

# Biochemistry

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## 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 a 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.

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## 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)  
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 & ENGL 102 or ENGL 103	Introduction to Composition and Rhetoric and Composition, Rhetoric, and Research Accelerated Academic Writing
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3-6

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

## 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 & CHEM 116 & CHEM 215	Fundamentals of Chemistry and Fundamentals of Chemistry and Introductory Analytical Chemistry
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or:

CHEM 117 & CHEM 118	Principles of Chemistry and Principles of Chemistry
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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
or MATH 153 & MATH 154	Calculus 1a with Precalculus and Calculus 1b with Precalculus
MATH 156	Calculus 2

STAT 211	Elementary Statistical Inference	3
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### A track is required. 31

Number of credits may vary depending on courses selected

### Biochemistry Electives

AEM 341	General Microbiology
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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 & BIOL 325	Molecular Genetics and 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
BIOL 454	Immunology
BIOL 496	Senior Thesis
BIOL 497	Research
CHEM 310	Instrumental Analysis
CHEM 312	Environmental Chemistry
CHEM 339	Organic Syntheses
CHEM 422	Intermediate Inorganic Chemistry
CHEM 460	Forensic Chemistry

CHEM 496	Senior Thesis
CHEM 497	Research
CHEM 514	Mass Spectrometry Principles and Practices
CHEM 516	Bioanalytical Chemistry
CHEM 552	Biochemical Toxicology
ENTO 404	Principles of Entomology
ENTO 412	Pest Management
FDST 445	Food Microbiology
FDST 449	Food Microbiology Lab
GEN 371	Principles of Genetics
HN&F 460	Advanced Nutrition
HN&F 473	Medical Nutrition Therapy 1
HN&F 474	Medical Nutrition Therapy 2
HORT 330	Plant Propagation
PPTH 401	General Plant Pathology
VETS 302	Animal Pathology
VETS 401	Veterinary Anatomy
VETS 405	Parasitology

**Capstone Requirement**

ASBMB Track, select one of the following options:

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

ACS Track, complete both of the following:

CHEM 401 & CHEM 403	Chemical Literature and Undergraduate Seminar
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**General Electives** 11

Number of electives may vary depending on course options selected

Total Hours 120

**AMERICAN CHEMICAL SOCIETY (ACS) TRACK**

CHEM 310	Instrumental Analysis	3
CHEM 401	Chemical Literature (Minimum grade of C-)	1
CHEM 403	Undergraduate Seminar	1
CHEM 422	Intermediate Inorganic Chemistry	3
CHEM 497	Research	3
PHYS 111	General Physics (Minimum grade of C-)	4
PHYS 112	General Physics (Minimum grade of C-)	4
Biochemistry Electives (See list above)		12

Total Hours 31

**SUGGESTED PLAN OF STUDY FOR THE AMERICAN CHEMICAL SOCIETY (ACS) TRACK****First Year**

Fall	Hours Spring	Hours
WVUE 191	1 GEF 4	3
ENGL 101 (GEF 1)	3 BIOL 117 (GEF 8)	4
AGBI 199	1 CHEM 116 (GEF 8)*	4
BIOL 115 (GEF 2)	4 MATH 156	4
CHEM 115 (GEF 8)*	4	
MATH 155 (GEF 3)	4	
	17	15

**Second Year**

<b>Fall</b>	<b>Hours Spring</b>	<b>Hours</b>
BIOL 219	4 ENGL 102 (GEF 1)	3
CHEM 233 & CHEM 235	4 GEF 5	3
PHYS 111	4 BIOL 310	3
STAT 211	3 CHEM 234 & CHEM 236 PHYS 112	4
	15	17

**Third Year**

<b>Fall</b>	<b>Hours Spring</b>	<b>Hours</b>
GEF 6	3 F 7	3
AGBI 410 & AGBI 412	4 CHEM 341 & CHEM 342	4
CHEM 215	4 CHEM 462 & CHEM 464	4
Biochemistry Elective 1	3 General Elective	3
	14	14

**Fourth Year**

<b>Fall</b>	<b>Hours Spring</b>	<b>Hours</b>
CHEM 401 (Capstone)	1 CHEM 310	3
CHEM 422	3 CHEM 403 (Capstone)	1
CHEM 497	3 Biochemistry Elective 3	3
Biochemistry Elective 2	3 Biochemistry Elective 4	3
General Elective	3 General Elective	3
General Elective	2	
	15	13

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**

AGBI 401	Senior Seminar in Biochemistry	1
BIOL 313	Molecular Basis of Cellular Growth	3
or BIOL 410	Cell and Molecular Biology Methods	
Choose one of the following:		3
AGBI 386 & AGBI 486	Undergraduate Research Experience 1 and Undergraduate Research Experience 2	
A&VS 402	Values and Ethics	
BIOL 423	Biochemistry of Nucleic Acids and Proteins	3
Choose one of the following:		8
PHYS 101 & PHYS 102	Introductory Physics and Introductory Physics	
PHYS 101 & PHYS 112	Introductory Physics and General Physics	
PHYS 111 & PHYS 112	General Physics and General Physics	
Biochemistry Electives (see list above)		13
Total Hours		31



## SUGGESTED PLAN OF STUDY FOR THE AMERICAN SOCIETY OF BIOCHEMISTRY AND MOLECULAR BIOLOGY (ASBMB) TRACK

### First Year

Fall	Hours Spring	Hours
WVUE 191	1 GEF 4	3
ENGL 101 (GEF 1)	3 BIOL 117 (GEF 8)	4
AGBI 199	1 CHEM 116 (GEF 8)*	4
BIOL 115 (GEF 2)	4 MATH 156	4
CHEM 115 (GEF 8)*	4	
MATH 155 (GEF 3)	4	
	17	15

### Second Year

Fall	Hours Spring	Hours
BIOL 219	4 ENGL 102 (GEF 1)	3
CHEM 233 & CHEM 235	4 GEF 5	3
PHYS 101	4 BIOL 310	3
STAT 211	3 CHEM 234 & CHEM 236 PHYS 102	4
	15	17

### Third Year

Fall	Hours Spring	Hours
GEF 6	3 GEF 7	3
AGBI 410 & AGBI 412	4 BIOL 313 or 410	3
CHEM 215*	4 CHEM 341 & CHEM 342	4
Biochemistry Elective 1	3 CHEM 462 & CHEM 464	4
	14	14

### Fourth Year

Fall	Hours Spring	Hours
BIOL 423	3 AGBI 401	1
Biochemistry Elective 2	4 Biochemistry Elective 4	3
Biochemistry Elective 3	3 Capstone	3
General Elective	3 General Elective	3
General Elective	2 General Elective	3
	15	13

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.