Biochemistry

Intercollegiate Undergraduate Program in 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/archivedcatalog/2014-15/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/archivedcatalog/2014-15/undergraduate/eberlycollegeofartsandsciences/#otherdegreetext).

FACULTY

ANIMAL AND NUTRITIONAL SCIENCES INTERIM DIRECTOR
• Matthew E. Wilson - Ph.D. (Iowa State University)
  Associate Professor - Reproductive physiology

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)
  Nutritional Biochemistry, Protein and Amino Acid Metabolism, Curriculum Committee Chair, Intercollegiate Undergraduate Program in Biochemistry
• Jonathan R. Cumming - Ph.D. (Cornell University)
  Associate Provost for Graduate Academic Affairs. Environmental plant physiology, Ecophysiology of root-mycorrhizal-soil interactions, Urban ecology
• Robert A. Dailey - Ph.D. (University of Wisconsin)
  Reproductive physiology
• Harry O. Finklea - Ph.D. (California Institute of Technology)
  Analytical/physical chemistry, Electron transfer kinetics, Solid oxide fuel cells, Gas phase sensors
• Jorge A. Flores - Ph.D. (The George Washington)
  Animal physiology: endocrinology of reproduction
• Keith Garbutt - Ph.D. (University of Wales)
  Dean, University Honors College. Population genetics: Ecological genetics and population biology of weedy plants
• Terry Guilllon - Ph.D. (William and Mary)
  Physical chemistry, Solid State NMR, Biological Materials, Polymers
• E. Keith Inskeep - Ph.D. (University of Wisconsin)
  Reproductive physiology
• Jacek Jaczynski - Ph.D. (Oregon State University)
  Food safety
• Charles Jaffe - Ph.D. (U. Colorado)
  Theoretical chemistry, Molecular dynamics, Chaotic systems
• Jeryl C. Jones - D.V.M., Ph. D. (Auburn University)
  Veterinary radiology
• Robert Jones - Ph.D. (SUNY College)
  Dean of the Eberly College of Arts and Sciences. Forest ecology.
• P. Brett Kenney - Ph.D. (Kansas State University)
  Muscle protein functionality
• Fred L. King - Ph.D. (U. 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. (U. Wisconsin-Madison)
  Chemical education, On-line instruction methods in organic chemistry
• Jeffrey L. Petersen - Ph.D. (U. Wisconsin-Madison)
  Associate Chairperson, Physical inorganic chemistry, Electrophilic transition metal complexes, X-ray crystallography
• Kenneth Showalter - Ph.D. (U. Colorado)
  Bennett Distinguished Professor, physical chemistry, Chemical kinetics, Multi-stability and oscillating chemical systems
• Bjorn Soderberg - Ph.D. (Royal Inst. of Tech., Sweden)
  Organic synthesis using transition metals
• Michele Wheatly
  Provost. Comparative physiology

ASSOCIATE PROFESSORS
• Jim H. Belanger
  Neuroethology adaptive behavior, Comparative physiology
• Suzanne Bell - Ph.D. (U. New Mexico)
  Analytical chemistry, Forensic science
• Clifton P. Bishop - Ph.D. (University of Virginia)
  Molecular genetics, Developmental biology, Forensic biology
• Kevin C. 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
• 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
• Lisa A. Holland - Ph.D. (U. North Carolina-Chapel Hill)
  Analytical chemistry, Micro-separations, High-throughput drug screening
• Glen Jackson - Ph.D. (West Virginia U.)
  Mass spectrometry, forensic chemistry
• Philip E. Keeting
  Molecular endocrinology, Cancer biology
• Marlon Knights - Ph.D. (West Virginia University)
  Reproductive physiology
• K. Marie Krause - Ph.D. (University of Wisconsin)
  Dairy science nutrition
• Kristen Matak - Ph.D. (Virginia Tech)
  Food science and human nutrition
• Susan N. Partington - Ph.D., R.D. (University of Wisconsin)
  Nutrition environment
• William T. Peterjohn
  Ecosystem ecology: Effects of global change on ecosystem dynamics, Nitrogen cycling in natural ecosystems.
• Michelle Richards-Babb - Ph.D. (Lehigh U.)
  Chemical education
• Rita V.M. Rio - Ph.D. (Yale University)
  Symbioses
• X. Michael Shi - Ph.D. (U. Maryland)
  Organic synthesis, Bioorganic chemistry
• Ronald B. Smart - Ph.D. (U. Michigan)
  Environmental analytical chemistry, Electrochemistry, Trace metals, Coal chemistry
• Alan M. Stolzenberg - Ph.D. (Stanford U.)
  Inorganic chemistry, Bio-inorganic chemistry, Organometallic chemistry
• Janet C. L. Tou - Ph.D. (University of Toronto)
  Human nutrition and foods
• Michelle D. Withers - Ph.D. (University of Arizona)
  Biology education, Neurobiology
• Jianbo Yao - Ph.D. (McGill University)
  Functional genomics

CLINICAL ASSOCIATE PROFESSOR
• Donna Ford-Werntz - Ph.D. (Washington University/Missouri Botanical Garden)
  Plant systematics: Portulacaceae, West Virginia flora
• Margaret A. Minch - D.V.M. (The Ohio State University)
  Veterinary medicine

ASSISTANT PROFESSORS
• Kimberly M. Barnes - Ph.D. (University of Nebraska)
  Lipid metabolism
• Scott Bowdridge - Ph.D. (Virginia Tech)
  Veterinary immunology
• Jonathan Boyd - Ph.D. (Texas Tech University)
  Analytical biochemistry and toxicology
• Fabien Goulay - Ph.D. (U. Rennes, France)
  Physical chemistry, Laser spectroscopy
• Jennifer Hawkins
  Plant comparative genomics, Molecular evolution
• Jessica Hoover - Ph.D. (University of Washington)
  Organometallics chemistry, Catalysis
• Justin Legleiter - Ph.D. (Carnegie Mellon U.)
  Biophysical chemistry, Atomic force microscopy
• 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 - Dr.P.H., M.S., R.D. (Loma Linda University)
  Health and wellness
• Brian Popp - Ph.D. (U. Wisconsin-Madison)
  Organic and organometallic chemistry, Catalysis
• Stephen Valentine - Ph.D. (Indiana University)
  Mass spectrometric analysis of biomolecules

TEACHING ASSISTANT 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
• Dana Huebert-Lima - Ph.D. (University of Wisconsin-Madison)
  Epigenetics
• Kevin Lee
  Virology, Cell and molecular biology methods
• Tabitha Chigwada - Ph.D. (West Virginia U.)
  Physical chemistry
• Catherine Merovich - Ph.D. (Western Michigan University)
  Amphibian conservation
• Joshua Osbourn - Ph.D. (University of Pittsburgh)
  Organic chemistry
• Betsy Ratcliff - Ph.D. (U. Binghamton - SUNY)
  Physical chemistry
• Jennifer Robertson-Honecker - Ph.D. (West Virginia U.)
  Analytical chemistry, Science education
• Valerie Smith - Ph.D. (Clemson University)
  Organic chemistry
• Jennifer Stueckle - Ph.D. (West Virginia University)
  Aquatic toxicology
• Mingming Xu - Ph.D. (Ohio U.)
  Analytical 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 U.)
  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
• Ramsey H. Frist
• Roland B. Guthrie
• Denis W. H. MacDowell - Ph.D. (Mass. Inst. Tech.) 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 U.) Polymer chemistry

Degree Requirements
Students seeking to graduate with a B.S. in Biochemistry must complete the GEC requirements, their program requirements, and, if necessary, electives to reach 128 credit hours.

Program Requirements for the B.S. in Biochemistry
Students must select between a Biology track and a Chemistry track.

- **Biology track**: the Biology track follows the recommendations of the American Society of Biochemistry and Molecular Biology, and students seeking to complete a program certified by the American Society of Biochemistry and Molecular Biology must meet the following requirements: in addition to the courses below, students must also take AGBI 494, BIOL 493, CHEM 462, CHEM 464, PHYS 101, PHYS 102, and 16 credits of biochemistry elective classes.

- **Chemistry track**: the chemistry track follows the recommendations of the American Chemical Society. For students seeking to complete a program certified by the American Chemical Society, students must meet the following requirements: a grade of C or better is also required in CHEM 341 and CHEM 401. In addition to the Chemistry courses below, students must also take CHEM 310, CHEM 401, CHEM 403, CHEM 422, CHEM 497, as well as the requirement for calculus based physics (PHYS 111 and PHYS 112), and an additional 9 credits of biochemistry elective classes.

- **Biochemistry Program Honors**: The option of graduating with biochemistry program honors is available to students with a 3.5 or higher overall grade point average and the approval of the faculty of the intercollegiate program. Graduation with biochemistry program honors includes a senior thesis based upon an approved research project conducted under the supervision of a faculty mentor. For further information, and to apply for admission, qualified students should consult their advisers.

- **Calculation of the GPA in the Major**: Maintain at least a 2.0 overall GPA and a 2.0 cumulative GPA in any coursework in biology, chemistry, and biochemistry courses fulfilling major requirements. A grade of C or better grade is required in all prerequisite courses for biochemistry, biology, and chemistry courses (BIOL 115, BIOL 117 and BIOL 219; CHEM 115, CHEM 116, CHEM 215, CHEM 233, CHEM 234, CHEM 235 and CHEM 236; MATH 155 and MATH 156; PHYS 101 or PHYS 111 and PHYS 102 or PHYS 112, AGBI 410 and AGBI 412 and CHEM 462 and CHEM 464).

- **Writing Course Requirement**: The General Education Curriculum requires the successful completion of a writing course ("W"), preferably in the major. Biochemistry majors may take any writing course.

- **Capstone Requirement**: The General Education Curriculum requires the successful completion of a Capstone course. Biochemistry majors must successfully complete A&VS 496, A&VS 497, BIOL 496, BIOL 497, CHEM 496, or CHEM 497.

**GENERAL EDUCATION CURRICULUM**

Please use this link to view a list of courses that meet each GEC requirement. ([http://registrar.wvu.edu/current_students/general_education_curriculum](http://registrar.wvu.edu/current_students/general_education_curriculum))

NOTE: Some major requirements will fulfill specific GEC requirements. Please see the curriculum requirements listed below for details on which GECs you will need to select.

<table>
<thead>
<tr>
<th>General Education Curriculum</th>
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<tbody>
<tr>
<td>ENGL 101</td>
<td>Composition And Rhetoric and Composition And Rhetoric</td>
</tr>
<tr>
<td>&amp; ENGL 102 or ENGL 103</td>
<td>Accelerated Academic Writing</td>
</tr>
<tr>
<td>GEC 2A - Mathematics</td>
<td>3-4</td>
</tr>
<tr>
<td>GEC 2B - Natural and Physical Science</td>
<td>7-8</td>
</tr>
<tr>
<td>GEC 2C - Additional GEC 2A, B or C</td>
<td>3</td>
</tr>
<tr>
<td>GEC 3 - The Past and Its Traditions</td>
<td>3</td>
</tr>
<tr>
<td>GEC 4 - Issues of Contemporary Society</td>
<td>3</td>
</tr>
<tr>
<td>Course</td>
<td>Credits</td>
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<td>-------------------------------------------</td>
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</tr>
<tr>
<td>GEC 5 - Artistic Expression</td>
<td>3</td>
</tr>
<tr>
<td>GEC 6 - The Individual in Society</td>
<td>3</td>
</tr>
<tr>
<td>GEC 6F - First Year Seminar</td>
<td>1-3</td>
</tr>
<tr>
<td>GEC 7 - American Culture</td>
<td>3</td>
</tr>
<tr>
<td>GEC 8 - Western Culture</td>
<td>3</td>
</tr>
<tr>
<td>GEC 9 - Non-Western Culture</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td><strong>38-45</strong></td>
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**CURRICULUM REQUIREMENTS**

**UNIVERSITY REQUIREMENTS**

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>WUE 191</td>
<td>First Year Seminar</td>
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<tr>
<td><strong>GEC Requirements:</strong></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Writing Course</strong></td>
<td></td>
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**PROGRAM CORE REQUIREMENTS**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>AGBI 199</td>
<td>Orientation to Biochemistry</td>
</tr>
<tr>
<td>AGBI 410</td>
<td>Introduction to Biochemistry (min. grade of C)</td>
</tr>
<tr>
<td>AGBI 412</td>
<td>Intro - Biochemistry Wet Lab (min. grade of C)</td>
</tr>
<tr>
<td><strong>Biology Requirement:</strong></td>
<td></td>
</tr>
<tr>
<td>BIOL 115</td>
<td>Principles of Biology (min. grade of C)</td>
</tr>
<tr>
<td>BIOL 117</td>
<td>Introductory Physiology (min. grade of C)</td>
</tr>
<tr>
<td>BIOL 219</td>
<td>The Living Cell (min. grade of C)</td>
</tr>
<tr>
<td>BIOL 310</td>
<td>Adv Cellular/Molecular Biology</td>
</tr>
</tbody>
</table>

**Chemistry Requirement:**

Select 1 group (min. grades of C) | 10-12 |

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CHEM 115</td>
<td>Fundamentals of Chemistry</td>
</tr>
<tr>
<td>&amp; CHEM 116</td>
<td>and Fundamentals of Chemistry</td>
</tr>
<tr>
<td>&amp; CHEM 215</td>
<td>and Intro to Analytical Chemistry</td>
</tr>
<tr>
<td>or CHEM 117</td>
<td>Principles of Chemistry</td>
</tr>
<tr>
<td>&amp; CHEM 118</td>
<td>and Principles of Chemistry</td>
</tr>
<tr>
<td>CHEM 233</td>
<td>Organic Chemistry (min. grade of C)</td>
</tr>
<tr>
<td>CHEM 234</td>
<td>Organic Chemistry (min. grade of C)</td>
</tr>
<tr>
<td>CHEM 235</td>
<td>Organic Chemistry Laboratory (min. grade of C)</td>
</tr>
<tr>
<td>CHEM 236</td>
<td>Organic Chemistry Laboratory (min. grade of C)</td>
</tr>
<tr>
<td>CHEM 462</td>
<td>Biochemistry 2</td>
</tr>
<tr>
<td>CHEM 464</td>
<td>Biochemistry 2 Laboratory</td>
</tr>
</tbody>
</table>

**Math and Stat Requirement:**

Select 1 group (min. grades of C) | 4-8 |

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MATH 155</td>
<td>Calculus 1</td>
</tr>
<tr>
<td>or MATH 153</td>
<td>Calculus 1a with Precalculus</td>
</tr>
<tr>
<td>&amp; MATH 154</td>
<td>and Calculus 1b with Precalculus</td>
</tr>
<tr>
<td>MATH 156</td>
<td>Calculus 2 (min. grade of C)</td>
</tr>
<tr>
<td>STAT 211</td>
<td>Elemfrty Statistical Inference</td>
</tr>
</tbody>
</table>

**A track is required. Please see course options below.**

**Biochemistry Electives**

**Animal Area**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>AGBI 512</td>
<td>Nutritional Biochemistry</td>
</tr>
<tr>
<td>&amp; AGBI 513</td>
<td>and Nutritional Biochemistry Lab</td>
</tr>
<tr>
<td>AGBI 514</td>
<td>Animal Biotechnology</td>
</tr>
<tr>
<td>ANPH 301</td>
<td>Intro to Animal Physiology</td>
</tr>
<tr>
<td>ANPH 400</td>
<td>Growth/Lactation Physiology</td>
</tr>
<tr>
<td>ANPH 405</td>
<td>Animal Physiology Laboratory</td>
</tr>
<tr>
<td>ANPH 424</td>
<td>Physiology of Reproduction</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
</tr>
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<td>-------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>BIOL 348</td>
<td>Neuroscience 1</td>
</tr>
<tr>
<td>BIOL 436</td>
<td>General Animal Physiology</td>
</tr>
<tr>
<td>BIOL 441</td>
<td>Vertebrate Microanatomy</td>
</tr>
<tr>
<td>ENTO 404</td>
<td>Principles Of Entomology</td>
</tr>
<tr>
<td>ENTO 412</td>
<td>Pest Management</td>
</tr>
<tr>
<td>HN&amp;F 460</td>
<td>Advanced Nutrition</td>
</tr>
<tr>
<td>HN&amp;F 474</td>
<td>Medical Nutrition Therapy 2</td>
</tr>
<tr>
<td>VETS 302</td>
<td>Animal Pathology</td>
</tr>
<tr>
<td>VETS 401</td>
<td>Veterinary Anatomy</td>
</tr>
<tr>
<td>VETS 405</td>
<td>Parasitology</td>
</tr>
</tbody>
</table>

**Cell and Molecular Biology**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BIOL 312</td>
<td>Introduction To Virology</td>
</tr>
<tr>
<td>BIOL 313</td>
<td>Molecular Basis of Cell Growth</td>
</tr>
<tr>
<td>BIOL 335</td>
<td>Cell Physiology</td>
</tr>
<tr>
<td>BIOL 413</td>
<td>Molecular Endocrinology</td>
</tr>
<tr>
<td>BIOL 432</td>
<td>Forensic Biology</td>
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</table>

**Chemistry**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>CHEM 310</td>
<td>Instrumental Analysis</td>
</tr>
<tr>
<td>CHEM 312</td>
<td>Environmental Chemistry</td>
</tr>
<tr>
<td>CHEM 422</td>
<td>Intermediate Inorganic Chem</td>
</tr>
<tr>
<td>CHEM 460</td>
<td>Forensic Chemistry</td>
</tr>
<tr>
<td>CHEM 514</td>
<td>Mass Spec Principles &amp; Practic</td>
</tr>
<tr>
<td>CHEM 516</td>
<td>Bioanalytical Chemistry</td>
</tr>
<tr>
<td>CHEM 552</td>
<td>Biochemical Toxicology</td>
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</tbody>
</table>

**Genetics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>BIOL 324</td>
<td>Molecular Genetics</td>
</tr>
<tr>
<td>&amp; BIOL 325</td>
<td>and Molecular Genetics Laboratory</td>
</tr>
<tr>
<td>BIOL 411</td>
<td>Intro To Recombinant DNA</td>
</tr>
<tr>
<td>BIOL 425</td>
<td>Developmental Genetics</td>
</tr>
<tr>
<td>GEN 371</td>
<td>Principles of Genetics</td>
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**Microbiology**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>AEM 341</td>
<td>General Microbiology</td>
</tr>
<tr>
<td>AEM 401</td>
<td>Environmental Microbiology</td>
</tr>
<tr>
<td>AEM 408</td>
<td>Applied Water Microbiology</td>
</tr>
<tr>
<td>AEM 420</td>
<td>Soil Microbiology</td>
</tr>
<tr>
<td>FDST 445</td>
<td>Food Microbiology</td>
</tr>
<tr>
<td>&amp; FDST 449</td>
<td>and Food Microbiology Lab</td>
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**Plant**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>BIOL 350</td>
<td>Plant Physiology</td>
</tr>
<tr>
<td>HORT 420</td>
<td>Plant Propagation</td>
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<tr>
<td>PPTH 401</td>
<td>General Plant Pathology</td>
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**Other**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>A&amp;VS 402</td>
<td>Values and Ethics - CAP *</td>
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<tr>
<td>A&amp;VS 451</td>
<td>Current Literature-Animal Sci *</td>
</tr>
<tr>
<td>BIOL 301</td>
<td>History Of Biology</td>
</tr>
<tr>
<td>BIOL 424</td>
<td>Protein Structure &amp; Function</td>
</tr>
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</table>

**Capstone Requirement**

3 Select one:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>A&amp;VS 496</td>
<td>Senior Thesis:Capstone</td>
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<tr>
<td>A&amp;VS 497</td>
<td>Research</td>
</tr>
<tr>
<td>BIOL 496</td>
<td>Senior Thesis</td>
</tr>
<tr>
<td>BIOL 497</td>
<td>Research</td>
</tr>
<tr>
<td>Course Code</td>
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<tr>
<td>CHEM 496</td>
<td>Senior Thesis</td>
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<tr>
<td>CHEM 497</td>
<td>Research</td>
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<tr>
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### AMERICAN SOCIETY OF BIOCHEMISTRY AND MOLECULAR BIOLOGY (ASBMB) TRACK

**American Society of Biochemistry and Molecular Biology (ASBMB) Track**

<table>
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<tr>
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<th>Semester Hours</th>
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<tr>
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<tr>
<td>BIOL 313</td>
<td>Molecular Basis of Cell Growth</td>
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<td>or BIOL 410</td>
<td>Cell/Molecular Biology Methods</td>
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<tr>
<td>BIOL 493</td>
<td>Physical Chem: Brief Course</td>
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<tr>
<td>CHEM 341</td>
<td>Experimental Physical Chem</td>
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### AMERICAN CHEMICAL SOCIETY (ACS) TRACK

**American Chemical Society (ACS) Track**

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<tbody>
<tr>
<td>CHEM 310</td>
<td>Instrumental Analysis</td>
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<tr>
<td>CHEM 341</td>
<td>Physical Chem: Brief Course (Minimum Grade C)</td>
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<tr>
<td>CHEM 342</td>
<td>Experimental Physical Chem (Minimum Grade C)</td>
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<tr>
<td>CHEM 401</td>
<td>Chemical Literature (Minimum Grade C)</td>
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<td>CHEM 403</td>
<td>Undergraduate Seminar</td>
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<tr>
<td>CHEM 422</td>
<td>Intermediate Inorganic Chem</td>
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<td>PHYS 111</td>
<td>General Physics (Minimum Grade C)</td>
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<tr>
<td>PHYS 112</td>
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### SUGGESTED PLAN OF STUDY FOR THE AMERICAN CHEMICAL SOCIETY (ACS) TRACK

**First Year**

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<td>4 MATH 156</td>
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**Second Year**

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<tr>
<td>CHEM 233</td>
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<td>3 BIOL 310</td>
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<tr>
<td>CHEM 235</td>
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<td>1 CHEM 234</td>
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<tr>
<td>BIOL 219</td>
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<td>Spring Hours</td>
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<tr>
<td>PHYS 111</td>
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<td>ENGL 102</td>
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<td>CHEM 215</td>
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<td>** Third Year **</td>
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<td>** Fourth Year **</td>
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<td>** Fall Hours **</td>
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<td>CHEM 422</td>
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</tbody>
</table>

Total credit hours: 128

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

** STAT 211 may be used to fulfill GEC 4.

*** Students could take BIOL 313, BIOL 410, or another upper-level biology class as a biology elective or a general elective.

**** The Biochemistry Capstone will consist of Capstone sections of CHEM 401 and 403, with a biochemistry orientation.

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall Hours</th>
<th>Spring Hours</th>
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<tr>
<td>AGBI 199</td>
<td>1</td>
<td>CHEM 116</td>
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<tr>
<td>BIOL 115</td>
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<td>CHEM 115</td>
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<td>MATH 156</td>
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<tr>
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<th>Spring Hours</th>
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<tr>
<td>CHEM 233</td>
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<td>BIOL 310</td>
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<td>ENGL 102</td>
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### Third Year

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<tr>
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<tbody>
<tr>
<td>AGBI 410</td>
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<tr>
<td>AGBI 412</td>
<td>1 CHEM 464</td>
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<td>STAT 211 **</td>
<td>3 CHEM 341</td>
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<td>4 CHEM 342</td>
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<td>General Elective</td>
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<tr>
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<tr>
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|                                    | 16                               | 16    |

Total credit hours: 128

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

** STAT 211 may satisfy GEC 4

### Fourth Year

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<tr>
<th>Fall</th>
<th>Hours Spring</th>
<th>Hours</th>
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<tr>
<td>BIOL 493</td>
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### AGRICULTURAL BIOCHEMISTRY COURSES

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

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

**AGBI 296A-Z. Honors. 1-3 Hours.**
PR: Students in Honors Program and consent by the honors director. Independent reading, study, or research.

**AGBI 393A-Z. 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 and present the topic in a seminar.

**AGBI 410. Introduction to Biochemistry. 3 Hours.**
PR: 8 hours of General Chemistry and CHEM 231 or equivalent. 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. Intro Biochemistry Laboratory. 1 Hour.**
PR or CONC: AGBI 410. Experiments to demonstrate certain principles and properties of animal and plant biochemicals.

**AGBI 412. Intro - Biochemistry Wet Lab. 1 Hour.**
PR or CONC: AGBI 410 or Consent. Classic and modern techniques in biochemistry.

**AGBI 480. Asgn Tp:General Biochemistry. 1-4 Hours.**

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

**AGBI 493A-Z. Special Topics. 1-6 Hours.**
PR: Consent. Investigation of topics not covered in regularly scheduled courses.
AGBI 494A-Z. 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.

AGBI 498A-Z. Honors. 1-3 Hours.
PR: Students in honors program and consent by the honors director. Independent reading, study or research.

BIOLOGY COURSES

BIOL 101. General Biology. 3 Hours.
PR or CONC: BIOL 103. Introductory course in biology: cellular, organismal, and population genetics, including reproduction, growth and development, and evolution.

BIOL 102. General Biology. 3 Hours.
PR or CONC: BIOL 104. Introductory biology: energetics and physiology of cells, organisms, and populations, including regulation and control of multicellular organisms.

BIOL 103. General Biology Laboratory. 1 Hour.
PR or CONC: BIOL 101. Experiments in biology: genetics and evolution; reproduction, growth, and development of cells, organisms, and populations.

BIOL 104. General Biology Laboratory. 1 Hour.

BIOL 105. Environmental Biology. 3 Hours.
(Intended for non-biology majors.) Population growth and human impacts on the environment, including ecosystem destruction, biological diversity, pollution, and global climate change are explored to obtain the concepts necessary to understand complex environmental issues of our time.

BIOL 106. Environmental Biology Lab. 1 Hour.
CoReq: BIOL 105. Field and laboratory exercises explore fundamental ecological concepts and environmental problems, such as biodiversity, pollution, and natural resource utilization.

BIOL 107. Biotechnology and Society. 3 Hours.
An overview of the use of biotechnology to solve agricultural, medical, and environmental problems. Bioethical concerns and societal impacts of the use of the technologies will be discussed.

BIOL 115. Principles of Biology. 4 Hours.
An introductory course presenting basic principles of modern biology. This course represents the first in a four-course, integrated sequence required of biology majors. Topics include ecology and evolution, organismal biology, and cellular/molecular biology.

BIOL 117. Introductory Physiology. 4 Hours.
PR: BIOL 115 or BIOL 101 and BIOL 102 AND BIOL 103 AND BIOL 104. Continuation of BIOL 115. The diversity of reproductive, developmental, functional, and integrative mechanisms in plants and animals.

BIOL 122. Human Sexuality. 3 Hours.
A study of biological, behavioral and societal aspects of sexuality. Issues considered include changing fecundity, social-legal implications, sex roles, sexually transmitted diseases, populations, erotica, aging, dysfunctions, and decision-making skills for sex related issues.

BIOL 124. The Human Environment. 3 Hours.
An examination of several aspects of current worldwide environmental deterioration caused by the actions of humans. Public policies and alternative mitigative strategies are also presented.

BIOL 215. Cell-Biology for Pre-Pharmacy. 3 Hours.
PR: BIOL 115 and BIOL 117 and (CHEM 115 or CHEM 117). Structure, function and diversity of cells with an emphasis on gene expression and cellular phenotype including cell chemistry, energetics, and regulation of cell activities. This course is offered only to Pre-Pharmacy majors.

BIOL 219. The Living Cell. 4 Hours.
PR: (CHEM 115 or CHEM 117) and BIOL 117. Continuation of BIOL 117. Structure, function and diversity of cells with an emphasis on gene expression and cellular phenotype including cell chemistry, energetics, and regulation of cell activities.

BIOL 221. Ecology And Evolution. 3 Hours.

BIOL 235. Human Physiology. 3 Hours.
PR: BIOL 101 and BIOL 102 and BIOL 103 and BIOL 104. (Intended for non-biology majors.) An introductory course in the function of the human.
BIOL 236. Human Phys:Quantitative Lab. 1 Hour.
PR: MATH 156 and CHEM 116 and BIOL 115 and PR or CONC: BIOL 235. Optional lab for BIOL 235 incorporating engineering concepts, such as mass and energy balances, circuit theory, and chemical kinetics to quantify and help understand many aspects of human physiology.

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

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

BIOL 301. History Of Biology. 3 Hours.
PR: (BIOL 101 and BIOL 103 and BIOL 102 and BIOL 104) or BIOL 115. History of development of biological knowledge with philosophical and social backgrounds.

BIOL 302. Biometry. 3 Hours.
PR: STAT 211. Application of quantitative methods and statistics to biological data with emphasis on hands-on hypothesis construction, experimental design, data analysis and biological interpretation of statistical results.

BIOL 310. Adv Cellular/Molecular Biology. 3 Hours.

BIOL 311. Adv Cellular/Molecular Biol Lab. 2 Hours.
PR or Conc: BIOL 310. Experimental approaches to the study of cellular systems.

BIOL 312. Introduction To Virology. 3 Hours.

BIOL 313. Molecrr Basis of Cell Growth. 3 Hours.
PR: BIOL 219. Study of the integration of internal and external influences as they regulate the division, growth, and differentiation of cells. Topics include hormones as cell effectors, cancer, and stem cells.

BIOL 316. Developmental Biology. 3 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219. A molecular genetic analysis of the mechanisms by which multicellular organisms develop from single cells.

BIOL 317. Developmental Biology Lab. 1 Hour.
PR: BIOL 219. CoReq: BIOL 316. Experimental approaches to the genetic analysis of the mechanisms by which multicellular organisms develop from single cells.

BIOL 318. Writing Appalachian Ecology. 3 Hours.
This course encouraged students to think about the long-term future of our planet. What could our world be like in 200 years? How will current environmental problems change the future? How will relationships with the natural world change? Students address questions like these in creative nonfiction essays they write about research being conducted at the Fernow Experimental Forest in WV.

BIOL 321. Total Science Experience Lab. 2 Hours.
PR or Conc: BIOL 221. Biological research experience incorporating diverse learning experiences that take place in the process of being a research scientist; including writing grant proposals, manuscripts, and presentation of results in a public forum.

BIOL 324. Molecular Genetics. 3 Hours.
PR: BIOL 219. Theoretical and practical knowledge in genetics as a field of study and as an approach for investigating biological problems.

BIOL 325. Molecular Genetics Laboratory. 1 Hour.
PR: BIOL 219. CoReq: BIOL 324. The laboratory is a logical sequence of experiments providing actual research experience in molecular genetics. Must be taken at the same time as BIOL 324.

BIOL 327. Professional Development. 1 Hour.
PR: BIOL 219. This course provides an overview of opportunities for students graduating with degrees in the biological sciences. An assessment test will help identify strengths and weaknesses within the field.

BIOL 335. Cell Physiology. 3 Hours.
PR: BIOL 117. Emphasis on the unity and diversity of cells; membrane structure and function; and the role that intracellular compartments, cytoskeleton, and extracellular matrix play in cell physiology.

BIOL 336. Vertebrate Embryology. 4 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219 and BIOL 221. An experimental and descriptive analysis of vertebrate development.

BIOL 337. Physiological Psychology. 3 Hours.
PR: PSYC 301 and junior or senior standing. Advanced study of the physiological mechanisms of behavior. Topics include neural and endocrine mechanisms of behavior and issues, methods, and findings in behavioral neuroscience. (Also listed as PSYC 426.).

BIOL 338. Behavioral Ecology. 3 Hours.
PR: BIOL 221. Consideration of the influences of environmental factors on short-and long-term regulation, control, and evolution of the behavior of animals.
BIOL 339. Animal Communication. 3 Hours.
PR: BIOL 221 or consent. Communication mediates most interactions between individuals and the brain dedicates much of its resources to generating and processing these signals. This course examines why and how animals communicate, the physiological mechanisms involved in generating/sensing communication signals, how evolution shapes communication, and how communication signals can influence decision making.

BIOL 340. Invertebrate Zoology. 4 Hours.
PR: BIOL 219 and BIOL 221. The evolution of animals without vertebral columns. The laboratory includes field trips, including one that takes an entire weekend. (Dissection kit required.).

BIOL 341. Ichthyology. 4 Hours.
Study of the internal and external structure of fishes, their systematic and ecological relationships, and their distribution in time and space. (Dissection kit required.).

BIOL 348. Neuroscience 1. 3 Hours.
PR: BIOL 219. An introduction to neuroscience, including basic neuroanatomical neurophysiology, and the relationship between the central nervous system, physiology, and behavior.

BIOL 349. Neuroscience 2. 3 Hours.
PR: BIOL 348. An introductory systems level course on organization of the nervous system, from an evolutionary to a clinical perspective. Topics include development and functional organization of sensory, motor, autonomic and cognitive systems. The evolutionary history and human health concerns associated with these systems will be addressed, through lecture, discussion, and readings in the primary literature.

BIOL 350. Plant Physiology. 4 Hours.
PR: CHEM 115 and CHEM 116 and ((BIOL 101 and BIOL 103) or BIOL 117). Physiochemical processes of plants.

BIOL 351. Plant Diversity. 4 Hours.
PR: (BIOL 101 and BIOL 102 and BIOL 103 and BIOL 104) or BIOL 115. Evolution, morphology, life cycles, ecology, and uses of cyanobacteria, lichens, algae, bryophytes, ferns, gymnosperms, and angiosperms. Laboratory emphasizes comparing living specimens with local field trips.

BIOL 352. Plant Anatomy/Development. 4 Hours.
PR: BIOL 117 or PLSC 206. How plants (especially angiosperms) develop, stand up, defend themselves, transport food and water, and reproduce; also evolution and uses of wood and bark. Students observe development from spores, seeds, and cuttings. (Two local field trips.).

BIOL 353. Flora Of West Virginia. 3 Hours.
PR: BIOL 221. World-wide distribution patterns of plants and factors related to these distributions, including dispersal. Limiting factors, climate, isolation, evolutionary history, plate tectonics, pleistocene glaciations, and human activities. Plant communities and soils of polar, temperate, and tropical biomes are discussed.

BIOL 361. Plant Ecology. 4 Hours.
PR: BIOL 221. Introduction to the four divisions of plant ecology, including physiological ecology, population ecology, community ecology and ecosystem ecology.

BIOL 362. Limnology. 4 Hours.
PR: (BIOL 101 and BIOL 103) or BIOL 115 or WMAN 224 or consent. Physical, chemical, and biological characteristics of inland waters with emphasis on the structure and function of stream ecosystems. (Also listed as WMAN 446.).

BIOL 363. Plant Geography. 3 Hours.
PR: BIOL 221. World-wide distribution patterns of plants and factors related to these distributions, including dispersal. Limiting factors, climate, isolation, evolutionary history, plate tectonics, pleistocene glaciations, and human activities. Plant communities and soils of polar, temperate, and tropical biomes are discussed.

BIOL 384. Marine EcoSystems Topics. 3 Hours.
Three-week field-based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of six-hours counts toward the biology major.

BIOL 384A. Marine EcoSystems Topics. 3 Hours.
Three-week field-based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of 6 hours counts toward the biology major.

BIOL 384B. Marine EcoSystems Topics. 3 Hours.
Three-week field-based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of 6 hours counts toward the biology major.

BIOL 384C. Marine EcoSystems Topics. 3 Hours.
Three-week field based courses offered at the Marine Science Consortium in Virginia. Courses vary by year including marine ichthyology, marine mammals, and coral reef ecology. A maximum of 6 hours counts toward the biology major.

BIOL 386. Undergraduate Research. 1-4 Hours.
PR: Written consent of chair and a 2.7 grade point average in biology. (May be repeated for a maximum of 6 credit hours.) Individual laboratory or field experiments supervised by a faculty member.
BIOL 393A-Z. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

BIOL 410. Cell/Molecular Biology Methods. 3 Hours.
PR: BIOL 219. Introduction to the theory, application, ethic and economics of biotechnologies.

BIOL 411. Intro To Recombinant DNA. 4 Hours.
PR: BIOL 219. An introductory course covering the basic principles and techniques of recombinant DNA technology, includes molecular cloning, isolation of plasmid DNA, agarose/acrylamide gel electrophoresis, restriction enzyme mapping, nucleic acid hybridization, and DNA sequencing.

BIOL 413. Molecular Endocrinology. 3 Hours.
PR: BIOL 219. Hormonal action is discussed at the cellular and molecular levels. Topics include hormone production and regulation, receptor kinetics and activation, and receptor output.

BIOL 414. Molecular Endocrinology - Lab. 1 Hour.
CoReq: BIOL 413. Experimental techniques used to study hormones and receptors.

BIOL 415. Epigenetics. 3 Hours.
PR: BIOL 219 or consent. Explore the molecular mechanisms, phenotypic phenomena and current application of epigenetics and the study of how genetic information is used and maintained.

BIOL 420. Genomics. 3 Hours.
PR: BIOL 219. Advanced elective examining biology and evolution on a genome-wide scale. Topics include fields of study and methods of DNA sequence acquisition and annotation, including exploration of the human genome and its contribution to disease discovery.

BIOL 424. Protein Structure & Function. 4 Hours.
PR: BIOL 219 and (CHEM 231 or CHEM 233). Explores fundamentals of the protein structure; methods of structure determination; features of globular, membrane, and fibrous proteins; and approaches to protein classification.

BIOL 425. Developmental Genetics. 3 Hours.
PR: BIOL 219. This course covers the mechanisms by which genetics instructs the process of development. The complex interactions between cells, the environment, and the genome are presented.

BIOL 426. Molecular Biology of Cancer. 3 Hours.
PR: BIOL 219. Exploration of molecular pathways leading to the development of cancer with emphasis on gene expression, cell cycle regulation, and signaling pathways targeted in conventional therapies.

BIOL 430. Bioinformatics. 3 Hours.
PR: BIOL 219 or Consent. An introduction to algorithms and tools for analysis of genetic and genomic data in an evolutionary context.

BIOL 432. Forensic Biology. 4 Hours.
PR: BIOL 219. A lecture and laboratory course focusing on the latest advances in forensic identification technologies, including advantages and limitations of different approaches. Students can gain extensive hands-on experience in the isolation, qualification, and analysis of DNA.

BIOL 433. Herpetology. 3 Hours.
Investigation into the biology, ecology, and evolution of reptiles and amphibians, emphasizing North American species especially those found in the state of West Virginia. (One field exercise outside of regular time is required.).

BIOL 436. General Animal Physiology. 3 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 119 and BIOL 221. In-depth, current treatment of physiological principles which operate at various levels of biological organization in animals of diverse taxonomic relationships. Understanding is developed from background lectures and student analyses in discussion sessions of research literature.

BIOL 438. Animal Behavior. 4 Hours.
PR: BIOL 221 and (BIOL 101 and BIOL 102 and BIOL 103 and BIOL 104 or BIOL 115). Introduction to animal behavior (ethology) emphasizing the ecology and evolution of individual and social behaviors. Laboratory includes independent investigation of behavioral phenomena. (Offered in even numbered years.).

BIOL 439. Neuroethology. 3 Hours.
PR: BIOL 348. Explores the way sensory systems process information to mediate behavior in a wide variety of animals in order to understand similarities and differences in neural mechanisms.

BIOL 440. Comparative Anatomy. 4 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219 and BIOL 221 or consent. A functional and evolutionary study of vertebrate structure. (Dissection kit required.).

BIOL 441. Vertebrate Microanatomy. 5 Hours.
PR: BIOL 115 and BIOL 117 and BIOL 219 and BIOL 221. Structural and functional approach to the study of tissues and organs of vertebrates.

BIOL 450. Plant Systematics. 4 Hours.
PR: (BIOL 101 and BIOL 103 and BIOL 102 and BIOL 104) or BIOL 117. Study of the taxonomy of flowering plants worldwide and related topics in angiosperm classification and evolution. Laboratories emphasize characteristics of selected families of monocotyledons and dicotyledons using living and herbarium material.
**BIOL 451. Plant Development. 4 Hours.**
PR: BIOL 221 and (CHEM 235 or AGBI 410). Experimental studies of plant growth and development.

**BIOL 453. Molecular Basis of Disease. 3 Hours.**
PR: BIOL 219. Examine medical, ethical, and legal/regulatory issues emerging from the Human Genome Project and its applications to personalized medicine.

**BIOL 454. Immunology. 3 Hours.**
PR: BIOL 219. Explores the fundamental principles and practices of immunology including how the immune system is organized, how it functions to keep us healthy, and how it can cause allergies and autoimmune disease.

**BIOL 455. Evolution-Infectious Diseases. 3 Hours.**
PR: BIOL 115 and BIOL 117 and BIOL 221. The application of phylogenetics, microbiology, immunology, and epidemiology towards understanding the evolution of infectious diseases. Students will develop a fundamental understanding of the significance of evolution and ecology in infectious disease emergence and control.

**BIOL 456. Microbial Symbiosis. 3 Hours.**
PR: BIOL 221. An understanding of the significance of microbial symbioses towards ecological and health processes will be developed. Molecular techniques used towards identifying the composition and functions of microbial communities will be discussed.

**BIOL 461. Principles of Evolution. 3 Hours.**
PR: BIOL 221. Introduction to the study of evolution, including genetics of evolutionary change, speciation and adaptation molecular evolution, the history of life, extinction, co-evolution and the origins of humans.

**BIOL 463. Global Ecology. 3 Hours.**
PR: BIOL 221. The Earth viewed as a changing biogeochemical system. Topics include the structure, composition and dynamics of the ecosphere, nutrient cycles, changing atmospheric composition, climate change, ozone depletion, land-use change, biological invasions, and changes in biodiversity.

**BIOL 464. Population/Quantitative Genetics. 3 Hours.**
PR: BIOL 221. Relationship of gene and genotype frequencies in populations of diploid organisms and the effects of mutation, selection, and non-random mating in relation to single gene pairs. Application of these concepts to multigenic inheritance of quantitative traits.

**BIOL 477. CNS Evolution and Development. 3 Hours.**
PR: BIOL 348. Origin and evolution of the central nervous system, focusing on development and genetic mechanisms underlying structural modifications that serve as the basis for the evolution of animal behavior.

**BIOL 478. Sensory Neural System/Behavior. 3 Hours.**
PR: BIOL 348. This course explores how brains acquire information about the external world and process this information to produce sensory perceptions. Students gain a deep understanding of sensory trasduction and neural processing at the cellular, network and systems levels. Additionally, the class is aimed at enhancing science communication.

**BIOL 479. Current Topics-Neuroscience. 3 Hours.**
PR: BIOL 348. Fundamental principles of nervous system organization with an emphasis on interactions between neurons and the consequences for behavior. There will be a focus on recent advances in our understanding of each organizational principle.

**BIOL 486. Honor Investigation & Thesis. 1-4 Hours.**
(May be repeated for credit; max credit 12 hr.) PR: Second semester of junior year, recommendation of advisor, biology majors only. Permission required. Supervised readings, investigation, and study.

**BIOL 490. Teaching Practicum. 1-3 Hours.**
PR: Consent. (May be repeated for a maximum of 9 credit hours.) Teaching practice as a tutor or assistant.

**BIOL 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.

**BIOL 492A-Z. Directed Study. 1-3 Hours.**
Directed study, reading, and/or research.

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

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

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

**BIOL 496. Senior Thesis. 1-3 Hours.**
PR: Consent.

**BIOL 497. Research. 1-6 Hours.**
Independent research projects.
CHEM 110A. Introduction to Chemistry A. 1 Hour.  
PR: Students must obtain a satisfactory score on the placement examination and must register for CHEM 110A and CHEM 110B in the same term. Required for students whose performance on ACT/SAT/placement examination indicates need for introductory work before enrolling in other chemistry courses. Elementary scientific terminology and concepts; simple chemical arithmetic’s; chemical symbols, formulae and equations; and mole concepts.

CHEM 110B. Introduction to Chemistry B. 1 Hour.  
PR or CONC: CHEM 110A with a grade of C or better. Required for students whose performance on the ACT/SAT/placement examination indicates need for introductory work before enrolling in other chemistry courses. Scientific terminology and concepts; chemical arithmetic’s; chemical symbols, formulae and equations; and mole concepts.

CHEM 111. Survey of Chemistry. 4 Hours.  
Designed primarily for students taking only one year of college chemistry. Atomic structure; chemical bonding; acids, bases, and salts; periodicity; properties of gases, liquids, and solids; stoichiometry; oxidation-reduction. (3 hr. lec., 3 hr. lab.) (Students may not receive credit for CHEM 115 or CHEM 117 and for CHEM 111.) (CHEM 111 and CHEM 112 cannot be used as pre-requisite courses for organic chemistry; students anticipating the possibility or likelihood of taking organic chemistry must have credit for CHEM 115 and CHEM 116 or for CHEM 117 and CHEM 118.).

CHEM 112. Survey of Chemistry. 4 Hours.  
PR: CHEM 111. Continuation of CHEM 111. Nuclear chemistry; air and water pollution; useful natural materials; consumer chemistry; introduction to organic and biochemistry. (3 hr. lec., 3 hr. lab.) (Students may not receive credit for CHEM 116 or CHEM 118 and for CHEM 112.) (CHEM 111 and CHEM 112 cannot be used as pre-requisite courses for organic chemistry; students anticipating the possibility or likelihood of taking organic chemistry must have credit for CHEM 115 and CHEM 116) and (CHEM 117 and CHEM 118).

CHEM 115. Fundamentals of Chemistry. 4 Hours.  
PR: Satisfactory ACT/SAT or placement exam performance, or grade of C or better in CHEM 110 or (CHEM 110A and CHEM 110B). For students who need more than one year of college chemistry and quantitative relationships on which subsequent chemistry courses are built. (3 hr. lec. 3 hr. lab.) (Students may not receive credit for CHEM 117 and for CHEM 115.) Pre-requisite(s) and/or co-requisite(s) may differ on regional campuses.

CHEM 116. Fundamentals of Chemistry. 4 Hours.  
PR: CHEM 115. Continuation of CHEM 115. (3 hr. lec., 3 hr. lab.) (Students may not receive credit for CHEM 118 and for CHEM 112 or CHEM 116.) Pre-requisite(s) and/or co-requisite(s) may differ on regional campuses.

CHEM 117. Principles of Chemistry. 5 Hours.  
PR: Satisfactory ACT/SAT and placement examination performance, or a score of four or five on AP Chemistry examination. A more advanced treatment of the principles and theories of chemistry than offered in CHEM 115 and CHEM 116. Primarily for students specializing in chemistry. (3 hr. lec., 2 3-hr. labs.) (Students may not receive credit for CHEM 117 and for CHEM 115.).

CHEM 118. Principles of Chemistry. 5 Hours.  
PR: CHEM 117. Continuation of CHEM 117. (3 hr. lec., two 3-hr. lab.) (Students may not receive credit for CHEM 118 and for CHEM 112, CHEM 116 or CHEM 215.).

CHEM 215. Intro to Analytical Chemistry. 4 Hours.  
PR: CHEM 116. Volumetric analysis, gravimetric analysis, solution equilibria, spectrophotometry, separations, and electrochemical methods of analysis. (2 hr. lec., two 3 hr. labs.) (Students may not receive credit for CHEM 215 and for CHEM 117 and CHEM 118.).

CHEM 231. Organic Chemistry: Brief Course. 4 Hours.  
PR: CHEM 116. Emphasis on biological applications for students in medical technology, agriculture, and family resources. Nomenclature, structure, reactivity, and stereochemistry are stressed. (3 hr. lec., 3 hr. lab.) (Students may not receive credit for CHEM 231 and for CHEM 233 and CHEM 234.).

CHEM 233. Organic Chemistry. 3 Hours.  
PR: CHEM 116 or CHEM 118 and PR or CONC: CHEM 235. Basic principles of organic chemistry. Modern structural concepts, the effect of structure on physical and chemical properties, reactions and their mechanisms and application to syntheses. (3 hr. lec.) (Students may not receive credit for CHEM 233, CHEM 234, and for CHEM 231.).

CHEM 234. Organic Chemistry. 3 Hours.  
PR: CHEM 233 and CHEM 235 and PR or CONC: CHEM 236. Continuation of CHEM 233. (3 hr. lec.).

CHEM 235. Organic Chemistry Laboratory. 1 Hour.  
PR or CONC: CHEM 233. Fundamental organic reactions and the preparation of organic compounds. (3 hr. lab.).

CHEM 236. Organic Chemistry Laboratory. 1 Hour.  
PR: CHEM 233 and CHEM 235 and PR or CONC: CHEM 234. Continuation of CHEM 235. (3 hr. lab.).

CHEM 293A-Z. Special Topics. 1-6 Hours.  
PR: Consent. Investigation of topics not covered in regularly scheduled courses.
CHEM 310. Instrumental Analysis. 3 Hours.
PR: CHEM 215 and physical chemistry. Lectures and demonstrations. Fundamentals of instrumental methods applied to chemical analyses: electrochemistry, spectroscopy, mass spectrometry, and chromatography. (2 hr. lec., 1 hr. demonstration.).

CHEM 312. Environmental Chemistry. 3 Hours.
PR: CHEM 215 and CHEM 234 and physical chemistry. Study of the nature, reactions, transport, and fates of chemical species in the environment. (2 hr. lec., 1 hr. demonstration.).

CHEM 313. Instrumental Analysis Lab. 1 Hour.
PR: CHEM 310. Practical application of modern instrumental methods to problems in chemical analysis. (3 hr. lab.).

CHEM 335. Method:Structure Determination. 4 Hours.
PR: CHEM 234 and CHEM 236. Use of chemical methods and UV, IR, NMR, and mass spectroscopy to elucidate structures of organic compounds. For students in chemistry and related fields who may need these methods in research and applied science. (2 hr. lec., 2 hr. lab.).

CHEM 337. Polymer Chemistry. 3 Hours.
PR: CHEM 234 and physical chemistry. Methods, mechanisms, and underlying theory of polymerization. Structure and stereochemistry of polymers in relation to chemical, physical, and mechanical properties. (3 hr. lec.).

CHEM 339. Organic Syntheses. 3 Hours.
PR: CHEM 234 and CHEM 236. Modern synthetic methods of organic chemistry. (1 hr. lec., two 3 hr. lab.).

CHEM 341. Physical Chem: Brief Course. 3 Hours.
PR: (CHEM 116 with a grade of C or better or CHEM 215 for chemistry majors) and MATH 156 and (PHYS 102 or PHYS 112.) Beginning physical chemistry covering the subjects of chemical thermodynamics, chemical dynamics, and the structure of matter. (3 hr. lec.) (Students may not receive credit for CHEM 346 and 348 and for CHEM 341.).

CHEM 342. Experimental Physical Chem. 1 Hour.
PR: (CHEM 341 or CHEM 346) and CHEM 215 and (CHEM 235 or CHEM 231). Laboratory work in physical chemistry designed to accompany CHEM 341. (One 3 hr. lab.).

CHEM 346. Physical Chemistry. 3 Hours.
PR: CHEM 234 and MATH 156 and PHYS 112. A first course in physical chemistry. Topics include a study of thermodynamics and chemical equilibria. (3 hr. lec.) (Students may not receive credit for CHEM 346 and for CHEM 341.).

CHEM 347. Physical Chem Lab. 1 Hour.
PR: (CHEM 118 or CHEM 215) and CHEM 346. Experimentation illustrating the principles of physical chemistry and offering experience with chemical instrumentation. (One 3 hr. lab.).

CHEM 348. Physical Chemistry. 3 Hours.
PR: CHEM 346 and MATH 251. Continuation of CHEM 346. Chemical dynamics and the structure of matter. (3 hr. lec.) (Students may not receive credit for CHEM 348 and for CHEM 341.).

CHEM 349. Physical Chemistry Laboratory. 2 Hours.
PR: CHEM 346 and CHEM 347 and CHEM 348. Continuation of CHEM 347. (Two 3 hr. lab.).

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

CHEM 401. Chemical Literature. 1 Hour.
PR: CHEM 234 and (CHEM 341 or CHEM 346). Study of techniques for locating, utilizing, and compiling information needed by the research worker in chemistry. (1 hr. lec.).

CHEM 403. Undergraduate Seminar. 1 Hour.
PR: CHEM 401. Instruction in design and presentation of topics of current chemical interest. (1 hour individual instruction and/or lecture.).

CHEM 411. Intermediate Analytical Chem. 3 Hours.
PR: CHEM 215 and physical chemistry. Concepts underlying modern analytical procedures and their application to the solution of contemporary problems; presented at the intermediate level. (3 hr. lec.).

CHEM 422. Intermediate Inorganic Chem. 3 Hours.
PR: Physical chemistry. Structure, bonding, and reactivity of compounds of main-group and transition metal elements. Molecular structure and symmetry, solid state chemistry, ligand field theory, and coordination chemistry. (3 hr. lec.).

CHEM 423. Inorganic Synthesis Laboratory. 2 Hours.
PR: CHEM 422. Application of modern synthetic and spectroscopic methods of analysis to the preparation and characterization of main group, solid-state, transition metal, and organometallic compounds. (Two 3 hr. lab.).

CHEM 440. Quantum Chemistry. 3 Hours.
PR: CHEM 348. Introduction to the principles of quantum mechanics and its application to atoms, molecules, solids, spectroscopy, and computational chemistry.
CHEM 444. Colloid & Surface Chemistry. 3 Hours.
PR: Physical chemistry. Selected topics in the properties and physical chemistry of systems involving macromolecules, lyophobic colloids, and surfaces.

CHEM 460. Forensic Chemistry. 3 Hours.
PR: CHEM 115 and CHEM 116 and CHEM 117 and CHEM 118 and CHEM 233 and CHEM 236 and CHEM 215 or instructor permission. Analytical chemistry as applied in forensic science. Drug analysis, toxicology, arson, paints, polymers, fibers, inks, and gunshot residue.

CHEM 462. Biochemistry 2. 3 Hours.
PR: AGBI 410. Second semester of undergraduate biochemistry with a focus on the molecular level processes that enable life and the integration of multiple hierarchies of mechanistic regulation.

CHEM 463. Forensic Chemistry Lab. 1 Hour.
PR: (CHEM 115 and CHEM 116) or (CHEM 117 and CHEM 118) and CHEM 233 and CHEM 236 required and CHEM 215 or instructor permission and PR or CONC: CHEM 460. Analytical chemistry as applied in forensic science. Drug analysis, toxicology, arson, paints, polymers, fibers, inks, and gunshot residue.

CHEM 464. Biochemistry 2 Laboratory. 1 Hour.
PR: AGBI 410 and AGBI 412 and PR or Conc:CHEM 462. Second semester of undergraduate biochemistry lab, familiarizes students with biochemical techniques used in the analysis of biological species/processes.

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

CHEM 490A. Teaching Practicum-CLC. 1-3 Hours.
PR: Consent. Teaching practice as a tutor or assistant.

CHEM 490B. Teaching Practicum - TA. 1-3 Hours.
PR: Consent. Teaching practice as a tutor or assistant.

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

CHEM 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.

CHEM 492A-Z. Directed Study. 1-3 Hours.
Directed study, reading, and/or research.

CHEM 493A-Z. Special Topics. 0-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

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

CHEM 496. Senior Thesis. 1-3 Hours.
PR: Consent.

CHEM 497. Research. 1-6 Hours.
Independent research projects.

CHEM 498A-Z. Honors. 1-3 Hours.
PR: Students in Honors Program and consent by the honors director. Independent reading, study, or research.