

Pre-MS and Pre-PhD Studies in the Biology Department at Winthrop University

There is no specific prescription of courses for students planning to get an MS or PhD degree. Students should take courses required or recommended by graduate programs in their desired area of graduate study (e.g., biomedical research, cell and molecular biology, ecology, evolutionary biology, microbiology, physiology). Students should look up specific graduate programs at schools they are interested in attending and select courses accordingly.

The most important thing for a student to do before applying to a graduate program is to email faculty members at the school to find a member of the faculty that agrees to serve as the research advisor. Some schools will not consider applications from a student unless a specific faculty member is willing to have the student join their lab. Thus, it is imperative that you check school requirements and email faculty. You should describe why you are specifically interested in the research being done in the lab and attach your curriculum vitae (CV), which is just a fancy name for a resume. The chances of being accepted into a program are greatly improved by having a faculty member that advocates for a student.

Some graduate programs have a rotation system; this is the standard in biomedical PhD programs. Students apply to a specific program (e.g., the Biochemistry, Cell, and Developmental Biology Graduate Program within the Graduate Division of Biological and Biomedical Sciences) or department and work in several labs (typically three) during their first semester or year in graduate school. During this time the student is deciding what research advisor and lab is right for them, while the faculty member is determining what students are a good fit for their lab. For programs with rotations, choosing a research advisor before applying would not be required because you are not committing to a specific mentor and lab when you decide to attend the school; however, having several potential faculty that are willing to have you rotate through their lab and potentially serve as the research advisor can only increase the chances of being accepted.

Acceptance to a graduate program typically includes a tuition waiver (full or partial) and a living stipend (amounts vary among schools). Most schools have teaching assistantship positions, and graduate students teach several lab sections each semester for a stipend and tuition waiver. Some faculty, particularly at larger universities, may have funding for a research assistantship to work on a specific research project that provides a stipend and tuition waiver. In addition, some schools have fellowships that provide a tuition waiver and stipend for graduate students to work on their graduate research projects.

Undergraduate research is not required for admission to graduate school, but it is highly recommended. Completing one or two semesters of undergraduate research will help you develop the skills required to be successful in graduate school, will help you determine what area of research you want to pursue in graduate school, and will be viewed favorably by potential graduate research advisors. If you plan to go straight from undergraduate to graduate school, taking BIOL 471 in the spring of your junior year is recommended so that the research course is on your transcript when you're applying to graduate programs. Then you could take BIOL 472 during your senior year for more research experience.

Students should also consider applying for summer research experiences, which can be done as early as the summer after their first year at Winthrop. Students could participate in a Research Experience for Undergraduates (REU; <https://www.nsf.gov/crssprgm/reu/>) at another university, conduct research with a Winthrop University professor, and/or find other summer research programs or field or laboratory assistant/technician positions. Research experiences at other universities may help students find labs they want to apply to work in for their graduate research. If you are interested in biomedical research opportunities, the Association of American Medical Colleges has information on summer undergraduate research opportunities (https://www.aamc.org/members/great/61052/great_summerlinks.html).

Whether you've conducted research for course credit or as a summer experience, you should present your research (in a poster or oral format) at state, regional, and/or national meetings. In addition, if you collected a lot of data and have an interesting story to tell, you should write a research paper that you can submit for publication in a peer-reviewed scientific journal. Presentations and/or publications (whether in review or already accepted) on your CV show that you are capable of doing things that are required in graduate school and are especially attractive to potential graduate research advisors and graduate admissions committees.

If you are in the Winthrop University Honors program, your thesis project could involve research in a laboratory or be a review of primary literature on a specific topic. Either of these options would be good experience for graduate school.

Students who accumulate a significant amount of research experience (typically more than one semester or one summer) and have a good idea for a research project that they could conduct in graduate school should consider applying for a National Science Foundation (NSF) Graduate Research Fellowship. Undergraduates can apply for this fellowship to get their own research funding for graduate school. If you have your own funding, you are likely to get into most (if not all) of the graduate programs where you apply. If you get a NSF fellowship, you are not committed to completing the project that you proposed; you were awarded a fellowship based on your critical thinking and writing ability, which are skills that lead to success in graduate school. More information about the NSF Graduate Research Fellowship and other graduate and undergraduate funding opportunities is available on the Winthrop University Office of Nationally Competitive Awards (ONCA) website.

Non-biology courses likely required or recommended by many graduate programs are listed below, but specific requirements and recommendations will vary by program.

- Organic Chemistry I (CHEM 301) and Organic Chemistry II (CHEM 302, 304)
- Biochemistry (CHEM 323, 520, 523/525, 524/526, and/or 528)
- Physics I (PHYS 201/201L or 211/211L) and Physics II (PHYS 202, 202L or 212/212L)
- Statistics (MATH 141)
- Calculus (MATH 105 or MATH 201)

You may want to consider taking BIOL 491 and BIOL 492 during your junior year (if you've met the prerequisites) so that research presentations can help refine your interests and you could meet faculty from other universities before you will be applying to graduate school.

Biology internships (BIOL 461 or BIOL 463) could provide experiences and help develop skills that will be useful for graduate school.

If you are interested in an ecology or conservation related graduate program, you may want to take the following courses.

- BIOL 552A – Conservation Biology Practicum A. Travel Field Conservation Biology and/or BIOL 552B – Conservation Biology Practicum A. Field Conservation Biology in the Local Community
- GEOG 305/GEOL 305 – Introduction to Geographic Information Systems, GEOG 308 – Introduction to Geospatial Technologies, or GEOG 320 – Remote Sensing of the Environment
- A geology course such as GEOL 225 – Soils and Land Use or GEOL 335 – Fundamentals of Geochemistry

If you plan to go straight from undergraduate to graduate school, you should take the GRE in the summer after your junior year or fall of your senior year. You should spend several weeks studying for the GRE. There are many resources available to help you prepare for the GRE, and studying seriously can have a large impact on your score. If you know you struggle with standardized tests, you should take the GRE earlier rather than later so you have time to take it a second time if you're not happy with your first score. Many schools have minimum GRE requirements, while some schools may not require the GRE. There is also a Biology GRE subject test, which some schools encourage or require. Be sure to check the specific requirements for the graduate programs where you want to apply.

Most PhD programs accept students that don't have a Master's degree, either straight from an undergraduate program or with several years of work experience. However, a requirement for some PhD programs is that applicants have a Master's degree.

Some students may want to consider taking a year or two (or more) between undergraduate and graduate school. This would allow students to get more research and/or work experience and help students determine their desired area of graduate study.

The information above is geared toward students that plan to complete a thesis (MS) or dissertation (PhD) for their graduate degree (as is required for the MS in Biology from Winthrop (thesis option) or PhD programs at schools such as the University of South Carolina and Clemson). Some Master's programs are non-thesis programs. For example, the Biology Department at Winthrop has a non-thesis MS option as well as an accelerated MS program (4 + 1), which requires students to take 9 hours of 500-level graduate credit during their senior year. Thus, as a Winthrop biology major, it is possible to earn a non-thesis MS in Biology in just five years; if you are interested in this option, it is important that you discuss it with your advisor as early as possible.

Example Course Schedules

The following course schedules are examples – remember that the most important thing is to check required and recommended courses for specific graduate programs. The timelines below are for students interested in going straight from undergraduate to graduate school.

For Biology courses, Area A is Ecology and Evolution, Area B is Cell and Molecular Biology, and Area C is Organismal Biology. The number of credits for each class is listed in parentheses.

Example for students interested in a **cellular and molecular or biomedical** related graduate program

Freshman Year

Fall (14-16 credits) ^a	Spring (17-18 credits)
BIOL 202 (0)	BIOL 221 (3) and BIOL 223 (1) or 271 (2)
BIOL 220 (3) and BIOL 222 (1) or 270 (2)	CHEM 105 (4)
CHEM 104 (3)	HMPX 102 (3)
WRIT 101 (3)	MATH 141 (3)
MATH 151 (3) or MATH 201 (4)	Gen Ed Elective (3)
ACAD 101 (1)	

Sophomore Year

Fall (16 credits)	Spring (16 credits)
BIOL 317 (4) ^b	BIOL 300 (4)
CHEM 108 (2)	CHEM 301 (4)
CRTW 201 (3)	Gen Ed Elective (3)
Foreign Language 101 (4)	Foreign Language 102 (4)
Gen Ed Elective (3)	PESH (1; activity course)

Junior Year

Fall (15-16 credits)	Spring (16-17 credits)
BIOL 315 (4) ^c	Biology Elective (3-4)
Biology Elective, Area A or C (3-4)	BIOL 492 (0)
BIOL 491 (0)	BIOL 471 (3)
CHEM 302 (3) / 304 (1)	CHEM 323 (3)
PHYS 201/201L or 211/211L (4)	PHYS 202/202L or 212/212L (4)
	Gen Ed Elective (3)

Senior Year

Fall (12-14 credits)	Spring (12-14 credits)
Biology Elective, Area A or C (3-4)	Biology Elective (3-4)
Biology Elective, 500-level (3-4)	BIOL 480 (3)
BIOL 472 (3) ^d	Gen Ed Elective (3)
Gen Ed Elective (3)	Elective (3-4)

^a If you complete the minimum credits suggested for **every** semester, you won't have the 120 credits required for graduation

^b BIOL 316 will also meet the Biology degree requirement, but Genetics with a lab is recommended for graduate school.

^c Cell Biology is a prerequisite for many 500-level Area B courses.

^d Two semesters of undergraduate research is not required. BIOL 471 and/or BIOL 472 could be taken any time during your junior year or senior year.

Example for students interested in an **ecology or conservation** related graduate program

Freshman Year

Fall (14-15 credits) ^a	Spring (17 credits)
BIOL 202 (0) BIOL 221 (3) and 223 (1) ^b CHEM 104 (3) WRIT 101 (3) MATH 151 (3) or MATH 201 (4) ACAD 101 (1)	BIOL 220 (3) and 222 (1) ^b CHEM 105 (4) HMXP 102 (3) MATH 141 (3) Gen Ed Elective (3)

Sophomore Year

Fall (16 credits)	Spring (16 credits)
BIOL 300 (4) CHEM 108 (2) CRTW 201 (3) Foreign Language 101 (4) Gen Ed Elective (3)	BIOL 317 (4) ^c CHEM 301 (4) Gen Ed Elective (3) Foreign Language 102 (4) PESH (1; activity course)

Junior Year

Fall (14-16 credits)	Spring (16-17 credits)	Summer (3 credits)
Biology Elective, Area A or C (3-4) Biology Elective, Area B (3-4) BIOL 491 (0) CHEM 302 (3) / 304 (1) PHYS 201/201L or 211/211L (4)	Biology Elective, Area A or C (3-4) BIOL 492 (0) BIOL 471 (3) CHEM 323 (3) PHYS 202/202L or 212/212L (4) Gen Ed Elective (3)	BIOL 552A

Senior Year

Fall (12-14 credits)	Spring (12-14 credits)
Biology Elective, Area A or C (3-4) Biology Elective, 500-level (3-4) BIOL 472 (3) ^d Gen Ed Elective (3)	Biology Elective (3-4) BIOL 480 (3) GEOL or GEOG (3-4) Gen Ed Elective (3)

^a If you complete the minimum credits suggested for **every** semester, and do not take BIOL 552A, you won't have the 120 credits required for graduation

^b If you are interested in SEA-PHAGES, you should take BIOL 220 first, and BIOL 270 and BIOL 271 will count for BIOL 222 and BIOL 223, respectively.

^c BIOL 316 will also meet the Biology degree requirement, but Genetics with a lab is recommended for graduate school.

^d Two semesters of undergraduate research is not required. BIOL 471 and/or BIOL 472 could be taken any time during your junior year or senior year.