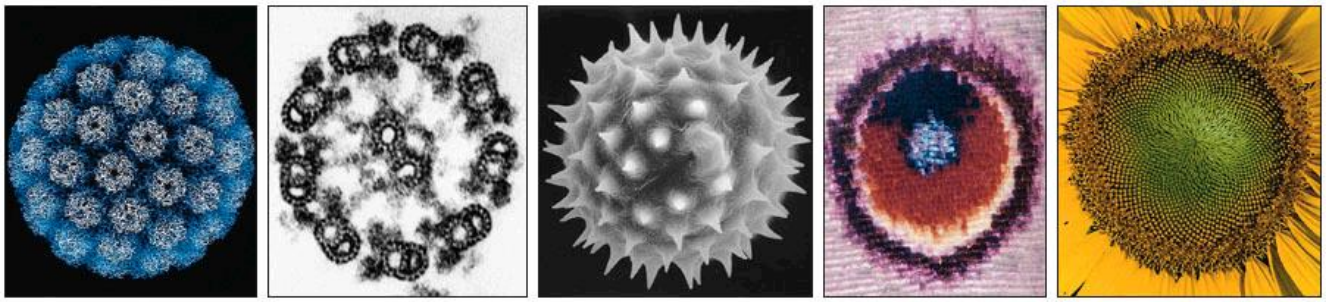
Biology Majors' Handbook



Washington & Jefferson College
Washington, PA
2017-18

BIOLOGY MAJORS' HANDBOOK 2017-18

TABLE OF CONTENTS

****

INTRODUCTION

This handbook is intended for students who are interested in pursuing a Biology Major at Washington & Jefferson College. It provides a useful resource for key departmental policies and information that will help students find resources to aid their Biology education and interests. In this manual, you will find information about the Biology curriculum, faculty, resources, and extracurricular opportunities for students. Please feel free to contact any faculty member to help you explore a Biology major or any of the opportunities in this handbook.

I. DEPARTMENTAL VISION AND MISSION STATEMENTS

Biology Department Vision Statement

The Biology program engages students in an exciting and challenging environment where they master biological concepts and develop scientific competencies necessary to be critical thinkers, successful professionals, and responsible citizens.

Biology Department Mission Statement

Faculty embrace a student-centered approach in a nurturing environment that combines personalized advising, innovative curricular and extracurricular experiences, and research opportunities to promote students' personal and professional development.

- Within the liberal arts curriculum, our students forge explicit connections between their education in the life sciences and their chosen careers and pursuits.

- As actively engaged scholars in their field, the Biology faculty lead students into the exploration of the life sciences through innovative and collaborative teaching methods, including classroom discussions, technology-enhanced learning, interdisciplinary collaborations, and laboratory and field experiences.

- Biology students become scientifically proficient by critically reading, discussing, and presenting primary literature; applying current research techniques in class research projects, independent studies, and internships; and developing their responsibility as biologists through outreach and service activities and clubs.

- Biology faculty strive to provide excellent opportunities for students by leading programs in specific fields such as pre-health, neuroscience, and biochemistry; contributing to the liberal arts curriculum; sustaining and developing new programs through grant writing and student recruitment; and providing contemporary and dedicated resources and facilities for biological research.

- Biology faculty mentor students as they navigate their way to success in their academic program and progress towards their professional goals.

We build lifelong relationships among faculty, students, and alumni that extend beyond the College through mentoring, work, and service opportunities. We are a community of scholars who share experiences, triumphs, and struggles.

II. STUDENT LEARNING OUTCOMES: BIOLOGY DEPARTMENT

Every W&J graduate with a Biology Major should:

Concepts:

1. Understand the central position of evolution to all biological science.
2. Identify basic structures and functions of all living organisms at all scales.
3. Appreciate the diversity among biological systems and biological processes.
4. Describe the dynamic nature of biological systems, including the interconnections between information flow, energy usage, and environmental interactions.
5. Synthesize biological concepts across multiple spatial (cell-organism-ecosystem) and temporal scales (reactions-lifetimes-evolution).

Competencies:

1. Practice the scientific method as a means of understanding the natural world.
2. Solve biological questions through individual or group research experiences.
3. Evaluate scientific concepts, hypotheses, data, and conclusions presented by others.
4. Apply quantitative analyses across multiple scales to analyze complex biological data.
5. Demonstrate proficiency in a specific area of biology.

Liberal Arts and Biology:

1. Engage in the community, nation, and world by making connections between biology and other disciplines.
2. Communicate biology through multiple media to both general and scientific audiences, both within and beyond the W&J community.

III. BIOLOGY FACULTY

Ronald J. Bayline	-Professor and Chair -Highmark Professor in the Health Sciences -Neuroscience, Developmental Biology -B.S. Pennsylvania State University -Ph.D. Cornell University
Thomas A. Contreras	-Associate Professor -Conservation Biology, Landscape Ecology, Vertebrate Biology -B.S., M.A.T., M.S. Central Michigan University -Ph.D. Carleton University
Candy S. DeBerry	-Professor -Cell Biology, Biochemistry -B.S. University of Maryland -Ph.D. Johns Hopkins University School of Medicine
Emily Furbee	-Adjunct Assistant Professor -Bioinformatics, Molecular Biology -B.S. Fayetteville State University -Ph.D. Carnegie Mellon University
Jason S. Kilgore	-Associate Professor -Plant Biology, Field Biology -B.S. Michigan State University -B.S. Michigan State University -M.S. Michigan State University -Ph.D. Michigan State University
Alice Grier Lee	-LeMoyne Professor of Biology -Biochemistry, Genetics -B.S. University of Maryland -M.S., Ph.D. Georgetown University
James G. March	-Associate Professor -Ecology, Environmental Studies -B.A. Macalester College -Ph.D. University of Georgia
Anne K. McGrain	-Biology Program Coordinator -B.S. Lehigh University -Ph.D. Binghamton University
Anupama Shanmuganathan	-Associate Professor -Molecular Genetics, Biochemistry, Microbiology -B.Sc. University of Madras -M.Sc. Pondicherry University -M.S., Ph.D. Georgia State University
Kelly Weixel	-Associate Professor -Physiology, Neuroscience -B.S. St. Francis University -Ph.D. University of Pittsburgh School of Medicine

IV. FACILITIES

The Biology Department is housed in Dieter-Porter Hall, which is shared between the Biology and Psychology Departments. Faculty have offices consisting of both an office and an associated laboratory for student-faculty research. Two laboratories for Foundations courses are on the ground floor with a large preparation room between them. There are seven additional teaching laboratories for advanced biology courses. Each of these laboratories has an associated preparation room. A research suite on the ground floor houses a computer room, cell culture facility, and confocal microscope. An animal suite and a greenhouse are located on the third floor. Four classrooms and a seminar room are also present in the building. A 200 seat auditorium in Dieter-Porter Hall is also available for speakers or lectures.

V. ABERNATHY BIOLOGICAL FIELD STATION

Figure 1. Air photo of the field station; the line represents the gas line right-of-way (ROW).

The 57-acre natural area depicted above, located five miles southeast of the College and owned by the Abernathy family, is available for research and course instruction. The terrestrial flora and fauna of the property are quite diverse (e.g., there are over 100 different tree species within its boundaries), and several small streams are present for sampling aquatic organisms. Students should not visit the field station unless accompanied by biology faculty.

VI. THE BIOLOGY CURRICULUM

The BIOLOGY MAJOR consists of at least 11.5 courses and is designed to expose students to foundational concepts across the discipline to allow flexibility in selecting advanced courses to fulfill each student's goal. All students should complete three foundational courses in Biology by the end of their third year. In addition, students take six upper-level biology electives and a biology literature research course. Majors must demonstrate mathematical proficiency at the pre-calculus level and complete a statistics course (MTH 125 or BIO/MTH 245). Majors must also complete CHM 160 Organic Chemistry. The Biology Capstone consists of a research experience, and the Biological Community Engagement must be completed. Specific requirements are listed below:

- Foundations in biology: BIO 111, BIO 121, and BIO 131
- Organic chemistry: CHM 160
- Upper-level biology electives:
    - Three 200-level BIO courses with laboratories
    - Two 300-level BIO courses, which can include NSC 300 or BCH 333
    - One additional BIO course at the 200-level or above. This may be fulfilled by a BIO intersession course; or BIO 245; or BIO 412/500/501.
- Quantitative proficiency: Math placement score of 19 or higher, or MTH 111; and MTH 125 or BIO/MTH 245
- Biology literature research course: BIO 401 or BCH 401 or NSC 400
- Biology Capstone: Independent research experience in biology, fulfilled by completing BIO 412 or BIO 500/501 or an approved summer research internship followed by an on-campus presentation.
- Biological Community Engagement: Biologically related service activity (or activities) approved by the department.
- The completion of a comprehensive standardized exam during the senior year.

The BIOLOGY MINOR consists of 7 courses. All students take the three foundational courses in Biology: BIO 111, BIO 121, and BIO 131. In addition, students take three upper-level biology electives. Minors must also complete CHM 160 Organic Chemistry I.

- Foundations in biology: BIO 111, BIO 121, and BIO 131
- Organic chemistry: CHM 160
- Upper-level biology electives:
    - One 200-level BIO course with laboratory
    - One 300-level BIO course; or NSC 300; or BCH 333
    - One additional BIO course at the 200-level or above

No more than two courses used to satisfy the requirements for another course of study may be used to satisfy the Biology Minor. No more than one Intersession BIO course may be used to satisfy the Biology Minor.

Capstone Experience:

All biology majors must complete a capstone experience during either **the junior or senior year** and take the Major Field Test in Biology. Any one of the following may be used to satisfy the capstone requirement:

- An approved biologically-related summer research internship*
- Approved summer on-campus research in the biological sciences*
- Experimental Biology (BIO 412)
- Independent Study (BIO 500 or 501)

All students are required to present their capstone work as a poster, oral presentation, or in some other approved format on campus or at a regional or national meeting.

*Students who do summer research must submit a detailed journal or research notebook documenting their work and they must make a formal presentation of the project on campus (as an oral presentation, poster presentation, or other approved form).

Possible pathways through the Biology Major:

Below are listed several different ways that students may combine courses to allow them to complete the Biology major in four years. These are not the only ways that students can complete the major. Consult with your advisor about your specific academic plan.

Year	Fall	Spring
1	BIO 111	BIO 2xx MTH 111+
2	BIO 121 CHM 160	BIO 131 BIO 2xx
3	BIO 2xx BIO 3xx	BIO 3xx MTH 225/245
4	BIO 401	BIO 412/501

Year	Fall	Spring
1	BIO 111	MTH 111+
2	BIO 121 CHM 160	BIO 131 BIO 2xx
3	BIO 2xx BIO 3xx	BIO 3xx MTH 225/245
4	BIO 2xx BIO 401	BIO 412/501

Year	Fall	Spring
1		BIO 111 MTH 111+
2	BIO 121 CHM 160	BIO 131 BIO 2xx
3	BIO 2xx BIO 3xx	BIO 2xx MTH 225/245
4	BIO 3xx BIO 401	BIO 412/501

Year	Fall	Spring
1	CHM 160	BIO 111 MTH 111+
2	BIO 121 BIO 2xx	BIO 131 BIO 2xx
3	BIO 2xx BIO 3xx	BIO 3xx MTH 225/245
4	BIO 401	BIO 412/501

Year	Fall	Spring
1	CHM 160 BIO 121	BIO 131 MTH 111+
2	BIO 2xx	BIO 111 MTH 225/245
3	BIO 2xx BIO 3xx	BIO 2xx BIO 3xx
4	BIO 401	BIO 412/501

Year	Fall	Spring
1	CHM 160 BIO 121	BIO 131 MTH 111+
2	BIO 2xx	BIO 111 MTH 225/245
3	BIO 2xx BIO 3xx	BIO 2xx BIO 3xx
4	BIO 401	BIO 412/501

Year	Fall	Spring
1		MTH 111+
2	BIO 111	BIO 2xx MTH 225/245
3	BIO 121 CHM 160	BIO 131 BIO 2xx
4	BIO 2xx BIO 3xx	BIO 3xx BIO 412/501 BIO 401

VII. OTHER RELATED PROGRAMS

Biology faculty are also involved in several biology-related majors. Many biology courses may be used to satisfy requirements for these majors. If interested, please see the college web page under academics, areas of study and the program directors listed below:

Biochemistry	Dr. Candy DeBerry
Biological Physics	Dr. William Sheers
Environmental Studies	Dr. Robert East
Neuroscience	Dr. Kelly Weixel

In addition, many biology students are planning careers in health care. The college has a comprehensive pre-health program. If interested, please contact Dr. Mark Harris.

VIII. CERTIFICATION FOR TEACHING BIOLOGY

W&J has a state approved program to grant certification for teaching in secondary schools (7-12). The biology department requirements are listed below. Since there is a sequence for many of the required courses and all courses are not taught every year, it is desirable to begin the program early in the student's college career. Tell your advisor if you have a possible interest in this program. You should complete the general biology major.

The required biology courses are:

- BIO 201 Genetics
- BIO 212 Cell Biology
- BIO 235 Animal Physiology
- BIO 305 Developmental Biology or BIO 306 Animal Behavior
- BIO 320 Ecology

In addition the student must complete at least one course in each of the following areas: chemistry, physics, mathematics, and earth and space sciences. Courses that would fulfill these requirements include:

- CHM 160, 170, and 260
- PHY 101 or 107
- MTH 125, or BIO/MTH 245
- Any ESS course (Earth and Space Science)

The College catalog should be consulted for the requirements of the Education Department.

In addition each student preparing for secondary education is required to assist in teaching for one term in a beginning biology laboratory. This involves instructing the class at the beginning of the period, working individually with students during the lab, and mastering the operation of all equipment. The student is paid the usual college rate for this work.

Students seeking teaching certification in biology teaching for grades 4-8 should see the Education Department.

The student should complete The Praxis Series: Professional Assessments for Beginning Teachers in the fall of his/her senior year.

IX. PHI SIGMA BIOLOGICAL SCIENCE HONORARY SOCIETY

Membership in the Phi Sigma Biological Sciences Honor Society is earned by "Students who are enrolled in an accredited 4-year college or university, who have shown research interest, and who have received an equivalent of at least two years of college credit of which at least one-fourth is in the biological sciences, with a scholarship rating in the upper thirty-five percent of their class."

To meet the qualifications for membership in Nu Chapter, W&J students will demonstrate the following characteristics:

1. Academic excellence: BIO GPA of 3.4 or higher (in BIO and related courses in BCH, NSC, EVS); overall GPA of 3.4 or higher;

2. Research interest: participation in a summer on-campus research internship, a summer off-campus research internship, an Independent Study course, or other equivalent experience;

3. Commitment to involvement in the creation, organization, and implementation of biology-related activities for the students and faculty of the Biology department and/or the greater community.

Juniors who meet the requirements for biology courses completed, GPA, and research interest will be contacted during the Fall semester and invited to affiliate with the Nu Chapter. Students who do not meet the requirements until their senior year will also be invited to affiliate with the chapter, but will be expected to become involved in the organization's activities during their senior year.

If you have any questions, please contact Dr. Alice Lee, Faculty Advisor to Phi Sigma.

X. ADVISING

Every Biology major must select a biology faculty member as an advisor by the time that they declare a major. Students must declare a major by the end of their sophomore year. To select an advisor, students should consider faculty members with whom they have had several courses in addition to other faculty members who have experiences in areas of interest to the student. The student should set up a meeting with a potential advisor to determine whether the faculty member would be an appropriate advisor. Students should consider several different faculty members for their advisors in case their first choice cannot serve as the advisor.

At any time during a student's career, s/he may change advisors for any reason, assuming that a new advisor is willing to work with the student. Additionally, students should feel free to consult with other faculty members at any time if they wish.

Transfer students desiring to major in Biology are assigned to a Biology faculty member. Currently, Dr. Contreras serves as the transfer faculty advisor.

Letters of Recommendation

Letters of recommendation are often required for internship, employment, graduate and professional school applications. In order to have the the most effective letters written, a student should select faculty members with whom they have completed several courses and/or other close working interactions (e.g., faculty advisors, research supervisors, lab assistant supervisors, etc.). Students desiring a letter of recommendation from a faculty member should contact the faculty member at least 2 weeks in advance of the due date for the letter to determine whether the faculty member is willing to write a recommendation letter for the student. The faculty member may request additional information (e.g., curriculum vitae, personal statements, transcripts) to help write the letter. Be prepared to provide these materials at least two weeks prior to the due date for the letter.

Students should also consult faculty members before including a faculty member's contact information on resumes/CVs, or job applications—even if a letter of recommendation is not required at that time.

XI. PRIZES

Departmental Prizes-Every year at the Honors Day Convocation the Biology Department awards up to three different student prizes.

The Edwin Scott Linton Prizes in Biology are awarded to the two senior biology majors with the highest averages in biology courses. Each student will receive a book of their choice related to their interests on Honors Day. The names of these students are added to a plaque in the atrium of Dieter-Porter Hall.

The Dr. Emory A. Rittenhouse II Prize in Biology is awarded to an outstanding graduating senior in the biological sciences. The biology faculty will determine the winner of this award based on the overall record of scholarly achievement, research activity, and service to the department, college, and field of biology. The student receives a $500 award and the name of the students is added to a plaque in the atrium of Dieter-Porter Hall.

The Dennis G. Trelka Prize for Original Research in the Life Sciences is awarded to the student who performs the best original research project in either biology, psychology, or another life science discipline as determined by the Biology and Psychology faculty. The award is determined in a competition held during the spring semester. Once nominated by a W&J life sciences faculty member, students may submit independent project papers, published manuscripts, or manuscripts in preparation for the competition. The research supervisor must submit a statement of support. Following an oral presentation, the Biology and Psychology faculty will select the prize winner. The winner will receive a $500 award and have their name added to a plaque in the atrium of Dieter-Porter Hall.

XII. APPLIED EXPERIENCES IN BIOLOGY

In addition to coursework, students should seek out other opportunities to enhance their education through research internships, independent studies, and community engagement activities.

1. Intersession and Summer Research Internships

Nationally, increasing numbers of biology majors obtain hands-on research experience in summer internship programs at major research universities, biotech companies, and government research institutions such as the NIH and the CDC. And research internship programs are not only for students who are planning to pursue a research career: more than 70% of applicants to medical school have research experience!

Biology majors are encouraged to gain as much practical experience as possible so that their eventual career choice is made in a realistic and informed manner. On average, about twenty biology majors complete a biologically-related research internship every academic year. During Summer 2015, 3 students completed on-campus internships and 36 students completed off-campus internships.

Summer research internships may be available on-campus at W&J. Contact your advisor or Dr. Thomas Contreras, Acting Department Chair in fall 2017 or Dr. Ronald Bayline, Department Chair in spring 2018 for more information.

Dr. Candy DeBerry serves as the Director of Off-campus Research internships. In this role, Dr. DeBerry publicizes research internship opportunities through the Biologically-related Internships website on the Biology Department homepage, the annual fall Internship Opportunities Presentation, the Summer Research Poster Session held each fall, and the bulletin board outside Dieter-Porter 102. Dr. DeBerry also assists students who are applying for internships and maintains records on all students who complete biologically-related off-campus internships.

The Biologically-related Internships Programs website (on the Biology Department homepage) includes listings for hundreds of research internship programs in the areas of Cell/Molecular Biology, Field/Organismal Biology, and Biomedical (clinically-based) research. A list of individual researchers who have agreed to host W&J students is included under "Individuals Affiliated with W&J". This website also lists internship programs in related areas including Science Education, Science Museums, Science Writing/Journalism, and Scientific/Medical Illustration.

Most internship programs are targeted at students between their junior and senior years. However, a growing number of programs accept students who are between their sophomore and junior year of college, and more programs are being created that are targeted to students who have completed only one year of college science courses. Therefore, you should meet with your academic advisor as soon as possible to make a plan to fit internships into your undergraduate experience.

There are also many programs that are designed for, or give preference to, students from small liberal arts colleges, first generation college students, students who are physically disabled, or students who are from a racial/ethnic minority group underrepresented in the sciences (note that this does not include Asians and Pacific Islanders). If you belong to any of these groups (and all W&J students are from a small liberal arts college), be sure to mention it in your application.

Internship programs organized and/or sponsored by research institutions (including biotechnology companies, research universities, and government institutions such as the NIH and the CDC) usually

have their own funding. These internship programs are typically very competitive, and receive applications from students across the U.S.

Note that different programs are targeted at different groups of students. Follow each program's guidelines regarding eligibility. For example, some programs are strictly designed for students who intend to enter a Ph.D. (doctoral) program to pursue a research career: other programs only accept students who are considering careers in biomedical research and who intend to enter M.D./Ph.D. programs.

Note that each program also sets its own application deadline, so deadlines will vary. Some application deadlines are as early as January 1. You are responsible for meeting all the deadlines. Applications typically include the following: a copy of your resume or C.V.; a copy of your transcript; an essay on your research interests and/or career goals; and two letters of recommendation from science faculty. If you are planning to apply for an internship, please ask faculty for letters of recommendation at least two weeks before they are due.

Acceptance into such an internship program usually includes a generous stipend. It may also include housing, meals, and perhaps travel funds. Specifics of each program differ, so check them carefully.

Students may also choose to contact individual researchers and apply directly to their specific laboratories. These individuals may have funds from their research grants to support a student intern; if not, the student will have to pursue other sources of funding to support their internship. A list of researchers who have agreed to host W&J students is on the Biologically-related Internships page under "Individuals Affiliated with W&J".

For internships that do not include a stipend, or when additional funds are needed to make an internship experience possible, students may pursue funding through the following W&J sources: Merck Internships for Excellence in Science (Summer internships); Edwin M. Linton Endowment for studies at Woods Hole Oceanographic Institution (Summer internships); Ellis Hyman Internship Award; and the Magellan Project's Geary, Walker, and Kelso Awards. More information about these funding opportunities is on the Biologically-related Internships webpage.

If you are interested in obtaining course credit for your research internship experience, contact your academic advisor for more information. Please note that if you are paid for a research internship, you have to register ahead of time and pay for course credit to have it count. This is consistent with the College policy.

2. Independent Studies

Independent study projects (BIO 500 and 501) are especially valuable to those biology majors seeking admission to a graduate program. Independent study projects allow a student to do individual work, under the guidance of a qualified independent study advisor, on a topic of special interest to the student. The student is responsible for the overall scope and direction of the project, but receives course credit only with the approval of the independent study advisor. During the fall or spring term, juniors and seniors are encouraged to pursue an independent study. Sophomores may petition the Academic Status Committee for permission to pursue independent studies.

Application forms are available from the Office of Academic Affairs. The project must be approved by the student's academic advisor, the independent study advisor, and the Office of Academic Affairs. To pursue an independent study, each student should follow the guidelines below:

1. Meet with a member of the biology faculty who may serve as the independent study advisor prior to the semester when the independent study will be carried out. If the faculty member agrees to serve as your advisor, follow his/her instructions for becoming prepared for the independent study prior to the onset of the project. This may involve reading various papers, carrying out some preliminary experiments, or completing certain courses.

2. Prepare a project proposal following the guidelines established by the college. The proposal must include a brief background section that references literature related to the project, a brief proposal that provides the experimental hypothesis, methods, and expected results, and a basis for the evaluation of your grade. Once the proposal has been approved by your project advisor, submit a copy of the proposal to the department chair and to academic affairs along with a completed "Independent Study Application" form by the end of the add/drop period of the semester.

3. At the end of the semester, the student must complete a scientific paper according to the standards appropriate to the specific discipline of the project. The student will work with the project advisor on preliminary drafts of the paper prior to the end of the semester. For the successful completion of the independent study, each student must:

    a. distribute copies of the PAPER to all Biology faculty and others directly interested in the project before the end of the semester;

    b. one week after distribution of the paper, present a SEMINAR to the Biology faculty and others interested in the project at a previously designated time and place;

    c. submit a revised PAPER, acceptable to the project advisor, to become part of the biology independent study library.

4. Registration for a second term of independent study is permissible if the student either pursues a second and different project, or advances the original project beyond the scope of the original project proposal. Decisions about the merit of a second independent study credit for a continued project will be at the discretion of the project advisor.

5. The project advisor is empowered to impose additional requirements beyond the general requirements stated above.

3. Community Engagement Activities

Biology majors are required to complete 30 hours of biology related work in their community before graduation. Twenty of the thirty hours are recommended to be completed before the start of their senior year.

Community engagement is part of the job of a biologist. Outreach and/or community engagement are in the mission of most professional biological organizations (e.g., Ecological Society of America, Society for Neuroscience, American Society for Microbiology). Research funding sources such as the National Science Foundation require proposals to include "Broader Impacts" such as increasing scientific literacy, public engagement with science, and increased partnerships between academia and other groups. Community engagement is also important for biologists in the private sector. Corporate social responsibility (CSR) is increasingly important for businesses (e.g., ThermoFisher, Bayer, and TetraTech). Engagement with people in the community is especially important for students entering the health professions. Patient contact hours and evidence of helping one's community are of increasing importance in applications for admission into health related schools as well as for scholarships (e.g., W&J Greb Award). Indeed, the American Association for the Advancement of Science (AAAS), whose mission and motto is advancing science and serving society, included "understand the relationship between science and society" as a core competency of an undergraduate biology education.

Dr. James March is the Biology Community Engagement Faculty Coordinator. The faculty coordinator will decide which activities will count towards the requirement. The following two questions will be used to guide which activities will count towards the requirement: 1) how does the activity relate to biology and 2) how does it engage the community? The faculty coordinator will work with W&J's Office of Community Engagement, which will help coordinate the events and document the students' participation. Students can contact the Office of Community Engagement for upcoming approved biology related opportunities. If a student has a specific activity that they want to count towards the requirement, they must get the activity approved. When students complete hours, they must report information about the event using an on-line form co-designed by the Biology Department and Office of Community Engagement. The form will contain basic logistical information as well reflection questions. Relevant community engagement projects completed as part of a course, first day of service, or activities associated with another group can count towards the requirement. Relevant community engagement projects completed prior to declaring a Biology major can also count pending verification and approval by the Biology Community Engagement Faculty Coordinator.

Examples:
The following is a list of examples community engagement projects. All of the examples assume that the topic is related to biology.

Conducting outreach projects for local k-12 students
Tutoring local k-12 students
Working with patients at hospital, retirement home, and hospice
Deliver educational programs at retirement homes
Measuring water quality with local watershed group
Caring for animals with the humane society or animal shelter
Assisting the Red Cross, Central Blood Bank with disaster relief.
Working with a community garden (e.g., Highland Ridge)
Cleaning local rivers (e.g., paddle without pollution)
Health related mission trips e.g., Presidents without Borders
Working with county parks on outdoor education programs
Helping community groups create educational outreach materials on local biological issues.

XIII. DEPARTMENTAL EMPLOYMENT OPPORTUNITIES

The biology department employs students to perform duties as laboratory teaching assistants, laboratory preparators, greenhouse attendant, animal room attendant, glassware washers, general office assistants, building monitors, computer assistants, safety assistants and teaching assistants for several Biology courses. The student is compensated at the minimum wage rate. These jobs provide varying degrees of learning experience for the serious student. There is no better way to learn biology than to attempt to teach it. Every student contemplating graduate school should work as a laboratory teaching assistant and/or laboratory preparator. Consult with your advisor or the department chairperson concerning departmental work.

XIV. STANDARDIZED TESTS

Most graduate and professional schools require the completion of a standardized test for admission to their programs. Most biology graduate schools require the applicant to take the Graduate Record Examination, including the subject portion. Registration materials may be obtained at www.ets.org/gre. Students seeking entrance to medical and other health-related professional programs should contact the Pre-Health Professions website for up-to-date information.

XV. WHAT W&J BIOLOGY MAJOR GRADUATES DO

Below is a list of the postgraduate outcomes of the biology, biochemistry, and neuroscience majors of the years 2003-2016 within one year of their graduation.

What biology graduates do	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
Allopathic	5	3	3	1	3	4	5	4	3	2	1	4	2	3
Osteopathic	1	4	5	0	1	4	1	4	2	5	2	2	0	1
Dental	1	0	0	1	1	1	2	1	0	1	2	0	2	0
Optometry	1	1	1	0	0	1	1	1	0	0	1	0	1	4
Podiatry	0	0	0	0	1	0	1	0	1	0	0	0	1	0
Veterinary	0	0	4	1	1	0	1	0	0	1	1	0	0	0
Physical therapy	1	1	0	0	2	1	0	2	1	0	0	0	0	0
OT	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Chiropractic	0	0	0	0	1	0	0	0	2	0	0	0	1	0
Graduate School	7	6	5	7	2	9	8	4	7	11	3	1	5	3
Medical Technical	1	1	0	0	7	2	3	2	7	8	0	0	0	0
Lab technical (nonmedical)	0	4	1	2	0	1	1	0	0	0	0	0	0	0
Ecology/Environmental Technical	0	0	0	0	2	1	0	1	1	0	0	0	0	0
Physician's Assistant	1	4	1	2	5	0	1	0	1	2	0	2	0	0
Nursing School	2	0	2	0	0	1	3	0	0	0	0	0	0	0
Pharmacy	0	0	0	0	1	0	0	0	0	0	2	0	0	0
Biology related employment	0	2	3	2	0	0	1	0	0	1	10	2	2	10
Non-biology related employment	0	0	0	0	0	2	2	1	0	1	0	0	3	1
Military	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Law School	0	0	0	0	0	0	0	1	0	0	0	1	1	1
Unknown	16	11	6	5	11	11	2	14	18	9	1	4	3	1
Other	0	2	5	0	0	2	0	0	0	7	0	6	1	0
TOTAL	38	40	37	21	38	40	32	35	43	48	23	22	22	24
Number in class	297	296	307	330	320	343	350	320	356	288	272	259	259	240
Percent of class	12.8	13.5	8.3	6.4	11.9	11.7	9.1	10.9	12.1	16.7	8.5	8.5	8.5	10.0