# 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.

## Certificate of Global Engagement

Students in the Eberly College, regardless of their major, can earn a Certificate of Global Engagement. Completion of the Certificate demonstrates the student's knowledge of diverse cultures, as well as the ability to communicate and interact effectively with people of different cultural backgrounds.  Students will be required to apply their knowledge of contemporary issues and global social contexts to their course work and their broader citizenship.  For details regarding Certificate requirements, please visit the Eberly College page (http://catalog.wvu.edu/undergraduate/eberlycollegeofartsandsciences/#otherdegreestext).

## FACULTY

### ANIMAL & NUTRITIONAL SCIENCES DIVISION DIRECTOR

- Robert L. Taylor - Ph.D. (Mississippi State University)
  Professorof Poultry Science, Immunology

### BIOLOGY CHAIR

- Richard B. Thomas - Ph.D. (Clemson University)
  Professor of Physiological plant ecology, Forest ecology, Global climate change

### CHEMISTRY CHAIR

- Gregory Dudley - PhD (Massachusetts Institute of Technology)
  Eberly Family Distinguished Professor and Department Chair, Natural product synthesis

### PROFESSORS

- Ashok P. Bidwai - Ph.D. (University of Utah)
  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 C. Daly - Ph.D. (University of Arizona)
  Sensory neurobiology
- 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 Holland - Ph.D. (University North Carolina-Chapel Hill)
  Micro-separations, High-throughput drug screening
- Jacek Jaczynski - Ph.D. (Oregon State University)
  Food Science and Technology
- Charles Jaffe - Ph.D. (University of Colorado)
  Theoretical chemistry, Molecular dynamics, Chaotic systems
- P. Brett Kenney - Ph.D. (Kansas State University)
  Animal Science and Meat Science
- 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)
  Physiology
- Kristen E. Matak - Ph.D. (VVirginia Polytechnic Institute and State University)
  Human Nutrition and Foods
- James B. McGraw - Ph.D. (Duke University)
  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 animla performance
- William Peterjohn - PhD
  Ecosystem ecology
- Jeffrey L. Petersen - Ph.D. (University of Wisconsin-Madison)
  Associate Chairperson, 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
- Matthew E. Wilson - Ph.D. (Iowa State University)
  Reproductive Physiology
- Jianbo Yao - Ph.D. (McGill University)
  Molecular Biology - Genetics

## ASSOCIATE PROFESSORS

- Kimberly M. Barnes - Ph.D. (University of Nebraska)
  Coordinator of the Intercollegiate Biochemsitry Program
- Clifton P. Bishop - Ph.D. (University of Virginia)
  Molecular genetics, Developmental biology, Forensic biology
- Scott Bowdridge - Ph.D. (Virginia Tech)
  Veterinary immunology
- Jonathan Boyd
- 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, France)
  Physical chemistry, Laser spectroscopy
- Jennifer Hawkins - Ph.D.
  Plant comparative genomics, Molecular evolution

- Marlon Knights - Ph.D. (West Virginia University)
  Reproductive Physiology and Animal Production
- K. Marie Krause - Ph.D. (University of Wisconsin)
  Dairy Science Nutrition
- Justin Legleiter - Ph.D. (Carnegie-Mellon University)
  Biophysical Chemistry, Atomic Force Microscopy
- Melissa Olfert - Ph.D., R.D. (Loma Linda University)
  Health and wellness
- Michelle Richards-Babb - Ph.D. (Lehigh University)
  Chemical education
- Rita V.M. Rio - Ph.D. (Yale University)
  Symbioses
- Stephen Valentine - Ph.D. (Indiana University)
  Mass spectrometric analysis of biomolecules

## ASSISTANT PROFESSORS

- Craig Barrett - Ph.D.
  Plant Evolutionary Biology
- Sadie Bergeron - Ph.D.
  Developmental Neuroscience
- Edward Brzostek - Ph.D.
  Forest Ecology and Ecosystem Modeling
- Andrew Dacks - Ph.D. (University of Arizona)
  Neurobiology
- Tim Driscoll - Ph.D.
- Jennifer Gallagher - Ph.D.
- Jessica Hoover - Ph.D. (University of Washington)
  Organometallics chemistry, Catalysis
- Peng Li
- Melissa Marra - Ph.D., R.D. (Florida International University)
  Healthy aging and nutritional prevention of chronic disease
- Gary Marsat - Ph.D.
  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. (Max-Planck Institute for Bioinorganic Chemistry)
  Bioinorganic organometallic chemistry
- Brian Popp - Ph.D. (University of Wisconsin-Madison)
  Organic and organometallic chemistry, Catalysis
- Kevin Shaffer - Ph.D.
  Extension Livestock Production Specialist
- Cangliang Shen - Ph.D. (Colorado State University)
  Food Systems and Human Health

## CLINICAL ASSOCIATE PROFESSOR

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

## CLINICAL ASSISTANT PROFESSOR

- Zach Fowler - Ph.D.
  Arboretum Director

## TEACHING ASSOCIATE PROFESSORS

- Megan Govindan - 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 B. Ratcliff - Ph.D. (Binghamton University)
  Innovative Teaching Methods
- Tabitha Razunguzwa - Ph.D. (West Virginia University)
  Physical 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)
  General Chemistry

## TEACHING ASSISTANT PROFESSORS

- Kevin Barry - Ph.D. (University of Maryland)
  Conservation Ecology
- Erin Battin - Ph.D. (Clemson University)
  Bio-inorganic chemistry
- Adam Burda - R.D.
- Melissa Ely - Ph.D. (West Virginia University)
  General Chemistry
- Amaris Guardiola - Ph.D. (Duke University)
- Dana Huebert-Lima - Ph.D. (University of Wisconsin-Madison)
  Epigenetics
- Kevin Lee - Ph.D. (Temple University)
  Virology, Cell and molecular biology methods
- John Navaratnam - Ph.D. (West Virginia University)
  Wetland ecology
- Mark R. Tinsley - Ph.D. (Leeds University, England)
  Nonlinear dynamics, chemical oscillators, moving precipitation patterns
- Stephanie T. Young - Ph.D. (West Virginia University)
  Molecular and Forensic Biology

## SENIOR LECTURERS

- Sue Raylman - Ph.D.
  Animal behavior
- Sydha Salihu
  Instructor
- Mark Schraf - M.S. (West Virginia University)
  Analytical chemistry
- Elizabeth Thomas - M.S. (Clemson University)
  Invertebrate zoology

## PROFESSORS EMERITI

- Harry O. Finklea - Ph.D. (California Institute of Technology
  Analytical/physical chemistry
- E. Keith Inskeep - Ph.D. (University of Wisconsin
  Reproductive physiology
- Paul Lewis - Ph.D.
  Assistant Director of Outreach and Community Affairs for Davis College
- Robert S. Nakon - Ph.D. (Texas A&M University)
  Inorganic chemistry
- Ronald B. Smart - Ph.D.
- Alan M. Stolzenberg - Ph.D. (Stanford University)
  Inorganic chemistry

- Anthony Winston - Ph.D. (Duke U.)
  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<br>& ENGL 102 | Introduction to Composition and Rhetoric<br>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 |
|---|---|---|
| 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<br>& CHEM 116<br>& CHEM 215 | Fundamentals of Chemistry<br>and Fundamentals of Chemistry<br>and Introductory Analytical Chemistry | |
| or: | | |
| CHEM 117<br>& CHEM 118 | Principles of Chemistry 1<br>and Principles of Chemistry 2 | |
| 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<br>& MATH 154 | Calculus 1a with Precalculus<br>and Calculus 1b with Precalculus | |
| MATH 156 | Calculus 2 | |
| STAT 211 | Elementary Statistical Inference | 0 or 3 |
| **A track is required.** | | 31 |
| Number of credits may vary depending on courses selected | | |
| **Biochemistry Electives** | | |
| AEM 341 | General Microbiology | |
| AEM 401 | Environmental 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<br>& BIOL 325 | Molecular Genetics<br>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<br>& AGBI 486 | Undergraduate Research Experience 1<br>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 | | 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 | 4 |
| | | 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<br>& CHEM 342 | 4 |
| Biochemistry Elective 1 | 3 | CHEM 462<br>& 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 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 communication.
5. The pervasive role evolution and homeostasis play in shaping the form and function of all biological molecules and organisms.