

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 accredited by the American Society of Biochemistry and Molecular Biology. 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.

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 - Ph.D.
Professor of Physiological plant ecology, Forest ecology, Global climate change

CHEMISTRY CHAIR

- Gregory Dudley - Ph.D. (Massachusetts Institute of Technology)
Eberly Family Distinguished Professor and Department Chair, Natural Product Synthesis, Organic Chemistry

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
- Kevin Daly - Ph.D. (University of Arizona)
Sensory neurobiology, Neural coding, Brain-behavior interactions, Comparative psycho-biology
- Stephen DiFazio - Ph.D. (Oregon State University)
Plant genomics, Molecular ecology, Plant population genetics, Biotechnology risk assessment
- 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

- 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
- Kristen Matak - Ph.D. (Virginia Tech)
Food science and human nutrition
- 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
- William T. Peterjohn - Ph.D.
Ecosystem ecology
- 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
- Kung Wang - Ph.D. (Purdue University)
Eberly Distinguished Professor of Chemistry, Organic chemistry
- Matthew Wilson - Ph.D. (Iowa State University)
Reproductive physiology
- Jianbo Yao - Ph.D. (McGill University)
Functional genomics

ASSOCIATE PROFESSORS

- Kimberly M. Barnes - Ph.D. (University of Nebraska)
Coordinator, Intercollegiate Undergraduate Program in Biochemistry; Lipid metabolism
- Clifton P. Bishop - Ph.D. (University of Virginia)
Molecular genetics, Developmental biology, Forensic biology
- Scott Bowdridge - Ph.D. (Virginia Tech)
Veterinary immunology
- Jonathan Boyd - Ph.D. (Texas Tech University)
Analytical biochemistry and toxicology
- 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
- Fabien Goulay - Ph.D. (University of Rennes)
Physical chemistry, Laser spectroscopy
- Jennifer Hawkins - Ph.D.
Plant comparative genomics, Molecular evolution
- 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

- Michelle Richards-Babb - Ph.D. (Lehigh University)
Office of Undergraduate Research; Chemical education
- Rita V.M. Rio - Ph.D. (Yale University)
Symbioses
- Stephen Valentine - Ph.D. (Indiana University)
Mass spectrometric analysis of biomolecules

CLINICAL ASSOCIATE PROFESSORS

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

TEACHING ASSOCIATE PROFESSORS

- 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
- Joshua Osbourn - Ph.D. (University of Pittsburgh)
Organic chemistry
- Betsy Ratcliff - Ph.D. (University of Binghamton-SUNY)
Physical chemistry
- Tabitha R. Razunguzwa - Ph.D. (West Virginia University)
General chemistry
- Crystal Smith - Ed.D. (West Virginia University)
Equine studies
- Jennifer Stueckle - Ph.D. (West Virginia University)
Aquatic toxicology
- Mingming Xu - Ph.D. (Ohio University)
Analytical chemistry

ASSISTANT PROFESSORS

- Craig Barrett - Ph.D.
Evolutionary biology
- Sadie Bergeron - Ph.D. (University of Massachusetts - Amherst)
Developmental genetics
- Edward Brzostek - Ph.D.
Forest ecology and Ecosystem modeling
- Andrew Dacks - Ph.D. (University of Arizona)
Neurobiology
- Tim Driscoll - Ph.D. (Virginia Tech)
Microbial metagenomics
- Jennifer Gallagher - Ph.D. (Yale University)
Genetics
- Jessica Hoover - Ph.D. (University of Washington)
Organometallics chemistry, Catalysis
- Peng Li - Ph.D. (Texas Tech University)
Micro-nano systems
- Melissa Marra - Ph.D., R.D. (Florida International University)
Healthy aging and nutritional prevention of chronic disease
- Gary Marsat - Ph.D. (McGill University)
Neuroscience
- Daniel Mathew - Ph.D. (University of Missouri)
Reproductive physiology
- Blake Mertz - Ph.D. (Iowa State University)
Computational biophysics and chemistry
- Carsten Milsmann - Ph.D. (Ruhr University Bochum)
Inorganic synthesis and spectroscopy
- Melissa Olfert - DrPh, R.D. (Loma Linda University)

Health and wellness

- Brian Popp - Ph.D. (University of Wisconsin-Madison)
Organic and organometallic chemistry, Catalysis
- Kevin Shaffer - Ph.D. (West Virginia University)
Extension livestock specialist
- Cangliang Shen - Ph.D. (Colorado State University)
Food system and human health

CLINICAL ASSISTANT PROFESSOR

- Zach Fowler - Ph.D.
Arboretum Director

TEACHING ASSISTANT PROFESSORS

- Kevin Barry - Ph.D. (University of Maryland)
General biology
- Erin Battin - Ph.D. (Clemson University)
Bio-inorganic chemistry
- Adam Burda - MS (Indiana University of PA)
Human nutrition
- Melissa Ely - Ph.D. (West Virginia University)
General chemistry
- Amaris Guardiola - Ph.D.
General biology
- Dana Huebert-Lima - Ph.D. (University of Wisconsin-Madison)
Associate Chair for Undergraduate Studies, Biology; Epigenetics
- Kevin Lee
Virology, Cell and molecular biology methods
- John Navaratnam - Ph.D.
General biology
- Mark R. Tinsley - Ph.D. (Leeds University)
General chemistry, Physical 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
- Elizabeth Thomas - M.S. (Clemson University)
Invertebrate zoology

INSTRUCTOR

- Sydha Salihu - Ph.D.
Plant physiology

PROFESSORS EMERITI

- Harry O. Findlea - Ph.D. (California Institute of Technology)
Analytical/physical chemistry
- E. Keith Inskeep - Ph.D. (University of Wisconsin)
Reproductive physiology
- Paul Lewis - Ph.D. (West Virginia University)
Reproductive physiology
- Robert S. Nakon - Ph.D. (Texas A&M University)
Inorganic chemistry
- Ronald B. Smart - Ph.D. (University of Michigan)
Analytical chemistry

- Alan M. Stolzenberg - Ph.D. (Stanford University)
Inorganic chemistry
- Anthony Winston - Ph.D. (Duke University)
Polymer chemistry

Admissions Requirements

Entering freshman are admitted directly into the major.

Students coming from another major can be admitted with a minimum overall GPA of 2.0.

Benchmark Expectations

By the end of their third semester in the major students are expected to have completed BIOL 115, BIOL 117, and CHEM 115 OR CHEM 115, CHEM 116, and BIOL 115 with a minimum grade of C- in each course and an overall GPA of 2.0.

Students must maintain a GPA of at least 2.0 in the major and overall. All majors must attend an advising session with their Biochemistry advisor each semester.

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

- American Chemical Society (ACS) (p. 8)
- American Society of Biochemistry and Molecular Biology (ASBMB) (p. 9)

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		3-6
ENGL 101 & ENGL 102 or ENGL 103	Introduction to Composition and Rhetoric and Composition, Rhetoric, and Research 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

ANRD 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

or:

CHEM 117
& CHEM 118

Principles of Chemistry 1
and Principles of Chemistry 2

and all of the following:

CHEM 233

CHEM 234

CHEM 235

CHEM 236

CHEM 341

CHEM 342

CHEM 462

CHEM 464

Organic Chemistry (Minimum grade of C-)
Organic Chemistry (Minimum grade of C-)
Organic Chemistry Laboratory (Minimum grade of C-)
Organic Chemistry Laboratory (Minimum grade of C-)
Physical Chemistry: Brief Course
Experimental Physical Chemistry
Biochemistry 2
Biochemistry 2 Laboratory

Mathematics and Statistics Requirement 8

Minimum grade of C-

MATH 155

or MATH 153
& MATH 154

MATH 156

Calculus 1
Calculus 1a with Precalculus
and Calculus 1b with Precalculus
Calculus 2

STAT 211 0 or 3

Elementary Statistical Inference

A track is required. 31

Number of credits may vary depending on courses selected

Biochemistry Electives

AEM 341

AEM 401

AEM 420

AEM 445

AGBI 386

AGBI 486

AGBI 496

AGBI 497

AGBI 498

AGBI 512

AGBI 513

AGBI 514

ANPH 301

ANPH 400

ANPH 405

ANPH 424

A&VS 402

A&VS 451

A&VS 496

A&VS 497

BIOL 302

BIOL 312

General Microbiology
Environmental Microbiology
Soil Microbiology
Food Microbiology
Undergraduate Research Experience 1
Undergraduate Research Experience 2
Senior Thesis
Research
Honors
Nutritional Biochemistry
Nutritional Biochemistry Laboratory
Animal Biotechnology
Introduction to Animal Physiology
Growth and Lactation Physiology
Animal Physiology Laboratory
Physiology of Reproduction
Values and Ethics
Current Literature in Animal Science
Senior Thesis
Research
Biometry
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	
General Electives		11
Number of electives may vary depending on course options selected		
Total Hours		117-120

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-)	0 or 4
PHYS 112	General Physics (Minimum grade of C-)	0 or 4
Biochemistry Electives (See list above)		12
Total Hours		23-31

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

First Year

Fall	Hours Spring	Hours
ANRD 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 111	4 BIOL 310	3
STAT 211	3 CHEM 234 & CHEM 236 PHYS 112	4
	15	17

Third Year

Fall	Hours Spring	Hours
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

Fall	Hours Spring	Hours
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 1 and Introductory Physics 2	
PHYS 101 & PHYS 112	Introductory Physics 1 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
ANRD 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	4
	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
<hr/>		
	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
<hr/>		
	15	13

Total credit hours: 120

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

Major Learning Outcomes

BIOCHEMISTRY

Graduates will demonstrate a working knowledge in the following core concepts:

1. Energy is required by and transformed in biological systems.
2. Macromolecular structure determines function and regulation.
3. Information storage and flow are dynamic and interactive.
4. Discovery requires objective measurement, quantitative analysis, and clear communications.
5. The pervasive role evolution and homeostasis play in shaping the form and function of all biological molecules and organisms.