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)
Biochemistry

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

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
<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>BIOL 115</td>
<td>Principles of Biology (Minimum grade of C-. May substitute BIOL 101-104)</td>
</tr>
<tr>
<td>BIOL 117</td>
<td>Introductory Physiology (Minimum grade of C-)</td>
</tr>
<tr>
<td>BIOL 219</td>
<td>The Living Cell (Minimum grade of C-)</td>
</tr>
<tr>
<td>BIOL 310</td>
<td>Advanced Cellular/Molecular Biology</td>
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</table>

**Chemistry Requirement**

28 credits minimum grade of C-

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 credits minimum grade of C-

- MATH 155 Calculus 1
- or MATH 153 and Calculus 1a with Precalculus
- & MATH 154 and Calculus 1b with Precalculus
- MATH 156 Calculus 2
- STAT 211 Elementary Statistical Inference

3 credits minimum grade of C-

**A track is required.**

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
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<td>BIOL 313</td>
<td>Molecular Basis of Cellular Growth</td>
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<tr>
<td>BIOL 324</td>
<td>Molecular Genetics</td>
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<tr>
<td>&amp; BIOL 325</td>
<td>and Molecular Genetics Laboratory</td>
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<td>BIOL 335</td>
<td>Cell Physiology</td>
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<td>BIOL 348</td>
<td>Neuroscience 1</td>
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<td>BIOL 350</td>
<td>Plant Physiology</td>
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<td>BIOL 386</td>
<td>Undergraduate Research</td>
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<td>BIOL 410</td>
<td>Cell and Molecular Biology Methods</td>
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<td>BIOL 411</td>
<td>Introduction to Recombinant DNA</td>
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<td>BIOL 413</td>
<td>Molecular Endocrinology</td>
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<td>BIOL 414</td>
<td>Molecular Endocrinology-Laboratory</td>
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<td>BIOL 415</td>
<td>Epigenetics</td>
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<tr>
<td>BIOL 420</td>
<td>Genomics</td>
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<tr>
<td>BIOL 423</td>
<td>Biochemistry of Nucleic Acids and Proteins</td>
</tr>
<tr>
<td>BIOL 424</td>
<td>Protein Structure and Function</td>
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<td>BIOL 425</td>
<td>Developmental Genetics</td>
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<tr>
<td>BIOL 426</td>
<td>Molecular Biology of Cancer</td>
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<tr>
<td>BIOL 432</td>
<td>Forensic Biology</td>
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<tr>
<td>BIOL 436</td>
<td>General Animal Physiology</td>
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<td>BIOL 440</td>
<td>Comparative Anatomy</td>
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<td>BIOL 441</td>
<td>Vertebrate Microanatomy</td>
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<td>BIOL 453</td>
<td>Molecular Basis of Disease</td>
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<td>Immunology</td>
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<td>BIOL 496</td>
<td>Senior Thesis</td>
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<td>BIOL 497</td>
<td>Research</td>
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<td>CHEM 310</td>
<td>Instrumental Analysis</td>
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<tr>
<td>CHEM 312</td>
<td>Environmental Chemistry</td>
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<tr>
<td>CHEM 339</td>
<td>Organic Syntheses</td>
</tr>
<tr>
<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>Senior Thesis</td>
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<td>CHEM 497</td>
<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>FDST 445</td>
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<td>GEN 371</td>
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<td>HN&amp;F 460</td>
<td>Advanced Nutrition</td>
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<td>HN&amp;F 473</td>
<td>Medical Nutrition Therapy 1</td>
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<td>HORT 330</td>
<td>Plant Propagation</td>
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<td>PPTH 401</td>
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<td>VETS 401</td>
<td>Veterinary Anatomy</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
**AMERICAN CHEMICAL SOCIETY (ACS) TRACK**

<table>
<thead>
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<th>Course</th>
<th>Hours</th>
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<tr>
<td>CHEM 310 Instrumental Analysis</td>
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<td>CHEM 401 Chemical Literature (Minimum grade of C-)</td>
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<td>CHEM 403 Undergraduate Seminar</td>
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<tr>
<td>CHEM 422 Intermediate Inorganic Chemistry</td>
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<td>CHEM 497 Research</td>
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<td>PHYS 111 General Physics (Minimum grade of C-)</td>
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<td>PHYS 112 General Physics (Minimum grade of C-)</td>
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<tr>
<td>Biochemistry Electives (See list above)</td>
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**SUGGESTED PLAN OF STUDY FOR THE AMERICAN CHEMICAL SOCIETY (ACS) TRACK**

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<td>MATH 155 (GEF 3)</td>
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<td>CHEM 403 (Capstone)</td>
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<tr>
<td>AGBI 401 Senior Seminar in Biochemistry</td>
<td>1</td>
<td>BIOL 313 Molecular Basis of Cellular Growth</td>
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<tr>
<td>or BIOL 410 Cell and Molecular Biology Methods</td>
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<td>AGBI 386 &amp; AGBI 486 Undergraduate Research Experience 1 and Undergraduate Research Experience 2</td>
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<td>A&amp;VS 402 Values and Ethics</td>
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<td>BIOL 423 Biochemistry of Nucleic Acids and Proteins</td>
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<td>PHYS 101 &amp; PHYS 112 Introductory Physics and General Physics</td>
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**SUGGESTED PLAN OF STUDY FOR THE AMERICAN SOCIETY OF BIOCHEMISTRY AND MOLECULAR BIOLOGY (ASBMB) TRACK**

**First Year**

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**Second Year**

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**Third Year**

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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.