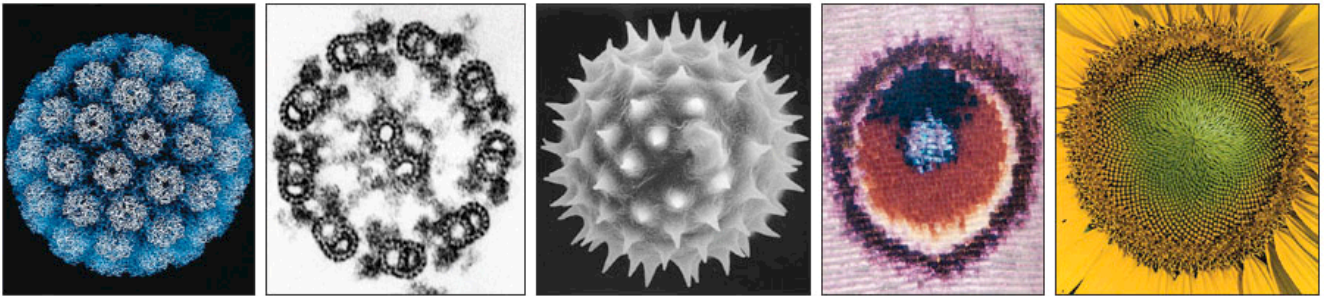


Biology Majors' Handbook



Washington & Jefferson College
Washington, PA
2009-2010

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INTRODUCTION

The purpose of this handbook is to make your time as a biology major easier and more beneficial for you. Most students do not take full advantage of the opportunities available to them. Education is peculiar in that it is an area where people do not seem to desire to receive their money's worth. We would like to change that thinking mode. In these pages we further emphasize what the W&J Biology Department has to offer you. Some policies and procedures of the Biology Department are also presented.

I. BIOLOGY FACULTY

Ronald J. Bayline	-Associate Professor- Neuroscience, Developmental Biology -B.S., Pennsylvania State University -Ph.D., Cornell University
Thomas A. Contreras	- Assistant Professor – Vertebrate Anatomy, Field Biology and Behavior - B.S., M.A., M.S. Central Michigan University - Ph.D. Carleton University
Heather W. Cushman	-Assistant Professor-Physiology, Neuroscience -B.S. University of Michigan -Ph.D. University of Minnesota
Candy S. DeBerry	- Associate Professor- Cell Biology, Biochemistry - B.S. University of Maryland - Ph.D. Johns Hopkins University School of Medicine
Jason S. Kilgore	-Assistant Professor-Botany, 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	- Professor (Department Chair) - Genetics and Molecular Biology - B.S. University of Maryland -M.S., Ph.D. Georgetown University
James G. March	-Associate Professor-Ecology -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	-Assistant Professor-Molecular Genetics, Biochemistry, Microbiology -B.Sc. University of Madras -M.Sc. Pondicherry University -M.S., Ph.D. Georgia State University

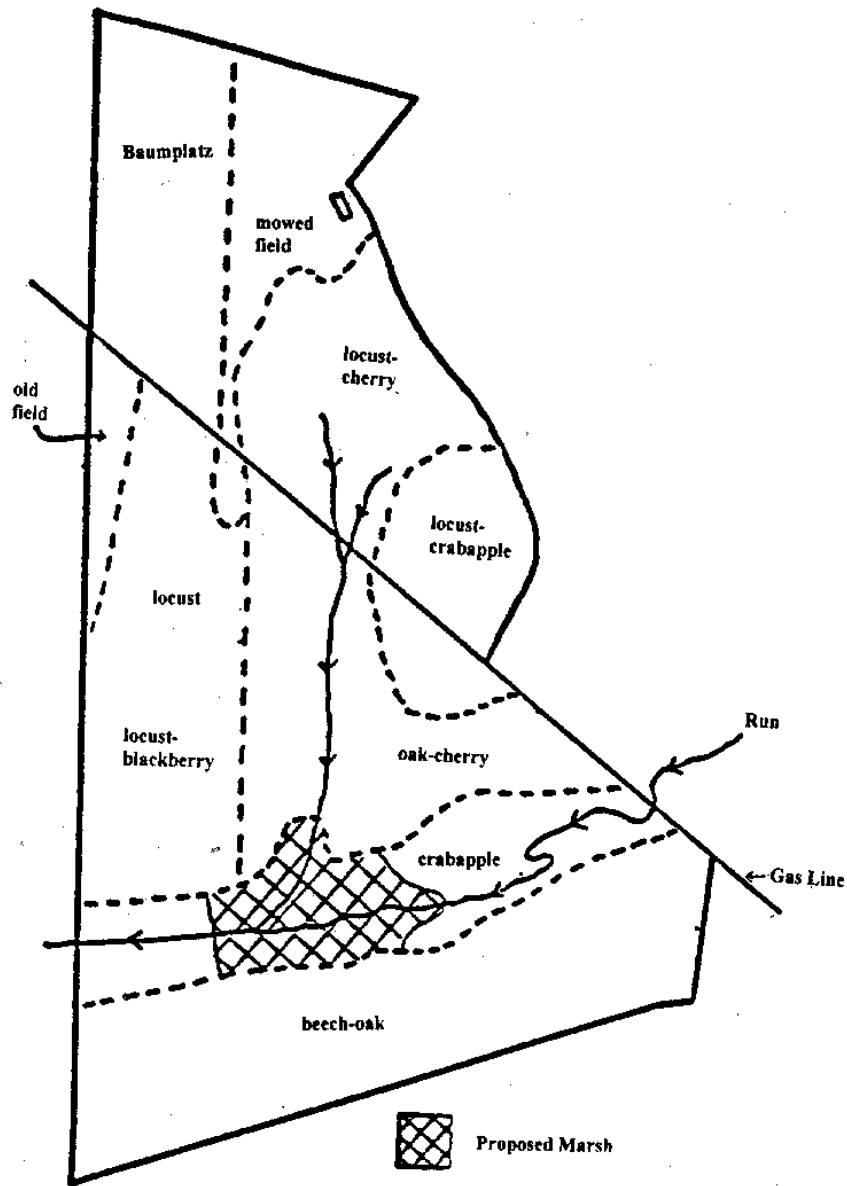
II. FACILITIES

The biology department is housed in Dieter-Porter hall with each of the professors located in office-complexes consisting of both an office and an associated laboratory for student and/or faculty research. Two freshman laboratories are in the basement with a large preparation room between them. Across the hall is the cold room that is kept at about 50°F for cold-blooded animals such as frogs and turtles. An animal suite for insects and for warm-blooded animals such as mice and rats is situated on the third floor.

The six advanced labs are: animal behavior/vertebrate anatomy, animal physiology, animal development/ecology/invertebrate zoology, botany/field biology/evolution, biochemistry/cell biology/molecular biology/genetics, and microbiology/immunology. These classrooms are used for other biological subjects as well. Each of these laboratories has an associated preparation room. Additional rooms available are a greenhouse, confocal microscopy room, and a cell culture room.

Classroom lectures are usually given in one of the two lecture rooms. An auditorium in Dieter-Porter Hall is also available for speakers or lectures. Field courses commonly make use of a fifty-acre plot five miles from campus that is available for our use.

III. ABERNATHY BIOLOGICAL FIELD STATION



The 57-acre natural area depicted above, located five miles southeast of the College and once owned by Dr. E. L. Abernathy, 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.

IV. THE BIOLOGY CURRICULUM

The biology curriculum is designed to permit maximum flexibility for students to work closely with advisors to customize their selection of courses to emphasize such areas biotechnology, environmental studies, or the neurosciences. Since specialization within biology has become more prevalent the department has formulated two tracks for fulfilling the major. The General Biology track is the one most likely to be used by pre-professional students. The Cell/Molecular Biology track is intended for students who wish to pursue careers in biomedical research and in biotechnology. Therefore, although the Cell/Molecular track may be used by pre-professionals, the student must be careful to meet the requirements of the Committee on Health Professions. The tracks within biology are described below.

Required Courses for Biology Majors

1. General Biology - Biology 101, 102, and 200; plus at least one course from Group 1- Biology 201, 212, or 215; at least two courses from Group 2- Biology 202, 204, 205, 206, 209, 235, 245 or 288; at least two courses from Group 3-Neuroscience 300, Biology 311, 314, 319, 320, 245, 412, 416, 435, Biochemistry 333, or Biology 500/501. Total courses for the major is nine. Additional courses in chemistry, physics, mathematics, computers, and language are highly recommended.
2. Cell/Molecular Biology - Biology 101, 102, (at least one course from Biology 201, 212 or 202), Biology 215 or 314, 311, and Biochemistry 333; plus at least two courses from 201 or 212, 202, 235, 215 or 314, 412 or 435, 500 or 501 (but not both), or Neuroscience 300 and one additional course at the 200 level or above. CHM 160, 170, 260, and 270 and PHY 101 & 102 – (Introductory Physics) or PHY 107 & 108 (General Physics-calculus based).

See information on **required Capstone Experience** on page 6.

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:

- Biology Seminar (BIO 301)*
- An approved biologically-related summer research internship**
- Approved summer on-campus research in the biological sciences**
- Experimental Biology (BIO 412)*
- Specified 300- and 400- level courses with the optional capstone projects ***: ecology (BIO 320)*; evolution (BIO 416)*, field biology (319)*
- Independent Study (BIO 500 or 501)*
- An approved Biology Tutorial (BIO 391 or BIO 392)* during the junior or senior year
- An approved senior research project in environmental studies (EVS 430)*

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 must earn a C- or better for a course to count as fulfilling the capstone experience.

**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).

***Capstone projects in courses must include the following: library research involving reading of original research publications; a written abstract of the project; and a formal presentation of the project (as an oral presentation, poster presentation, or other approved form).

Other courses strongly recommended include:

MTH 225 - Probability and Statistics or BIO 245 Applied Statistics for the Life Sciences
 Math 151 - Calculus I
 ITL 102 Introduction to Programming
 English 200 - Advanced Composition

Also it is highly recommended that a laboratory research experience be completed if a student's schedule permits. These experiences may include a 198J or 198S internship or an equivalent summer or January experience at a research facility or at a graduate and/or medical school. Biology 412 or either 500 or 501 may also be used to gain research experience.

It is recommended that several courses that require imaginative design be incorporated into your college course work. Some examples are:

English 205 - Creative Writing
 Music 105 - Fundamentals of Music, 205 - Music Theory
 Applied Music 101 – Choir, 217 - Chamber Music Ensemble
 Earth and Space Science 209 - Planetary Astronomy
 Art 108 – 2-D and 3-D Design
 Art 262-Beginning Sculpture
 Art 130 - Photography or a course dealing with Electronics Design or Computer Simulations.

Cell/Molecular Track - A suggested yearly checklist to help you to plan ahead in preparation for acceptance into graduate school in the biological sciences.

Freshman Year

Coursework (traditional student)

1. General Biology (BIO 101/BIO. 102)
2. Organic Chemistry (CHM 160/CHM 170)
3. Calculus (MTH 151)
4. English

Tasks

1. Declare a biology major (form in Registrar's Office)
2. Select an advisor (usually this is your lab instructor for BIO 101 or BIO 102)
3. Meet with your advisor who will discuss the program, help you plan and give you a copy of The Biology Majors' Handbook
4. Read the Handbook
5. Attend seminars by scientists and health care professionals

Sophomore Year

Coursework (traditional student)

1. Two 200-level biology courses (possibly 300-level course(s) if you are qualified)
2. Inorganic and Analytical Chemistry (CHM 260/CHM. 270)
3. Probability and Statistics (MTH 225) or Applied Statistics for the Life Sciences (BIO 245)

Tasks

1. Meet with your advisor each semester
2. Apply for summer programs
3. Serve as a lab assistant or plan to do so
4. Develop a curriculum vitae (the Career Services office and your advisor will help you)
5. Attend seminars (including "Summer Opportunities" seminar in December)

Junior Year

Coursework (traditional student)

1. Two 200- or 300-level biology courses (suggested: BCH 333 during spring)
2. Physics (PHY 101/102 or PHY 107/108)
3. Advanced Composition (ENG 200)

Tasks

1. Meet with your advisor each semester
2. Get catalogs and visit Web sites for possible schools/programs
3. Research Internship (Intersession) (see listings on the Intranet)
4. Apply for Summer Internships (see listings on the Intranet)
5. Summer Internship or other research experience
6. GRE completed
7. Plan visits for grad schools
8. Attend seminars
9. Participate in Biology Seminar (BIO 301) during the fall semester
10. Complete a capstone experience during junior or senior year

Senior Year

Coursework

1. Biology course(s) (suggested: Independent Study [BIO. 500 or BIO. 501] or Experimental Biology [BIO. 412])

Tasks

1. Meet with your advisor each semester
2. Retake the GRE if necessary
3. Ask for letters of recommendation from faculty
4. Apply to graduate schools in early fall
5. While at interviews at graduate schools, take plenty of time to see labs, talk with grad students and postdocs and see the campus and city
6. Continue to attend seminars and learn about biomedical research advancements
7. Attend Biology Seminar as a Phi Sigma member
8. Complete capstone experience if haven't done so

V. BIOLOGY MAJOR WITH EMPHASIS IN NEUROSCIENCE

Students may pursue an emphasis in neuroscience while completing their biology degree. To complete the emphasis, students must complete three core courses in neuroscience along with the requirements for either the general biology or cellular and molecular biology track. In addition, students must complete a research experience, which could occur as an independent study project or tutorial with a faculty member at Washington and Jefferson, or as a relevant internship performed during the summer or intersession.

For the general biology track with a neuroscience emphasis, a minimum of 11 courses are required. The course requirements are outlined below:

1. Biology 101, 102, and 200
2. One course from group 1--Biology 201, 212, or 215
3. Two courses from group 2--Biology 202, 204, 205, 206, 209, 235, or 245
4. One course from group 3—Biology 311, 314, 319, 320, 245, 412, 416, 500, 501, or Biochemistry 333.
5. One course of introductory science from another discipline; Chemistry 160, Physics 101 or 107, or Psychology 101
- 6: Neuroscience 210, 300, and 400
- 7: Approved Research Experience, which may be satisfied by Biology 299S, 299J, 391, 392, 500, 501, or an off-campus internship.

There are 16 required courses for the cellular and molecular biology major with neuroscience emphasis. The course requirements are outlined below:

1. Biology 101 and 102
2. Biology 201 or 212, Biology 215 or 314, Biology 311, and Biochemistry 333
3. One course from Biology 201, 202, 212, 235, 215, 314, 412, 435, 500 or 501.
4. Neuroscience 210, 300, and 400
5. Approved Research Experience, which may be satisfied by Biology 299S, 299J, 391, 392, 500, 501, or an off-campus internship.
6. Chemistry 160, 170, 260, and 270
7. Physics 101 and 102, or 107 and 108

VI. 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. Mark Harris
Biophysics	Dr. Joel Cannon
Environmental Studies	Dr. Robert East

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

VII. 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.

The required biology courses are:

- 101-102 General Biology
- 201 Genetics
- 212 Cell Biology
- 235 Animal Physiology
- 202 Developmental Biology or 206 Animal Behavior
- 320 Ecology

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

- Chemistry 160, 170 Organic Chemistry or 260 Inorganic Chemistry
- Physics 101 or 107, Introductory Physics
- Mathematics 225, Probability and Statistics or 245 Applied Statistics for the Life Sciences
- Any ESS (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 being well versed in the operation of all equipment. The student is paid the usual college rate for this work.

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

VIII. PHI SIGMA BIOLOGICAL SCIENCE HONORARY

Students who will have completed at least four biology courses by the end of their sophomore year with at least a 3.0 GPA in these courses and 3.0 overall may wish to affiliate with Nu Chapter of Phi Sigma Biological Science Honorary. In addition to the academic standing requirement, membership in Phi Sigma requires evidence of research interest in the biological sciences. This may be satisfied by successful completion of an Independent Study research project or Biology Seminar.

Phi Sigma is a research honorary. Therefore, we must see evidence of your having performed research in order to induct you into Phi Sigma. This can be accomplished by library research on the subject of your paper for Biology Seminar. The biology faculty is especially interested in how you have updated your paper; for instance, what work has been done on this topic since the publication of your paper? **Failure to include papers that were published after the paper that you present will preclude you from being inducted into Phi Sigma.**

IX. BIOLOGY SEMINAR

Students planning to undertake graduate studies in the biological sciences should take Biology Seminar in the fall of their junior or senior year. This is true even if you do not qualify for induction into Phi Sigma, as the experience of presenting a research article will be invaluable to you in your graduate career. Seminar is open to junior and senior students who have completed Bio 101 and 102 and who have a GPA of 2.5 or higher. To receive transcript credit, students must enroll in Biology 301 as a fifth course. Qualified students may participate informally by obtaining permission through their faculty advisor.

Students who are eligible for Biology Seminar and who have declared biology as their major will be notified by mail during the spring of their sophomore year. If you believe that you are eligible for Seminar but did not receive notification, you should contact Dr. March. If you do not qualify by the spring of your sophomore year but believe that you can remedy the problem by the end of the fall of your junior year, you may be allowed to participate in Seminar; again, see Dr. March.

After you have received notification of your eligibility to participate in Seminar, you will attend an informational meeting. At this meeting, you will select your two papers for presentation. The papers will be on a similar topic. Students are strongly encouraged to work on at least their first presentation during the summer.

Participation in Biology Seminar involves the presentation of two research articles to the biology faculty and your peers. Your first presentation will last up to 10 minutes and will be on a short scientific paper, while your second presentation will be 20 minutes and on a longer scientific article. You will also have the opportunity to answer questions from faculty members and your peers. A one page abstract of the paper is due the Friday before your presentation. Abstracts must conform to the Approved Format for Biology Seminar Abstracts. In addition to preparation of abstracts and presentation of papers, each participant is expected to contribute in discussions of papers presented by other seminar members.

Your grade in Seminar is determined by the biology faculty. Each faculty member will assign you a grade on each presentation; these grades are then averaged. If you receive an average grade of 3.0, you have met the research requirement for induction into Phi Sigma. Your grade will be based on the quality of your presentation, the quality of your research, and your participation during Seminar.

X. APPROVED FORMAT FOR BIOLOGY SEMINAR ABSTRACTS

Each seminar is based on a central article that the presenter has selected from a collection of articles submitted by the biology faculty or from the references of a book selected by the faculty. Your abstract should consist of a 5% condensation of this article and you should cite the article at least once. The perspectives of supplementary sources should be included in the abstract and they should be cited also. You may not cite any source that you have not seen in its original form. Begin your abstract by placing your name, Biology 301, and date in the upper right corner of the page as described in the Guidelines for Papers and Reports in Biological Science Courses to Accompany “A Short Guide to Writing About Biology” by J. Pechenik (5th edition, 2004, Addison, Wesley, Longman, NY). This document is found in the appendices of the Biology 101 and 102 manuals. You will use the actual date on which your seminar is to be presented, even though you distribute your abstract at least a week before the presentation.

Now skip a line and center the title of your central article on the page, capitalizing all words except articles and prepositions. Skip another line and center the word “Abstract” on the page. Skip another line and begin the body of the abstract. Following an outline that you have made while reading the article, the abstract should explain, in your own words, why this study was done, how it was carried out, what major findings were obtained, and what contribution this work has made to our knowledge of this subject. Work in any support or refutation contributed by supplementary sources (**keep in mind that in order to qualify for Phi Sigma, you must cite articles that are more recent than your article**) you have read. Skip a line at the end of the body and center the words “Literature Cited” on the page. You must cite your article and also any supplementary sources you use.

The citation in the text consists of the last name of each author of the article and the article’s year of publication. You may cite sources in the following ways:

- Include all of this information in parentheses, such as (Smith and Jones, 1985).
- Include the name(s) of author(s) within the context of a sentence and place only the year in parentheses- Smith and Jones (1985) described a new blotting technique.
- If you cite an article by three or more authors, use (Karl et al., 1987).

In either case, the parentheses are placed within the sentence, not after the period that ends it. Direct quotes are seldom used in scientific writing and should be avoided unless a particular effect is desired. This means that your abstract should include ideas from other sources, but should be written in your own words. Under “Literature Cited,” the sources you have cited should be listed alphabetically on the basis of the surname of the senior (first) author. You should skip a space after “Literature Cited” and between entries. You should follow the guidelines for writing this section as given in “A Short Guide to Writing about Biology, 6th edition” by Jan A. Pechenik (2007). So, if you have cited an article by Allen in addition to that by Smith and Jones, you would list these entries as follows.

Literature Cited

Allen, B. C. 1982. Silly seminars and dubious discussions. *J. Irreproducible Results* 15(3): 124-129.

Smith, L., Jones, K .C. 1985. Blotting directions: eastern, Southern and western. *J. Peculiar Biol.* 32(5): 321-330.

Each element in a listing is followed by a period and is separated from the next element by one space. The elements in a listing are author, date, title, and place of publication. The elements always appear in this order. Only the first word and proper nouns of the title are capitalized. Latin names are either printed out in italics or are underlined; no other words are underlined. In the case of an article published in a journal, the journal name is followed by the volume number, issue number (in parentheses), and pages following the colon with one spaces in between. When citing sources, always use the format described in the Guidelines for Papers and Reports in Biological Science Courses to Accompany “A Short Guide to Writing About Biology” by J. Pechenik (6th edition, 2007, Addison, Wesley, Longman, NY) found in the appendices of the Biology 101 and 102 laboratory manuals. **Note that this format is for journal articles and book formats are different.**

XI. ADVISING

Every biology major has a biology faculty member as an advisor. In most cases the instructor the student has for his or her beginning biology course laboratory will be his or her advisor. Since it is not always possible to assign a beginning biology laboratory section to every member of the biology department in the fall semester, some modification of this basic procedure is necessary. Your beginning biology laboratory instructor will tell you who your advisor is to be. This system permits the advisor and advisee to become immediately acquainted. If the relationship proves to be workable, it will continue through the student’s time at the college allowing the advisor to better assess the student’s growth and interests in order to provide the best advice.

Transfer students will normally have as their advisor a biology faculty member that they have their first semester at the college.

Letters of Recommendation

Students desiring a letter of recommendation should present the faculty member from whom they are making the request with a stamped addressed envelope, a short biographical sketch, and an up-to-date transcript. Requests for letters should be made at least two weeks before they are due to be sent. Students should also inform the faculty member of the result of their application.

XII. PRIZES

Departmental Prizes-Every year at the Honors Day Convocation the Edwin Scott Linton Prizes in biology are awarded to the two senior biology majors with the highest averages in biology courses. The names of these students are engraved on a metal plate and added to the plaque on the wall to the right of the entrance to the departmental office.

The Trelka Prize-This prize is for original research in the life sciences (biology and psychology). Guidelines follow.

A. FREQUENCY: One annual award

B. PRIZES: Winner - One hundred dollars, name(s) placed on plaque (it is possible that a project may be conducted by more than one student); all finalists to receive a certificate of participation; the winner(s) will receive recognition at the Honor's Day Convocation held during the Spring Session. In the case of more than one winner, the money prize will be shared. The winner and the project advisor will each receive a bound copy of the paper. A third copy will be bound and kept on file in the Dieter-Porter Student Library/Study.

C. GUIDELINES: Only one undergraduate project in each department will be considered for the prize. Before the announced dead-line, during the Spring Session, each department will recommend its project, based on established department criteria which should include an oral presentation at a formal meeting before at least one departmental representative. The project advisor will then provide Dr. Alice Lee, Coordinator of the Alumni Prize, with a supporting letter and a copy of the paper, resulting from the project, which should be drafted according to current professional standards for publication. All prospective candidates must be in good academic standing and officially enrolled at Washington and Jefferson College.

Projects for consideration may result from any of the following experiences:

1. Summer undergraduate research programs,
2. Intersession research internships or independent studies (299J),
3. Summer research internships
4. Practicums (Psychology 499),
5. Independent studies (500 or 501), and
6. Others (e.g., an extension of a laboratory project of an original idea).

D. EVALUATION: A panel, consisting of the project advisor from each department and Dr. Lee, will be established to evaluate each project. Alumni prize candidates will meet with this panel to discuss his/her or their project and the results presented in the paper. The eventual winner(s) will be determined by the collective decision of the panel.

XIII. PRACTICAL EXPERIENCE IN BIOLOGICAL AREAS

There are a number of means by which to gain practical experience in various related areas of the biological sciences.

1. Interession 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 2009, 9 students completed on-campus internships and 22 students completed off-campus internships. In addition, 5 students completed off-campus internships during Interession 2009.

Summer research internships may be available on-campus at W&J. Contact your advisor or contact Dr. Tom Contreras or Dr. Ron Bayline, Co-directors of On-campus Research, 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: HHMI Grant for Undergraduate Science Education (Intersession and Summer internships); 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.

2. **Independent Studies**

Biology 500 and 501 are especially valuable to those biology majors seeking admission to a graduate program. For more details refer to the section of this handbook dealing with Independent Studies (page 17).

3. **Volunteer Services**

Many biology majors volunteer their services to observe and assist at veterinary clinics and offices, and at hospitals, clinics, and in offices of practitioners, informally, to broaden their understanding of a specific health profession.

The value of practical experience in selecting a career to enter can not be underestimated. Experience in an area conveys to evaluation committees that you are an informed and well-prepared candidate.

XIV. 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 General Biology. 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.

XV. GRADUATE RECORD EXAMINATION

Most biology graduate schools require the applicant to take the Graduate Record Examination, including the subject portion. Registration materials may be obtained by calling 1-800-GRE-CALL or go to www.ets.org/gre.

XVI. INDEPENDENT STUDY GUIDELINES

1. Select a member of the biology faculty who agrees to serve as project advisor.
2. Prepare a project outline, acceptable to the project advisor, and distribute copies to all biology faculty and others in the college directly interested in the project during the academic session prior to the session in which the study is to be completed. For Biology 500, the outline must be distributed in the spring session prior to the year in which the study is to be completed, and for Biology 501, during the fall session of the year preceding completion. Deadlines for applications to the Office of Academic Affairs are April 15 for fall internships (Biology 500) and November 15 for spring internships (Biology 501).

3. Except under unusual circumstances, a student will be permitted to register for only one term of independent study. This will be for the session in which the study is completed. In this session the student must:
 - a. distribute copies of an ABSTRACT to all biology faculty and others directly interested in the project;
 - b. at least one week after distribution of the abstract, present a SEMINAR to the project advisor and others interested in the project at a previously designated time and place;
 - c. submit a PAPER, acceptable to the project advisor, to become part of the biology independent study library.
4. Even though registering for a single term of independent study, the student is expected to begin literature review in conjunction with preparation of the project outline, and to carry out research during the interim preceding the session in which credit is formally obtained.

It is anticipated that independent study will involve greater effort over a longer period than would a typical course. Only individuals willing to devote such effort should elect this course of study.

5. Registration for a second term of independent study demands either undertaking a second and entirely different project for which the above procedure is followed or undertaking a project of such magnitude as to warrant the granting of two course credits. Merit, in the latter case, will be judged by the biology department.
6. The project advisor is empowered to impose additional requirements beyond the general requirements stated above.

XVII. WHAT W&J BIOLOGY MAJOR GRADUATES DO

Below is listed, so far as is known, what the biology majors of the years 1988 through 2008 did after graduation.

	'08	'07	'06	'05	'04	1988-'03	<i>Total</i>
Allopathic Medicine	3	2	1	4	2	89	101
Osteopathic Medicine	2	4	2	2	0	64	74
Dental	0	1	2	0	2	23	28
Optometry	0	0	1	0	1	25	27
Podiatry	1	0	0	0	1	12	14
Veterinary	0	1	1	0	0	6	8
PT	1	1	0	0	0	12	14
OT	0	0	0	0	0	1	1
Chiropractic	2	0	0	0	1	5	8
Graduate School	7	7	3	1	5	104	127
Med Tech	7	0	0	0	0	3	10
PA	1	2	0	2	0	2	7
Nursing School	0	0	2	0	0	2	4
Biology related employment	1	8	10	2	2	113	136
Non-biology related employment	0	3	0	0	3	30	36
Army ROTC	0	0	0	0	0	8	8
Law School	0	0	0	1	1	7	9
Unknown	18	10	1	4	3	35	71
Other	0	1	0	6	1	18	26
TOTAL	43	40	23	22	22	559	666
Percent of Graduating Class	12.1	13.8	8.5	8.5	8.4	14.8	13.8