MOLECULAR BIOLOGY, B.S.

ABOUT THE MAJOR

Molecular biology is the basic science that seeks an understanding of biological processes in terms of the properties and functions of the molecules that make up living cells. The scope of questions addressed in molecular biology ranges from evolution to development to the regulation of gene expression. A career in molecular biology requires a strong background in biology as well as a solid foundation in chemistry, mathematics, and physics.

The molecular biology major has been designed primarily for three groups of students:

a. those who plan to enter a research career in molecular biology or related areas such as biochemistry, genetics, oncology, microbiology, cell biology or developmental biology;

b. pre-professional students who plan to enter either a research or clinical career in medicine, or allied health fields;

c. students who plan to teach biology at the college or secondary-school levels.

Students with other interests are also welcome, of course. Career opportunities for students with an undergraduate degree in molecular biology are amazingly diverse. Graduates of the program have gone into patent law, science journalism, forensics, philosophy, nutrition, genetic counseling, veterinary medicine, anthropology, archeology, marine biology, theology, and much more (http://molecularbio.ls.wisc.edu/documents/What_can_I_do_with_a_MolBio_Major_.pdf).

Major requirements have been set to assure a high degree of proficiency in the various areas specified while still allowing as much flexibility as possible for students to individualize their programs. For the undergraduate interested in life sciences, this major uniquely provides access to the extraordinary scope and strength of biology courses and laboratories on the UW–Madison campus. Each student in the major is assigned a faculty advisor, and it is hoped that students will take advantage of both the staff and faculty advising service available to make a judicious choice of courses, as well as to gain scholarly experience outside the classroom that will further their academic and career goals.

Students who wish to obtain further information about the program or to declare a molecular biology major should contact the student services coordinator. (http://molecularbio.ls.wisc.edu/advising.htm) Faculty advisors are assigned through the program office and are located in many related departments throughout campus. Molecular biology faculty advisors are especially competent to provide counsel regarding the major and career opportunities in molecular biology.

UNDERGRADUATE RESEARCH

Undergraduate molecular biology students at UW–Madison are fortunate to have the opportunity to work with some of the world’s leading researchers. Many opportunities for laboratory research experience are available on campus for undergraduate students and this type of experiences is strongly encouraged. Such an experience provides students the opportunity to apply what they’re learning and compliment their knowledge with practical skills. Research experience is highly valued by employers, graduate programs, and professional schools. See the major website (http://molecularbio.ls.wisc.edu/57.htm) for more information on how to get involved in undergraduate research.

HOW TO GET IN

To declare the molecular biology major, students must contact or make an appointment (https://calendar.wisc.edu/scheduling-assistant/public/profiles/abNbotSX.html;jsessionid=53F9D957BE6099BCF895E0A8487F3B94.primary) with the molecular biology student services coordinator.

If students are not currently in the College of Letters & Science (L&S), you must transfer into L&S before declaring. However, students are welcome to meet with the molecular biology student services coordinator to discuss the major before transferring.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext) section of the Guide.

Requirements Description

General Education

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Breadth—Humanities/Literature/Arts</td>
<td>6</td>
</tr>
<tr>
<td>Breadth—Natural Science</td>
<td>4-6</td>
</tr>
<tr>
<td>Communication Part A &amp; Part B</td>
<td></td>
</tr>
<tr>
<td>Ethnic Studies</td>
<td></td>
</tr>
<tr>
<td>Quantitative Reasoning Part A &amp; Part B</td>
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</table>

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE

BREADTH AND DEGREE REQUIREMENTS: BACHELOR OF SCIENCE (B.S.)

Students pursuing a bachelor of science degree in the College of Letters & Science must complete all of the requirements below. The College of Letters & Science allows this major to be paired with either a bachelor of arts or a bachelor of science curriculum. View a comparison of the degree requirements here. (https://pubs.wisc.edu/home/archives/ug15/images/babs2009.pdf)
BACHELOR OF SCIENCE DEGREE REQUIREMENTS

Requirements Detail

Mathematics
Two (2) 3+ credits of intermediate/advanced level MATH, COMP SCI, STAT
Limit one each: COMP SCI, STAT

Foreign Language
Complete the third unit of a foreign language
Note: A unit is one year of high school work or one semester/term of college work.

L&S Breadth
- Humanities, 12 credits: 6 of the 12 credits must be in literature
- Social Sciences, 12 credits
- Natural Sciences, 12 credits: must include 6 credits in biological science; and must include 6 credits in physical science

Liberal Arts and Science Coursework
Depth of Intermediate/Advanced work
60 intermediate or advanced credits

Major
Declare and complete at least one (1) major

Total Credits
120 credits

UW-Madison Experience
30 credits in residence, overall
30 credits in residence after the 90th credit

Minimum
2.000 in all coursework at UW–Madison
2.000 in intermediate/advanced coursework at UW–Madison

NON–L&S STUDENTS PURSUING AN L&S MAJOR

Non–L&S students who have permission from their school/college to pursue an additional major within L&S only need to fulfill the major requirements and do not need to complete the L&S breadth and degree requirements above.

REQUIREMENTS FOR THE MAJOR

MATHEMATICS, CHEMISTRY & PHYSICS

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 221</td>
<td>Calculus and Analytic Geometry 1</td>
<td>5</td>
</tr>
<tr>
<td>or MATH 211</td>
<td>Calculus</td>
<td></td>
</tr>
<tr>
<td>Calculus 2 or Statistics—one course:</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>MATH 222</td>
<td>Calculus and Analytic Geometry 2</td>
<td></td>
</tr>
<tr>
<td>MATH 213</td>
<td>Calculus and Introduction to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Differential Equations</td>
<td></td>
</tr>
<tr>
<td>STAT 301</td>
<td>Introduction to Statistical Methods</td>
<td></td>
</tr>
<tr>
<td>STAT 371</td>
<td>Introductory Applied Statistics for</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the Life Sciences</td>
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</tr>
</tbody>
</table>

General Chemistry—complete one option:
CHEM 103 General Chemistry I and General Chemistry II
CHEM 109 Advanced General Chemistry
CHEM 115 Chemical Principles I and Chemical Principles II (by consent of instructor only)

Analytical Chemistry
CHEM 327 or CHEM 329 Fundamentals of Analytical Science

Organic Chemistry
CHEM 343 Introductory Organic Chemistry
CHEM 344 Introductory Organic Chemistry Laboratory
CHEM 345 Intermediate Organic Chemistry

Physics—complete one option:
PHYSICS 201 General Physics
& PHYSICS 202 and General Physics
PHYSICS 207 General Physics
& PHYSICS 208 and General Physics

Total Credits 25-31

GENERAL BIOLOGY

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tr>
<td>Complete one option:</td>
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<tr>
<td>Option A:</td>
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<td></td>
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<tr>
<td>BIOLOGY/</td>
<td>Introductory Biology and</td>
<td></td>
</tr>
<tr>
<td>BOTANY/</td>
<td>Introductory Biology</td>
<td></td>
</tr>
<tr>
<td>&amp; ZOOLOGY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>151 &amp;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&amp; BIOLOGY/</td>
<td>Evolution, Ecology, and Genetics</td>
<td></td>
</tr>
<tr>
<td>BOTANY/</td>
<td>and General Physics</td>
<td></td>
</tr>
<tr>
<td>&amp; ZOOLOGY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>152 &amp;</td>
<td></td>
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</tbody>
</table>

Option B (BIOCORE): 1

BIOCORE 381 Evolution, Ecology, and Genetics
BIOCORE 382 Evolution, Ecology, and Genetics Laboratory
BIOCORE 383 Cellular Biology
BIOCORE 384 Cellular Biology Laboratory
BIOCORE 485 Organismal Biology

1 BIOCORE is an Honors program. Students may find more information here (http://biocore.wisc.edu).

BIOCHEMISTRY AND MOLECULAR BIOLOGY

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Biochemistry</td>
<td></td>
<td>3-6</td>
</tr>
<tr>
<td>BIOCHEM 501</td>
<td>Introduction to Biochemistry</td>
<td>3</td>
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<tr>
<td>or BIOCHEM 507</td>
<td>General Biochemistry I</td>
<td></td>
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</tbody>
</table>

Molecular Biology - 3 credits from:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>AGRONOMY/</td>
<td>Plant Biotechnology: Principles and</td>
<td>3</td>
</tr>
<tr>
<td>HORT 339</td>
<td>Techniques I</td>
<td></td>
</tr>
<tr>
<td>AGRONOMY/</td>
<td>Plant Cell Culture and Genetic</td>
<td></td>
</tr>
<tr>
<td>HORT 340</td>
<td>Engineering</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM/</td>
<td>Prokaryotic Molecular Biology</td>
<td></td>
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<tr>
<td>GENETICS/</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MICROBIO 612</td>
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</tr>
<tr>
<td>BIOCHEM/</td>
<td>Eukaryotic Molecular Biology</td>
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<tr>
<td>GENETICS 620</td>
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<tr>
<td>GENETICS 545</td>
<td>Genetics Laboratory</td>
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<tr>
<td>HORT/PATH-</td>
<td>Molecular Biology Techniques</td>
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<tr>
<td>BIO 500</td>
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</tbody>
</table>
Molecular Biology, B.S.

**Advanced Courses - 6 credits from 2 areas:**

**Development**

- **BOTANY 500**  Plant Physiology
- **ZOLOGY 470**  Introduction to Animal Development
- **ZOLOGY 555**  Laboratory in Developmental Biology
- **ZOLOGY 625**  Development of the Nervous System

**Microbiology**

- **BOTANY/PL PATH 505**  Plant-Microbe Interactions: Molecular and Ecological Aspects
- **MICROBIO 303**  Biology of Microorganisms
- **MICROBIO 304**  Biology of Microorganisms Laboratory
- **MICROBIO 330**  Host-Parasite Interactions
- **MICROBIO/SOIL SCI 425**  Environmental Microbiology
- **MICROBIO/PL PATH 622**  Plant-Bacterial Interactions
- **MICROBIO/ONCOLOGY/PL PATH 640**  General Virology-Multiplication of Viruses
- **M M & I/ BIOCHEM 575**  Biology of Viruses

**Genetics**

- **AGRONOMY/ HORT 338**  Plant Breeding and Biotechnology
- **GENETICS/BOTANY/HORT 561**  Introductory Cytogenetics
- **GENETICS/MD GENET 565**  Human Genetics
- **GENETICS 566**  Advanced Genetics
- **MICROBIO 470**  Microbial Genetics & Molecular Machines
- **MICROBIO/ GENETICS 607**  Advanced Microbial Genetics

**Cell Biology (Endocrinology, Neurobiology, Immunology)**

- **BIOCHEM/ PHMCOL-M/ ZOOLOGY 630**  Cellular Signal Transduction Mechanisms
- **BIOCORE 587**  Biological Interactions
- **MICROBIO/ M M & I/PATH-BIO 528**  Immunology
- **M M & I 341**  Immunology
- **ONCOLOGY 401**  Introduction to Experimental Oncology
- **ONCOLOGY/ MICROBIO/ PL PATH 640**  General Virology-Multiplication of Viruses
- **ZOOLOGY/ PSYCH 523**  Neurobiology
- **ZOOLOGY 570**  Cell Biology

**Biochemistry and Physical Chemistry**

- **BIOCHEM 508**  General Biochemistry II
- **BIOCHEM/NUTR SCI 510**  Biochemical Principles of Human and Animal Nutrition
- **BIOCHEM 550**  Topics in Medical Biochemistry
- **BIOCHEM 551**  Biochemical Methods
- **BIOCHEM/ BOTANY 621**  Plant Biochemistry
- **CHEM 561**  Physical Chemistry
- **CHEM 565**  Biophysical Chemistry
- **PHYSIOL 533**  Molecular Physiology

**Quantitative and Computational Sciences**

- **B M I/COMP SCI 576**  Introduction to Bioinformatics
- **BOTANY 563**  Phylogenetic Analysis of Molecular Data
- **COMP SCI/I SY E/ MATH 425**  Introduction to Combinatorial Optimization
- **F&W ECOL/HORT/ STAT 571**  Statistical Methods for Bioscience I
- **F&W ECOL/HORT/ STAT 572**  Statistical Methods for Bioscience II
- **STAT 333**  Applied Regression Analysis
- **STAT/B M I 541**  Introduction to Biostatistics

**Total Credits**  15-18

**LABORATORY/INDEPENDENT RESEARCH**

2 credits from:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td><strong>Lab/Research courses:</strong></td>
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<td></td>
</tr>
<tr>
<td>HORT/PATH-BIO 500</td>
<td>Molecular Biology Techniques</td>
<td></td>
</tr>
<tr>
<td>GENETICS 545</td>
<td>Genetics Laboratory</td>
<td></td>
</tr>
<tr>
<td>BMOLCHEM 504</td>
<td>Human Biochemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>MICROBIO 304</td>
<td>Biological Interactions</td>
<td></td>
</tr>
<tr>
<td>BIOCHEM 551</td>
<td>Biochemical Methods</td>
<td></td>
</tr>
<tr>
<td>ZOOLOGY 555</td>
<td>Laboratory in Developmental Biology</td>
<td></td>
</tr>
<tr>
<td><strong>Thesis/Directed Study:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOL BIOL 681</td>
<td>Senior Honors Thesis</td>
<td></td>
</tr>
<tr>
<td>MOL BIOL 699</td>
<td>Directed Studies in Molecular Biology</td>
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</tbody>
</table>

2  For assistance finding a directed lab or research experience and for information about scholarships, see the advisor for this program and/or consult the Undergraduate Research page (http://www.molecularbio.ls.wisc.edu/57.htm).

**RESIDENCE AND QUALITY OF WORK**

2.000 GPA in all MOL BIOL and major courses
2.000 GPA on 15 upper-level major credits, taken in residence
15 credits in MOL BIOL, taken on the UW–Madison campus

HONORS IN THE MAJOR
Students may declare Honors in the Molecular Biology Major in consultation with the Molecular Biology undergraduate advisor.

HONORS IN THE MOLECULAR BIOLOGY MAJOR REQUIREMENTS
To earn a B.A. or B.S. with Honors in the Major in Molecular Biology students must satisfy both the requirements for the major (above) and the following additional requirements:

- Earn a 3.300 overall university GPA
- Earn a 3.500 GPA for all MOL BIOL courses, and all courses accepted in the major
- Complete the Molecular Biology advanced course requirement utilizing the courses indicated with the above, taken for Honors credit and with grades of B or better earned in each individual course
- Complete a two-semester Senior Honors Thesis in MOL BIOL 681 Senior Honors Thesis and MOL BIOL 682 Senior Honors Thesis, for a total of 6 credits
- Complete MOL BIOL 686 Senior Honors Seminar in Molecular Biology

UNIVERSITY DEGREE REQUIREMENTS

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Detail</th>
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<tbody>
<tr>
<td>Total Degree</td>
<td>To receive a bachelor’s degree from UW–Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.</td>
</tr>
<tr>
<td>Residency</td>
<td>Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. “In residence” means on the UW–Madison campus with an undergraduate degree classification. “In residence” credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.</td>
</tr>
<tr>
<td>Quality of Work</td>
<td>Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.</td>
</tr>
</tbody>
</table>

6. Utilize the scientific method to solve biological problems characteristic of today’s society.
7. Understand the primary scientific literature and apply concepts from literature to draw conclusions about modern topics in the field.
8. Communicate scientific ideas in written and oral form.

ADVISING AND CAREERS
Students in the major are assigned to a team of advisors composed of a faculty advisor and a the major’s student services coordinator. See the major’s advising page (http://bacmajor.ls.wisc.edu/advising.htm) for a list of advisors and for the student services coordinator information. The faculty advisor provides guidance specific to the molecular biology discipline through discussions about undergraduate experiences (i.e., research, coursework, internships) that will help prepare students for graduate work or a career after graduation. The student services coordinator provides guidance specific to the discipline, and also helps students with major declarations, course selection, registration, DARS, L&S degree and major requirements, and tracking progress toward graduation, as well as connecting students with important resources on campus.

PEOPLE

FACULTY
Professors Hardin (chair, jdhardin@wisc.edu), Bement, Blair, Carpenter, Gammie, Halloran, Ives, Lee, Newmark, Porter, Riters, Stanley, Stretton, Turner and Vander Zanden
Associate Professors Amann, Damschen, Grinblat, McIntyre and Orrock
Assistant Professors Sharma and Wolman
Adjunct Professor Peckarsky
Committee of Advisors: Ahmad (Dermatology), Amann (Zoology), Fabry (Pathology and Laboratory Medicine), Filutowicz (Bacteriology), Martin (Biochemistry), McMahon (Civil Engineering and Environmental Engineering), Schuler (Comparative Biosciences), Skop (Genetics)

LEARNING OUTCOMES

1. Summarize the energetic and thermodynamic basis of life.
2. Define and explain the molecular basis of life and relationships between the structure and function of biological macromolecules.
3. Describe the nature of the cell and its role as the basic unit of life.
4. Understand the nature of the genetic material and its roles in inheritance, evolution, and cellular function.
5. Demonstrate comprehension of basic molecular biology laboratory techniques.