

MOLECULAR AND CELL BIOLOGY, BA

Molecular and Cell 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 and cell biology ranges from evolution to development to the regulation of gene expression. A career in molecular and cell biology requires a strong background in biology as well as a solid foundation in chemistry, mathematics, and physics.

The Molecular and Cell Biology major has been designed primarily for three groups of students:

1. those who plan to enter a research career in molecular and cell biology or related areas such as biochemistry, genetics, oncology, microbiology, cell biology, or developmental biology;
2. pre-professional students who plan to enter either a research or clinical career in medicine or allied health fields; and
3. students who plan to pursue careers in the biotechnology and pharmaceutical science industries.

Students with other interests are also welcome, of course. Career opportunities for students with an undergraduate degree in molecular and cell 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 (https://molecularbiologymajor.wiscweb.wisc.edu/wp-content/uploads/sites/290/2017/07/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. (<https://molecularbio.ls.wisc.edu/advising/>) Faculty advisors are assigned through the program office and are located in many related departments throughout campus. Molecular and Cell Biology faculty advisors are especially competent to provide counsel regarding the major and career opportunities in molecular biology.

UNDERGRADUATE RESEARCH

Undergraduate Molecular and Cell 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 experience is strongly encouraged. Such an experience provides students the opportunity to apply what they're learning and complement their knowledge with practical skills. Research experience is highly valued by employers, graduate programs, and professional schools. See the major

website (<https://molecularbio.ls.wisc.edu/undergraduate-research/>) for more information on how to get involved in undergraduate research.

HOW TO GET IN

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To declare the Molecular and Cell Biology major, students must make an appointment with the Molecular and Cell Biology academic advising manager through Starfish.

Students who intend to major in Molecular and Cell Biology may not combine this major ("double major") with the Biology or Biochemistry majors in either the College of Letters and Science or the College of Agricultural and Life Sciences (CALS).

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/#requirementsforundergraduatestudyttext>) section of the *Guide*.

General Education

- Breadth—Humanities/Literature/Arts: 6 credits
- Breadth—Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth—Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* 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 DEGREE REQUIREMENTS: BACHELOR OF ARTS (BA)

Students pursuing a bachelor of arts 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.

BACHELOR OF ARTS DEGREE REQUIREMENTS

Mathematics Complete the University General Education Requirements for Quantitative Reasoning A (QR-A) and Quantitative Reasoning B (QR-B) coursework.

Language

- Complete the fourth unit of a language other than English; OR
- Complete the third unit of a language and the second unit of an additional language other than English.

L&S Breadth

- 12 credits of Humanities, which must include 6 credits of literature; and
- 12 credits of Social Science; and
- 12 credits of Natural Science, which must include one 3+ credit Biological Science course and one 3+ credit Physical Science course.

Liberal Arts and Science Coursework Complete at least 108 credits.

Depth of Intermediate/Advanced work Complete at least 60 credits at the intermediate or advanced level.

Major Declare and complete at least one major.

Total Credits Complete at least 120 credits.

UW-Madison Experience

- 30 credits in residence, overall; and
- 30 credits in residence after the 86th credit.

Quality of Work

- 2,000 in all coursework at UW-Madison
- 2,000 in Intermediate/Advanced level 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. They do not need to complete the L&S Degree Requirements above.

REQUIREMENTS FOR THE MAJOR MATHEMATICS, CHEMISTRY & PHYSICS

Code	Title	Credits
Mathematics and Statistics		
6-10		
<i>Complete one of the following:</i>		
MATH 221	Calculus and Analytic Geometry I	5
MATH 217	Calculus with Algebra and Trigonometry II	5
<i>Complete one of the following:</i>		
MATH 222	Calculus and Analytic Geometry 2	4
MATH 213	Calculus and Introduction to Differential Equations	3
STAT 240	Data Science Modeling I	4
STAT 301	Introduction to Statistical Methods	3
STAT 371	Introductory Applied Statistics for the Life Sciences	3

General Chemistry—complete one option: 5-10

CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	9
CHEM 109	Advanced General Chemistry	5
CHEM 115 & CHEM 116	Chemical Principles I and Chemical Principles II (by consent of instructor only)	10

Organic Chemistry -complete the sequence 8

CHEM 343	Organic Chemistry I	3
CHEM 344	Introductory Organic Chemistry Laboratory	2
CHEM 345	Organic Chemistry II	3

Physics -Choose a first and a second calculus based physics option OR elementary based physics sequence with additional calculus 10-12

Calculus Based Physics: First Introductory Course—complete one class:

PHYSICS 207	General Physics	5
PHYSICS 201	General Physics	5
PHYSICS 247	A Modern Introduction to Physics	5

Calculus Based Physics: Second Introductory Course—complete one class:

PHYSICS 208	General Physics	5
PHYSICS 202	General Physics	5
PHYSICS 248	A Modern Introduction to Physics	5

Elementary Based Physics --complete three

PHYSICS 103	General Physics	4
PHYSICS 104	General Physics	4
MATH 234	Calculus--Functions of Several Variables	4

INTRODUCTORY BIOLOGY

Code	Title	Credits
Complete one option:		10-13
<i>Option A:</i>		
ZOOLOGY/ BIOLOGY/ BOTANY 151	Introductory Biology	5
ZOOLOGY/ BIOLOGY/ BOTANY 152	Introductory Biology	5
<i>Option B: ¹</i>		
BIOCORE 381	Evolution, Ecology, and Genetics	3
BIOCORE 382	Evolution, Ecology, and Genetics Laboratory	2
BIOCORE 383	Cellular Biology	3
BIOCORE 384	Cellular Biology Laboratory	2
BIOCORE 485	Principles of Physiology	3
<i>Option C:</i>		
ZOOLOGY/ BIOLOGY 101	Animal Biology	3
ZOOLOGY/ BIOLOGY 102	Animal Biology Laboratory	2

BOTANY/ BIOLOGY 130	General Botany	5
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BREADTH COURSEWORK

Code	Title	Credits
Biochemistry –complete one of the following:		
BIOCHEM 501	Introduction to Biochemistry	3
BIOCHEM 507 & BIOCHEM 508	General Biochemistry I and General Biochemistry II	6
Cell Biology		
ZOOLOGY 570	Cell Biology	3
Molecular Biology and Genetics –complete one of the following:		
BIOCORE 381 & BIOCORE 383 & BIOCORE 587	Evolution, Ecology, and Genetics and Cellular Biology and Biological Interactions	9
GENETICS 466	Principles of Genetics	3
GENETICS 467 & GENETICS 468	General Genetics I and General Genetics II	6
MICROBIO 470	Microbial Genetics & Molecular Machines	3
Total Credits		9-18

DEPTH COURSEWORK

Code	Title	Credits
Students must complete 6 unique credits of depth coursework. Courses may be concentrated in one area or distributed across multiple areas. ²		
Biochemistry and Biophysics (no minimum)		
CHEM 575	Advanced Topics in Chemistry	1-4
BIOCHEM/ NUTR SCI 560	Principles of Human Disease and Biotechnology	2
BIOCHEM 601	Protein and Enzyme Structure and Function	2
BIOCHEM/ GENETICS/ MICROBIO 612	Prokaryotic Molecular Biology	3
BIOCHEM/ GENETICS/ MD GENET 620	Eukaryotic Molecular Biology	3
BIOCHEM/ BOTANY 621	Plant Biochemistry	3
BIOCHEM 625	Mechanisms of Action of Vitamins and Minerals	2
Cellular Systems (no minimum)		
ZOOLOGY 470	Introduction to Animal Development	3
ZOOLOGY/ PSYCH 523	Neurobiology	3
ZOOLOGY 603	Endocrinology	3-4
GENETICS 627	Animal Developmental Genetics	3
ONCOLOGY 401	Introduction to Experimental Oncology	2
PATH-BIO/ M M & I 528	Immunology	3
BIOCORE 587	Biological Interactions	3

NTP/ NEURODPT 610	Cellular and Molecular Neuroscience	4
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Genetics (no minimum)

AN SCI/DY SCI 361	Introduction to Animal and Veterinary Genetics	2
AGRONOMY/ HORT 338	Plant Breeding and Biotechnology	3
GENETICS 520	Neurogenetics	3
GENETICS/ HORT 550	Molecular Approaches for Potential Crop Improvement	3
GENETICS/ MD GENET 565	Human Genetics	3
HORT/AGRONOMY/ BOTANY 340	Plant Cell Culture and Genetic Engineering	3
MICROBIO 607	Advanced Microbial Genetics	3
GENETICS/ BIOCHEM/ MICROBIO 612	Prokaryotic Molecular Biology	3
GENETICS/ BIOCHEM/ MD GENET 620	Eukaryotic Molecular Biology	3
GENETICS 627	Animal Developmental Genetics	3
GENETICS/ BIOCHEM 631	Plant Genetics and Development	3
GENETICS/ MD GENET 662	Cancer Genetics	3

Microbiology and Virology (no minimum)

MICROBIO 303	Biology of Microorganisms	3
MICROBIO/AN SCI/ BOTANY 335	The Microbiome of Plants, Animals, and Humans	3
MICROBIO/ SOIL SCI 425	Environmental Microbiology	3
MICROBIO/ SOIL SCI 523	Soil Microbiology and Biochemistry	3
MICROBIO 526	Physiology of Microorganisms	3
PL PATH 622	Plant-Bacterial Interactions	2-3
BOTANY/ENTOM/ PL PATH 505	Plant-Microbe Interactions: Molecular and Ecological Aspects	3
BIOCHEM/ M M & I 575	Biology of Viruses	2
ONCOLOGY/ M M & I/ PL PATH 640	General Virology–Multiplication of Viruses	3

Quantitative Biology (no minimum)

MATH/ COMP SCI 240	Introduction to Discrete Mathematics	3
MATH 340	Elementary Matrix and Linear Algebra	3
STAT 303	R for Statistics I	1
STAT 304	R for Statistics II	1
STAT 305	R for Statistics III	1
STAT 333	Applied Regression Analysis	3
STAT 421	Applied Categorical Data Analysis	3
B M E 556	Systems Biology: Mammalian Signaling Networks	3
COMP SCI 300	Programming II	3

COMP SCI 368	Learning a Programming Language	1
COMP SCI 540	Introduction to Artificial Intelligence	3
COMP SCI/ B M I 567	Medical Image Analysis	3
COMP SCI/ B M I 576	Introduction to Bioinformatics	3
MICROBIO 657	Bioinformatics for Microbiologists	3

LABORATORY COURSE

Complete 2 credits minimum:

Code	Title	Credits
Students who complete at least 4 credits of MOL BIOL 699 fulfill both the Laboratory Course and Directed/Independent Study requirements		
CHEM 327	Fundamentals of Analytical Science	4
CHEM 329	Fundamentals of Analytical Science	4
COMP SCI 220	Data Science Programming I	4
MICROBIO 304	Biology of Microorganisms Laboratory	2
MICROBIO 657	Bioinformatics for Microbiologists	3
MOL BIOL 681	Senior Honors Thesis	3
MOL BIOL 691	Senior Thesis	3
MOL BIOL 699	Directed Studies in Molecular Biology	1-4
ZOOLOGY 555	Laboratory in Developmental Biology	3

DIRECTED/INDEPENDENT STUDY

Code	Title	Credits
Students who complete at least 4 credits of MOL BIOL 699 fulfill both the Laboratory Course and Directed/Independent Study requirements		
Complete two credits minimum:		
Directed/Independent Research		
MOL BIOL 699	Directed Studies in Molecular Biology	1-4
Senior Thesis		
MOL BIOL 682	Senior Honors Thesis	3
MOL BIOL 692	Senior Thesis	3

RESIDENCE AND QUALITY OF WORK

- 2.000 GPA in all MOL BIOL and major courses
- 2.000 GPA on at least 15 credits of upper-level in the major, taken in residence³
- 15 credits in MOL BIOL, taken on the UW-Madison campus

HONORS IN THE MAJOR

Students may declare Honors in the Molecular Biology and Cell Biology major in consultation with the Molecular and Cell Biology undergraduate advisor.

HONORS IN THE MOLECULAR AND CELL BIOLOGY MAJOR REQUIREMENTS

To earn Honors in the Major in Molecular and Cell 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 3.300 GPA for all courses accepted in the major
- Complete at least 15 credits of honors courses in the major while in residence at UW-Madison. This requirement can be broken down as indicated below:
 - At least 9 credits from the Breadth and Depth course options in the Molecular and Cell Biology major
 - Complete two semester Senior Honors Thesis, a piece of original research composition.

Code	Title	Credits
MOL BIOL 681	Senior Honors Thesis	3
MOL BIOL 682	Senior Honors Thesis	3

- Complete one semester of the Molecular Biology senior honors seminar course.
- | Code | Title | Credits |
|--------------|---|---------|
| MOL BIOL 686 | Senior Honors Seminar in
Molecular Biology | 1 |

FOOTNOTES

- ¹ BIOCORE is a competitive honors program and certificate.
- ² Students are encouraged to see their advisor for assistance in choosing depth coursework.
- ³ Courses accepted in the major that are Intermediate or Advanced are considered upper-level in this major.

UNIVERSITY DEGREE REQUIREMENTS

Total Degree	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.
Residency	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.
Quality of Work	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.

LEARNING OUTCOMES

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1. Integrate the energetic and thermodynamic bases of life, with an emphasis on the molecular mechanisms underlying them
2. Integrate the nature of genetic material and its roles in inheritance, evolution, and cellular function
3. Summarize the fundamental relationship between the structure and function of biological macromolecules
4. Summarize the principles of cell structure, function, and biological dynamics
5. Appraise the molecular mechanisms and quantitative principles in biochemistry/physical chemistry, cellular systems, genetics, and microbiology.
6. Develop skills to communicate scientific information in oral and written form
7. Develop the ability to formulate hypotheses and plan, design, and carry out scientific experiments to test them
8. Developing quantitative reasoning skills and the ability to use quantitative approaches to understand basic principles of life.

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

This Sample Four-Year Plan is a tool to assist students and their advisor(s). Students should use it—along with their DARS report, the Degree Planner, and Course Search & Enroll tools—to make their own four-year plan based on their placement scores, credit for transferred courses and approved examinations, and individual interests. As students become involved in athletics, honors, research, student organizations, study abroad, volunteer experiences, and/or work, they might adjust the order of their courses to accommodate these experiences. Students will likely revise their own four-year plan several times during college.

Freshman

Fall	Credits Spring	Credits
Communication A	3 MATH 221	5
Quantitative Reasoning A	3-5 Ethnic Studies	3
CHEM 103	4 CHEM 104	5
Foreign Language (if needed)	3-4 Humanities Breadth	2
	15	15

Sophomore

Fall	Credits Spring	Credits
ZOOLOGY/BIOLOGY/ BOTANY 151	5 ZOOLOGY/BIOLOGY/ BOTANY 152	5
CHEM 343	3 CHEM 344	2
Social Science Breadth	3 CHEM 345	3
Humanities Breadth	3 STAT 371	3
INTER-LS 210 ¹	1 Elective	2
	15	15

Junior

Fall	Credits Spring	Credits
PHYSICS 207	5 PHYSICS 208	5

GENETICS 466	3 BIOCHEM 501	3
ZOOLOGY 570	3 Literature Breadth	3
Social Science Breadth	3 MOL BIOL 699 or Elective	3
MOL BIOL 699	1-4	
	16	14

Senior

Fall	Credits Spring	Credits
Depth Coursework	3 Depth Coursework	3
Laboratory Course	2-4 MOL BIOL 699 or Elective	3
MOL BIOL 699 or Elective	3 Literature Breadth	3
Social Science Breadth	3 Social Science Breadth	3
Elective	3 Elective	3
	15	15

Total Credits 120

¹ INTER-LS 210 L&S Career Development: Taking Initiative is an option, but not required for students pursuing the Molecular and Cell Biology major.

ADVISING AND CAREERS

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The MCB Academic Advising Manager 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.

L&S CAREER RESOURCES

Every L&S major opens a world of possibilities. SuccessWorks (<https://successworks.wisc.edu/>) at the College of Letters & Science helps students turn the academic skills learned in their major, certificates, and other coursework into fulfilling lives after graduation, whether that means jobs, public service, graduate school or other career pursuits.

In addition to providing basic support like resume reviews and interview practice, SuccessWorks offers ways to explore interests and build career skills from their very first semester/term at UW all the way through graduation and beyond.

Students can explore careers in one-on-one advising, try out different career paths, complete internships, prepare for the job search and/or graduate school applications, and connect with supportive alumni and even employers in the fields that inspire them.

- SuccessWorks (<https://careers.ls.wisc.edu/>)
- Set up a career advising appointment (<https://successworks.wisc.edu/make-an-appointment/>)
- Enroll in a Career Course (<https://successworks.wisc.edu/career-courses/>) - a great idea for first- and second-year students:
 - INTER-LS 210 L&S Career Development: Taking Initiative (1 credit)
 - INTER-LS 215 Communicating About Careers (3 credits, fulfills Comm B General Education Requirement)

- Learn about internships and internship funding (<https://successworks.wisc.edu/finding-a-job-or-internship/>)
 - INTER-LS 260 Internship in the Liberal Arts and Sciences
- Activate your Handshake account (<https://successworks.wisc.edu/handshake/>) to apply for jobs and internships from 200,000+ employers recruiting UW-Madison students
- Learn about the impact SuccessWorks has on students' lives (<https://successworks.wisc.edu/about/mission/>)

PEOPLE

PEOPLE

MCB Steering Committee: Bement (Integrative Biology, Major Chair), Hoskins (Biochemistry) Grinblat (Integrative Biology), Otegui (Botany), Ritters (Integrative Biology), Roy (Biostatistics and Medical Informatics)

RESOURCES AND SCHOLARSHIPS

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HILDALE UNDERGRADUATE/FACULTY RESEARCH FELLOWSHIP

The Hilldale (<https://awards.advising.wisc.edu/all-scholarships/hilldale-undergraduatefaculty-research-fellowship/>) Undergraduate/Faculty Research Fellowships support undergraduate research done in collaboration with UW-Madison faculty or research/instructional academic staff. Approximately 97-100 Hilldale awards are available each year. The student researcher receives \$3,000, and the faculty/staff research advisor receives \$1,000 to help offset research costs (e.g., supplies, faculty or student travel related to the project).

HOLSTROM ENVIRONMENTAL RESEARCH FELLOWSHIP

The Holstrom Environmental Research Fellowship (<https://awards.advising.wisc.edu/all-scholarships/holstrom-environmental-research-fellowship/>) supports undergraduate research done in collaboration with UW-Madison faculty or research/instructional academic staff. Research proposals must have an environmental focus, and applicants must have at least a junior standing at the time of application.

SOPHOMORE RESEARCH FELLOWSHIP

Funded by grants from the Brittingham Fund and the Kemper K. Knapp Bequest, the Sophomore Research Fellowships (<https://awards.advising.wisc.edu/all-scholarships/sophomore-research-fellowship/>) support undergraduate research done in collaboration with UW-Madison faculty or research/instructional academic staff. Approximately 15 awards are available.

UNDERGRADUATE RESEARCH SCHOLARS

The Undergraduate Research Scholars (<https://urs.ls.wisc.edu/>) (URS) program is dedicated to enhancing the academic experience of UW-Madison students by providing first- and second-year undergraduates with opportunities to earn credit for participating in research and creative work with UW-Madison faculty and staff. The program has been designed to include partnerships between students and mentors, seminars on research-relevant issues, and practice in research/

artistic presentations. The many benefits of the program are found in the fluid interaction between these activities.

UNDERGRADUATE SYMPOSIUM

The annual Undergraduate Symposium (<https://ugradsymposium.wisc.edu/>) showcases undergraduate creativity, achievement, research, service-learning, and community-based research from all areas of study at UW-Madison, including the humanities, fine arts, biological sciences, physical sciences, and social sciences. This past year nearly 700 students presented, displayed, or performed their work for members of the university, the surrounding community, family, and friends.

UNIVERSITY BOOK STORE AWARD

Supported by a generous grant from the University Book Store, (<https://awards.advising.wisc.edu/all-scholarships/university-book-store-award/>) this award recognizes undergraduate students who have completed an outstanding independent project, such as a senior thesis, at UW-Madison. Projects in all academic fields are eligible.

WISCONSIN IDEA FELLOWSHIPS

Wisconsin Idea Fellowships (<https://morgridge.wisc.edu/students/wisconsin-idea-fellowships/>) are awarded annually to undergraduate student projects working toward solving a challenge identified along with local or global community partners. Fellowships are awarded to semester-long or year-long projects designed by an undergraduate student (or group of students) in collaboration with a community organization and a UW-Madison faculty or academic staff member.