degree programs and requirements, departmental resources, curriculum options, student responsibilities and opportunities.

**AGBI 293. Special Topics. 1-6 Hours.**
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

**AGBI 298. Honors. 1-3 Hours.**
PR: Students in Honors Program and consent by the honors director. Independent reading, study, or research.

**AGBI 386. Undergraduate Research Experience 1. 1,2 Hour.**
PR: At least sophomore standing and faculty permission. Students will write a research proposal, conduct supervised research, and write a progress report. This course is the first of a two-course sequence that leads to a research-based capstone experience. Students must also complete AGBI 486 for this to serve as the Biochemistry Capstone course.

**AGBI 393. Special Topics. 1-6 Hours.**
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

**AGBI 401. Senior Seminar in Biochemistry. 1 Hour.**
PR: Senior standing in biochemistry. Students select a topic at the forefront of biochemistry and gather information on the subject. Students then read, critically evaluate, write about the subject and present the topic in a seminar.

**AGBI 403. Applied Biochemistry Literature. 3 Hours.**
PR: Senior standing. Biochemistry Capstone Experience involving literature review, grant writing, and orally defending a proposal.

**AGBI 410. Introductory Biochemistry. 3 Hours.**
PR: CHEM 231 or (CHEM 233 or CHEM 235). Introduction to chemistry of cellular constituents (proteins, amino acids, carbohydrates, lipids, nucleic acids, enzymes and coenzymes) and their metabolism in animals and plants.

**AGBI 411. Introductory Biochemistry Laboratory. 1 Hour.**
PR or CONC: AGBI 410. Experiments to demonstrate certain principles and properties of animal and plant biochemicals.

**AGBI 412. Introduction to Biochemistry Wet Laboratory. 1 Hour.**
PR or CONC:AGBI 410 or Consent. Classic and modern techniques in biochemistry.

**AGBI 480. Assigned Topics. 1-4 Hours.**

**AGBI 486. Undergraduate Research Experience 2. 2-4 Hours.**
PR: AGBI 386 and faculty permission. Continuation of a research-based Capstone Experience where students will conduct supervised research, present their research, and prepare a final report. This course is the second of a two-course research-based sequence and must be completed after AGBI 386 to count as the capstone experience.

**AGBI 490. Teaching Practicum. 1-3 Hours.**
PR: Consent. Teaching practice as a tutor or assistant.

**AGBI 491. Professional Field Experience. 1-18 Hours.**
PR: Consent. (May be repeated up to a maximum of 18 hours.) Prearranged experiential learning program, to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development.

**AGBI 492. Directed Study. 1-3 Hours.**
Directed study, reading, and or research.

**AGBI 493. Special Topics. 1-6 Hours.**
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

**AGBI 494. Seminar. 1-3 Hours.**
PR: Consent. Presentation and discussion of topics of mutual concern to students and faculty.

**AGBI 495. Independent Study. 1-6 Hours.**
Faculty-supervised study of topics not available through regular course offerings.

**AGBI 496. Senior Thesis. 1-3 Hours.**
PR: Consent.
AGBI 497. Research. 1-6 Hours.
Independent research projects.