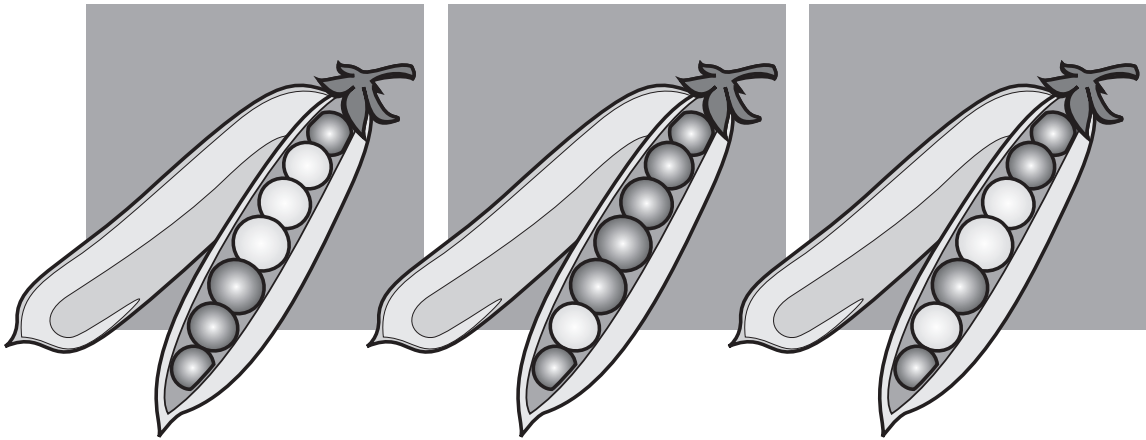


UNDERGRADUATE
STUDIES IN
BIOLOGY



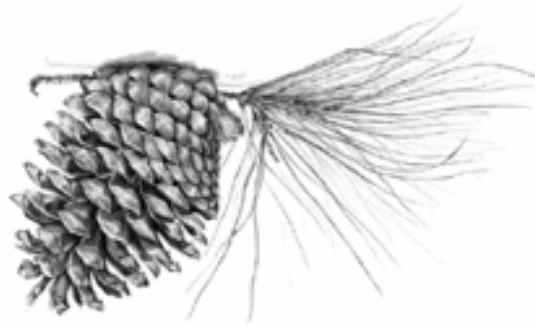
VILLANOVA UNIVERSITY

Revised August 2018

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Welcome to Biology!

This handbook provides answers to questions you may have about the Department of Biology and its courses, and gives some suggestions for winding your way through the labyrinth of Villanova to a biologically related career. The handbook is by no means complete; feel free to approach any faculty member in the Department for more information, perhaps starting with your advisor. The names, office and lab room numbers, and phone numbers of Biology faculty members are listed at the back of this handbook.

The handbook is an ever-evolving project. We constantly seek additional information for subsequent additions, and we invite you to suggest improvements. Please send all suggestions to:

Advisory Committee
Department of Biology
147 Mendel Science Center
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Tel. 610-519-4830

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Information about the courses, faculty, activities, and programs of the Department is also available online. For the most up-to-date material, visit our site at <http://biology.villanova.edu>.



Jurgis Menckel

Mission Statement

Department of Biology's Undergraduate Mission Statement

The primary goals of the Bachelor of Science in Biology program at Villanova University are to promote the development of the student's (1) understanding of biological patterns and processes from the subcellular to the ecosystem levels, (2) facility to communicate ideas in the language of science through intensive writing and oral presentation, and (3) ability to apply the scientific method through experimentation and deductive reasoning. In addition to traditional classroom lectures and discussion, the program in biology provides intellectual experiences in a diversity of formats such as: laboratory and field study, seminar, and research. Each experience provides the student the opportunity to develop skills in analysis, synthesis, and quantitative reasoning that have broad application in hypothesis testing, critical thinking, and interpretation. The undergraduate program features advanced course work that provides exposure to the primary literature and research in diverse areas of faculty expertise. Qualified students are encouraged to undertake research with mentors who are teacher-scholars in a variety of biological sub disciplines. The Department of Biology values a multicultural student body taught by a diverse faculty committed to teaching, scholarship and service that promotes the exchange of different ideas and perspectives and provides mentorship roles in the University community. A faculty advisor guides the student toward achieving his or her goals throughout the four years at Villanova and beyond. The program promotes the skills and spirit of inquiry necessary for life-long learning. The field of biology provides many career choices. Through required curricular elements in biology, chemistry, mathematics, and physics, and advanced biology electives, Villanova's program provides a foundation for graduate study in the biological sciences, health professions, law, education, or business, or a basis for employment in the fields of applied biology, biological research, environmental and health sciences, or teaching.



The Major in Biology

Requirements for completing the Biology major are formally stated in the *Villanova University Catalog—Undergraduate Studies* and summarized in the *Enchiridion*. Completion involves three components—Biology courses, other sciences, and College Core requirements—that must total at least 136 earned credit hours. Current requirements are as follows:

Total Number of Credits for Graduation

Biology majors must accumulate a total of at least **136** earned credit hours of course work (major requirements, Core Curriculum requirements, and electives), including any approved advanced placement or transfer credits. (Students must earn a grade of D- or better to get credit toward the total required for graduation. If a course is repeated, each grade will appear on the transcript, but grades are in essence averaged when calculating GPA.) In addition, Biology majors must maintain a “technical GPA” (i.e., a grade-point average in science and mathematics courses) of ≥ 2.00 .

Required Biology Courses

Students must earn at least **37 credits** in Biology courses numbered 2000 or higher (36 for students entering before F'17). Some courses in other departments (e.g., Biochemistry) may be used to count toward this total; check with your advisor for details. **Required** courses include:

- **General Biology** (Biology 2105 and Biology 2106; 8 credits): two semesters with laboratory
- **Genetics** (Biology 3351; 4 credits)
- **Biology Laboratory & Distribution Requirement** (≈ 20 credits): Five biology laboratories at the 3000 level or above. A few courses in other departments may count toward this total (e.g., Biochemistry w/lab; Chm 4611/4601). Your courses must include at least one Biology course *with laboratory* from each of the following categories:

Cellular and Subcellular

Bio 3595
Bio 4105
Bio 4205
Bio 4285
Bio 4355
Bio 4505
Bio 4605
Bio 7321/7322
selected TOPICS w/lab

Organismal

Bio 3055
Bio 3155
Bio 3405
Bio 3455
Bio 3505
Bio 3525
Bio 3555
Bio 3755
Bio 3801/3802
Bio 3905
Bio 4251/4252
Bio 7205
Bio 7905
selected TOPICS w/lab

Ecology, Evolution, Population

Bio 3015
Bio 3255
Bio 3485
Bio 4305
Bio 4385
Bio 4451/4452
Bio 7105
Bio 7151/7152
Bio 7705
Bio 7555
Bio 7755
Bio 7955
selected TOPICS w/lab

- **“Research” course** (Several of the lab courses above are designated as “Research” as well; see subset courses designated as such for any given term). Typically taken sophomore and/or junior year.
- **Capstone course** (Biology 5300- 3 credits; taken either Fall or Spring of senior year) or **Senior seminar** (Biology 5100- 1 credit; taken Spring of senior year as part of senior thesis under the supervision of a Biology faculty member—whether they do so through the Honors program or the Department of Biology). All capstones emphasize higher-order learning and

student presentations, with Bio 5100 focusing on preparation for an oral presentation of the student's research. See **Research & Senior Thesis** section for more information.

Note that there are additional courses at the 8000-level that may count for credit in one of these areas as well; please see your advisor for more information. In addition, two other undergraduate lab courses that will count toward the 5 total but are not in one of the three categories above are Bio 3105/7805 and Bio 3225.

Important notes: Along with the requirements included in the list above, most students also will have to take **one (1) or more additional credits in biology** to reach the total of 36 credits. Considerable flexibility exists in completing these credits, including taking a sixth upper-level lab course; a "Topics" or a lecture-only course at the 3000-level or above, an internship, and/or a combination of directed research/independent study courses. If you opt to complete a senior thesis, it will count for one of the lab requirements. Students can petition to take international study or summer field courses as well. All of these options are detailed elsewhere in this handbook.

Other Science Requirements

- Two semesters of inorganic chemistry with laboratory (Chem 1151/1103 and 1152/1104)
- Two semesters of organic chemistry with laboratory (Chem 2211/2201 and 2212/2202)
- Two semesters of mathematics, including at least one semester of calculus (Math 1312 or MAT 1500) and one of the following: MAT 1313:Statistics for Life Sciences, MAT 1314: Modeling for the Life Sciences, MAT 1505:Calculus II or MAT 4310:Stat Methods
- Two semesters of physics with laboratory (Physics 1100/1101 and 1102/1103)

The choice of the second (and optional third) mathematics course(s) is dependent upon your career goals. We suggest that all biology majors take a statistics course either through the MAT department (MAT 1313 or 4310) or the BIO department (BIO 3105:Biostatistics and Experimental Design). Not only is this a useful set of skills to have, but it is a prerequisite for many graduate and professional programs (e.g., many health professions). We recommend that senior thesis students take MAT 1312, the modeling course (MAT 1314) and Biostatistics and Experimental Design (BIO 3105). Note that this last course will count toward the five BIO lab requirement for the major. Consult with your advisor for additional information and course recommendations.

The Core Curriculum

The Core Curriculum for the College of Arts & Sciences has been changed recently, and the "New Core" will go into effect with the Class of 2015. Thus, there are two sets of requirements, depending on when you started at Villanova. These notes provide an overview of the requirements. Consult the *Enchiridion* or your advisor for more explanation or questions about each specific requirement.

Summary of Core Curriculum...

CORE CURRICULUM with some notes specific to BIO majors

Below is a summary of the course requirements of the New Core that goes into effect with the Class of 2015 (entering in Fall 2011).

For more information, see http://www1.villanova.edu/villanova/artsci/undergrad/new_core.html

Note: under the New Core, AP credit cannot be used to fulfill a Core requirement (with the exception of Language), but can be used to fulfill requirements for the major.

2 Augustine and Culture Seminars: ACS 1000: Ancients and ACS 1001:Moderns

2 Theology courses: THL 1000:Christian Faith and Life and a second THL course (or courses offered by other departments when designated by the appropriate attribute)

Ideally, the second course is taken after the following "Foundational courses": ACS 1000, ACS 1001, THL 1000, and PHI 1000

1 Philosophy Course: PHI 1000:Knowledge, Reality, Self

1 Ethics course: ETH 2050: The Good Life: Ethics and Contemporary Moral Questions

Ideally taken after the other "Foundational courses" and by the end of the junior year.

2 Language courses: Can be fulfilled in one of three ways: (1) Complete at Villanova two courses above the elementary level in French, Italian, Latin, Portuguese, or Spanish, or two courses at the elementary/introductory level in Arabic, Chinese, ancient Greek, Hindi-Urdu, Japanese, or Russian; (2) Pass a proficiency test or Credit-by-Examination offered by the Department of Romance Languages & Literatures (French, German, Italian, Portuguese, or Spanish), Classical Studies (Latin and Ancient Greek), and/or the Institute for Global & Interdisciplinary Studies (GIS; Arabic, Chinese, Japanese, Russian) at the levels above; or (3) attain a 4-5 score on the appropriate AP test.

1 Mathematics or Statistics course: for BIO majors, typically MAT 1312:Biocalculus (BIO majors also take a second MAT course; see above)

Special note for BIO students: All students have to fulfill this requirement, even if you have received AP credit for Calculus (score of 4 or 5 on one of the Calculus exams). New in 2015, one calculus course is required for the Biology major (MAT 1312 or MAT 1500) along with a second course can include MAT 1313:Statistics for Life Sciences, MAT 1314: Modeling for the Life Sciences, MAT 1505:Calculus II, or MAT 4310:Stat Methods. In addition, interested students can opt to take additional MAT courses relevant to their career goals, including MAT 2705: Differential Equations, some MAT 5920: TOPIC courses (such as Medical Imaging), especially if you plan to go into Cognitive Science, Computational Biology, or Bioinformatics.

1 Literature and Writing Sophomore Seminar: Literature - Sophomore Writing Seminar

Most sections of the *Sophomore Writing Seminar* will be offered through the English Department. The course is scheduled to begin in the 2012-2013 academic year.

1 History course: Any course designed for the Core, as indicated in the *attribute* field.

2 Social Science courses: Any two courses designed for Core, as indicated in the *attribute* field.

includes courses in Criminal Justice, Economics, Education, Gender and Women's Studies, Geography and the Environment (some), Institute of Global Interdisciplinary Studies, Political Science, Psychology, and Sociology

1 Fine Arts course: Any course designed for the Core, as indicated in the *attribute* field.

Special designated courses in Theater, Studio Art, Art History, English, and Communication (e.g., Rhetoric/Performance and Media/Film Studies). Note that not all Studio Art courses meet the Fine Arts requirement.

2 Core Science courses each with a lab: Fulfilled many times over in BIO curriculum!

Other requirements fulfilled in conjunction with other courses in major or Core

- **Writing: 2 BIO courses in addition to other courses taken in the Core Curriculum**
Six Core courses will especially emphasize writing with drafts and opportunity for revision - ACS 1000 and 1001, PHI 1000, THL 1000, and ETH 2050, Sophomore Writing Seminar. In addition, the two BIO courses that majors will complete are one BIO "Research" course (numbered 3000 or higher and designated as such) and the BIO "Capstone" course, each of which will have a writing component.

- **Diversity: 2 courses with “Diversity” attribute, one in each of two of three areas:**
 - Diversity 1:** Courses that focus on dominant groups, minority groups, or impoverished groups in the United States and/or minorities/“marginalized” people in Western Europe
 - Diversity 2:** Courses that provide a focus on women’s experiences and/or highlight the relationship between gender and culture
 - Diversity 3:** Courses that provide a focus on the culture, economics, politics or ecology of societies and nations other than those of Europe and the United States
- Service learning courses, internships, and other experiential courses may be applied toward this requirement, provided they include a significant reflective component just as traditional diversity courses do, and are pre-approved. Study abroad courses may also be applied toward this requirement; such courses will be assessed the same way as courses at Villanova.

NOTES:

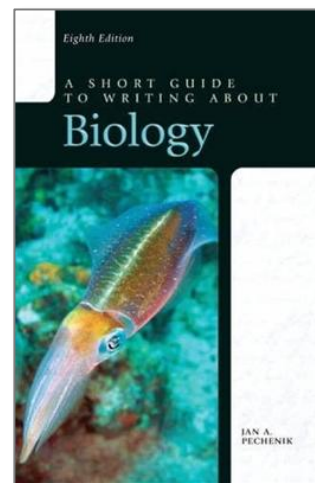
1. A student may not use a single course to fulfill more than one category of the diversity requirement.
2. The diversity requirement cannot be fulfilled by independent study or a senior thesis.
3. Language courses cannot fulfill the requirement, although literature courses in a foreign language can fulfill the requirement provided they focus on appropriate material.
4. A student may take 1-credit workshops provided they meet the above stated requirements of a total of 3 credits in two of the Diversity categories.
5. The spirit of the diversity requirement calls for students to select courses that will broaden their education. The Core Diversity Committee believes it is ultimately the student’s responsibility to select courses to achieve this goal.

Writing across the curriculum

Members of the Biology faculty consider gaining proficiency in scientific writing to be an integral element of successful completion of the major. Indeed, writing skills are frequently mentioned by prospective employers and by graduate and professional schools as major factors in selecting among candidates. For these reasons, we offer a wide range of biology courses as Writing Enriched (with components defined by both the College’s Old and New Core Curriculum) to give students maximal flexibility in fulfilling the writing requirements, while providing enough instruction to assist students in honing their writing skills. Courses that currently are structured as such are indicated in the Course Descriptions section of this handbook and are listed in the online Master Schedule for each semester. (On rare occasions, a course that is *usually* Writing Enriched may be offered in a format that does not include the Writing Enriched credit; check the Master Schedule carefully.) Students may also receive credit for one Writing Enriched/Intensive course by successfully completing a Senior Thesis (Bio 6709).

Written assignments are central to *most* upper-level Biology courses, not just those offered as Writing Enriched. In many courses, we incorporate both “learning-to-write” and “writing-to-learn” elements. In Writing Enriched courses, writing skills are given some degree of special emphasis, and students have the opportunity to revise and resubmit at least one assignment in response to feedback from their instructor. We therefore encourage Biology majors to begin taking Writing Enriched courses in the major as early as possible; the training should pay dividends in other advanced courses. Students usually take most of their Writing Enriched courses in Biology *after* completing (or concurrent with) the Sophomore Writing Seminar; instructors of the Writing Enriched courses in Biology will assume students have previously mastered basic rules of grammar and standards of composition (e.g., logical organization, paragraph construction), so that the emphasis in Biology courses can be on structural, stylistic, and rhetorical aspects of writing that are specific to the discipline.

We urge all incoming students to purchase *A Short Guide to Writing About Biology*, 8th edition, by J. Pechenik (Longmans, 2012); this brief but helpful book is used in all Writing Enriched courses in the Department of Biology and typically can be bought at the Villanova Shop, listed as a text for General Biology.



In addition, Biology majors may benefit from a variety of additional sources of help with their writing. Although limited in their capability to speak to the scientific content of the paper, staff at the University's Writing Center (Dalton Room, 202 Old Falvey; 519-4604; see also <http://www.writingcenter.villanova.edu/>) can work with students (at no cost or obligation) to bring written assignments up to expected standards of organization, grammar, and structure prior to submission, or during the revision stage.

Integrity and writing

Some reminders about Academic Integrity regarding writing assignments (also see ***Academic Integrity*** section below):

- Students have an obligation to acknowledge fully their indebtedness to all sources of information, ideas, data ... the works. When in doubt about what or how to cite, ask!
- Take care to avoid relying too directly on wording from your sources (plagiarism); describe facts and concepts in your own words, while still citing sources appropriately
- You are not allowed to submit the same work for more than one course, without explicit prior approval from the instructor(s) involved

EndNote

Villanova has made a commitment to supporting the development of literacy in the broadest sense among its students. To this end, EndNote—a program for organizing and using sources when writing papers and reports—is freely available to students.

The program is an amazing tool for scientific writers. Once you have developed your own Library of sources (and their bibliographic details: authors, title, publication date, journal, etc.), you can draw on these sources using EndNote's "Cite While You Write" function: the program adds citations to your main text and simultaneously **creates a formatted, alphabetized Literature Cited section** at the end of your document!

EndNote is installed on several computers on campus. Students will need to maintain a portable version of their EndNote library database (set of files in which you store references) on an external storage device. In addition, students may download the program for installation on their own computers through a Falvey Library web page (<http://www.library.villanova.edu/endnote/>).

Sample Schedule

FRESHMAN YEAR

	Credits		Credits
BIO 2105	4	BIO 2106	4
MAT 1312	4	MAT 1313/1505/4310	3/4/3
CHM 1151	4	CHM 1152	4
CHM 1103	1	CHM 1104	1
ACS 1000	3	ACS 1001	3
Language**	3	Language**	3

SOPHOMORE YEAR

BIO 3351 or Adv. BIO	4	BIO 3351 or Adv. BIO	4
CHM 2211	3	CHM 2212	3
CHM 2201	1	CHM 2202	1
THL 1000 or Soph. Writing Seminar**	3	Soph. Writing Seminar** or THL 1000	3
HIS Core course (check for attribute)	3	PHI 1000	3
1 st Soc. Sci. course (check for attribute)	3	Elective	3

JUNIOR YEAR

Adv. BIO	4	Adv. BIO	4
PHY 1100	3	PHY 1102	3
PHY 1101	1	PHY 1103	1
Adv THL or ETH 2050	3	ETH 2050 or Adv THL	3
Electives	6	2 nd Soc. Sci. course (check for attribute)	3
		Elective	3

SENIOR YEAR

(2) Adv. BIO or Adv. BIO + Capstone †	4 - 8	(2) Adv. BIO or Adv. BIO + BIO 5100/Capstone †	4- 8
Fine Arts	3	Electives	9-12
Electives	6-9		

Courses listed in **BOLD TYPE** should normally be taken during the years indicated. Adv. BIO refers to Biology courses at the 3000-level and above.

* Many variations are possible, especially as they relate to the completion of the **core requirements** for the College of Arts & Sciences. The sequence of these courses is by personal choice and also will be affected by whether you are pursuing a double major, concentration, or a minor. Exceptions include the Sophomore Writing Seminar, College Ethics, and language (see note ** below). Confer with your advisor for scheduling these courses.

** Complete the Sophomore Writing Seminar and College Ethics in sophomore year and (usually) language early in undergraduate years.

† Students completing a Senior Thesis will take the special section of Bio 5100 in **spring** semester.

Biology courses must include at least one laboratory course in **each** of the three categories within Biology outlined above. A **minimum** of five advanced courses with laboratory is required. Students must also fulfill

the writing requirements for Biology majors (Capstone and “Research” courses) and core curriculum requirements regarding diversity (consult the University *Catalog*).

Research & Senior Thesis

Members of the Biology faculty pride themselves on being able to offer Villanova undergraduates the opportunity to be involved in meaningful biological research. We welcome all qualified students to consider including a research experience in their undergraduate curriculum.

Undergraduate research may be conducted over a single semester, or over more than a year. To get a taste of research, students may arrange with a faculty member to take Directed Research (Bio 6509), in which they complete a project lasting one semester. Any Biology major having a GPA of at least 3.0 can work toward a senior thesis (Bio 6609, 6610, 6709) that would involve at least two semesters of research for credit. How much research you complete is up to you, in consultation with your advisor and supervising faculty member—but the effort is virtually never wasted: few experiences can better help you stand out from your competitors when it comes time to apply for graduate school, professional programs, or employment. Moreover, performing independent research is invaluable input as you decide about your future career options.

How does one get involved in biological research at Villanova?

- ❖ Learn about the research activities of our faculty as soon as you can. In recent years, faculty members have made “guest appearances” in General Biology to introduce students to their areas of study. Follow this up by going to see any faculty member whose work interests you: make an appointment, or just drop by during office hours. It never hurts to ask about opportunities that might exist!
- ❖ Another excellent way to get involved is by working part-time as a laboratory or field assistant during the regular school year, or over the summer. Ample opportunities exist (at Villanova and elsewhere) for helping faculty and their graduate students in the tasks that are central to biological research, while earning hourly pay. Duties may include laboratory preparation, care of animals, preparation of specimens, computerized data entry, or collection of data or samples in the lab or field. Working in several different labs can expose you to a range of possibilities for independent study, while helping you get to know several different faculty with whom you might want to work. Some faculty members will suggest a project to get you started; others would prefer to see you develop a general interest in the work being done, from which ideas for a specific project can develop. Experience gained in this way at Villanova or elsewhere can develop into an independent research project.

It is best to get involved in research *as early as possible* during your undergraduate career. The capability to complete a thesis successfully increases with the amount of time that you can devote to it. Taking advanced courses in your area of interest is always a good idea. In addition, there is much to be gained from prior exposure to the activities of a lab as an hourly worker assisting with the research. The kind of research is also a consideration; for instance, lab-based projects can usually be done throughout the year, including winter, whereas field-based research (e.g., ecology or behavior) may require more advance planning, especially if a phenomenon of interest (e.g., breeding or germination) only occurs seasonally (e.g., in spring or summer). It’s not uncommon for students doing ecological studies to begin working with a faculty member during their Sophomore or Junior year. No matter what, the earlier you have data in hand, the more time you will have to complete a satisfying and scientifically valuable senior thesis.

The commitment of time and effort required for completing a senior thesis is probably going to be greater than you might think. Your senior thesis will involve planning, data collection, analysis, and preparation of the thesis document (usually a report comprising 20 or more pages, along with figures and tables reporting your original results). Thus, a thesis is not worth doing unless you are able to make this a high priority during your Senior year (and, perhaps, the year before that). Still, completing a thesis is without doubt worth the effort if done well. You have an opportunity at Villanova to gain research experience through work on a thesis that students at many schools are not given. Further, it will give you an opportunity to make a scientific contribution that will be significant in your applications to graduate and professional school. The Department of Biology would be happy to see more of its majors succeed in meeting this challenge.

Frequently asked questions about Senior Thesis research

- Do I have to be in the Honors program to do a Senior Thesis in Biology?
No. You only need to have a GPA > 3 and have made arrangements with a faculty member to conduct research under her or his direction.
- Does the thesis (Bio 6709) count for laboratory credit?
Yes, in conjunction with the prerequisite courses, Bio 6609 and Bio 6610. Same deal for Honors students, for Hon 6001 (or Hon 6000) + Hon 6002.
- Can the thesis count toward the area distribution requirement for Biology majors?
No. You must take at least one regular class with laboratory in each of the three areas (Cellular and Subcellular Biology; Organismal Biology; Ecology, Evolution, and Population Biology).
- Does the thesis fulfill the writing requirement?
Yes. Successful completion of Bio 6709 fulfills one of the writing requirements within Biology. You will complete the requirement once you combine this with Bio 5100-Thesis section and at least one other Writing Enriched course in Biology. Hon 6002 by itself earns Writing Intensive credit, but students doing their thesis through Honors while working with a Biology faculty member should still take the Thesis section of Bio 5100.
- Can I wait until Senior year to do a thesis?
Maybe. Doing a thesis requires that you work out a mutually agreeable arrangement with a Biology faculty member. Many faculty members typically expect students wishing to do a thesis to become involved in the lab before Senior year, to learn about lab procedures and research questions, before tackling a thesis. Students can (with the mentor's permission) earn credit for research involvement during Junior year through Bio 6509:Directed Research; indeed, it can be a great way "to get your feet wet" in research. Students may get paid for working in research labs when they are not earning course credits.
- Can I do a thesis that counts for Biology credit by doing off-campus research?
Maybe. The Department of Biology has developed a policy regarding supervision of thesis projects by off-campus scientists. Check with your academic advisor for details.

Student Research Experiences: Off-Campus Projects

In order to enhance the research experience of Villanova undergraduates the number and range of research opportunities available to students may include projects carried out at other institutions in the Philadelphia area. Such opportunities will allow students to do research in subdisciplines other than those encompassed by the expertise of Villanova faculty and to carry out projects in a wider range of research environments. The following guidelines must be followed in order for students to receive Senior Thesis credit for such off-campus projects.

Procedures

Students in their junior or senior years at Villanova may pursue research training at area institutions under the direction of faculty-level personnel at those sites. Potential mentors must have a doctoral or medical degree, and will need to submit a curriculum vitae to the Departmental Director of off-campus experiences (the Assistant Chair). The student will need to approach a Villanova faculty member with appropriate expertise to request involvement as the on-campus supervisor/second reader, and upon mutual agreement, will inform the Director of off-campus experiences of the choice. The student may earn credit for one semester of Directed Research (Biology 6509; 2 cr), or, if more extensive and worthy of senior thesis credit, for two semesters (Biology 6609 and Biology 6709, or HON 6000/1 and 6002; 3 or 2 and 3 cr, resp.). In either case, the student must have ≥ 3.0 GPA. If the student is completing a senior thesis, they should register for two 1-cr courses in their senior year as well- BIO 6610:Proseminar in Fall and BIO 5100:Senior Seminar:Senior Thesis in Spring. Additional research may be carried out during the summer, with or without remuneration, but a student may not receive credit for work performed for which he or she is receiving payment, though travel expenses, etc., may be compensated.

Expectations and Assignment of Grades

Research students will be expected to commit approximately 10-15 hours per week in the laboratory or field setting. Upon selection of the off-campus research mentor, and during the first month of the research period, the student will develop a research plan in the form of a one to two page proposal with appropriate references. This plan, after discussion with and signed approval by the off-campus mentor, will be submitted for approval to the designated Villanova faculty member who serves as the on-campus supervisor. The plan will be maintained in the student's academic file. During the execution of the study, the student must maintain a laboratory or field notebook, including all information appropriate for repetition and evaluation of the work performed. The student will prepare a 3 to 5 page final report at the end of one semester. The off-campus mentor will read this report, and the student will submit it along with a confidential letter of evaluation from the off-campus mentor to the Villanova faculty supervisor. The off-campus mentor's letter should provide a grade recommendation for the work performed. The Villanova faculty supervisor will read the report and the off-campus mentor's letter, and will assign a final grade considering typical expectations for students performing research on campus. If the study is continuing in a second semester, an IP ("In Progress") grade may be given for the first semester; in such cases, the final grade will be assigned retroactively after the study is completed. The Villanova faculty supervisor will deliver the letter and all reports to the student's academic file.

If a second semester of research is undertaken, the student will complete a senior thesis under the standard Villanova guidelines, and will enroll in the Thesis section of Senior Seminar. Senior Seminar students are generally expected to prepare a poster on their research for presentation at the Sigma Xi conference at Villanova; students pursuing research off-campus will be encouraged to also participate in similar opportunities at their off-campus host institutions.

Senior Thesis students will also present their findings in a research symposium held on a Reading Day in May; their off-campus mentors will be required to attend. The Senior Thesis will be prepared under the direction of the off-campus mentor, and will be submitted to the Villanova faculty supervisor along with the confidential letter of evaluation and a grade recommendation from the mentor. The Villanova faculty supervisor will assign the final grade.

Policy presented to Biology Faculty May 2005

Revised and Approved by Research and Budget Committee March 17, 2006

Approved by Biology Faculty, April 7, 2006

Further revised, April 2, 2013

Internship Program

The Department of Biology offers its majors the opportunity to earn course credit for approved internships. A suitable internship is any intellectually challenging activity grounded in basic science that actively involves the student in the collection, analysis, and evaluation of data, or in other scholarly activities such as teaching biology. An internship is pursued at an off-campus site in conjunction with an extramural research or educational program. Examples of locations potentially suitable for an internship include research laboratories, field stations, zoos, aquariums, or museums. Although clinical experiences (e.g., work in physician's offices, hospital emergency rooms, or physical therapy facilities) are worthwhile, these are typically not suitable for internship credit, nor are enrichment activities such as non-credit courses.

In most cases, a research activity approved for internship credit will also count as a laboratory course. However, the Department will evaluate each internship for its suitability for laboratory credit. In any case, only **one** (1) of the upper-level laboratory courses required for the major may be filled by an internship; up to six total credits may be counted toward the 36 required of Biology majors. Any additional internship credit (up to 9, for an overall total of up to 15) must be counted as "free electives." An internship may be undertaken during either the academic year or the summer. Credits earned through an internship **do** require payment of Villanova tuition.

Requirements

To qualify for an internship, Junior and Senior Biology majors must have a GPA of ≥ 3.0 at the time of application. Students must apply for approval of an internship through the Department of Biology before registering for the internship. Although the internship program is run through the *Office of Undergraduate Studies* (SAC 107), we encourage you to search for opportunities using both internal online resources, such as Handshake (via our Career Center) and the Internships link via the Center for Undergraduate Research and Fellowships, and off-campus websites such as campusphilly.org. To apply for any internship, the student must submit (1) a proposal that fully describes the planned activities and objectives of their internship, and (2) a supporting statement from the proposed supervisor. Internships may count for three or six credits; each three credits require a minimum of 150 hours of participatory activity over the term. Additional time will be required to fulfill the requirements specified by the Internship Program Office, including maintenance of a journal and completion of a final report.

To receive credit for the internship, the student's performance on several elements and an evaluation of the student by the supervisor must be acceptable after review by the Internship Office and a committee within the Department of Biology (please see ***Internship Agreement*** referenced below for details). Although the format of the final report may vary depending on the nature of the internship, a typical report should describe in detail the objectives and goals of the internship; how the objectives and goals were met; and any scientific interpretation or conclusions drawn from the experience. In the case of research projects, for example, the report should specifically include a description of the conceptual context/scope and objectives of the research, the methodology followed in the course of the research, the results obtained, and the interpretation of the results in the context of the project's objectives. All internships are graded Satisfactory/Unsatisfactory.

See the handouts, ***Internship Program, Department of Biology and Villanova University Department of Biology Internship Agreement*** (available through the Internship Office and the Department of Biology office) and the Biology web site (<http://biology.villanova.edu>) for more information on the general requirements for internship credit through the Department.

Interdisciplinary Concentrations

Biology majors can add a **Concentration** to their curriculum. Concentrations are often interdisciplinary, and thus include an integration of coursework across a variety of traditional disciplines. Successful completion of a Concentration can be invaluable for further study or work in a given area. Fulfilling the requirements is often easier than one might think, as many of the requirements also fulfill requirements in the Core Curriculum and/or the student's chosen major.

The College of Arts & Sciences offers Concentrations in a variety of areas, including:

Africana Studies (www.artsci.villanova.edu/africanastudies)

Arab & Islamic Studies (www.artsci.villanova.edu/arabislamic)

Asian Studies (<http://www1.villanova.edu/villanova/artsci/asian>)

Augustine in Dialogue with Faith and Culture (<http://www1.villanova.edu/villanova/artsci/augustine>)

Biochemistry (<http://www1.villanova.edu/villanova/artsci/biochem>)

Cognitive Science (www.artsci.villanova.edu/cogsci)

Ethics (www.villanova.edu/artsci/ethics/concentration/)

Irish Studies (www.artsci.villanova.edu/irishstudies)

Latin American Studies (www.latinamericanstudies.villanova.edu)

Peace & Justice (www.peaceandjustice.villanova.edu)

Russian Area Studies (www.artsci.villanova.edu/Russian)

Teacher Certification (<http://www1.villanova.edu/villanova/artsci/education>)

Woman's Studies (www.villanova.edu/womensstudies)

Writing & Rhetoric (www.writingprogram.villanova.edu/concentration/index.html)

For more information on specific programs, contact the Director of the Concentration or access the appropriate web site. See also <http://www.villanova.edu/artsci/college/academics/>

In addition to several of the Concentrations above, several minors are available. Some of special interest to Biology majors include Environmental Studies (www.villanova.edu/artsci/geoenv/), Spanish, Biochemistry (www.villanova.edu/artsci/chemistry/undergrad/minor.htm), and Bioengineering (www.villanova.edu/engineering/academics/undergrad/minors/bio/). Information on the requirements of most Concentrations and minors can be accessed via the Villanova University website.

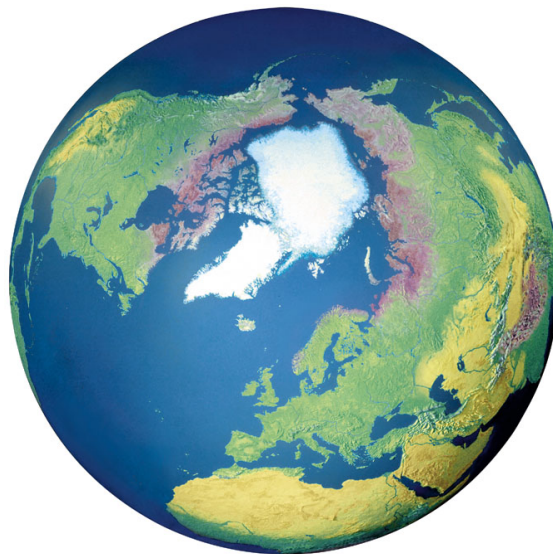
International Studies and Overseas Programs

Since its establishment in 1986, the Office of International Studies has encouraged students to consider the many options available for study abroad in a variety of international academic programs, as well as enrollment in Area Studies programs on campus. There are many relevant opportunities for biology majors. Some programs are exclusively for biology majors, while others have courses in a wide variety of disciplines, including the sciences. Of particular interest to biology majors are the series of programs run by the School for Field Studies. This organization coordinates semester-long and summer programs in Australia, Kenya, the Virgin Islands, Baja California, mainland Mexico, Ecuador, Costa Rica, the Northern Himalayas, Greece, the Gulf of Mexico, and the North Atlantic, as well as a variety of sites in North America. These programs give biologists a chance to engage in intensive study in the field in areas such as marine biology, conservation ecology, wildlife ecology and management, animal behavior, ethnobotany, and plant ecology.

All students wishing to study overseas must apply to the Office of International Studies. Ordinarily, students study abroad during their sophomore or junior year. Applicants must have maintained at least a 2.7 GPA, be in good health, and have the approval of the Office of International Studies, their Department Chair, and their Dean.

The Office of International Studies coordinates Villanova's summer intensive language programs in Europe and Jerusalem. Other activities and events sponsored by the Office are film series, special evenings on Study Abroad, International Week, Fall/Spring Orientation seminars, and Welcome Back/Re-entry conferences.

Students wishing further information about international opportunities are encouraged to call 519-6412 or go to 2nd and 3rd floors, Middleton Hall, 1st floor to arrange a meeting with the Director, Mr. Lance Kenney. See also <http://www.villanova.edu/vpaa/intlstudies/>



Opportunities for Field Study

In addition to opportunities for field work arranged through individual investigators at Villanova or elsewhere (see previous section), there are also dozens of field stations around the country that offer field courses and credit for field study through many different universities. Many also offer internship/assistantship programs that provide room and board or confer a stipend or both. Requirements for earning course credit through such an internship are detailed in the next handbook section. It is also possible to complete a period of field study for its own sake, without earning course credit for transfer to Villanova



Many Biology faculty have personal experience with field stations and their programs, having been students, teachers, and researchers at some of these facilities. Here is a partial list of field stations and the names of faculty familiar with each. Feel free to talk to them about these programs and look for the posters advertising these and other programs on the bulletin boards outside of the Department of Biology office (Mendel 147) and some faculty research labs and offices (first and ground floors of Mendel).

- Archbold Biological Station, Florida (Curry, Iyengar)
- Bodega Bay Marine Lab (Russell)
- Charles Darwin Research Station, Galápagos Islands (Curry)
- Estuarine Research Laboratory (Academy of Natural Sciences)(Wieder, Curry)
- Friday Harbor Laboratories, U. Washington (Russell, Iyengar, Olson)
- Hatfield Marine Science Center (Russell)
- Lake Itasca (U. Minn.) (Curry)
- Marine Biological Laboratory, Woods Hole (Stephens)
- Mountain Lake Biological Station (U. VA) (Curry)
- Oregon Institute of Marine Biology (Russell)
- Pymatuning Biological Station (U. of Pittsburgh) (Curry)
- Rutgers University Field Stations (Russell, Wieder)
- Southwestern Research Station, Arizona (American Museum of Natural History) (Curry)
- Stroud Water Research Center (Wieder, Curry)
- University of Delaware Marine Lab, Lewes (Russell)
- University of Michigan Biological Station, Pellston (Curry)

Procedures

A. Pre-registration

Each semester before the pre-registration period, the Registrar will mail a pre-registration form to you. The Registrar will also list the time of your pre-registration appointment in the online Master Schedule. You must meet with your academic advisor before your scheduled pre-registration appointment to plan your course schedule and to obtain your registration PIN for the coming semester; most advisors will post sign-up sheets for pre-registration advisement. Students may pre-register online, using NOVASIS, at any time after their scheduled registration time.

Juniors with a GPA ≥ 3.4 and Seniors with a GPA ≥ 3.0 may register for 7000-level Biology courses. Seniors with a GPA ≥ 3.8 may register for 8000-level Biology courses. In both cases, the student must submit a 'Permission To Enter Graduate Course' card, obtained from the Biology Office and initialed by the professor teaching the course, and signed by your advisor, the Department of Biology Chair, the Dean of the College of Liberal Arts and Sciences, and the Dean of the Graduate School, in that order. The card is turned in at pre-registration.

All course sections receive a unique number ("CRN") that the Registrar uses to maintain computerized enrollment records in a program called **Banner**. You can save time and effort at registration if, when penciling in your schedule, you jot down the CRNs—which are listed each semester in the Master Schedule—for all sections in which you hope to enroll, along with the more traditional department and course number codes.

B. Drop/Add

There are times when it becomes necessary to make changes in your course schedule. This can be done only during the Drop/Add period (usually the first five days of each semester). You should meet with your advisor to discuss the changes you wish to make, and then make the desired changes to your schedule on-line through NOVASIS.

C. Satisfactory/Unsatisfactory Option

Juniors or seniors may take elective courses on a Satisfactory/Unsatisfactory basis; courses that fulfill a major, minor, or core curriculum requirement may not be taken on a S/U basis. No more than one course per semester may be taken on a S/U basis. To select the S/U option, you must register for the course during pre-registration and then fill out a change form, available in the Registrar's Office, during the Drop/Add period. This form does not require the signature of your advisor, but we strongly recommend that you consult with your advisor to be certain that the S/U option is appropriate. The student earns an S grade if their performance in the course is equivalent to C or better. Otherwise, a grade of U is recorded.

D. Audit Option

You may audit a course with the consent of your advisor. Students who audit a class 'sit in' on class meetings, but do not complete the course assignments nor receive a grade; they *are* assessed tuition, on the same basis as any other course. To select this option, you must register for the course during the pre-registration period and then fill out a change form, available in the Registrar's Office, during the Drop/Add period. This form does not require the signature of your advisor, but we strongly recommend that you consult with your advisor to be certain that the audit option is appropriate.

E. Credit by Examination

A registered student, who has not previously been enrolled in an equivalent course, has the opportunity to show academic competency in that course through the Credit by Examination program. The student may satisfy the requirements and earn credit for the course by passing a departmentally-administered examination. Each test is generally administered shortly after the mid-semester break and pre-registration. A fee of \$35 per credit hour is charged for credit received as a result of passing one of these examinations. A student can earn up to 30 credits through this program. More specific details are available from your advisor or from Dr. Dorley, the Program Director (448 St. Augustine Center).

F. Transfer Credits

Credit for university-level courses taken at other institutions can be transferred to Villanova and will count toward the total credits required for graduation. Only courses taken at 4-year colleges and universities that grant a baccalaureate degree will be considered for transfer credit; credit will not be granted for courses taken at community colleges. To receive credit for a course taken elsewhere, submit a copy of the course description and the transcript on which the grade and number of credits granted is recorded to the Department of Biology office.

If you wish to take a course offered by another university (for instance, in the summer), you should obtain approval *before* registering for that course to insure that the transfer credit will count towards your Villanova degree requirements. Fill out a request for Transfer Credit form with a copy of the description of the course (from the course catalog of the school to be attended) to the Department of Biology office. Upon approval by the department chair, you should submit the form to the Dean of the College of Liberal Arts and Sciences; you should also request a letter to take for registration at the school where you will take the course. Upon completion of the course, the grade must be sent to Villanova; some schools will do this automatically. We recommend that you check with the Registrar to be certain that the grade has been submitted to Villanova.

There are many opportunities that will allow biology students to receive credit for summer research, summer field courses, and related opportunities. Often, transfer credit may be granted for Biology course equivalents required for graduation. In most cases, the Department chair will match up the transferred course with a specific equivalent course at Villanova. Students should be aware that in this instance, they may not subsequently take the same course for credit at Villanova.

Some opportunities for transfer credit are available to students who have completed only General Biology I and II, but most are geared toward students between the junior and senior years. The bulletin boards on the first floor of Mendel (outside the Biology office), the large loose-leaf notebooks in the Department of Biology Office, and your advisors can provide you with information about a range of opportunities to suit your interests.

While transfer credits can count toward the credits you need for graduation, they are not included in the calculation of your Villanova GPA. However, most graduate and professional programs will take into account not just your Villanova GPA, but the grades you earn in *all* college-level courses you complete. Therefore, it's advisable to put just as much effort into courses you take elsewhere as you would in courses taken on the Villanova campus.

G. Change of Major

Students who wish to transfer *into* Biology from another major must complete a transfer request form in the Department of Biology Office, they will then be asked to discuss their application with one or more members of the Department of Biology's Advisory Committee. That committee subsequently will evaluate the request and make its recommendation to the Chair of the Department

of Biology, who will notify the student of the outcome. Prospective transfer students should be aware that they may require additional time, relative to their original incoming class, to complete all the graduation requirements for the Biology major, depending on the mix of courses they have completed prior to their transfer. Students who wish to transfer *from* Biology to another major must complete a transfer request form in the office of the department/program *into* which they wish to transfer.

H. Transfer to Villanova University

Students who wish to transfer to Villanova from another institution in order to major in Biology must file an admissions application with the Admissions Office. Upon acceptance to the University, the Department of Biology Advisory Committee will evaluate the application to decide which courses will be accepted and for which required courses transfer credit will be granted.



Awards and Grants for Biology majors

Departmental Awards

The faculty of the Department of Biology typically makes two awards each spring. To learn more about these awards, contact your faculty advisor.

John H. McClain Medallion of Excellence

A graduating Biology major is chosen to receive the McClain Medallion. The award is named for a former Chair of the Department and recognizes Dr. McClain's contribution to the growth of the biological sciences at Villanova. This award is based primarily on academic performance; occasionally, the award is given jointly to students who have demonstrated equivalent mastery in Biology.

Rev. Lawrence C. Gallen, OSA Award

The Gallen Award is given to one or more students demonstrating both academic excellence and notable service to the Department throughout their program of study at Villanova. Such service may include extraordinary contributions to collaborative research, leadership in student groups relating to biology, or involvement in other programs, committees, or initiatives associated with the Department.

National Scholarships

Biology majors frequently apply for—and have had excellent success in winning—national scholarships. National awards relevant for Biology majors include:

- Rhodes Scholarships
- Barry Goldwater Scholarships
- Morris K. Udall Scholarships
- National Science Foundation Predoctoral Fellowships

For more information, contact your faculty advisor or the Office of Undergraduate Grants and Awards in 138 SAC (<http://www.villanova.edu/uga/>).

Undergraduate Collaborative Research Grants

Villanova strives to support research by undergraduates. Besides funds provided to thesis and directed research students through the budget of the Department of Biology, the University also sponsors a program of competitive research fellowships to support summer research, or independent studies during the academic year. To learn more about these awards—the application deadlines for which are usually in April—contact the Office of Undergraduate Grants and Awards for more information.

Resources

Departmental equipment and facilities

Teaching and research laboratories are housed in modern, air-conditioned Mendel Hall. The Department maintains a greenhouse, an animal-care facility, and an electron microscope facility. Equipment for a variety of research applications is available both in labs of individual faculty and in common equipment rooms. Among the instruments available are a liquid scintillation spectrometer and a gamma counter for work with radioisotopes; an automated DNA sequencer; a micro-cytospectrophotometer; PCR and qPCR machines; both scanning and transmission electron microscopes; a cabinet X-ray facility; a cell culture laboratory; fresh and saltwater aquarium and aquatic culture systems; open-circuit respirometer; chromatographic and electrophoretic instruments; a variety of centrifuges including a preparative ultracentrifuge; a computerized gel documentation system; a geographic information system (GIS); and spectrophotometric, photographic, bioelectronic, and other instruments. Departmental staff members also make use of the Villanova Arboretum.

Campus phone system and voice mail

All Villanova faculty members, staff (including TAs and RAs), and program offices have phone numbers preceded by **519**. To dial these numbers from internal campus phones, one need only dial the 5-digit extension, beginning with 9. For example, to reach a faculty member whose number is 519-6493 from an internal phone, one would dial 96493. To call students or faculty from an off-campus phone, dial the full number like any other phone call. Villanova is in area code **610**.

All Villanova students, faculty, and staff (*including* students who may live off campus) are assigned a voice mail account. The University encourages everyone to activate their account so that the system may be used to transmit important announcements about the University (snow closings, for example), course-related notices, news from student groups, etc. For more information about activating and using your voice mail account, contact the Telecommunications Dept. (519-7820).

Computer facilities

The Department of Biology maintains both Windows and Macintosh computers in Mendel Hall that are available for student use when not needed for specific classes. As of Fall 2011, these facilities include Mendel 141 (The Marks Visualization Lab) and Mendel 086 (Ecology Computer Lab). If you have specific problems with software programs, you may be able to get help from UNIT consultants at the Mendel Hall public site or from the UNIT Help Desk.

Using e-mail and other services

All Villanova students are assigned an account on the University's Data General computer that they can use to send e-mail, to sign on to electronic bulletin boards, or to obtain files and services over the Internet. For more information or help with problems, contact UNIT: Call: Help Desk at 610-519-7777; E-Mail: support@villanova.edu; Walk in: TechZONE, Vasey Hall Room 101.

Scientific literature

Nearly all Biology majors need to gain access to the scientific literature at some point. Falvey Library subscribes to many top professional journals in biology and other areas of natural science. Recent issues are available in the Current Periodicals on the first floor, east side. Falvey also receives *Biological Abstracts*, *Science Citation Index*, and other helpful datasets and reference materials; current issues are available on CD-ROM, for which students can obtain access by speaking to staff at the Reference

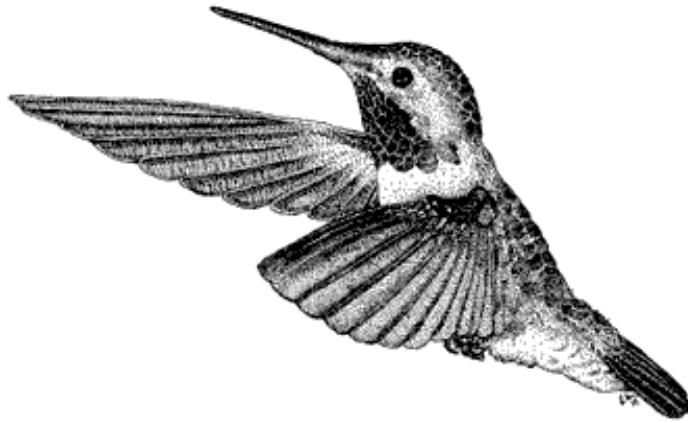
Desk. Additional services available through Falvey include Interlibrary Loan and various on-line computerized database tools, such as Dialog.

Biology majors may also want to make use of other sources available within Mendel Hall. Individual faculty members often maintain personal collections of journals specific to a particular sub-discipline; many faculty members will let students in their courses or involved in research to use these journals. If you are looking for a source that you know isn't available through Falvey, it's a good idea to ask around to determine whether some Biology faculty member can lend you the material you need.

The Department of Biology also subscribes to a few journals that are available for general use (in the Department conference room, M175). These include *Science*, *Nature*, *Scientific American*, and *Current Contents*. In accordance with the College Code of Academic Integrity and common courtesy, students using these materials have an obligation to return them immediately when they are finished, so that others may have equal access, and to follow any posted sign-out procedures. Consult your advisor or another faculty member if you have questions about the availability and use of these sources.

Other possibilities for obtaining references not available in Falvey or in the Department of Biology include Interlibrary Loan and libraries at the University of Pennsylvania, the Academy of Natural Sciences, and other local institutions. The librarians in Falvey can help you determine where to obtain a particular reference source most efficiently. Be aware that Interlibrary Loan requests may take some time, depending on the nature of the source (books take longer to arrive than do electronic copies of journal articles), so plan accordingly.

Making the EndNote citation management program available to all students is another component of Villanova's efforts to help students gain knowledge about, and proficiency in using, the scientific literature. See *Endnote* section above for more information.



Counseling & Study Skills Center

The University Counseling Center provides personal counseling, helping students with their social and emotional wellness. Study skills counseling is also available, as well as a Learning Lab.

Study Skills and the Learning Lab

The study skills counselor can help you adjust to the academic demands of college, improve the effectiveness with which you study and take exams, and manage your study time. Self-help audio tapes are available in the Learning Lab, as well as computer-assisted programs.

Counseling

Confidential and private—All contacts are completely confidential. They do not release information without your permission to *anyone*. That includes professors, deans, parents, and other students. The sessions are very private. The reception area is used only by our Center, so other students you might see there are waiting for their meeting with a counselor, too.

Voluntary—Students contact the Center on a voluntary basis. That means that you will *not* be called in by a counselor. It is totally up to you to make contact with the Center if you wish to meet with one of their staff. Unlike high school, where counseling is sometimes mandatory, the student's freedom to choose counseling is one element that results in students' good feelings about the counseling they receive there.

What kinds of concerns draw students to the Center?

- confusion, anxiety, or depression
- compulsive eating
- needing help with an important decision
- self-destructive use of alcohol or drugs
- loneliness
- loss of a relationship
- adjusting to living away from parents
- balancing academics and social needs
- friendship problems
- shyness
- romantic concerns
- family concerns—including parental divorce
- illness or death of a friend or family member

What does it cost? There is *no fee* for current students.

Who are the counselors? You will meet with a psychologist who specializes in helping you with the concerns common during the college and young adult years. There are male and female psychologists available. The staff is highly skilled and concerned.

How to make an appointment: Call 519-4050 or go to the Counseling Center (206 Health Services Building) and the receptionist will schedule your appointment that fits your schedule. They are open weekdays 9-5. If you feel very upset or urgent, they will arrange to see you right away. Otherwise your first appointment will usually be within a week. You and the psychologist with whom you meet will decide if and when to schedule additional appointments. Most students go for 3-8 meetings, but it is completely up to you.

Academic Integrity

Villanova's College of Arts & Sciences has established a **Code of Academic Integrity**. The following excerpt from the *Enchiridion* encapsulates the basis of this Code:

Each student in the College of Liberal Arts and Sciences is responsible for the completion and presentation of work which is the result of an individual effort. Academic integrity is at the heart of the values expressed in the University's mission statement. A Villanova student agrees to accept this responsibility as a member of an academic community which was founded in the spirit of St. Augustine's search for knowledge in an atmosphere of cooperation and trust. The intellectual health of this community depends on and draws nourishment from the integrity and mutual respect of each of its members. Academic integrity is vital, therefore, to any university community.

Several acts are considered to be violations of the Code. The following list summarizes types of violations included; students should refer to the *Enchiridion* for additional explanation:

- Cheating:** obtaining or using unauthorized help on an assignment or exam
- Fabrication:** using falsified, invented, or misleading information—including bogus scientific data or literature references
- Assisting in dishonesty:** helping to commit an academically dishonest act
- Plagiarism:** relying on someone else's ideas or information without adequate acknowledgment—whether verbatim *or* paraphrased
- Multiple submission:** submitting the same work for > 1 course without prior approval

We all have an obligation to foster a healthy intellectual climate in which each participant receives credit for her or his own work and ideas. All students taking courses in the College are therefore responsible for understanding and abiding by the Code of Academic Integrity. College policy mandates that students violating the Code may be assigned a failing grade for an assignment or for an entire course—and depending on individual circumstances, they may receive further discipline that could even lead to expulsion from the University. The *Enchiridion* provides additional details about policies relating to the Code. Included there are the procedures to be used by both faculty and students in cases of suspected violation of the Code, including complaints that may be initiated by one student against another.

Biology majors should be particularly aware that in science, even more is at stake than the philosophy behind the Code outlined above—because honesty is *essential* in scientific practice. In many scientific activities, only the individual investigator knows exactly what was done, what was observed, or which ideas were truly original. Unless each scientist abides by a strict code of ethical conduct, the scientific process will unravel in a destructive spiral of diminished effectiveness and relevance. If scientists can't trust each other to report methods, results, and ideas honestly, how can the general public have any confidence in our findings and conclusions?

For all the reasons reviewed above, members of the Department of Biology place great importance on academic and scientific integrity. Consequently, we expect each student to adhere strictly to the Code in every facet of all biology courses and all related activities. Students who have violated the Code in biology courses in the recent past have, unfortunately, been disciplined severely—even in situations where the penalties resulted in delay of graduation.

Graduate & Professional Study

Graduate School

Villanova's biology graduates face virtually unlimited opportunities for advanced study in biology. Many biological careers require at least a Master's degree; some require the Doctorate (Ph.D.). The Master's is a usual, but not essential, precursor to the Ph.D.; exceptionally well-prepared students with top grades and test scores (see below) can consider going straight into a doctoral program.

The Department of Biology has a copy of *Peterson's Guide to Graduate Programs in the Biological and Agricultural Sciences* available for your perusal. It contains directories of programs by subject area, profiles for thousands of programs in the U.S. and full descriptions including names of faculty and their research interests for many. Most institutions now also provide the same information on World Wide Web "home pages" that describes their programs, faculty, and research activity.

If you are interested in graduate study in biology, you should begin to discuss options with your advisor no later than the start of your **junior** year. Admission requirements vary among programs; fortunately, completion of the Biology Major at Villanova enables students to meet the course requirements of the vast majority. Most programs have application deadlines in early winter for students expecting to start at the beginning of the following September; some also accept students to start at other times of year.

Nearly all graduate programs require the Graduate Record Examination (GRE), including at least the **General Test**. Students planning to apply for graduate study in biology (M.S., M.A., or Ph.D.) should also plan on taking the Biology **subject test**; there is now an additional subject test in Biochemistry, Cell and Molecular Biology (check with graduate programs to which you're applying for their test preferences). The General Test can now be taken in computer-based testing (CBT) format at many locations; you can take this version at your convenience and get nearly instantaneous access to your results. Paper-based versions of the General test are offered in November and April. Subject Tests are offered on these dates and in December. Application deadlines are approximately five weeks before the test date. For further information or on-line GRE registration, visit <http://www.gre.org>. Application forms are also available from Career Services in Corr Hall or from Dr. Russo's office (Mendel 143A).

Students planning to attend graduate school should seek financial support. If you're a good student and you search diligently, you should be able to find a way for someone *else* to pay for your graduate training, be that the university, the government, or an employer. Many programs offer teaching or research assistantships to qualified applicants. Students with outstanding academic records should consider applying for graduate fellowships offered by national and international agencies (e.g., National Science Foundation, Office of Naval Research); most of these fellowships have deadlines in the summer or fall before your graduation date. See your advisor for more information—and get started on applications *early*.

Professional Study

The Health Sciences Advisor, Dr. Louise Russo (Mendel 143A) maintains a library of information about health-related careers. All students interested in professional study in the health-related sciences are encourage to contact Dr. Russo, by the end of their Sophomore year (and no later than Fall of Junior year), particularly since some professional programs have specific course requirements for admission.

There are several different admission tests for the health sciences:

- MCAT: for students applying to medical, osteopathic, and podiatry schools
DAT: for students applying to dental school
OAT: for students applying to optometry school
GRE: for students applying to some allied health programs (for example, Physical Therapy)

Students should plan to take these tests in April of their Junior year. Applications for the tests are available in the Health Science Office—where you can also pick up the central application for admission used by some health professional schools.



Careers in Biology

Career choices are often difficult. It is important to talk to as many people as possible before you make a decision. The members of the Biology faculty are as varied as the flora and fauna you study. As a consequence, they are an excellent source of information. In addition to personal discussions, we offer career information from many professional societies in the biological sciences.

It is never too early to begin preparing for your post-graduate career. Whether you plan to go on to professional school, graduate school, a technical field, or any other biologically related area, you will be judged—at least in part—on your performance at Villanova. This means not only that you need to get good grades, but also that you must distinguish yourself in some way to the people who will be writing letters of recommendation on your behalf. Faculty members cannot write glowing letters about you if all they know is your final grade. Get to know the faculty. All our faculty members are approachable people who want to help you get the most out of your time at Villanova. If you make the effort to talk to your instructors, to seek help when you need it, to do a research project, and to become involved in organizations affiliated with the Department of Biology (honor societies, etc.), you will be more than a ID number to your teachers. A weak recommendation (or a poorly informed recommendation) can be worse than no recommendation at all. Don't wait until your senior year to get to know the faculty; start your interactions with people doing work in a field that interests you as soon as possible.

The Career Services office in Garey Hall (519-4060) runs workshops and has additional publications available to help with career decisions and the job search. The staff is available to talk to students about career decisions. The office presents workshops in résumé preparation and interviewing to help students in the job search. The office prepares a Placement Manual each semester that gives general information on the services available through the office, along with the recruiting schedule for the semester. The office also has copies of the CPC Annual, a directory of employment opportunities for college graduates. Copies are provided to students who register with the office.

What careers can I pursue with a Biology degree?

Many students who choose to major in Biology plan on a career in the health professions (medicine, dentistry, optometry, veterinary medicine, etc.). This goal is sufficiently common that the College of Liberal Arts and Sciences assigns a special advisor, Dr. Russo, to counsel interested students (see next handbook section). You may not be aware, however, that *many* alternatives exist for Biology graduates. Here we provide an overview of some lesser-known career possibilities you may wish to consider; our summary is adapted from *Careers in Animal Biology* (American Society of Zoologists, 1982).

Students considering careers in biology should be realistic in their expectations both in regard to their education and to current job opportunities. Keep the following in mind:

1. There are many different kinds of opportunities for employment as a biologist, but competition for employment in almost every field is very great. The reputation of the institution in which you have been educated, the academic record and reputation you have acquired during that education, and hard work in job hunting will all be important in gaining employment.
2. Do not expect to know at the outset of your undergraduate studies your precise interest and goal as a future biologist. Give yourself time to explore and permit your initial interest to change. The courses you take, the instructors you encounter, and the laboratory and field work you experience will all be important introducing you to different areas of biology, shaping your interests and directing you toward a particular goal as a biologist.

3. In general, a broad undergraduate educational background is more valuable than one restricted to specialization. In addition to study in your particular area of interest, obtain a good foundation in related areas, in biology as a whole, and in basic mathematics, chemistry and physics. Be in a position to exploit the maximum number of opportunities for becoming an employed biologist. Many fields, such as marine biology and environmental science, require graduate study before employment. It is neither necessary nor even desirable that an undergraduate student have a major or extensive specialization in such fields.

Opportunities in Academic Fields

The majority of biologists, excluding those in health fields, are employed by academic institutions. Most are involved with teaching, some with research and many are engaged in both teaching and research. Biology is currently taught in nearly all high schools, colleges, and universities. Therefore, there is continual demand for individuals qualified to teach biology, particularly individuals with excellent training and demonstrated teaching ability. This demand lies in two major areas and involves different types of skills and preparation.

SECONDARY SCHOOL TEACHING. Many people interested in biology find their greatest rewards in introducing others to the subject. Such rewards may be found in teaching at the secondary school level, which requires a B.A. or B.S. degree. Each state has specific requirements for certification of secondary school teachers that usually include courses in professional education and some in the discipline to be taught. The M.A. or M.S. degrees in biology improve professional competence and generally provide improved opportunities in obtaining employment.

Biologists who teach in secondary schools typically are not experts in a particular branch of biology. They must be generalists who view the whole field and are capable of providing students with insights to the broad spectrum of knowledge of living organisms. Secondary school biology teachers frequently are involved in teaching other science courses. Preparation for secondary school teaching should therefore emphasize background in mathematics, physics, and chemistry.

TEACHING IN COLLEGES AND UNIVERSITIES. Teaching at the post-secondary level typically requires no formal training in teaching but does require considerable training in one or more disciplines of biology. Generally, a Ph.D. degree is required for teaching in a college or university, although some colleges occasionally have positions available for individuals with only a master's degree.

Opportunities for teaching at the college level exist in all types of colleges and universities. The large number of qualified individuals seeking such positions makes these jobs highly competitive, however. Success as a college or university professor is increasingly dependent upon funded research activity and publications, although teaching remains the major activity of faculty members at many junior and community colleges.

Opportunities in Non-Academic Fields

MUSEUM CURATORS AND STAFF. Museum and zoological park curators possess exceptional knowledge of different groups of animals and are responsible for the collection, identification, maintenance, and study of specimens in their areas of specialization. Large museums have a separate staff responsible for exhibits. Some museums have only research collections and have no exhibits. Museum curators usually have the Ph.D. degree in their field. Since curatorships are not numerous, students interested in this kind of work are advised to prepare for a career in research and teaching with specialization at the graduate level in a broad area of zoology. With such preparation the student may serve in a college or university until an opening for which he or she is qualified appears.

Museums hire additional people with biology backgrounds as well. Preparators or taxidermists mount and care for skeletons, skins, and other specimens. Artists design background, make

reproductions, and illustrate material in other ways. Separate educational sections of museums and zoos organize lectures, publish popular articles on the work of the museum, present radio and television programs, and sometimes offer special classes for school children.

BIOLOGICAL ILLUSTRATORS prepare drawings, paintings, photographs, exhibits, charts, teaching models, television visuals, motion picture adjuncts for the classroom, publications and educational programs. They may be employed by a hospital, medical schools, textbook publisher, biological supply firm or museum. They may freelance for doctors, lawyers, scientists, publishers, pharmaceutical houses or advertising agencies. The primary requirement is artistic and technical ability. A biological illustrator, however, needs to match his sound training in art with biology courses which emphasize the biology of organisms.

SCIENCE LIBRARIANS. In medical, biological, agricultural, and industrial libraries, librarians perform the usual services of ordering circulating and binding books and journals; making literature searches; and compiling reports and bibliographies in biomedical fields. Such positions are found in college, university, or hospital libraries; in governmental agencies; in dental, medical, nursing, and pharmacy schools; in oceanographic and marine laboratories; with medical societies; and in pharmaceutical houses. Candidates for such work should earn the bachelor's degree with a major in one of the life sciences, including some work in chemistry and physics and with training at an approved library school. Knowledge of Latin is helpful; modern languages are required.

THE MASTERS IN BUSINESS ADMINISTRATION. The M.B.A. is a valuable advanced degree for those who wish to provide their scientific expertise to various segments of industry. The biologist with an inclination toward industry will find this avenue challenging and rewarding.

ENVIRONMENTAL AND PATENT LAW. Opportunities in these fields are burgeoning for graduates who can combine college-level training in biological science with a law degree. Major law firms are increasingly including environmental law in their practices. Many government agencies and non-governmental organizations (see below) also maintain staff positions for environmental lawyers. The emergence of new biotechnologies based upon recombinant DNA methods has created increased demand for patent lawyers with a knowledge of biology.

INDUSTRY. There is a variety of opportunities in industry for biologists. Pest control using biological and chemical agents is performed by people trained in the economic aspects of zoology and entomology. Industries hire biologists to help reduce pollution or to investigate the safety of products, and the number of environmental consulting firms that hire staff biologists is growing.

Pharmaceutical and chemical firms have openings for biologists. Compounds are tested for their pharmacological effects on cancer, growth, blood pressure, animal behavior, human parasites, and diseases of animals. Candidates for these positions should have a degree in biology with a minor in chemistry or special advanced work in psychology. Experience in bacteriology, microbiology, pharmacology, physiology, molecular biology, and systematic botany is desirable.

Biotechnology companies and firms engaged in agricultural research employ many biologists. Their different activities include the development and production of drugs, vaccines, food products, fertilizers, and new plant varieties. In addition to a strong background in basic biological sciences such as bacteriology, plant physiology, and genetics, advanced work in molecular biology and recombinant DNA technology is often required.

Technical positions in biological supply houses are concerned with collection and preservation of animal carcasses; preparation of bones and skeletons; mounting of skins; and production of microscope and film slides, models, teaching charts, and collecting equipment. Supply houses need biologists with ability to bleed animals such as pigs, horses, and sheep because blood components are used in many growth media. Tissue cultures, an increasingly important form of investigation are

prepared by supply houses via tissue removal, cuttings or dissections. Competent personnel are sought for these positions in increasing numbers. Graduates in biology, pharmacy, and pre-medical work also find jobs as salespersons for pharmaceutical, publishing, and supply firms. Previous sales experience can be important. Some firms, however, are interested in individuals trained in science, and they will provide the necessary training in sales and development.

SCIENCE MEDIA. Science writers are employed by pharmaceutical firms, insurance companies, wildlife organizations, newspapers, and magazines. To meet communication needs, individuals are employed to translate scientific knowledge and discoveries into language or visual material which is understandable and interesting to the lay public without losing scientific accuracy. Science writers should be trained in both basic science and writing. Opportunities for qualified individuals exist in radio and television, education films, and other forms of mass media. The student should have the bachelor's or master's degree with broad training in the physical and biological sciences together with specialization in creative writing, photography, and radio-TV techniques.

Opportunities in Government Agencies

FEDERAL AGENCIES. Agencies of the federal government provide opportunities in applied biology for varied specialties. Such positions may be in laboratories, hospitals, field stations, or administrative offices. In addition to agencies of the federal government, state, county, and municipal governments have some opportunities for biologists.

Positions are filled through rosters of eligible persons based on results of competitive examination. Information about Federal examinations can usually be obtained in college libraries and career placement offices and from a U.S. Civil Service Commission office. The Civil Service Commission operates under a system of Grades. The level of appointment for an individual will be determined by his educational background experience. Biologists holding the bachelor's degree could qualify for appointment at the GS-9 level, and an individual with the Ph.D. degree could start at the GS-12. Salaries are competitive with other areas of employment. In this area, as in most others covered in this pamphlet, salaries are constantly changing and improving.

THE PUBLIC HEALTH SERVICE employs more biologists than any other single governmental agency. Many biologists and technicians are employed at the various Institutes of Health in Bethesda, Maryland. The opportunities are in both applied and basic biology. Work is carried on in a variety of fields; physiology, ecology, parasitology, microbiology, developmental biology and genetics, to mention a few. There is also a Commissioned Corps of the Public Health Service composed of scientists, physicians, nurses, dentists, pharmacists, sanitary engineers and others. Types of positions open to biologists include aquatic biologist, biochemist, entomologist, industrial hygienist, parasitologist, physiologist, and protozoologist. The Ph.D. or M.D. degree is required.

U.S. FISH AND WILDLIFE SERVICE. The Bureau of Commercial Fisheries employs three types of fisheries biologists - research, general, and management. The fields of investigation are broad and include basic research in physiology, ecology, life history, and yields of commercially important stocks of marine fish, freshwater fish, mollusks, crustaceans, marine mammals and plants. Wildlife biologists are responsible for conservation, protection, and management of wild mammals, waterfowl, and upland game birds and game fish. Summer employment for young scientists is sometimes available.

THE NATIONAL PARK SERVICE employs Park Rangers to carry out conservation efforts to protect plant and animal life from fire, disease, and heavy visitor use; to perform law enforcement and rescue work; and direct interpretive programs to help visitors become aware of the natural, cultural and historical significance of the areas. When available, Biologist positions are of a research nature and require advanced academic degrees and/or several years of specialized work experience.

THE DEPARTMENT OF AGRICULTURE offers positions to biologists as Agriculture Research Scientists in the following specialties: animal husbandry, physiology, dairy husbandry, entomology, genetics, nematology, parasitology in general, and range conservation. The Office of Personnel, U.S. Dept. of Agriculture, Washington, D.C. 20025 can provide a number of career publications upon request of interested applicants.

THE FOOD AND DRUG ADMINISTRATION, Department of Health, Education and Welfare, enforces the Federal Food, Drug and Cosmetics Act and ensures that foods, drugs, therapeutic devices and cosmetics are pure and wholesome, safe to use, made under sanitary conditions and truthfully labeled. Animal biologists are employed as Food and Drug Inspectors, Medical Technicians, Medical X-ray Technicians. Employment may be in the central research laboratories in Washington, D.C., or as Food and Drug Inspectors in the 16 district offices.

THE ENVIRONMENTAL PROTECTION AGENCY coordinates federal, state, and local activities concerned with the quality of the environment. Persons employed by the agency would be engaged in establishing standards for air and water quality, monitoring pollution, enforcement of standards, and supporting research.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION is involved with the exploration of oceanic waters and of marine resources. The NOAA describes, monitors, and predicts atmospheric conditions and provides weather forecasts. Biologists employed by this agency would be engaged in these activities and in supporting research.

PEACE CORPS. Graduates in biology have gone on to rewarding involvement in Peace Corps projects in Africa and other regions. The Peace Corps often sponsors programs involving applied research to address problems of public health, natural resources, and conservation. The Corps also often assigns volunteers with biology training to participate in science education programs.

STATE AGENCIES. State Conservation Commissions employ wildlife scientists, game managers, and conservation wardens at several civil service grades. These individuals are concerned with management of wild game resources. Wardens assure that game laws are obeyed. Fish and Game Commissions employ fisheries and wildlife biologists. Duties include the collection of ecological data on fish, analyzing water samples, improving habitats of animals, and propagating fish.

Opportunities with Non-Governmental Organizations (NGOs)

Non-governmental organizations include a wide variety of research, lobbying, advocacy, and public education groups, many of which offer employment opportunities for graduates with training in biology. Organizations such as the World Wildlife Fund, the Audubon Society, Conservation International, and the Nature Conservancy hire conservation biologists, ecologists, and zoologists to work on policy-related issues, to conduct original research, and to manage nature and wildlife preserves. Other groups, such as the Natural Resources Defense Council, are more heavily involved in policy development relating to public health issues, as well as research. Still others focus on lobbying activity, supported by “in house” scientific staff positions. Job openings with such organizations are few in number, and their pay scales tend to be modest, but some offer unmatched opportunities for direct involvement in critical issues, for people with appropriate scientific training.

Student Organizations

Alpha Epsilon Delta — A E Δ

Alpha Epsilon Delta (or A.E.D.) is a national premedical honor society composed of outstanding students interested in careers in the health professions. Membership is by application and interview, though all students are invited to participate in the activities of the Villanova Chapter. Activities include sponsoring talks about professional school and the health science occupations. Faculty moderator is Dr. Louise Russo, the Health Sciences Advisor. For more information about A.E.D. activities, leave a note in the A.E.D. mailbox in the Department of Biology office.

E. S. V.—The Ecological Society of Villanova

The Ecological Society of Villanova was founded in 1994 by a group of Biology and other majors who sought a scientifically-oriented society to complement the activities of V.E.G. (Several students are members of both groups.) E.S.V. sponsors speakers on issues in ecology and environmental science including, in 1995, two Congressional representatives from the area; organizes field trips to regional localities for natural history study; coordinates volunteers working with local conservation groups, such as The Nature Conservancy's serpentine barrens fire ecology program; and provides a forum for student discussion of current issues in ecology, including related political developments. Faculty advisor for the group is Dr. Curry. Society information and materials are posted outside Mendel 088. For news about this group's meetings and activities, visit the ESV web site (<http://www.students.villanova.edu/esv/activities.htm>).

Sigma Xi — Σ Ξ

Sigma Xi—The Scientific Research Society is a national organization that honors scientific achievement and promotes research in all scientific disciplines. The Villanova University Chapter brings together faculty and students from across campus, along with interested members from other nearby institutions and industries. Membership in Sigma Xi is by nomination, based on research achievement. Consequently, few undergraduates are active members of the Villanova Chapter. Nevertheless, biology students who are actively involved in research, especially those completing undergraduate thesis projects, are welcome to inquire about joining the Society. Election to Sigma Xi is one way that students can have their research accomplishments honored, and they can transfer their membership to a new institution should they go on to graduate or professional school. For more information, contact the chapter web site (<http://www.csc.villanova.edu/~sigmaxi/>).

Tri-Beta National Biological Honors Society — βββ

The Tri-Beta national biological honors society was founded in 1922 at Oklahoma State University, and since then has grown to include 533 chapters, and over 200,000 members within the United States and Puerto Rico. An honors fraternity based on scholarship and academic inquiry, Tri-Beta has been one of the nation's foremost societies for students studying the biological and life sciences. The Villanova University chapter connects students to researchers on campus, and seeks to increase scientific involvement through mentoring programs to help younger students, tutoring services for upper level biology courses within the fraternity, group study sessions, and volunteering events which will connect students within the sciences. For more information, contact the chapter via email (tribetavu@gmail.com).

V. E. G.—The Villanova Environmental Group

The Villanova Environmental Group was started in the fall of 1987 by concerned students wanting to heighten environmental awareness on campus. Through group effort, V.E.G. has been able to end the careless release of hundreds of balloons on Balloon Day, which added to our pollution problems. Other tasks students have taken on are those of recycling, the prohibition of styrofoam use on campus, and setting up tables in the Connelly Center to distribute information on environmental issues. V.E.G. has also sponsored a speaker from the Sierra Club and activists from Greenpeace. V.E.G. wants students to enjoy our natural environment. Trips have been taken to Valley Forge Park and to the Baltimore Aquarium. In the future there will be day hikes planned as well as overnight backpacking trips. By getting outdoors, students can experience the natural environment first hand. This creates a greater appreciation and respect for the environment and hopefully a greater force fighting for its protection. The Villanova Environmental Group runs out of the Center for Peace and Justice which is located in the basement of Sullivan Hall. For more information, contact the group's web site (<https://www1.villanova.edu/villanova/artsci/peaceandjustice/studentorgs/environgroup.html>).



Anatomy of a Course Number

Course numbering in Biology follows a uniform scheme. In particular, the first and last digits of a course number tell you much about the course.

X



Y

Y

Z



Course Level	
1	Non majors (can be taken by Majors but will not count toward major requirements)
2	Majors, required course and Internships, Bio 2993 and 2996 (not required)
3	Advanced Biology with General Biology + labs as the only prerequisite
4	Advanced biology with additional prerequisites beyond General Biology
5	Advanced Biology, senior status required
6	Research courses by special arrangement only
7	Graduate students and Juniors or Seniors with GPA of ≥ 3.4 and 3.0 (resp.)
8	Graduate students and Seniors with GPA of ≥ 3.8

Course Type	
0	Seminar or discussion
1	Lecture
2	Laboratory
3	Lecture continuation
4	Laboratory continuation
5	Lecture/Laboratory combined
6	Lecture/Laboratory continuation
9	Research

Thus, for example, if you saw Biology 4505 (Molecular Biology) in the master schedule, you would know that the course had prerequisites beyond General Biology (4xxx) and that it was a combined lecture and laboratory course (xxx5).

Undergraduate Courses

In accordance with the system described on the preceding page, all courses listed below have General Biology I and II with lab (or the Honors equivalent) as prerequisites. Some courses have additional requirements. Home pages for courses with dedicated web sites are listed under the course title; these sites may provide course syllabus, announcements, reference lists, assignment descriptions, or other information. Check the Department of Biology web site (<http://biology.villanova.edu>) for recent additions to the list of web-supported courses.

Courses listed as “dormant” are not expected to be offered in the near future, because of changes in staffing, sabbaticals, and scheduling constraints. Check with your advisor or the Department office for more information.

Biology 3015 **Animal Behavior** 4 Credits

Dr. Iyengar and/or Dr. Curry

Lecture topics include communication, foraging, territoriality, mating systems, parental behavior, and social organization. Laboratories include collection, statistical analysis, and interpretation of behavioral data, culminating in a small-group independent research project.

3 hours lecture, 3 hours laboratory Spring

Writing Enriched/Research Requirement

Biology 3055 **Animal Physiology** 4 Credits

Dr. Stephens

Coverage of the systems of the body using a comparative approach to study the physiology of a variety of animals including humans. The lecture schedule is divided into three sections. The first section covers how the body controls its various functions using nerve, muscle, and endocrine systems. The second covers how molecules pass from the outside world to the cells, while the third section covers homeostasis or how the body maintains a constant internal environment. The laboratory portion illustrates principles outlined in lecture and uses modern equipment including Macintosh computers, oscilloscopes, spectrophotometers, amplifiers, transducers, manipulators, stimulators, and respiration chambers. The course is designed to provide students with a grounding in physiology and to provide a frame-work for future, more specialized physiology courses.

3 hours lecture, 3 hours lab Fall and Spring

Biology 3105 **Biostatistics and Experimental Design** 4 Credits

Dr. Russell

Conceptualization of experimental design, hypothesis testing, execution of statistical analyses, written and oral expression of statistical results, and effective graphical presentation of quantitative data.

3 hours lecture, 3 hours lab Fall

Writing Enriched/Research Requirement

Biology 3155 **Comparative Vertebrate Anatomy** 4 Credits

Dr. Bauer

Evolutionary and functional morphology of vertebrates and protochordates. Lecture material in this course covers the basic structure and function of all organ systems of the vertebrate body. Variation in form among the major vertebrate lineages is discussed. The systematic significance of anatomical variation is stressed and the value of comparative anatomy for evolutionary studies is emphasized. When possible, developmental and paleontological information is brought to bear on the identification of homologies. Laboratory exercises concentrate on dissections of the lamprey, dogfish, salamander, and cat. In addition there are demonstrations of skeletal morphology and other organ systems. Graded material includes lecture-based essay exams and laboratory practical exams as well as a short paper on any topic in vertebrate anatomy.

2 hours lecture, 5 hours lab Spring

Biology 3225 **Imaging Technology** 4 Credits

Staff

Introduction to imaging technologies, including light and fluorescent microscopy and scanning and transmission electron microscopy. Course covers both theoretical and applied microscopy.

1 hour lecture, 5 hours laboratory (1 common lab and 1 to be arranged) Fall, even years

Biology 3255 **Introductory Ecology** 4 Credits

<http://www.homepage.villanova.edu/robert.curry/3255/index.html>

Drs. Curry and Iyengar

Introduction to the ecology of individuals, populations, and communities. Lectures cover physiological adaptations, life history strategies, population regulation, predator/prey dynamics, competition, social behavior, and relevance to global environmental problems and biological conservation. (Lectures do *not* cover other applied aspects of environmental science such as energy generation, recycling, pollution control, or land-use planning.) The course emphasizes quantitative methods that are fundamental to ecology, and useful in many other sub-disciplines; these include collection and statistical analysis of field data; simulation modeling; design and completion of a semi-independent greenhouse experiment; and graphical presentation of data. Evaluation is based on hour exams; a review paper involving analysis of primary literature; laboratory reports covering weekday exercises, field trips, and projects; and a final exam. (Recommended precursor to Field Ecology & Evolution, though alternatives (e.g., Evolution) can also serve as prerequisites.)

3 hours lecture, 3 hours laboratory; **required** field trip (Sat./Sun.) to be arranged Fall

Writing Enriched/Research Requirement

Biology 3351

Genetics

4 Credits

Dr. DiBenedetto, and Dr. Wykoff

Intensive introduction to the science of genetics, including transmission, molecular, evolutionary and population genetics, gene regulation and genomics. Emphasis on fundamental principles of heredity, and questions of how genetic information is stored, regulated and transferred, how genes relate to phenotypic characters, and how they interact. In tutorials students will apply genetic principles to solve problems, learn to use electronic bibliographic and genetic databases and analysis tools, and discuss ethical/social issues related to genetic technologies.

Prerequisites: Chemistry 1103/1151; 1104/1152 (preferred; can be taken as corequisite)

3 hours lecture with 1 hour recitation

Fall and Spring

Biology 3405

Higher Vertebrates

4 Credits

Dr. Olson

Introduction to the study of birds and mammals. Lecture material covers the evolutionary origin of these taxa, their subsequent radiation into modern species, their basic physiology, ecology, and behavior. Special traits of these taxa that have allowed them to exploit various habitats will be addressed. Laboratory exercises focus on taxonomy and identification of specimens, both in the laboratory and in the field. A major portion of the laboratory involves a collaborative research project on some aspect of mammalian/avian ecology or behavior. Several laboratories involve short field trips to local natural areas for faunal surveys. Graded material includes exams, a short critique/review on some aspect of avian/mammalian biology based on the primary literature, a theme paper, and laboratory assignments/quizzes.

3 hours lecture, 3 hours lab

Fall, odd years

Writing Enriched/Research Requirement

Biology 3455

Histology

4 Credits

Staff

Microscopic examination of all of the basic tissues and organs in the mammalian body with the goal of being able to identify the predominant organs in the body from a microscopic slide taken from them. The lectures and labs are integrated into one course so that the lab material immediately reinforces what has been presented in lecture. Students are presented with a series of study questions on which they work as teams. The goal of these questions is to help students become independent learners in their approach to microscopic anatomy. The course is cumulative in its scope meaning that all material is referred to on tests throughout the course.

3 hours lecture, 3 hours laboratory

Spring

Biology 3485

Marine Biology

4 credits

Dr. Russell

Introduction to the scientific study of the oceans. An emphasis will be placed upon the unique features of the ocean environment and the unique opportunities and challenges faced by marine

organisms. Topics to be covered in lecture will include: principles of oceanography, biology of plankton and marine algae, measurement and patterns of primary and secondary productivity, marine food webs, ecology and physiology of marine fishes, marine reptiles, sea birds and marine mammals, and a comparative treatment of the ecology of marine habitats including: estuaries, rocky intertidal, kelp forests, coral reefs, the deep sea and hydrothermal vent communities. The laboratory portion of the course will compliment and reinforce the material covered in lecture. Students will be responsible for writing formal laboratory reports and keeping a notebook of observations. Laboratory topics will include: ocean geography and remote sensing, chemical and physical properties of water, analysis of plankton communities from three oceans, observation of larval invertebrates, identification and anatomy of marine fishes, fish development, identification of algae and seaweeds, behavior of invertebrates. There will be two required field trips: field observations of cetacean behavior (Cape May) and a trip to a salt marsh and trawl in coastal waters (Jersey Shore or Chesapeake Bay). The last laboratory session will be a symposium where each student will give an oral presentation on a topic from the original literature. Grading will be based on two lecture exams, a final examination, lab reports, lab/field notebook, and an oral presentation and a short research paper based on the original literature.

3 hours lecture, 3 hours laboratory

Fall

Writing Enriched/Research Requirement

Biology 3505

Invertebrate Zoology

4 Credits

Dr. Russell

An integrated lecture/laboratory course that uses a phylogenetic framework to survey the anatomical and morphological diversity of "animals without backbones." Each week we focus on different groups and explore various aspects of their systematics, physiology, development, ecology, and behavior. The lecture material for a particular group is immediately followed by a laboratory where we examine in detail the anatomy and morphology of representatives of that group through a series of carefully outlined observations and dissections. By emphasizing distinguishing features as well as the shared common history of these organisms, students gain an appreciation for both the diversity and unity of life. One goal of the course is to familiarize students with invertebrates to the point where they will be able to identify specimens at least to the level of higher taxonomic categories. In addition to studying and observing invertebrates in the laboratory, students will participate in field trips where they will observe, collect, and identify samples in both marine and estuarine environments. Grades are based on the student's performance in lecture short answer and essay exams, laboratory practical exams, and brief laboratory and field reports.

This course complements Entomology, which focuses on terrestrial invertebrates.

2 hours lecture, 5 hours lab

Fall, odd years

Biology 3525

Entomology

4 Credits

Dr. Iyengar

A lecture/laboratory course in which we will explore the fascinating world of insects. Lecture topics include external anatomy, sensory systems, physiological adaptations, reproductive biology, social behavior and interactions with humans. Lecture time will primarily cover readings from the textbook, although we will also incorporate critical evaluation of papers from peer-reviewed journals, film clips, and discussions regarding current topics in entomology. The laboratory portion of the course will involve investigating the internal and external anatomy of preserved specimens to learn about

functional morphology, ecology and taxonomy. Additionally, you will put together an insect collection that will allow you to learn collection and specimen preparation techniques as well as become familiar with the most commonly encountered local invertebrates. Grades will be based on lecture exams, laboratory practicals, the insect collection and a short paper on some aspect of insect biology.

This course is designed to complement Invertebrate Zoology, which focuses primarily on freshwater and marine invertebrates.

3 hours lecture, 3 hours lab

Fall, odd years

Writing Enriched/Research Requirement

Biology 3555

Lower Vertebrates

4 Credits

Dr. Bauer

Introduction to the biology of fishes, amphibians and reptiles. Lecture material covers all aspects of the biology of these organisms, including systematics, anatomy, physiology, development, ecology and behavior. In addition, topics such as zoogeography, human interactions with lower vertebrates, and the biology of dinosaurs and other fossil reptiles are briefly treated. Laboratories emphasize the diversity of the groups and highlight selected features of the biology of the organisms. Laboratory exercises include identification of specimens, recording and analysis of frog calls, practice of field techniques and faunal surveys. Many laboratories involve short field trips. Field trips to the National Aquarium, Philadelphia Zoo and optional trips to more distant localities are also scheduled. The goal of this course is to apply the many approaches of organismal biology to a particular group of vertebrates. This holistic approach complements more traditional courses that emphasize a single approach to biology in a comparative context. Graded items include lecture essay exams, laboratory practicals and a short paper on some aspect of lower vertebrate biology.

2 hours lecture, 5 hours lab

Spring, odd years

Biology 3595

General Microbiology

4 credits

Drs. Friede, Knepper, Wilson, Langley

Overview of the growth, properties and uses of microorganisms. This broad based course will give the student a fundamental understanding of the nature and importance of microorganisms in air, water and soil as well as interactions with plants and animals. It includes elements of bacteriology, virology, immunology and eukaryotic microbiology. Agricultural, commercial, industrial and medical uses of microorganisms will be addressed. The laboratory will provide basic techniques for isolation, cultivation and identification of microorganisms.

3 hours lecture, 3 hours lab

Fall and Spring

Biology 3651(Dormant)

Non-Vascular Plants

2 Credits

Dr. Orkwiszewski

Coverage of Monera, Protoctista, Plantae, and Fungi. In the review of the Monera, emphasis will be placed upon the structure, physiology, and environmental aspects of Cyanobacteria. The transition between prokaryote and eukaryote cell types will be covered by a discussion of theories that attempt to account for the origin of the eukaryotic cell. When Protists are considered, several of the main groups of algae will be discussed with particular emphasis on structure and physiology. The

environmental impacts of algae will also be reviewed. In considering the Plant Kingdom, only the Bryophytes will be discussed; evolutionary implications of this group of lower plants will be considered. Finally, the structure, physiology, and economic and ecological importance of the Fungi will be reviewed.

2 hours lecture

Biology 3652 (Dormant) **Non-Vascular Plants Laboratory** 2 Credits

Dr. Orkwiszewski

Physiological experimentation and microscopic study of Monera, Photosynthetic Protists, Bryophytes, Fungi, and Lichens

Corequisite: Non-Vascular Plants Lecture.

5 hours laboratory (Bio 3651)

Biology 3661 **Environment and Human Health** 3 Credits

Dr. Olson

Presentation and discussion of scientific aspects of topics relating to the environment and human health. Specific topics covered vary, but could include biodiversity and health, ecosystem services, infectious diseases, climate change, endocrine disruption, food production (including GMOs), and urban ecology.

3 hours lecture

Fall or Spring

Biology 3755 **Parasitology** 4 Credits

Staff

Major groups of parasites of animals are studied in this course with emphasis on those that afflict domestic animals and man. For each organism or group of organisms, the life cycle, the mode(s) of transmission, associated pathology, immunological and other host responses to the parasite, biochemical and physiological characteristics, preventative measures and treatments are considered within a taxonomic framework. In the laboratory the parasites in the various stages of their life cycles will be examined through the use of preserved and living material. A term paper of at least 10 pages is required for the course. There will be three examinations in lecture and three in the laboratory (including final examinations). Current readings will be assigned for lecture.

2 hours lecture, 5 hours laboratory

Spring, even years

Writing Enriched/Research Requirement

Biology 3801 (Dormant) **Plant Physiology** 2 Credits

Dr. Orkwiszewski

Physiology and metabolism of plants. Photosynthesis, respiration, hormones, photoperiodism, radioisotopes in biological research, DNA biosynthesis, and metabolism during plant development.

2 hours lecture

Biology 3802 (Dormant) **Plant Physiology Laboratory** 2 Credits

Dr. Orkwiszewski

Experiments include exogenous and endogenous respiration, hormones, cytochrome oxidase function in the electron transport system, DNA biosynthesis in roots, autoradiographic techniques, and liquid scintillation spectrometry.

Corequisite: Plant physiology lecture

5 hours laboratory (Bio 3801)

Biology 3905 **Vascular Plants** 4 Credits

Staff

Basic concepts of vascular plant structure and development. Organization of the vascular plant body, plant reproduction and development, systematic and environmental considerations, and hormonal regulation of plant growth.

2 hours lecture, 5 hours laboratory

Fall, even years

Writing Enriched/Research Requirement

Biology 3950 **Special Topics in Biology** 3 Credits

Staff

Coverage of current topics in biology. Topics will be announced on a semester-by-semester basis. Specific information available in the departmental office.

3 hours lecture, seminar, or combination

Biology 3952 **Special Topics in Biology LAB** 1 Credit

One credit lab in Biology. Topic to be determined by term.

Prerequisites: Bio 2105 and Bio 2106

Usually 3 hours laboratory

Biology 3955 **Lecture and Lab in Special Topics in Biology** 4 credits

Staff

Coverage of current topics in biology with lectures and accompanying lab. Topics will be announced on a semester-by-semester basis. Specific information available in the departmental office.

Prerequisites: Bio 2105 and Bio 2106

Usually 3 hours lecture and 3 hours laboratory

Biology 4105

Bacterial Pathogens and Pathogenesis

4 credits

Dr. Wilson

Coverage of the nature and activities of bacterial pathogens. The factors that contribute to the pathogenesis and virulence of bacterial pathogens will be discussed. The role of cell components and toxins in pathogenesis will be presented as well as the defense mechanisms used by the host. Specific genera will be covered, including specific detail on invasiveness of the pathogen and symptoms of infection, on diagnosis and on treatment. The laboratory will focus on selective isolation and cultivation of pathogens as well as the characterization of the isolates.

Prerequisite: General Microbiology (Bio 3595)

3 hours lecture, 3 hours lab

Spring, even years

Writing Enriched/Research Requirement

Biology 4205

Cell Biology

4 Credits

Drs. Russo and Youngman

Explores the structure and function of eukaryotic cells, the mechanisms by which these are acquired and maintained, the relationships between structure and function, and the methods by which these aspects are studied. The organellar contents of cells will be studied in addition to extracellular structures. The processes by which cells establish and maintain differentiation, control proliferation, and communicate with other cells will be discussed. Experimental models for the study of cell structure and activity will be emphasized, with consideration of microscopic, biochemical, genetic, and molecular approaches to many problems. Selected model systems will be explored through the primary literature. The course will include significant writing experiences stressing experimental design and analysis. Laboratories will include both hands-on experiments and demonstrations of many state-of-the-art approaches to cell biology detailed in lectures, including microscopic observation, antibody visualization, cell fractionation, electrophoretic analysis of proteins, cell dissociation and aggregation, autoradiography, and analysis of cellular DNA. Written analyses of experimental results will be expected.

Prerequisite: Genetics, Organic Chemistry

3 hours lecture, 3 hours lab

Fall, odd years

Writing Enriched/Research Requirement

Biology 4251/8251

Endocrine Physiology and Pharmacology

3 Credits

Dr. Gardner

Survey of the major endocrine glands and tissues that play a role in the maintenance of homeostasis. Hormonal control of adaptation, reproduction, metabolism, growth, digestion, and electrolyte homeostasis will be discussed. A significant part will involve discussions of the molecular mechanisms by which hormones produce their biological effects.

Prerequisite: Animal Physiology

3 hours lecture

Spring

Biology 4252/8252 **Endocrine Physiology and Pharmacology Laboratory** 1 Credit

Dr. Gardner

Includes hormone receptor assays, radioimmunoassays, and pulse-chase experiments to study hormone action. In addition, techniques related to small animal surgery, isolated organ bath preparations, and organ culture will be used.

Prerequisite: Animal Physiology. Corequisite: Comparative Endocrinology

3 hours lab

Spring

Biology 4285 **Developmental Biology** 4 Credits

Staff

Coverage of the major stages of vertebrate embryogenesis at the organ and tissue level of biological organization and to appreciate the cellular and molecular mechanisms underlying the transformation of an embryo from a one cell zygote to a multicellular fetus or larva. Although an understanding of genetics, animal physiology, and comparative anatomy help in the understanding of developmental biology, only genetics is required as either a corequisite or prerequisite. In other words, the lectures will cover enough background to make the concepts understandable with only a general biology background. The lab emphasizes both descriptive slide work of chick embryos and experiments with living sea urchin, frog, and chick embryos. Initially, slides are used to learn the major parts and anatomical terms to describe embryogenesis; then, living embryos are used to appreciate the 3-dimensionality and spatial relationships of the various organs and tissues. Depending upon seasonal weather conditions, labs use live material to explore fertilization, sperm motility, and gastrulation. A major experience of the lab is doing independent research. Students working in groups of four execute various parts of a class project. All of the groups exchange data so that each group can report on the entire project. The projects occupy 25% of the total lab time. In addition to doing the experimental work and collecting the data, the groups research the primary literature for relevant information, exchange their literature findings with the rest of the groups, and report their findings in a final project report written as a scientific paper. Labs prior to the project acquaint students with techniques they will need for their projects. Many student projects in the past have developed into Masters theses or publication. All students have found that this experience has introduced them to the way research is done and many students have found the project experience has helped them considerably in getting jobs.

Prerequisite: Genetics

2 hours lecture, 5 hours lab

Fall

Writing Enriched/Research Requirement

Biology 4305 **Evolution** 4 Credits

Dr. Jackman

Examines major topics in the study of evolutionary processes and patterns. Areas of consideration in microevolution include the theory of natural selection, population genetics, quantitative genetics, molecular evolution, and neutrality. Macroevolutionary topics span adaptation, speciation and species concepts, phylogeny, biogeography, evolutionary rates, and extinction. Lecture topics are supplemented by laboratory exercises involving computer-, field-, and laboratory-based

experimentation and analysis. Graded assignments include two lecture exams plus final, a short term paper and a number of laboratory reports and problem sets.

Prerequisite: Genetics

3 hours lecture, 3 hours laboratory

Spring, odd years

Writing Enriched/Research Requirement

Biology 4331

Biology of Cancer

3 Credits

Dr. Russo

Coverage of causes, genetics, clinical aspects, and cell biology of cancer from preneoplastic state to invasive metastasis. Includes diagnosis, therapeutics, treatment, and prevention. Coursework in cell and/or molecular biology preferred.

Prerequisite: BIO 3351: Genetics

3 hours lecture

Biology 4355

Experimental Genetics

4 Credits

Dr. DiBenedetto

Laboratory exploration and discussion of selected topics in bacterial, developmental, molecular, population and transmission genetics. Readings in the primary literature and class discussion will be stressed.

Prerequisites: Genetics; 1 year of Calculus

2 hours lecture, 5 hours laboratory/week

Spring, odd years

Writing Enriched/Research Requirement

Biology 4385/7385

Global Change Ecology

4 Credits

Dr. Langley

Explores roles of ecology in documenting, responding, feeding back to, and mitigating human-caused changes to Earth's chemistry, geography and climate. Accompanying lab includes ecological techniques, such as carbon flux measurements, and develop independent research projects in the laboratory.

Prerequisites (4385): Bio 2105 and 2106. Course in ecology preferred or permission of instructor.

Prerequisites (7385): course in ecology or permission of instructor.

Biology 4451

Field Ecology and Evolution

2 Credits

<http://www.homepage.villanova.edu/robert.curry/4451/index.html>

Drs. Curry, Russell, Iyengar

The ecology and evolution of the biota of a selected biogeographic region, from the perspective of two of the faculty members listed above. The region chosen will vary from year to year; locations have included Mexico (Yucatan Peninsula), South Florida, Nova Scotia, Arizona, and Puerto Rico. Topics discussed include historical and ecological biogeography; ecological interactions among elements of the biota; roles of ecological and evolutionary processes (e.g. competition, disturbance and succession, speciation, selection) in structuring local communities; and conservation and management problems in the focal region. Evaluation is based on one or more take-home essay exams, a term paper involving synthesis and interpretation of primary literature, and a final exam. This is an advanced ecology course intended primarily for students who have developed an interest in population biology through completion of introductory courses.

Prerequisite: Introductory Ecology, Evolution, **or** Animal Behavior, **or** permission of **both** instructors.

2 hours lecture

Spring, even years

Biology 4452

Field Ecology and Evolution Laboratory

2 Credits

<http://www.homepage.villanova.edu/robert.curry/4451/index.html>

Drs. Curry, Russell, Iyengar

Hands-on experience with examples illustrating the principles presented in Biology 4451. The course will meet **off campus** for 15-20 days in a region that matches the lecture material; it usually will be taught by two faculty members. The region chosen will vary from year to year; locations have included Mexico (Yucatan Peninsula), South Florida, Nova Scotia, Arizona, and Puerto Rico. Students will receive instruction in natural history (i.e., identification of organisms, along with ecological and behavioral observation) and field methods used in ecological and evolutionary studies. Students will complete both structured group exercises and an independent project, the results of which they will present in written and seminar format before the end of the trip. Students will pay for their accommodation and travel expenses (both vary depending on the site); costs will be kept to a minimum and students will be informed of expected expenses when registering (*see course web site*). This course is offered to all students with appropriate preparation, but it is especially appropriate for those planning further study (senior thesis or graduate work) in ecology, evolution, or behavior.

Prerequisite: Same courses as for Bio 4451 *plus* one associated laboratory, **or** another laboratory course relevant to the biology of the focal region with consent of instructors. Corequisite: Biology 4451.

9-20 days field laboratory; schedule to be arranged Spring, even years

Writing Enriched/Research Requirement (with Bio 4451)

Dr. Knepper

Explores the processes of cellular propagation and expression of phenotype by gaining an understanding of the molecular mechanisms involved in the performance of these functions. Includes the study of the basic chemistry of macromolecules and the forces that govern their interactions; an introduction to the genetics and biochemistry of the bacterium, *Escherichia coli*; an exploration of the processes of replication, transcription, translation, and regulation of gene expression in bacterial and their viruses; and gene structure and function in eukaryotes, with discussions of the determination of antibody diversity, the molecular biology of animal viruses, including the AIDS virus, and the molecular biology of cancer. Throughout the course, the experimental approach is emphasized, so that students are not only exposed to the facts of molecular biology, but also the ways in which this knowledge has been obtained. Accordingly, an understanding of the experimental manipulation of biologic systems is stressed, with a heavy emphasis on the advances made possible by recombinant DNA and genetic engineering. The molecular biology laboratory closely parallels the lectures. Experiments include analysis of bacterial and phage growth parameters, bacterial matings and mutagenesis, purification of bacteriophage, phage recombination, *in vitro* translation, isolation of phage and plasmid DNAs, restriction analysis of DNA, *in vitro* DNA synthesis, Southern blotting, and gene cloning.

Prerequisites: Organic Chemistry, Genetics

3 hours lecture, 3 hours laboratory

Spring

Writing Enriched/Research Requirement

Dr. Stephens

Lecture examines the functioning of the nervous system in vertebrates and invertebrates. The fundamental principles underlying membrane potentials, action potentials, and conduction are followed by mechanisms of communication between single cells and groups of cells. Different aspects of sensory, motor, and integrative physiology will be discussed. The laboratory portion of the course is used to demonstrate certain principles and phenomena outlined in lecture. Every effort is made to synchronize lecture and laboratory. Student exercises will involve the use of computers, oscilloscopes, manipulators, transducers, and amplifiers—equipment used in Animal Physiology. The laboratory will use videos and demonstrations.

Prerequisite: Animal Physiology

3 hours lecture, 3 hours laboratory

Fall

Writing Enriched/Research Requirement

<http://www.homepage.villanova.edu/robert.curry/4801/index.html>

Dr. Curry

Introduction to the scientific study of the present global biodiversity crisis, and to interdisciplinary approaches to preserving biological diversity. Survey of patterns and causes of endangerment and extinction. Ecology of rare and declining species. Biological aspects of species, community, and ecosystem management. Scientific foundation of conservation policy development and

implementation. Course includes lecture and discussion components. Students will complete writing assignments involving summary and synthesis of primary literature.

Prerequisite: Introductory Ecology (Bio 3255) or permission of instructor

3 hours lecture

Spring, Odd years

Writing Enriched/Research Requirement

Biology 4950

Advanced Topics in Biology

3 Credits

Staff

Coverage of current topics in biology. Topics will be announced on a semester-by-semester basis. Specific information available in the departmental office.

3 hours lecture, seminar, or combination

Biology 4955

Lecture and Lab in Adv Topics in Biology

4 Credits

Advanced topics course with integrated lab. Topics will be announced on a semester-by-semester basis. Typically has a course at the 3000 level as a prerequisite. Specific information available in the departmental office.

Prerequisites: Bio 2105 and Bio 2106

Usually 3 hours lecture and 3 hours laboratory

Biology 5100

Senior Seminar

1 Credit

Dr. Wilson

Special capstone/seminar for senior thesis students. This course is required for graduation.

Prerequisite: Senior status and enrollment in Bio 6709 or HON thesis.

1 hour seminar

Spring

Biology 5300

Capstone Seminar

3 credits

Faculty

Special topics in biology, covered through readings from primary and secondary literature, student presentations and/or projects, and informal discussions. Topics to be announced each semester.

Attributes: Biology Capstone requirement

Biology 6509

Directed Research

2 Credits

Faculty

Library and/or laboratory research under the direction of a student-selected Biology faculty member. Special problems may be used to explore the possibility of doing a senior thesis, for which it is a prerequisite.

Prerequisite: Junior or Senior status; consent of mentor; minimum cumulative average of 3.0.

Independent study Fall and Spring

Biology 6609 **Thesis Research I** 3 Credits

Faculty

Laboratory research with Biology faculty member selected by student (part 1 of two-semester sequence). Requires permission of faculty mentor and instructor and 3.0 QPA. Restricted to junior or senior biology & BSC majors. Part 1 of two semester sequence; continues as Thesis Research II, which culminates in a written thesis.

Prerequisite: (BIO 2105 or HON 1075) and (BIO 2106 or HON 1076); Co-requisite: BIO 6610

Independent study Fall

Biology 6610 **Thesis Proseminar** 1 Credit

Dr. Olson

Scheduled group meetings with other research students in the department, focusing on general and specific aspects of thesis research. Requires permission of instructor and 3.0 QPA. Restricted to junior or senior biology or BSC majors.

Prerequisites: (BIO 2105 or HON 1075) and (BIO 2106 or HON 1076); Co-requisites: BIO 6609 or HON 6000 or HON 6001

Independent study Fall

Biology 6709 **Thesis Research II** 2 Credits

Faculty

Continuation of Thesis Research I or Directed Research. Laboratory research with Biology faculty member selected by student. Requires permission of instructor and 3.0 QPA. Restricted to junior or senior biology or BSC majors. Culminates in a written thesis. Counts for writing Intensive credit and typically for Laboratory credit toward the major.

Prerequisites: BIO 6509 or BIO 6609; Co-requisite: BIO 5100 (Thesis section)

Independent study Spring

Writing Intensive/Research Requirement



Graduate-Level Courses (if not cross-listed)

Undergraduates with Junior status and a GPA ≥ 3.4 or Senior status and a GPA ≥ 3.0 may register for 7000-level courses with consent of their advisor, Department chair, college Dean, and the graduate Dean (see Procedures section). We especially encourage undergraduate majors who are planning to go on to graduate study in a particular discipline to include one or more courses at this level in their curriculum. Interested students should note that many graduate-level courses are offered only every other year.

Undergraduates with Senior status and a GPA of at least 3.8 also may register for **8000-level** courses. Descriptions of these advanced courses are not included here; see the *Villanova University Catalog, Graduate Studies–Arts & Sciences* or the Biology web site for detailed information and procedures.

Courses listed as “dormant” are not expected to be offered in the near future, because of changes in staffing, sabbaticals, and scheduling constraints. Check with your advisor or the Department office for more information.

Biology 7105 **Vertebrate Ecology** 4 Credits

<http://www.homepage.villanova.edu/robert.curry/7105/index.html>

Dr. Curry

Selected topics in evolutionary and behavioral ecology, with applications to conservation problems. Topics considered include natural selection and adaptation; foraging ecology; social behavior, altruism, and game theory; ecology of sex, sexual selection, and mating systems; reproductive ecology; life history evolution; speciation, species interactions, and species diversity; population viability; and endangered species management. Emphasis is on animals, especially vertebrates (complementing Bio. 7705, Plant Ecology); specific areas of focus will be determined in part by the interests and background of students who enroll. Laboratory exercises and field trips complement lecture material, with emphasis on identification and ecology of local organisms; collection and analysis of ecological and behavioral field data; and review of regional habitats and conservation problems. This course includes an integral writing component. Each student will complete and revise a review paper, a research proposal, and a project report, as well as providing peer evaluation of papers written by classmates.

Prerequisite: One or more previous laboratory courses in ecology, evolution, or animal behavior, **or** consent of instructor.

3 hours lecture, 3 hours lab; field trips, to be arranged

Spring, odd years

Biology 7151 **Biogeochemistry** 2 Credits

Dr. Wieder

For each of several elements of the periodic table, this course will focus on patterns of geological abundance, biotic and abiotic factors affecting solubility and therefore availability, and the role of each element in biological systems (deficiency, essentiality, toxicity). While the course will emphasize the essential elements, some attention will be paid to the nonessential, but potentially toxic, metals. Grading is based on a mid-term and a final examination and on an annotated bibliography on an approved topic of the student's choice.

2 hours lecture

Fall, odd years

Biology 7152

Biogeochemistry Laboratory

2 Credits

Dr. Wieder

This course will provide an in-depth coverage of methods for the collection, preservation, and storage of water and soil samples, as well as methods for the biological, chemical, and physical characteristics of water and soil samples. After a 4-week introduction to the fundamentals of sampling and analyses, the class will be divided into groups that will conduct a descriptive study comparing two bodies of water or two types of soil. A final report will be submitted that will consist of a general introduction and an overall summary and conclusions, as well as specific sections (e.g., physical, chemical, microbiological, or macrobiological characterization), each prepared by an individual student. Grading will be based on a take-home mid-term examination, a final written report, and an in-class oral presentation of the final report

5 hours laboratory

Fall, odd years

BIO 7201

Ecosystem Ecology

3 Credits

Dr. Chapman

Examination of how living organisms interact and role of non-living entities such as climate, soil and atmosphere in large-scale processes. Includes coverage of topics such as biodiversity and ecosystem function, climate change, and link between ecosystem processes, community ecology and genetics.

Prerequisites: course in ecology or permission of instructor

Biology 7205

Comparative Physiology

4 Credits

Dr. Olson

A survey of topics in regulatory and integrative physiology. Course follows comparative approach in coverage of contemporary topics in physiology, and includes discussion of both vertebrates and invertebrates. Lectures will include a review of any pertinent background information on each topic, including the anatomy and physiology of selected organ systems. Topics to be covered include, but are not limited to, locomotion, feeding, osmoregulation, thermoregulation and reproduction. The laboratory portion of the course emphasizes the collection, statistical analysis, and interpretation of data collected in both prescribed laboratories and in independent projects using state-of-the-art techniques. Each student will be expected to engage actively in background reading, experimental design, and creative and critical thinking. Evaluation is based on written midterm and final exams, laboratory reports, and several elements associated with the independent project (including an annotated bibliography for the approved topic, the final report, and an oral presentation of the results of the project).

Prerequisites: Animal Physiology or Invertebrate Zoology

2 hours lecture, 5 hours lab

Spring, even years

Biology 7321

Immunology

2 Credits

Dr. Bamezai

Fundamental principles underlying innate and adaptive immunity. Cellular and molecular mechanism of development and function of immune cells including lymphocytes and mechanisms related to self-tolerance, antigen processing and presentation, lymphocyte activation, lymphocyte death and generation of cellular and humoral immune response. Consequences of malfunctioning of the immune response and clinical implications discussed.

2 hours lecture

Spring, odd and even years

Biology 7322

Immunology Laboratory

2 Credits

Dr. Bamezai

Experimental methods used to analyze humoral and cell mediated immune responses. Qualitative and quantitative analyses of immune response, with the focus on the understanding of the rationale behind the methods used and its applicability. Develop skills in researching the literature related to cellular and molecular immunology.

Corequisites: Bio 7321:Immunology

5 hours lab

Spring, even years

Biology 7331

Cancer Biology

3 Credits

Dr. Knepper

Study of characteristics, causes, genetic influences, and treatment strategies, with readings from primary literature. Emphasis on experimental approaches and analyses. Prerequisite: coursework in cell and/or molecular biology.

3 hours lecture

Biology 7385

Global Change Ecology

4 Credits

Dr. Langley

Explores roles of ecology in documenting, responding, feeding back to, and mitigating human-caused changes to Earth's chemistry, geography and climate. Accompanying lab includes ecological techniques, such as carbon flux measurements, and develop independent research projects in the laboratory

Prerequisites: course in ecology or permission of instructor.

3 hours lecture, 3 hours lab

Biology 7451

Behavioral Ecology

3 Credits

Dr. Iyengar

Advanced course in topics relating to animal behavior, including foraging, communication, sexual selection, parental care, and sociality. Emphasis on critical analysis of research papers from the primary literature.

Pre-requisites: undergraduate course in ecology or animal behavior or permission of instructor

Biology 7555 (Dormant)

Molecular Ecology and Evolution

4 Credits

Staff

The application of modern molecular techniques to ecological and evolutionary questions. Many questions in ecology and evolutionary biology can be addressed more directly with molecular data than through the more traditional means available to the evolutionary ecologist. Specific contributions of molecular techniques to ecology and evolutionary biology will be addressed in the lecture with emphasis on those areas where molecular data are most useful or have had great impact on the field. The laboratory will focus on practical applications of molecular techniques such as protein electrophoresis, amplification of DNA with the polymerase chain reaction, and DNA sequencing. Analytical methods will be considered as an integral part of the laboratory.

Prerequisites: Genetics, Molecular Biology

2 hours lecture 5 hours lab

Biology 7601 (Dormant)

Paleobiology

3 Credits

Dr. Russell

Fossils are but the remaining threads of a once luxuriant tapestry of life and paleobiology is an exploration of the rich historical data of the fossil record and what it reveals about evolutionary, ecological, and biogeographic patterns and processes. Specific topics include the causes and consequences of extinction and speciation and the effects these processes have on patterns of abundance and distribution of organisms through space and time.

3 hours lecture

Biology 7705

Plant Ecology

4 Credits

Dr. Wieder

The two major objectives of this course are to develop an understanding of and an appreciation for the interactions of plants with their environment, and to foster critical thinking. Topics discussed in some depth include physiological ecology (light and photosynthesis, plant-water relations, soils and plant nutrition), plant population ecology, plant community ecology, and the structure and function of terrestrial ecosystems. Lecture material is supplemented with reading and discussion of current primary literature. The laboratory portion of the course emphasizes the collection, statistical analysis, synthesis, and interpretation of field-collected and laboratory-generated data. Grading is based on a written mid-term examination, an oral final examination, 4 written laboratory reports, an annotated

bibliography on an approved topic of the student's choosing, and an oral presentation based on the bibliography.

2 hours lecture, 5 hours lab

Fall, even years

Biology 7755

Plant Ecophysiology

4 Credits

Staff

Plant interactions with the biotic and abiotic environment. Lecture emphasizes plant anatomical, morphological, physiological, and biochemical adaptations and acclimations determining plant and population survival, performance, and distribution in dynamic ecosystems. Laboratory focuses on field methods and techniques culminating in student-driven, independent research projects.

2 hours lecture, 5 hours lab

Fall, odd years

Biology 7805

Biostatistics & Experimental Design

3 Credits

Dr. Wieder and Dr. Russell

A practical study of the application of statistical methods to the biological sciences. Topics include the characterization and representation of data, probability, point and interval estimation, hypothesis testing, regression and correlation, the analysis of variance, and the analysis of frequencies. The emphasis of the course is on the interpretation of statistical results in context. The course is less concerned with the detail of number crunching (the computing machinery will be extensively used to avoid the need for tedious calculation), and more with the interpretation and presentation of results.

3 hours lecture

Spring, even years

Biology 7905

Eukaryotic Microbiology

4 Credits

Staff

Morphology, life cycles, methods of reproduction, feeding methods, methods of locomotion, biochemical characteristics, taxonomy, and evolution of free-living and parasitic protozoa will be discussed. Laboratory exercises will include collecting, isolating, and culturing protozoans. Stained slides will be prepared of selected specimens. Modes of feeding, locomotion, and reproduction will be investigated for selected organisms. Prepared slides will be employed as part of a taxonomic survey. A major term paper on a topic related to protozoology is required.

In the laboratory students will be required to isolate an organism from nature and identify it by whatever means are at their disposal.

2 hours lecture, 5 hours lab

Fall, odd years

Biology 7955

Biodiversity and Systematics

4 Credits

Dr. Bauer

This course presents an overview of the theoretical and methodological underpinnings of modern systematic biology, the study of evolutionary patterns. The application of systematic thought and phylogenetic practice to comparative biology in general will also be considered. Historical biogeography, molecular systematics, and the application of systematics to ecology, behavior, and

conservation are further topics. Students will be exposed to primary literature in the field as well as hands-on exposure to the collection of systematic data and a wide variety of data analysis techniques, including the use of the most important phylogenetic analysis software (PAUP, Hennig86, MacClade, etc.). Lecture periods provide the opportunity to discuss current issues in the field and to analyze recent primary literature. The laboratory experience culminates in an original research project analyzing the evolutionary relationships within a group of organisms selected by the student.

3 hours lecture, 3 hours lab

Spring, even years

Biology 7950 **Special Topics in Cell, Molecular, and Developmental Biology** 2 Credits

Staff

Current topics in cellular, molecular, and developmental biology. Topics will be announced on a semester by semester basis. Specific information available in the departmental office.

2 hours lecture, seminar, or combination

Biology 7960 **Advanced Topics in Cell, Molecular, and Developmental Biology** 3 Credits

Staff

More intensive coverage of current topics in cellular, molecular, and developmental biology. Topics will be announced on a semester by semester basis. Specific information available in the departmental office.

3 hours lecture, seminar, or combination

Biology 7970 **Selected Topics in Ecology, Evolution and Organismal Biology** 2 Credits

Staff

Current topics in ecological, evolutionary and organismal biology. Topics will be announced on a semester by semester basis. Specific information available in the departmental office.

2 hours lecture, seminar, or combination

Biology 7980 **Advanced Topics in Ecology, Evolution and Organismal Biology** 3 Credits

Staff

More intensive coverage of current topics in ecological, evolutionary and organismal biology. Topics will be announced on a semester by semester basis. Specific information available in the departmental office.

3 hours lecture, seminar, or combination

Full-time Faculty, Department of Biology

Each faculty member's research interests are indicated beneath their name. Office and lab room numbers refer to the basement (0), ground (G), and first (100) floors of Mendel Science Center.

	Office	Lab	Tel.	E-mail
Dr. Anil Bamezai <i>Immunology</i>	120B	G17	519-4847	Anil.Bamezai@villanova.edu
Dr. Aaron Bauer <i>Systematics, evolutionary morphology, and historical biogeography of amphibians and reptiles</i>	191B	112	519-4857	Aaron.Bauer@villanova.edu
Dr Samantha Chapman <i>Ecosystem ecology</i>	122C	G08	519-5343	Samantha.Chapman@villanova.edu
Dr. Robert Curry <i>Evolutionary ecology, social behavior, and conservation biology of birds</i>	190A	106	519-6455	Robert.Curry@villanova.edu
Dr. Angela DiBenedetto <i>Molecular biology and genetics; programmed cell death; developmental mechanisms</i>	G24E	114	519-5197	Angela.Dibenedetto@villanova.edu
Dr. Russell Gardner <i>Endocrinology; pharmacology; hormonal control of uterine growth and development</i>	122A		519-6621	Russell.Gardner@villanova.edu
Dr. Vikram Iyengar <i>Behavioral ecology; entomology; chemical ecology</i>	147B	113	519-8081	Vikram.Iyengar@villanova.edu
Dr. Todd Jackman <i>Population genetics, evolutionary ecology, herpetology</i>	G24C	108	519-5502	Todd.Jackman@villanova.edu
Dr. Janice Knepper <i>Molecular biology; virology; molecular mechanisms of viral oncogenesis</i>	G24A	G20	519-7338	Janice.Knepper@villanova.edu
Dr. J. Adam Langley <i>Global change ecology</i>	G65E	157	519-3102	Adam.Langley@villanova.edu
Dr. John Olson Chair, Metabolic and muscle physiology; ecological physiology	147A	110	519-4831	John.Olson@villanova.edu
Dr. Michael Russell <i>Paleobiology; evolutionary and reproductive ecology of marine invertebrates</i>	190B	155	519-4695	Michael.Russell@villanova.edu
Dr. Louise Russo Health Sciences Advisor; Cell biology	143A	G19	519-4869	Louise.Russo@villanova.edu
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